Climate Adaptation Policy and Evidence: Understanding the Tensions between Politics, Experts and Evidence in Environmental Policy Making

Author

Tangney, Peter Noel

Published

2015

Thesis Type

Thesis (PhD Doctorate)

School

Griffith School of Environment

DOI

10.25904/1912/422

Climate adaptation policy and evidence

Understanding the tensions between politics, experts and evidence in environmental policy making

Peter Tangney **MSc. DIC BSc.(hons)**

Submitted in fulfilment of the requirements of the degree of Doctor of Philosophy

March 2015

Griffith School of Environment, Griffith Sciences, Griffith University, Brisbane

Abstract

Evidence-based policy making has been advocated by liberal democracies around the world. To date, this approach has principally been pursued through 'rationalist' linear-technocratic decision making methods which assume that policy problems are tractable and that experts can provide adequate and impartial advice to government. Using case-studies in Queensland, Australia and the UK, this research utilises a comparative political analysis alongside the 'knowledge systems' framework first proposed by Cash et al. (2002) to understand how norms, values and prevailing politics influence evidence development and use for adaptation policy. In Queensland, the evidence-based mandate has been weakened by prevailing politics, even though policy makers still seek to develop a business-case, for which climate science is often perceived to be incompatible. In the UK by contrast, evidence-based policy is enshrined in the *Climate Change Act (2008)*, yet how evidence has been developed under this mandate raises important questions about the extent to which it can ever be considered apolitical.

Both cases reveal normative and political tensions which suggest that evidence is used for climate adaptation policy making only to the extent that it is congruent with prevailing politics. Evidence lacks salience for policy players because it cannot fulfil the linear-technocratic promise of policy-making rhetoric. Evidence lacks legitimacy and credibility when it does not adequately account for varying local, contextual or political perspectives important for understanding adaptation problems. Queensland and the UK have developed adaptation-related policy through quite different conceptual frames; although in both cases evidence development requires important normative choices by experts and bureaucrats before it is used (or rejected) in support of political goals. Under a linear-technocratic schema, I argue, these normative choices have resulted in the politicisation of policy evidence, and a 'scientised' policy making process. I conclude that legitimacy holds primacy over credibility and salience when developing useful and usable evidence for climate adaptation policy.

Statement of Originality

This work has not previously been submitted for a degree or diploma in any university. To the best of my knowledge and belief, this thesis contains no material previously published or written by another person except where due reference is made in the thesis itself.

Material in Box 3. Section 5.5 of this thesis was published under my co-authorship in a modified form in: Heazle, M, Tangney, P, Burton, P, Howes, M, Grant-Smith, D, Reis, K, & Bosomworth, K 2013, ‘Mainstreaming climate change adaptation: An incremental approach to disaster risk management in Australia’, *Environmental Science & Policy*, vol. 33, pp. 162 - 170

Peter Noel Tangney

26th March 2015

Table of Contents

List of Figures

List of Tables

Acknowledgements

I want to thank my thesis supervisors, Michael Howes and Michael Heazle, who have shown great patience and conscientious attention to detail during their supervision of my work. They have taught me more about nuance and the economy of the written word than I ever hoped to learn.

Thanks to all those who kindly agreed to participate in this study and to Griffith University and the Australian Government for providing the financial means to allow me to continue pursuing my passion for research. I would particularly like to thank Paul Burton and Jago Dodson in this regard.

I owe a debt to my friend Michael Marriott for his generous assistance while preparing the maps used in this thesis. I also want to thank my dear friends, Paul and Miriam, for their incredible hospitality while I undertook research in the UK.

I came to Australia, as much as any reason, because of the support of my life-long friends Tony and Ingerlisa. I am eternally grateful to them for their support and faith in me.

I also want to thank all of my other Brisbane friends, and a few in particular. Thank you Jessica, Michele, Panos, Mareike, Leticia, Dave and Erika. You made my time in Brisbane the happiest of my life.

Finally, thanks to my parents, Noel and Patricia, for all their endless support.

Acronyms

CCIRG: Climate Change Impacts Review Group

CDF: Cumulative Distribution Function

COAG: Council of Australian Governments

COP: Conference of the Parties

CPRS: Carbon Pollution Reduction Scheme

DEFRA: The UK Department of Environment, Food and Rural Affairs

DERM: Department of Environment and Resource Management

DRM: Disaster Risk Management

EA: Environment Agency of England & Wales

EC: European Commission

EEC: European Economic Community

EMA: Emergency Management Australia

ENSO: El Nino/ Southern Oscillation

ESD: Ecologically Sustainable Development

ESM: Earth System Model

ETS: Emissions Reduction Scheme

EU: European Union

GCM: Global Circulation Model/ Global Climate Model

GDP: Gross Domestic Product

GHG: Greenhouse Gas

HMIP: Her Majesty's Inspectorate of Pollution

IPCC: Intergovernmental Panel on Climate Change

LNP: Liberal-National Party

NAP: National Adaptation Plan

NGRS: National Greenhouse Response Strategy

NPM: New Public Management

NRA: National Rivers Authority

OFWAT: UK Water Services Regulatory Authority

OPEC: Organisation of the Petroleum Exporting Countries

PDF: Probability Density Function

PPRR: Prevent, Prepare, Respond, Recover

QRA: Queensland Reconstruction Authority

SEQ: Southeast Queensland

SEE: Southeast England

STS: Science and Technology Studies

UKCCRA: UK Climate Change Risk Assessment

UKCIP: UK Climate Impacts Programme

UKCP09: UK Climate Projections 2009

UNFCCC: United Nations Framework Convention on Climate Change

WFD: Water Framework Directive

Preface

The seeds of the research questions addressed here were sown in my mind about 9 years ago. I began my professional career in environmental science and policy in 2005-2006 as a consultant to the UK water industry at a time when adaptation was still considered a 'cop-out' by many climate change policy advocates. Nonetheless, tentative steps were being made in the UK at that time toward the development of adaptation policy. It's probably fair to say that the water industry saw the problems of climate change on the horizon sooner than any other UK industry sector. As a long-time consultee of the climate science community and under regulatory pressure to produce 25 year Strategic Direction Statements outlining their provision of water resources for agriculture, industry and the public, the water industry have become used to strategising in terms of decades rather than simply over the course of a few years. My early professional experience in water industry regulation and the UK's implementation of the *EC Water Framework Directive (2000)* involved almost as many conversations about the future threat of climate change as about the feasibility of Europe's water quality standards or the sustainable abstraction of water resources. At that time, however, not much technical climate change impact and risk analysis was being done by the industry, and many believed that the arrival of the UK Climate Impact Programme's (UKCIP) next set of climate change projections would provide many of the necessary answers.

Later, I worked as a policy advisor for the Environment Agency of England & Wales, where I was enrolled to tackle the problem of climate change adaptation. I was tasked with assessing (and helping others to assess) potential climate change impacts, and eventually, with interpreting and disseminating the outputs of the UKCIP's Climate Projections 2009 (UKCP09). It was then that I began to realise the full extent of the difficulties encountered when attempting to use climate science for policy, difficulties that continue to the present day. Whereas, up to that point, I had only rudimentary experience of the strategic management of 'wicked' policy problems, I had suddenly been thrown into the deep end of probably the most wicked problem of them all.

I believe that climate change can teach us much about the nature of effective policy making and the use of science and other evidence for that purpose. More broadly, I believe that climate change can be a great source of learning about how to manage the many wicked problems facing humanity in its pursuit of sustainable development. This thesis marks a further step in my understanding of complex, uncertain and contentious environmental and social problems. It incorporates both my professional experience and academic understanding of what makes society's relationship with climate so confounding for policy makers, and whether science and policy can effectively collaborate for that purpose.

Chapter 1. Introduction

When reason is against a man, he will be against reason – Thomas Hobbes

1.1 Overview

Climate change is a persistent and challenging problem for policy makers and political representatives around the world. It has also been the subject of some of the most dramatic and superlative-laden political statements of recent times. Described variously as “the greatest and widest ranging market failure ever seen” (Stern, 2006), “the most severe problem that we are facing today, more serious even than the threat of terrorism” (King, 2004) and “one of the greatest moral challenges of our age” (Rudd, 2009); alternatively it is “absolute crap” (Abbott, 2009, cited in Rintoul, 2009) and “a Frankenstein monster that threatens to devour its own designers” (Peiser, 2009). These descriptions by both politicians and experts are symptomatic of the fact that, despite its original identification and characterisation by the scientific community, climate change is much more than simply a scientific problem. Climate change is a problem of sustainable development so complex and inter-related with every aspect of human society that climate-related policy problems have proven to be exceedingly difficult to adequately or impartially define, understand and to resolve (Hulme, 2009). Climate change policy, I argue, has become a key arena for debating societal norms, values and priorities, and not just through the legitimate decision making processes of democratic government. As my research demonstrates, important values and political positions are also decided during the development of supposedly objective technical evidence that is then used to inform and legitimise government decisions.

My research is concerned with how scientific experts and other policy players[1] interact to deal with the specific task of climate adaptation policy making, and why it has proven so difficult for scientists to inform and for governments to manage this policy problem in an evidence-based way

[1] In this thesis I use the term ‘policy player’ to correspond to the full range of expert and non-expert actors involved in the development and implementation of policy across all levels and institutions of government. By contrast the term ‘policy maker’ is only used in reference to those democratically elected to government.

(Head, 2008b). The central argument of my research is this: that evidence is used for climate adaptation policy making only to the extent that it is congruent with prevailing norms and politics. My research demonstrates that, such is the nature of expert knowledge concerning climate change and adaptation, as well as policy makers' and other players' expectations for how it should be used, this evidence is developed, interpreted, used or ignored in ways that legitimise prevailing political positions and suppress explicit normative debate.

Using case-studies in Queensland, Australia and the UK, this research utilises a comparative political analysis alongside a series of semi-structured interviews with key policy players involved in climate adaptation to understand how norms, values and politics influence evidence development and use for policy. These political influences on evidence development are symptomatic of the unavoidable tensions that exist in liberal democratic government between expert (i.e., derived from claims of privileged objective knowledge) and political (i.e., democratically representative) authority.

According to Cash et al. (2002), effective knowledge systems for sustainable development require the balancing of three evidence attributes:

Credibility: whether an actor perceives information as meeting standards of scientific plausibility and technical adequacy;

Salience: the perceived relevance of information for an actor's decisions, or for the decisions that affect that actor; and,

Legitimacy: whether an actor perceives the process of knowledge production by the system as unbiased and meeting standards of political and procedural fairness; that the knowledge production system considers appropriate values, interests, concerns and specific circumstances from multiple perspectives.

When considered and addressed during the development of policy knowledge, Cash et al. (2002) argue that these attributes can be pursued to ensure an appropriate balance between the need for technically adequate objective expert authority (such that it exists) on the one hand, and evidence which meets the practical and normative/political requirements of decision makers on the other. My research builds upon Cash et al.'s (2002) framework in order to understand the tensions that exist between expert and political authority for climate adaptation policy making. In doing so, I seek to understand when and how decision making norms and politics interact in the development, provision and use of expert evidence for policy in the context of the prevailing political forces of two similar liberal democratic states.

In this thesis I argue that Cash et al. (2002, 2003) have not adequately accounted for the tensions that exist between expert and political authority during the development and use of evidence for policy. My research demonstrates that, although credibility has traditionally been deemed the priority attribute of technical evidence, in practice legitimacy holds primacy over credibility and salience as the dominant attribute of effective policy evidence for climate adaptation[2]. Yet, I argue, Cash et al.'s (2002) definition of legitimacy is ambiguous and limiting and should be adjusted to account for the degree of 'political acceptability' required from policy makers for contentious, complex and uncertain science and evidence. My research demonstrates that the political acceptability of knowledge produced for policy making is dependent on the congruence of prevailing political values and priorities with those inscribed in or attributed to the available evidence. Political acceptability is a principal determinant of the subsequent interpretation, communication and use of that evidence and therefore an important indicator of effective knowledge systems. This finding, I argue, is indicative of the political nature of adaptation policy problems that is facilitated by the limited ability of experts to apprehend objective reality in relation to them. I argue that evidence relating to climate change has become a malleable component of the policy making process that cannot fulfil prevailing linear-technocratic norms of evidence-based policy making. However, I also demonstrate that, because of the importance of developing sufficient

[2] Throughout this thesis I use the terms *climate science* and *policy evidence* in precise ways to mean two distinct forms of policy knowledge that reflect the character of evidence development for adaptation policy making (see Chapter 5 for details). Where I use the word *evidence* on its own I am referring to the broader body of information available to policy makers. Likewise, the terms *political legitimacy*, *evidence legitimacy*, *credibility* and *salience* are used in precise ways – see Glossary for details. Given the propensity for confusion between these terms, particularly in relation to the rather ambiguous concept of evidence *legitimacy*, the precise use of these terms is repeatedly clarified throughout this thesis.

evidence legitimacy, the available scientific research is prone to processes of politicisation that influence evidence outputs in important ways.

For the purposes of my research, I distinguish here between two types of politicisation prevalent in the development of policy evidence for climate adaptation. The first type, a politicisation-by-process, is an inevitable outcome of climate change evidence development, whereby experts must make important normative and subjective decisions when developing climate change science and disseminating its outputs to decision makers. The second type, a politicisation-by-agency, is a deliberate intervention in evidence development whereby either expert or non-expert policy players may seek to adjust the outputs or communication of research evidence in support of political priorities under the guise of supposed expert objectivity. Unless otherwise stated, when referring to politicisation in the course of this thesis, I am speaking about this deliberate politicisation-by-agency. In order to understand the tensions between expert and political authority I argue that this latter form of politicisation can be usefully conceived as a process of 'scientisation', whereby policy players seek to suppress political or normative debates during the policy making process through recourse to the 'facts'.

Importantly, examination of the cases of Queensland and the UK reveal a curious irony relating to the pursuit of evidence-based policy in these liberal democracies. Despite (or because) of prominent Australian politicians' scepticism of climate science, and despite Australia's increasing alienation from the international community in relation to its neglect of the climate change issue (Bourke, 2014b; White, 2014), I argue here that climate adaptation-enhancing policy in Queensland is relatively well developed and appears to have largely avoided many of the difficulties that climate *change* policy making has encountered in the comparative case of the UK.

Queensland's policies have largely been developed under the guise of concurrent priorities such as disaster risk management and urban planning and, under the Newman administration (2012 – 2015), have largely ignored the issue of climate change. In part, this is possible because of the extreme nature of Queensland's climates which means that government here is already well-rehearsed in the management of extreme events and has been forced to learn much more about how vulnerable, exposed and resilient its society and economy is to climate, compared to liberal democratic governments in more benign climate regimes. However I argue that the Australian approach to adaptation policy making has also been less problematic because governments at all levels have been less enthusiastic in their embrace of evidence-based policy making, despite their explicit adherence to this schema; this attitude has allowed greater flexibility in the extent to which problematic evidence sets are expected to inform policy decision making and the freedom with which political or normative motives can be explicitly and openly pursued.

By contrast, my research indicates that the UK's strict adherence to the evidence-based mandate under the *Climate Change Act (2008)* and their advocacy for climate science as a principal policy making tool has resulted in the need for significant political decisions (for instance, in relation to the management of sea-level rise and flood risk) to be covertly addressed through the development of policy evidence, since their explicit debate in legitimate political forums would reveal important conflicts between the conclusions of experts and the prevailing political priorities of the executive. Thus, my comparative analysis of these cases point to some rather inconvenient truths about the usefulness and usability of climate change science and policy evidence when seeking to legitimately address the climate adaptation problem.

Evidence-based policy as practiced in the UK, I argue, is a double-edged sword. My research demonstrates that, although the use of evidence for policy is a valuable ideal, the legitimacy granted to evidence relating to contentious policy issues like climate change (that has high levels of complexity and uncertainty) may actually result in a greater propensity for the politicisation of that evidence under an evidence-based mandate, in order to ensure timely and expedient policy responses to climate variability and change. This is due to a fundamental mismatch between the 'rational' expectations of politicians and the public, and the wicked and irrational characteristics of climate adaptation problems. The uncertain, complex and contentious nature of adaptation policy problems ensure that important political choices can be made through the development of supposedly impartial expert evidence for policy. To openly discuss these decisions in democratic forums under an evidence-based mandate might result in ongoing normative debates and political conflict and inertia, whereas, under a linear-technocratic policy making schema, I argue, such decisions can be usefully made under the guise of objective expertise through processes of politicisation and scientisation.

In Queensland, by contrast, because the issue of climate change in recent years was deficient in both policy and evidence legitimacy, the adaptation policy process has proceeded primarily through governments' political and ideological prioritisation alongside a selective adherence to the evidence-based mandate that could exclude contentious expert authority or any associated rationalist expectations for the role of climate change science in policy making. I conclude that significant questions remain about the utility of problematic evidence sets such as climate change projections for adaptation policy, given the nature and extent of the uncertainties, complexities and associated political problems that arise in relation to their use. These difficulties are demonstrated by the comparative cases in this research which show how, although climate change science is useful for helping policy players to understand the need to consider climate change in policy making and the potential scale of the associated hazards, this information is often simply too complex, uncertain and contentious to provide meaningful direction or prediction for policy making in a linear or rationalist way that would allow impartial assessments of impact and risk. Further, I argue that this science is prone to deliberate politicisation when used in the development of subsequent policy evidence, in ways that are contrary to the ideals of liberal democratic policy making.

1.2 Why is climate adaptation policy making problematic?

Scientists and economists often frame the problem of climate change in terms of CO_2 emissions, average changes in temperature or precipitation, or the loss of gross domestic product in order to communicate the immediacy of the associated risks and to elicit policy responses. However, these metrics are often less useful for informing policy making beyond the development of its legitimacy as a worthy political priority. Commonly, this is because of a mismatch between, on the one hand, the global and regional scales at which this information is available, and the contextual and multi-scalar nature of climate change policy issues on the other, for which much of the available evidence has limited value[3] (see Chapter 5). Where attempts at enhancing the resolution or precision of climate science have been made, this evidence is subject to increasing uncertainty and considerable difficulties of interpretation (Frigg et al., 2013b; Tang and Dessai, 2012).

As my research explains, these difficulties are symptomatic of a broader issue concerning the extent to which technical experts can apprehend objective reality concerning the present and future state of society and the natural environment. In particular, experts struggle to definitively characterise complex and uncertain climatic and 'social-ecological' systems[4], or to cast unequivocal judgement on context-specific considerations of climate risk and vulnerability. Resolving contemporary environmental problems like climate change, therefore, presents a formidable challenge for government policy makers. Western society has traditionally expected liberal democratic governments to look to experts, and in particular scientists and economists, to understand and inform such policy problems (Kitcher, 2011; Head, 2008a). However, the expert community has struggled with a problem notable as much for its political divisiveness as for its scientific and socio-economic intractability (Hulme, 2009).

Climate change cannot be understood or explained by scientists in the ways that politicians and the public have traditionally expected. Despite individual policy players' pragmatism in this regard, government prescriptions for 'evidence-based' policy making still seek to use evidence in a way that assumes that policy issues are sufficiently tractable and that the available evidence provides enough objective truth about adaptation problems to allow effective and rational solutions to be identified. These evidence-based approaches are based on a 'rationalist' linear-technocratic

---

3 Wilbanks and Kates (1999) were perhaps the first to highlight these difficulties.

4 *"A social-ecological system consists of a bio-geophysical unit and its associated social actors and institutions. Social-ecological systems are complex and adaptive and delimited by spatial or functional boundaries surrounding particular ecosystems and their problem context"* (Glaser et al, 2008).

heuristic that assumes that policy is principally in need of scientific and technical evidence free from political influence in order to maximise social gain. As I argue here, adaptation problems defy this rational approach to policy making because of their 'wicked' characteristics (Rittel and Webber, 1973). Adaptation policy problems resist definitive characterisation and, I argue, politics does not just occur in open democratic forums or during climate adaptation policy making; norms and politics are also significant and inevitable determinants of adaptation evidence development. Further, evidence-based adaptation policy is prone to being overcome by political influence (i.e., through processes of politicisation) because it clings to these rationalist ideals of objective instrumentalism that disguise the inevitable normative components of evidence within the provision of supposedly objective facts. Thus, I argue, the linear-technocratic policy making schema facilitates the deliberate politicisation of adaptation evidence.

My research demonstrates how both scientists and policy makers have, thus far, failed to adequately account for the influence of the norms, values and politics that are inextricably linked to the development of adaptation evidence. This failure, I argue, is indicative of ongoing attempts to achieve Enlightenment ideals of policy legitimacy that seek to make public decisions through a transparent and legitimate combination of expert (i.e., as the purveyors of objective truth) and political (i.e., democratically representative) authority. These ideals are based on the premise that there is a clear divide between these forms of authority and that they can work seamlessly together to arrive at rational policy decisions. In this thesis, I argue that such a clear interface between expert and political authority does not exist for adaptation policy decision making. Experts must address normative/political questions in the development of evidence, just as non-expert policy players must provide important subjective and normative input to expert evidence to make it useful and usable. Thus, there is an ongoing tension between these forms of authority within liberal democratic government; they are expected to be separate and functionally differentiated entities, yet in order to function effectively they must overlap.

The tendency for subjective and normative interpretations to be inscribed within the apparent objectivity of expert evidence is not a new problem for evidence-based policy approaches (Owens et al., 2004; Weale, 2001). However, this influence is, I argue, very significant in matters concerning the management of social-ecological systems, and in particular for climate adaptation due to:

- The complex, uncertain, multi-level and highly interconnected nature of individual adaptation problems;
- The pressing need to value future as well as present needs;
- The interdependence of climate adaptation policy making with a broad range of concurrent policy priorities; and,
- The degree of political conflict climate adaptation issues provoke as a result of these characteristics.

The interpretive decisions required in the development of adaptation policy evidence highlight the difficulties of appropriately reconciling legitimate expert and political authority in the development of public policy. We may not ever be able to distinguish exactly where science ends and policy making begins for wicked problems, but I argue, we cannot assume that this divide is located where experts and policy makers say it is. Both parties appear to have much to either gain or to lose by shifting the locus of this divide. In light of this, I argue here that legitimate and effective understandings of what is, what will be and what should be done to adapt to climate require a restructuring of how we think about and utilise science for adaptation policy, if not also for environmental decision making more generally.

1.3 Australia and the UK: two perspectives on the development and use of evidence for adaptation

Queensland, Australia and the UK provide intriguing comparative cases for the study of climate adaptation policy making. The extent to which evidence has been relied upon to justify adaptation policy is quite different in these two countries while their differing approaches sit in stark contrast to their experiences of climate to date.

Queensland's climate is a story of persistent extremes and society's ongoing need to adapt. Yet climate *change* has been a strongly polarising issue because of its tense relationship to the state's socio-economic development. By contrast, in the UK a relatively benign climate[5] has been offset by increasing socio-economic vulnerability, a persistent public concern for the natural environment and bipartisan political concern for resource independence which ensures public and political support for the prioritisation of the largely abstract risk of future climate disaster. What these two cases demonstrate is that, despite such differences in perspective, the political difficulties of deriving agreed solutions to adapt to climate and in agreeing about the suitability of the available evidence mean that politics has a tendency to overcome evidence development and expert authority during adaptation policy making. Behind the approaches to climate adaptation taken by both Queensland and the UK lie tendencies to circumvent the evidence-based mandate where possible and where not, to disguise political decisions within technical evidence and regulatory metrics, that is, to politicise evidence.

In Queensland, climate change has been subject to strong political polarisation such that its legitimacy as a priority political concern has always been in doubt. At the time of writing, the coalition (Liberal-National) parties at all levels of government (federal, state[6] and local), have largely rejected the climate change policies established by previous Labor governments, due to differences in their socio-economic values and priorities. Not only has the current federal government dismantled Labor's *Clean Energy Act (2011)*[7], but at state level the Newman government has also dismantled Labor's policies and plans to explicitly adapt to climate change (Dedekorkut-Howes and Howes, 2014). Furthermore, concurrent policy initiatives such as disaster risk management (DRM)

5 Relative to Queensland at least. The UK has nonetheless experienced a range of flooding, storm and drought events in recent years that perhaps have enhanced the immediacy of climate adaptation problems (The Met Office, 2014).
6 As this thesis nears completion, the Newman (LNP) administration has been defeated in Queensland's state general election by a Labor Party government led by Annastacia Palaszczuk.
7 Containing a hard won and controversial Carbon Emissions Trading Scheme (see Chapter 4)

and urban planning schemes, although capable of incorporating climate change science, generally do not do so as well as they might (or at all) due to a lack of legitimacy for both the policy and the science of climate change[8]. At federal level there appears to be very limited strategic consideration of climate change, and at state level the funding arrangements for DRM policy also ensure a lack of incentive for states and local authorities to incorporate such considerations. In the aftermath of climate extremes, for instance, state government is usually only provided funding by federal government to rebuild infrastructure on a like-for-like basis.

Figure 1.1 Queensland, Australia

While the political battle over climate change rages on in relation to its legitimacy as a policy issue, in particular for the mitigation of greenhouse gases (GHG), climate adaptation – which is largely the responsibility of local and state government – is a bipartisan priority only as long as policy action isn't justified on the basis of climate *change*, including the use of climate science which has varying levels of perceived legitimacy and credibility amongst policy makers. In effect, therefore, although Australian governments espouse the virtues of evidence-based policy, some types of evidence are deemed more valid (i.e., legitimate) than others. It appears that climate change evidence holds little sway in affecting DRM, water resources management, urban planning and other climate adaptation-enhancing policy. Yet these policy priorities persist out of necessity due to the

[8] This is not to suggest that these policy portfolios do not enhance the adaptive capacity of Queensland. On the contrary, as I argue in Chapter 4, these policy efforts make a considerable contribution to climate adaptation generally, and in many respects this contribution appears equivalent to those made in the UK under the guise of climate *change* adaptation.

extreme nature of Queensland's climates. Indeed, the associated policy provisions (particularly in relation to the integration of emergency services, urban planning, and community awareness and resilience) appear quite advanced relative to similar liberal democratic governments around the world.

By contrast, in the UK there has been considerable bipartisan support for climate change as a policy priority, as demonstrated by the pioneering *Climate Change Act* of 2008 which provides a legislative mandate to reduce GHGs and to adapt to existing and future climate impacts. This support has been derived through bipartisan consensus on national priorities relating to resource independence and the status of Britain as a player on the world stage, as well as through popular public interest in the preservation of the natural environment. The global financial crisis in 2008-2009 and the European public debt crisis in its aftermath, however, have caused adaptation to be downgraded as a policy priority, irrespective of the legislative mandate this consensus previously created. Although support for action on climate change remains high and there is a strong bureaucratic attachment to the evidence-based mandate, the existing government has nonetheless sought, where possible, to prioritise present economic concerns over future climate risks.

Figure 1.2. The United Kingdom of Britain and Northern Ireland

The Westminster government has removed responsibilities from local government to report on climate risks and adaptation policies and are seeking to achieve the requirements of the *Climate Change Act (2008)* through the existing reporting and regulatory mechanisms of government agencies and through voluntary agreements with major infrastructure and public service providers. Where there is legislative freedom to do so (i.e., at local government level) adaptation is now only justified on the basis of a 'business case' relating to costs and benefits in the present and immediate future, which supersede evidence about future climate risks, thereby effectively de-legitimising climate change evidence for local government policy making.

Where government activity falls under the remit of the requirements of the *Climate Change Act (2008)* however, my research demonstrates how politics has infiltrated the preparation of evidence for informing policy. In particular, the *UK Climate Change Risk Assessment (UKCCRA)* (a five yearly requirement of the Act) has been heavily influenced by political forces in its first iteration, whereby political positioning and prioritisation were disguised within an apparently independent and objective technical assessment of climate risks to the UK. Such politicisation was possible, I argue, due to the fundamental mismatch that exists between the nature of climate change science and expertise on the one hand, and the rational, linear-technocratic expectations of the evidence-based mandate on the other. My examination of these cases leads me to conclude that legitimacy holds primacy over credibility and salience in determining the usability of climate change science and policy evidence, and that the evidence-based mandate is pursued only to the extent that it aligns with prevailing norms and politics.

1.4 Research Questions

The fundamental mismatch between understanding the climate adaptation problem and the conflicting forces of rationalism and politics in bureaucratic government poses significant questions about the interactions between experts and policy makers. The principal question my research seeks to answer, therefore, is:

- **How do political attitudes toward climate science influence the development of climate adaptation policy?**

In order to answer this question, my research will address the following related questions:

- How do tensions between expert advice and political authority influence the generation of knowledge about climate change risks for adaptation policy?
- How do contextual and political forces influence the role of experts in climate adaptation?
- How does the need for political legitimacy for climate change policy influence the provision of evidence and the interpretation of climate risks?
- How do *ex-ante* policy analyses account for political influences in the development and presentation of evidence?

My research seeks to answer these questions through a combination of comparative political analysis, case-study analysis and a series of semi-structured interviews with various policy players involved in the development and use of evidence for adaptation policy making.

1.5 Addressing the research agenda

The hybrid comparative analysis used in this research seeks to understand the relationship between expert and political forms of authority for climate adaptation in four steps. These steps are not achieved entirely sequentially, as they are intertwined through my exploration of the epistemology of the climate change problem and the comparative cases of Queensland and UK policy making. They can be summarised as:

1. Examining the character of the available expert evidence for policy making, to elucidate the nature of expert authority for climate adaptation;
2. Examining the wicked characteristics and underlying politics of the climate adaptation problem. This will explain the potential role that norms, values and politics can play in adaptation policy making and their relationship to and influence on the available evidence.
3. Examining the outputs of climate science and policy evidence to understand how usable evidence and expertise is in practice;
4. Using the outputs of the preceding three stages of analysis in comparison with policy players' perceptions of the credibility, legitimacy and salience of climate science and adaptation evidence to understand:
    - The tensions that exist between expert and political authority in the generation of knowledge about climate risks;
    - The contextual and political forces influencing experts and evidence;
    - The need for political legitimacy as a precursor for evidence legitimacy;
    - The role of *ex-ante* policy analyses in the development and presentation of this evidence; and therefore finally,
    - How politics influence the role of evidence and expertise in climate adaptation policy making.

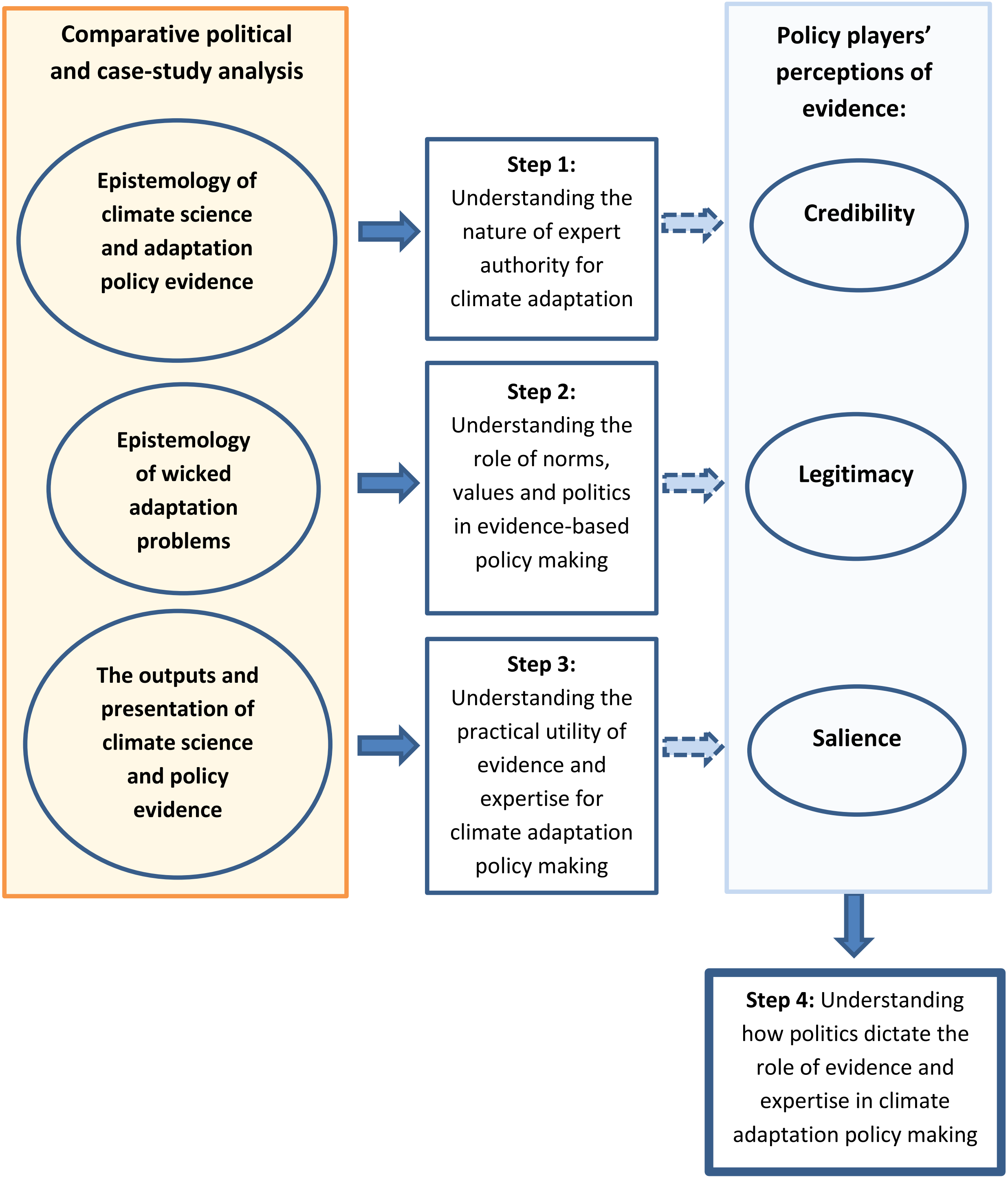


Figure 1.3. A hybrid comparative analytical method to elucidate the science-policy interface for climate adaptation policy

My research investigates and challenges a number of prevailing assumptions in the development of climate adaptation policy. In particular that:

1. Adaptation policy is and should be evidence-based, and that adaptation evidence should be expert-driven and principally scientific, technical and/or economic in content;
2. The most important scientific evidence required for adaptation policy is robust and usable descriptions of the hazards and potential impacts of future climate change; and,
3. There is heuristic value for policy making in the notion that science informs policy in a rational and linear way.

These assumptions have developed from ideals concerning the importance of evidence and reason to inform policy, rather than relying on normative inclinations or political ideology. They also stem from an associated ideal epistemology where science can find useful answers to how the world works and that this information can help us to make robust decisions. However, as I demonstrate here, the climate change problem is characterised as much by its uncertainties and complexity as by the dramatic conclusions scientists make about the future and so adaptation policy making has encountered significant difficulties when pursued on the basis of these assumptions.

As my research shows, adaptation policy making cannot rely on the provision of deterministic (or even conventional probabilistic) and impartial expert evidence about future climate change, should not assume that evidence development and use is free from political influence, nor that policy players are neutral servants of bureaucratic government that can rationally oversee evidence-based policy. My thesis demonstrates that:

- Adaptation policy is only evidence-based to the extent that the evidence is congruent with political priorities.
- In the face of intractable uncertainties, climate change projections (i.e., climate science) and expert assessment of potential impacts (i.e. policy evidence) often lack one or more of *salience*, *legitimacy* and at times even *credibility* for policy makers and the public in helping them to adapt:

i. Neither climate science nor derivative policy evidence are salient because these outputs fail to meet the instrumental-rationalist norms of decision makers expecting deterministic and objectively correct answers to policy questions.
ii. Both of these forms of evidence often lack legitimacy because they conflict with prevailing political and socio-economic values and priorities. Policy evidence in particular necessarily relies upon a narrow framing of what any given impact or risk from climate change may be, and therefore fails to account for the multiple valid perspectives of climate risk in a fair or representative way.
iii. Policy evidence derived through ex-ante policy appraisal lacks credibility because it fails to account for the perspectives and priorities of policy players at contrasting governance levels and scales.

- More and better information about future climate change is not the most important type of evidence needed to inform adaptation policy once the legitimacy of climate change as a policy issue has been established.
- Legitimacy holds primacy over credibility and salience as the principal attribute for the development of useful, usable evidence for policy. Although, as Cash et al. (2003) have argued, credibility, legitimacy and salience are attributes that should be balanced against one another to ensure effective knowledge systems for sustainable development, for the purposes of climate adaptation at least, my research shows that legitimacy (interpreted as a political acceptability for both the knowledge production process and the resulting knowledge) is the principal limiting factor for evidence use in policy making. I argue that the political acceptability of evidence is strongly correlated with the existence of political legitimacy within liberal democratic government for climate change as a priority policy concern.
- Science does not and cannot inform adaptation policy in a rational or linear way because of the nature of bureaucratic policy making processes, the 'wicked' characteristics of the

> climate change problem and the necessity for coproduced policy knowledge for effective adaptation to climate change. Adherence to this rationalist heuristic, I argue, has been promoted through government guidance as a means of reinforcing an ethic of impartiality within bureaucratic policy making. However, my research demonstrates how this linear-technocratic schema can help to disguise political debates within 'objective' assessments of science for policy and thus, I argue, enhances the propensity for the deliberate politicisation of adaptation evidence. This rationalist ideal facilitates the scientisation of contentious adaptation policy debates whereby recourse to the 'facts' suppresses substantive normative, political debate.

As a result of these difficulties associated with the prevailing assumptions underlying adaptation policy making to date, I conclude that it is time to reconsider not only what evidence scientists should strive to deliver for adaptation policy making, but how we value and consider the use of expertise for informing environmental policy more generally.

1.6 Chapter Outline

This thesis consists of a theoretical analysis of science-policy interactions; a comparative political analysis of Queensland, Australia and the UK and their historical approaches to climate change policy; an epistemological analysis of climate change evidence and the 'wicked' characteristics of climate adaptation policy problems; an analysis of policy players' perceptions of evidence credibility, legitimacy and salience, and a series of comparative case-study analyses from Southeast Queensland, Australia and Southeast England in the UK that demonstrate the wicked characteristics of adaptation policy problems and the processes of politicisation and scientisation that can occur as a result.

Chapter 2 – Method

Chapter 2 outlines the method used for this research, describing a combination of comparative political analysis between Queensland, Australia and the UK, case-study analysis between Southeast

Queensland and Southeast England, and semi-structured interviews with a range of experts and other policy players in Australia and the UK to understand the role of experts and evidence in climate adaptation policy making.

Chapter 3 – Science, Evidence and Public Policy

Chapter 3 begins by providing a review of the available academic literature to examine various theories put forward concerning how policy is made, how science informs policy and the relationship between experts and policy making. This chapter provides a foundational understanding of the underlying concepts of policy making within liberal democracies and the tensions that exist between expert and political authority that arise when attempting to manage contemporary public policy issues such as climate adaptation. In particular, this review focuses on the difficulties that arise when seeking to know where one form of authority ends and another begins for evidence-based policy making. This issue is an important component for understanding the relevance and utility of policy players' perceptions of the credibility, legitimacy and salience of climate adaptation science and policy evidence, investigated in Chapter 6.

Chapter 4 – Australia and the UK: comparing the pursuit of climate adaptation between liberal democracies

Through comparative political analysis, Chapter 4 provides an introduction to the historical and socio-political background and context of Queensland, Australia and the UK relevant to this research, as a means of understanding the prevailing attitudes of both politicians and the public to climate change and climate adaptation as a policy priority. I then describe the relative approaches to adaptation policy making between the comparative case-study regions of Southeast Queensland and Southeast England as well as the state of the available science and evidence for informing adaptation policy in these two regions. This chapter will provide the background for the case-study analyses that appear across subsequent chapters.

Chapter 5 – Climate adaptation evidence and policy

Chapter 5 presents a characterisation of how evidence for adaptation policy develops. I outline here a three step ‘coproduction’ process in which evidence progresses from the field of climate change science and the development of climate change models; to a negotiation about how those model outputs are to be presented to those who might use them; to the development of impact and risk assessments whereby policy makers and experts negotiate a body of mutually agreed and internally consistent policy knowledge about how climate change may affect a given jurisdiction or set of priorities. This characterisation is designed to explain how subjective and normative assumptions and decisions are a necessary component of adaptation science due to the existence of both tractable and intractable uncertainties about bio-geophysical and social-ecological systems in the present and the future.

Building on the literature reviewed in Chapter 3, I then assess the wicked characteristics of adaptation policy problems which make their pursuit under an evidence-based mandate particularly prone to political influence. Using the two case-study regions, this chapter describes a series of examples to explain various approaches to the development of adaptation policy evidence and how uncertainty, complexity and political and contextual factors have influenced evidence development and use. I provide a typology by which to understand the constraints that policy makers are under when seeking to understand and address adaptation policy problems and how these difficulties have influenced policy makers’ perceived evidence requirements for adaptation policy.

Chapter 6 – Perceptions of the usefulness and usability of climate change science and evidence for policy

Chapter 6 begins with a discussion of the analytical framework developed by Cash et al. (2002) for understanding knowledge systems for policy. I discuss the suitability of the criteria of credibility, legitimacy and salience as a means of measuring the effectiveness of knowledge and knowledge systems for climate adaptation policy. I propose an alternative interpretation of these criteria as a means of understanding the interactions between experts and policy making and demonstrate its suitability using the interview results compiled for this research.

This chapter draws on the outputs of research interviews and this revised interpretation of Cash et al. (2002) to assess the perceived efficacy of existing evidence for climate adaptation policy. Whereas Tang & Dessai (2012) limited their analysis to climate change projections within the UK, the analysis in Chapter 6 examines both climate change science and those evidence outputs such as impact and risk assessments which, although often not considered wholly scientific by the science community, are nonetheless used by the policy making community (and interpreted by the media and the public) as scientific evidence. This analysis is drawn from policy players in both Australia and the UK and therefore can be said to have a degree of generalisability across comparable liberal democracies.

Chapter 7 – Evidence-based policy and the politicisation and scientisation of climate risk management

Using two case-study examples, Chapter 7 assesses the contemporary use of the rational model and the *ex-ante* policy analysis tools used for climate adaptation in the UK and Australia. I describe how the rational model can disguise political debates within science-policy analyses and demonstrate how risk assessment outputs in particular (e.g. the UK's CC Risk Assessment and the Q100 metric in Queensland) have become politicised in the course of developing evidence-based adaptation policy due to the expectations arising from the linear-technocratic model. In the UK risk assessment has been used as a means of legitimising political decisions regarding the relative priority of climate risks under the guise of impartial expert evidence, while subsequently being sidelined in favour of more overt political prioritisation. In Queensland, rationalist heuristics have also been used to disguise political deliberation and decision making as expert evidence and has resulted in a technocratic approach to the concurrent policy priorities of disaster risk management and urban planning policy, resulting in policy makers' failure to account for the full range of risks presented by climate extremes and a subsequent loss of resilience and adaptive capacity of communities and government as a result.

Chapter 8 – Conclusion

Chapter 8 addresses each of the aforementioned research questions using the preceding analysis. It then draws conclusions about what the role of experts is and should be in the development of adaptation policy.

Chapter 2. Method

That which can be asserted without evidence, can be dismissed without evidence
– Christopher Hitchens

2.1 Introduction

For this research I use a hybrid comparative method to understand the role of experts and evidence in adaptation policy making and how political attitudes toward climate science and expertise influence adaptation policy making. Data collection for this thesis involved a combination of desk-based literature research alongside a series of semi-structured interviews. This data collection is discussed here in tandem with the stages of analysis described below.

To begin, my research involved a broad comparative historical and political analysis of the UK and Queensland, Australia to understand the prevailing stable and dynamic political influences upon policy decision making in these two liberal democratic states. Second, I examine the case-studies of Southeast England and Southeast Queensland to understand the nature of climate and adaptation in these regions, the evidence available to understand these issues, and the approaches taken to adaptation policy making by their governments to date. Third, in tandem with an epistemological analysis of climate change science and adaptation policy problems, I examine a number of specific examples within these cases to understand some important characteristics of adaptation policy problems in these regions. Fourth, I analyse the outputs of a series of 34 semi-structured interviews undertaken with various policy players' involved in the development of adaptation evidence and policy. These interviews demonstrate policy players' perceptions of evidence development and use and are analysed to help understand the tensions that exist between expert and political authority. In particular, how norms, values and politics relate to adaptation problems and the evidence and expertise used to understand them. Finally, I combine these preceding steps with the available theory on the interactions between expert and political authority to understand the influence of political attitudes on the role of experts and evidence for climate adaptation policy making.

2.2 Comparative political analysis

The comparative method of political analysis has many interpretations and variations. Peters (1998) suggests that there are at least five types of study that fall within the field of comparative politics, ranging from single country descriptions of politics to statistical analyses of all countries of the world. Peters (1998, p. 10) describes the type most relevant to my research as "analyses of similar processes and institutions in a limited number of countries, selected (one expects) for analytical reasons". Likewise, Hirschi (1973: p. 500) describes the comparative method as "the rigorous and systematic comparison of a small number of supraindividual[9] units from more than one culture".

For my research I have undertaken a comparative political analysis between the State of Queensland in Australia and the United Kingdom. In particular, I investigate the developing socio-political and economic cultures of these two liberal democratic states as they relate to the management of the environment, and more specifically, the management of climate change. This comparative analysis provides the necessary context for understanding the role of values and politics in the development of policy evidence for climate adaptation and the correlation between the political legitimacy available for an issue like climate change and the evidence legitimacy available for contentious policy knowledge relating to climate change. These points of analysis are then developed further through individual case-studies and semi-structured interviews as described below. The data collection for this comparative analysis was drawn primarily from the extensive historical and political literatures available for these liberal democracies.

A common complaint concerning the comparative method of political analysis is the problem of "many variables, small number of cases" (Lijphart, 1971: p. 685; Hirschi, 1973) which means that it is usually impossible to fully control for a vast array of potential contributing factors when seeking to

[9] "of, relating to, or being an organism, entity, or complex of more than individual complexity or nature" (Merriam-Webster, 2015)

understand a variable or set of variables under examination. As Lijphart (1971) argues, this problem of experimental control is faced by all social science research to some extent. Hirschi (1973) argues that a lack of precision with regard to understanding comparative cases is not necessarily as great an impediment as might be imagined since the task of comparison between cases can nonetheless be revealing:

> *Explicit comparison reduces rather than intensifies measurement problems. We may not know how tall friend A is, but if we know that he is "taller than" friend B, we have at least the basis of an assertion – and our concern for the "exact" heights of friends A and B is correspondingly reduced* (Hirschi , 1973: p. 504).

Hirschi (1973) and Clifton (1979) highlight other prominent criticisms of comparative analysis as, respectively, those of intrinsic or fundamental dissimilarity between cases and the multi-causality of social phenomena, such that it is all too easy to draw convenient over-arching explanations or hypotheses when there are so many pertinent variables with which to construct such an argument. However, Hirschi (1973) notes that this problem can be at least partially avoided by ensuring that the comparisons one makes should be tightly bounded by the research questions.

For the purposes of this research, the cases of the UK and Queensland provide a degree of experimental control by keeping a number of key factors constant. For example, both cases have similar three-tier liberal democratic governance systems and adaptation policy is principally governed through the central tier of their governance structures (in Queensland at the state level, and in the UK, at the national level) with increasing pressure being placed on local government in both cases to take on greater responsibilities. Although these cases have quite different climatic hazards and levels of exposure, both have heavily urbanised and rapidly expanding regions (Southeast Queensland and Southeast England) with similar levels of socio-economic vulnerability to climate. I argue that both cases have good reason to be worried about climate adaptation policy (albeit for somewhat different reasons), and both utilise very similar institutions of government and mechanisms of bureaucratic governance when attempting to address this issue. These similarities allow for this research to focus its comparison on the important subject of evidence development and use for policy making, and provide important contextual knowledge about the political values at play for policy players engaged in evidence-based policy.

Clifton (1979) argues that comparative analysis should not attempt to make definitive generalisations about phenomena and their inter-relationships without considering all possible cases and through multiple modes of comparison. Similarly, Lijphart (1971) suggests that comparative political analysis may often provide greatest utility as the first stage of research during which preliminary hypotheses may be formulated, in order to facilitate further research at higher levels of resolution that are amenable to greater levels of analytical precision. The initial comparative political analysis in this research does not, by itself, propose definitive explanations for why climate adaptation policy is considered important (or otherwise), nor reach general conclusions on its own about the relative influence of political versus expert authority in adaptation policy making. However, it provides initial hypotheses in relation to these questions which are then tested using subsequent modes of comparative case-study and interview analysis.

Thus, I use this initial comparative analysis to understand the broad history and landscape of political and socio-economic development for these two cases. Initial hypotheses about the nature of the political legitimacy available for climate change and climate adaptation policy are drawn, alongside some general indication of the relative influence of climate science versus norms and political values during adaptation policy making. This analysis suggests a number of potential reasons (some of which have already been hypothesised or alluded to in the literature) for how climate change legitimacy may be influenced by the socio-economic and political ethos of governments and the public. The comparative method then adds precision to its analysis through a case-study comparison of Southeast England and Southeast Queensland.

2.3 Case-study analysis

Case-studies are "an intensive study of a single unit with an aim to generalise across a larger set of units" (Gerring, 2004: p. 341) which, in comparison with one another, can allow for useful generalisations about liberal democratic governance. Case-study analysis may be considered a subtype of the comparative method (Lijphart, 1971). The data collected for the purposes of this analysis were principally drawn from the existing bodies of historical and political literature for these two regions, as well as from a review of the grey literatures produced by government in relation to climate adaptation and related policy initiatives.

The type of case-studies investigated in this research may be categorised as what Lijphart (1971: p. 692) defines as 'hypothesis-generating case-studies', which are approached with a "more or less vague notion of possible hypotheses" which may subsequently be tested against a broader number of cases. In this research the hypotheses generated by the preceding comparative analysis of the UK and Queensland relate to the idea that political concerns get in the way of evidence-based policy making and as a result policy makers utilise evidence only to the extent that it is congruent with prevailing norms, values and politics. Alternatively these case-studies, in combination with the literature review of Chapter 2, provide a degree of 'theory-confirming' function for the established theory in the literature relating to the nature of science for policy and the interactions between expert and political authority for policy making. Lijphart's (1971) categorisation is an idealised one and he concedes that in practice case-studies may fulfil the profile of more than one of his proposed categories.

The case-study areas investigated for this research have been examined in a number of ways. First, in Chapter 4, as part of the characterisation of each case-study an analysis of extant and lapsed policy initiatives seeks to understand the extent to which adaptation policy has been considered by the governments of Southeast England and Southeast Queensland. Second, in Chapters 5 and 6, specific examples of adaptation policy making challenges have been picked to help understand the wicked nature of these policy issues and the difficulties that each case-study area has encountered when developing evidence to understand and resolve them. Third, in Chapter 7, two of these specific examples are examined in detail to explain how politics may influence the development of evidence for policy through processes of deliberate politicisation and scientisation.

The comparison of these case-studies provides a valuable basis of research, I argue, because they hold a number of characteristics in common, relating to their population density, urban form and increasing socio-economic vulnerability to climate, along with those similarities identified in the preceding comparative political analysis concerning their styles and systems of liberal democratic governance. These controlled variables, in combination with the literature review, help to inform the in-depth analysis of perceptions of credibility, legitimacy and salience of climate science and other evidence for policy making presented in Chapter 6, and therefore allow preliminary generalisations to be made concerning the relative importance of these characteristics for the purpose of climate adaptation policy. However, these cases also allow generalisations to be made in relation to the contrasting political influences not controlled for, yet which are evident in these cases under a linear-technocratic schema. In particular, these cases demonstrate how Queensland and the UK place different emphasis on the evidence-based mandate and hold differing levels of legitimacy for climate change as a policy priority.

Although caution is required when attributing undue importance to the outputs of this case-study research, since my findings require future verification against a greater number of comparable cases, my conclusions are supported through extensive interview analysis with key policy players involved in the development and use of evidence for policy.

2.4 Semi-structured research interviews

A principal component of my research relates to policy players' perceptions of climate science and policy evidence which is then related to the comparative political and case-study analyses described above, as well as to the underlying hypotheses of evidence use for policy. This research compares the perceptions of a range of both expert and non-expert policy players through a series of 34 semi-structured interviews. The documentation of policy players' perceptions is used to draw conclusions about the influence of norms, values and politics on evidence-based policy making for climate adaptation and the tensions that exist between expert and political authority as a result.

Given the complexity and nuance associated with ideas of evidence credibility, legitimacy and salience, and the propensity for confusion between Cash et al.'s (2002) criteria (Tang and Dessai, 2012; Weichselgartner and Kasperson, 2010), semi-structured interviews were chosen in preference to other types of data collection. Structured interview techniques that strictly adhere to a set of proforma questions would not have allowed for the development of interview participants' ideas nor allowed me to elicit important information from participants about the usefulness and usability of science and evidence for adaptation policy making. In particular, a structured interview format would have struggled to ensure that participants made a discernible distinction between concepts of credibility, legitimacy and salience that were possible using a semi-structured interview format. These difficulties have been encountered in a previous study where interview participants were observed to conflate concepts of credibility, legitimacy and salience (Tang and Dessai, 2012). Similar problems would have arisen, I believe, had I collected data through the use of questionnaires or written correspondence with research participants. Conversely, unstructured interviews would have struggled to collect the level of detailed information that was facilitated by using the semi-structured format. Conducting research workshops with groups of policy players would have been another viable alternative or additional source of data for this research. Unfortunately, due to time and resource constraints, workshops were not feasible during the course of this research.

Using the concept of 'knowledge systems' for sustainable development[10] (Cash et al., 2002) as a framework for analysis, a sample of 34 key policy players were interviewed to provide a firsthand account of their experiences of the development and use of climate change science and evidence for policy. Policy players participated on a confidential basis in order to entice them to provide truthful and unabridged accounts of their experiences. Interview participants were sourced from ministerial departments of central government, local government councils and their administrative departments, non-departmental government agencies involved in adaptation policy making and implementation, scientific advisory agencies and academia, as well as non-governmental

[10] Albeit adjusted as per my revised criterion of legitimacy, described in Chapter 6.

organisations regularly consulted by government in the course of adaptation policy making. This broad sampling of the policy making community ensured that participants' testimony could be cross-checked through triangulation across a range of participating organisations.

Finally, relating interview findings to the preceding comparative political and historical analysis, as well as to the theory of the philosophy and sociology of science, allowed for those interview results to be placed in their political and historical context. Thus, while interviews on their own provide an indication as to *what* considerations are important in the design and use of evidence for adaptation policy, their relationship to the context of prevailing norms, values and politics helps to explains *why* those priorities are as they are, and point to some interesting conclusions about the relationship between expert and political authority that can advance the underlying theory.

The 34 semi-structured interviews undertaken included 14 from Australia and 20 from the UK. Interviewees were sourced from three types of participant involved in the development and use of adaptation evidence for policy in the UK and Queensland, across three levels of government. Participants were divided between *Climate Change Scientists* involved in the production of climate projections and scenarios; *Policy Scientists* involved in the development of adaptation science and policy evidence such as impact and risk assessments that utilise climate science; and *Policy Players* working either in ministerial departments, non-departmental government agencies, or in or with local government councils who have used (or have been expected to use) climate-related evidence for policy making and implementation. The ratio of interviewees between categories of participant was as follows: Climate Change Scientists (6): Policy Scientists (16): Policy Players (12). Questions were tailored to participants' individual perspectives on adaptation policy making, informed by their descriptions of their professional duties (see Appendix C). In line with Griffith University's Ethics Guidelines, the identities of interview participants have been kept confidential and each has been given a label (e.g., UK-Climate Change Scientist 1; Aus-Policy Player 3, etc) (see Appendix D).

Although a principal aim of the interviews was to understand policy players' perceptions of the knowledge-systems' criteria of credibility, legitimacy and salience, as a means to understand the tensions between expert and political authority, interview questions did not explicitly use the terms *salience* and *legitimacy* when investigating perceptions of these attributes for climate science. This strategy was pursued due to the subtle distinctions between the definitions of these criteria which meant that explicit use of these criteria may have caused confusion amongst participants. This approach appears to have been validated by the difficulties encountered by Weichselgartner and Kasperson (2010) and Tang and Dessai (2012) when attempting to elicit coherent and distinct perceptions of Cash et al.'s (2003) criteria, whereby interview participants were observed to conflate these concepts. Instead, participants were asked about their impressions and experiences of working with climate change science, projections, scenarios and impact and risk assessments, and the extent to which this evidence was perceived to be useful and usable. Participants were asked for their views of:

1) How climate science does and should inform policy making;
2) What constitutes climate change evidence for policy;
3) What types of climate change evidence are most usable for policy making;
4) What gives climate science and other evidence its expert authority;
5) How contextual and political factors influence the development, provision and presentation of climate science and other adaptation evidence; and,
6) The role that experts and non-experts should play in the provision of policy evidence.

Questions were directed first to participants' use of climate science and then to the development and use of adaptation science and policy assessments of climate impact and risk[11]. By asking participants about their experiences of the usefulness and usability of evidence outputs and the role of varying policy players in this way, interview recordings and transcriptions were then analysed to understand participants' perceptions of climate science credibility, salience and legitimacy. UK participants' experience of evidence development and use has principally been shaped by the requirements of the *Climate Change Act (2008)*, most recently during the

[11] See Appendix C for a full list of interview questions.

development of the Department of Environment Food and Rural Affair's *UK Climate Change Risk Assessment (UKCCRA)* (DEFRA, 2012a,b), the Adaptation 'Reporting Power' (DEFRA, 2009) and by the (now defunct) National Indicator 188 requirement on local government (DEFRA, 2010). In Australia, most participants' experiences of evidence development related to regional and local risk and impact assessment and the use of climate science and other evidence tailored to this purpose. The research findings presented here reflect this imbalance, while demonstrating the contrasting priorities of evidence salience and legitimacy between the two case-studies.

2.5 Theoretical Framework

Constructivism[12] and Critical Realism:

This research pursues a constructivist epistemology which assumes, as a founding premise, that climate-related hazards and risks cannot be objectively apprehended by experts in a rational, instrumental way. This framework aligns with the characteristics of climate science and evidence and the nature of wicked policy problems described in Chapters 3 and 5 which mean that adaptation problems are too complex, uncertain and subject to diverging values and priorities to ever allow experts to account for their true nature in a positivist or instrumental way. Within this constructivist framework however there are varying interpretations of climate hazard and risk which give varying recognition to or acceptance of their objective reality, and which broadly align with concepts of weak versus strong constructivism.

[12] It seems worth noting here, for clarity, the distinction between construct*ivism* and construct*ionism*. Although often used interchangeably, it has been suggested that these words describe different epistemological perspectives, if not also slightly different theoretical concepts. Both terms have been used in cognitive psychology as ways to describe modes of learning and knowing. Constructivism, describes the internal cognitive processes of individuals and the ways in which they construct meanings. Social constructionism, by contrast, which has been adopted by the social sciences, refers to the ways in which social groups collectively construct knowledge and meaning (McNamee, 2004; Ackermann, 2001). It is social *constructionism* therefore which forms the conceptual framework underpinning this research and that I am principally concerned with investigating in the development of evidence for policy. Nonetheless, the term 'constructionism' is not commonly used in the fields of political and social science and it is more common to see the term 'constructivism' used to discuss the development of science, evidence and public policy, even where it appears that constructionism would be more accurate. Therefore, although I refer principally to constructivism here due to the greater usage of this term over the former, I reference published work that uses the term constructionism to mean the same thing (In particular, see Keller, 2009; Lupton, 1999).

Weak Constructivism is based on the idea that hazards and risks, such as those examined for this research, are objectively real and have an ontological basis, and it is in attempts to apprehend this objective reality that experts and policy makers construct their version of this reality. By contrast, the **S*trong Constructivist*** view argues that nothing is a risk in itself, but that anything can be a risk, depending on one's perspective; risks have no ontological basis or objective reality and we assign the label of risk to whatever we are concerned about (Lupton, 1999: p. 28).

In critiquing the realist perspective of objective instrumental positivism associated with the linear-technocratic policy making schema and the ability of this model to understand climate adaptation problems (see Chapter 5 for details), my research must, by necessity, pledge allegiance to constructivism as a framework of analysis. This approach also makes sense given the virtual nature of contemporary climate change science which utilises complex models as a laboratory through which to understand the climate system (Kellow, 2009) and which requires, out of necessity, significant subjective/normative interpretation to derive coherent outputs. For the purposes of my research, I adhere to a *critical realist* perspective that broadly aligns with a weak social constructivism. I presume that both intransitive (that which knowledge is about, i.e., some objective reality) and transitive (constructed knowledge) components exist in the epistemology of climate adaptation. As Archer et al. (1998: p. xii) note:

> *The Western philosophical tradition has mistakenly and anthropocentrically reduced the question of what is to the question of what we can know. This is the 'epistemic fallacy', epitomized by concepts like the 'empirical world'. Science is a social product, but the mechanisms it identifies operate prior to and independently of their discovery (existential intransitivity). Transitive and intransitive dimensions must be distinguished. Failure to do so results in the reification of the fallible social products of science. Of course being contains, but it is irreducible to, knowledge, experience or any other human attribute or product. The domain of the real is distinct from and greater than the domain of the empirical.*

The critical realist perspective, I argue, is coherent with my research questions and strategy which assume that there is no clear delineation between expert authority derived from privileged access to objective reality, and political authority derived from prevailing and democratically representative political values and priorities.

The Sociology of Science – Science and Technology Studies and Science Policy Studies:

This research largely relies upon the theoretical frameworks developed to date by the social-science sub-disciplines of Science and Technology Studies (STS) and Science-Policy Studies. These schools of thought broadly identify with the idea that theory relating to the interactions between expert and political authority has gone through three modes (or waves) of theoretical development (Spruijt et al., 2014). Described in detail in Chapter 3, I use this model of theoretical development as the starting point of my analysis and as a means to understand the relationships between science and policy for climate adaptation described here.

As part of its central analysis, my research uses the conceptual framework developed by Cash et al. (2002) regarding perceptions of evidence credibility, legitimacy and salience as indicators of effective knowledge systems for sustainable development. This framework is used in combination with the aforementioned two-part comparative analysis to understand the nature of expert authority, the role of norms and politics in policy development and evidence use, and the usefulness and usability of the available evidence for adaptation policy making.

Chapter 3. Science, Evidence and Public Policy

The ideologies of our time (economism, scientism and technocracy) support the progressive view that experts, using scientific methods, can manage the world's problems by objective and efficient means […]. Several aspects of that view are no longer tenable. These include the notion of an objective and value-free natural science and the idea that economics can be separated from ideology (Ludwig, 2001: p. 758).

3.1 Introduction

This chapter explains some of the significant issues discussed in the literature to date concerning the relationship between expert and political authority and how they interact for the purposes of policy making. This literature review lays the foundations for understanding the analysis presented in subsequent chapters that describes how political attitudes toward the role of experts and evidence can influence climate adaptation policy making.

Evidence-based policy has taken on increasing significance for liberal democratic government at the beginning of the twenty-first century, though its origins date back to the Enlightenment or earlier. More than ever before, commentators would have us believe, we are producing vast quantities of evidence and we increasingly rely on expertise to justify, inform and otherwise influence the development of public policy (Grundmann, 2009; Keller, 2009: p. 2; Nilsson et al., 2008; Maasen and Weingart, 2005; Jasanoff, 2003a). Although this view seems partially incongruous with the findings of the research presented here, given Australian governments' apparent reticence toward science and the evidence-based mandate in recent years (Milman, 2014; Towell et al., 2013), globally, experts continue to produce large amounts of evidence for informing policy making. Alongside this ongoing emphasis on evidence and expertise, however, has been a notable shift in policy making practice concerning how and what evidence should be developed. As Jasanoff (2003a, 2005) and Irwin (2006) amongst others note, policy players have finally begun to take on board at least some of the messages the academic community have long stated about the necessarily partial and subjective nature of expert assessment for public decisions and a need for the democratisation of expertise in the policy making process[13]. These ideas invoke the need for broader concepts of what expertise is, greater public participation in evidence development, and greater access to expert knowledge for all policy players and the public. As Jasanoff (2005: p. 211) notes:

> *Incoherence, not consensus, is the normal epistemological condition in many domains of policy-relevant knowledge […] scientists can no longer stand on firmly secured platforms of knowledge. The questions contemporary policymakers ask of science are rarely of a kind that can be answered by scientists from within the parameters of their home disciplines.*

Increasingly, although often implicitly, scientists are expected by policy makers to act within a broader concept of expertise by which they must draw upon their practical and analytical skills to cast judgement on issues that transcend their disciplinary competence (Fischer, 2009), and to share their authority with a broader range of valid perspectives in the development of policy knowledge (Maasen and Weingart, 2005). Thus, for complex policy problems it has been suggested that science has increasingly been replaced by expertise, and knowledge replaced with expert judgement (Jasanoff, 2005). This shift away from science as the sole arbiter for defining and understanding policy problems with technical underpinnings has occurred despite the tenacity of technocratic concepts of scientific governance (Irwin, 2006) which still largely assume that science can "speak truth to power" (Price, 1965). This latter concept is still reflected in the perspectives of many policy players (Grundmann, 2006) as well as in much of the rhetoric of and guidance to the policy making community, advocating for 'sound science' as impartial and capable of apprehending objective reality (Hertin et al., 2009), sometimes even alongside calls for the democratisation of expertise (Irwin, 2006; Jasanoff, 2005).

There appear to be, therefore, conflicting influences in the development of evidence-based policy. Yet, as this chapter explains, an increasing perception of the fallibility of science and expertise raises important questions about:

i) What constitutes credible, authoritative evidence? and,

ii) The extent to which we should believe experts' claims in this regard?

[13] Although it is unlikely that the natural sciences academy would advocate such views, given their implicit adherence to a positivist epistemology, these messages have been forthcoming from social scientists concerned with the philosophy and social studies of science, science and technology studies, and science-policy studies.

I begin here by describing the major theories of public policy making and the roles commonly expected from experts and evidence during the policy process. I then describe the tensions between expertise and political authority relating to the questions above, which result in the dual and conflicting problems of *legitimacy* and *extension* (Collins and Evans, 2002), and the associated difficulties of demarcating where expert authority ends and politics begins for policy making. I then describe some of the practical challenges faced in the development of evidence for policy making when managing the tensions between expert and political authority. Here, I introduce the knowledge systems framework first described by Cash et al. (2002) and which is used in Chapter 6 for the purposes of my interview analysis. Finally, I describe how the role of experts and evidence compares to that of policy makers and other policy players and how understanding these relationships can help to understand what the role of experts for climate adaptation policy is and should be.

Jasanoff (2005) suggests that there are three bodies of expertise relevant to understanding the interactions between science and policy and in seeking answers to the aforementioned questions:

1. The bodies of knowledge that experts represent;
2. The experts themselves; and,
3. The committees and institutions through which experts offer judgement for policy making.

My research is principally focused on the first two of these bodies in as much as it is meaningful or possible to assess their contributions without also discussing the ways in which they are organised. However, in the course of investigating the role of knowledge and expertise in policy making, this chapter reveals how effective evidence for policy has become increasingly dependent on the mechanisms and institutions of contemporary bureaucratic government. Indeed, I contend that both the literature and the research presented here support the conclusion that the viability of evidence-based policy is strongly dependent on the relations between these three bodies of expertise and bureaucratic government. My research is concerned with how these expert and political institutions balance the norms, values and priorities of the policy making community under an evidence-based mandate. By enhancing our understanding of how adaptation policy evidence develops, my research seeks to understand more clearly just how expert, bureaucratic and executive authority integrates for the purposes of climate adaptation policy.

Given the historical development of social and institutional legitimacy for evidence-based policy making (Kitcher, 2011), it is unsurprising that much of the available theory described here is subject to multiple interpretations across sub-disciplines of political and social-science, such as science-policy studies and science and technology studies (Spruijt et al., 2014; Miller and Neff, 2013). There are already a number of very good summaries available recounting the development of contemporary theories of evidence-use for environmental policy (See for example, Keller (2009) and Jasanoff and Wynne (1998)). This chapter will not attempt a definitive summary; rather, it seeks to consolidate varying theoretical interpretations and to find common ground across these literatures in order to understand the dynamics of policy making and the potential roles for experts and evidence in this process.

3.2 Theories of public policy making

Table 3.1. A range of policy making models

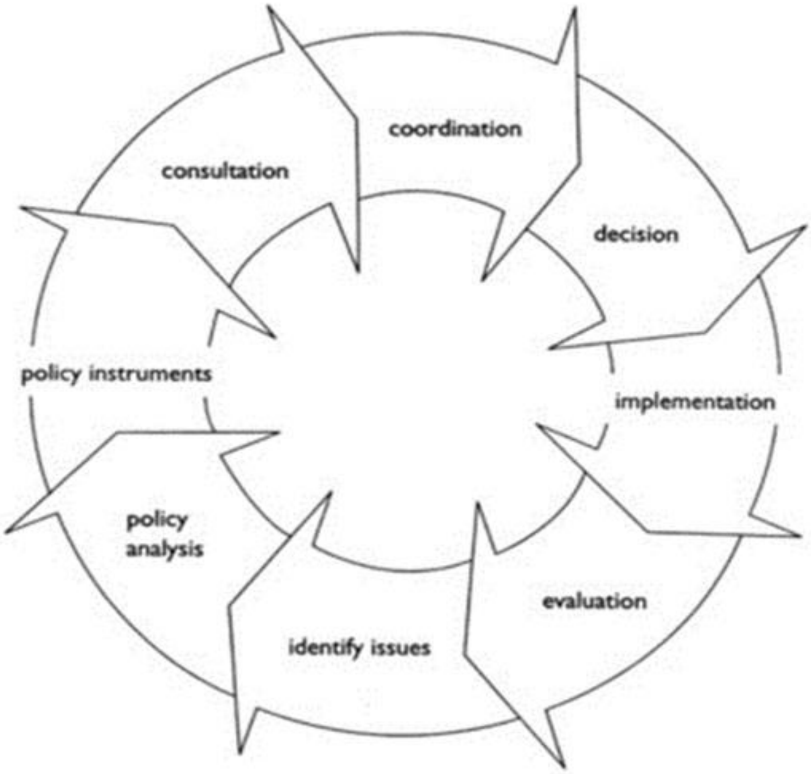
Image has been removed.

3.2.1 Rationalism and Incrementalism

The linear or 'rational' model has long been regarded as probably the most useful or widely applicable model or heuristic for policy decision making (Althaus, Bridgman and Davis, 2007; APSC, 2007; Bell, 2004; Jasanoff and Wynne, 1998). Perhaps as a result of this hegemony over policy making theory and practice, the rational model has been the focus of extensive criticism and debate across the academic community (Head, 2013; Keller, 2009; Sutton, 1999) and has been interpreted as both a descriptive and a normative model across various academic literatures in ways that can sometimes be challenging to untangle. Although it is a broad theoretical frame, all variants share a perspective that evidence can provide facts and apprehend objective reality with sufficient detail and accuracy to linearly inform how best to achieve political ends (Keller, 2009; Sabatier, 1999: p. 6). In political theory for instance, such interpretations include the 'rational actor' model where rational decisions are made by a unitary actor (Allison, 1971), and the rational 'comprehensive' model where rational decisions are made through a linear, sequential set of steps each time a new policy response is required (Parsons, 1995: p. 271). Generally speaking, however, the broader rational decision making model prescribes an approach which assumes that the decision-maker(s) is motivated to maximise social gain; that he or she has adequate objective knowledge of the problem and the value preferences of those involved, knows all the options available, understands all the costs and benefits of these options, and can rationally choose and evaluate the best one (Dye, 2005: p. 15). Sutton (1999) outlines the steps prescribed by the rational approach, as follows:

- Recognising and defining the nature of the issue to be dealt with;
- Identifying possible courses of action to deal with the issue;
- Weighing up the advantages and disadvantages of each of these alternatives;
- Choosing the option that offers the best solution;
- Implementing the policy;
- Possibly evaluating the outcome.

One manifestation of this model has been the concept of the policy cycle, as shown in figure 3.1. below. Although there is much that is attractive about this model as a heuristic device amongst practitioners (Heazle et al., 2013) there has been considerable commentary and evidence to suggest that it is fundamentally flawed and problematic for policy decision making. This is due to difficulties associated with agreeing on the goals that would dictate decision making criteria; the nature of contemporary policy problems which often defy scientific or political agreement concerning what the problem actually is (or indeed that there is even a problem in the first place); and the difficulties of objectively understanding what a 'best' response might look like (Head, 2008a,b; Nilsson et al., 2008; Sutton, 1999; Rittel and Webber, 1973).



The Australian policy cycle

Althaus, C., Bridgman, P., and Davis. G. 2007. The Policy Cycle, in *The Australian Policy Handbook* (4th edn), *Crows Nest: Allen & Unwin, pp32-44.*

Figure 3.1. The Policy Cycle

Possibly the most notable proponent of rational decision making was Nobel Laureate Herbert Simon (cited in Parsons, 1995: p. 273)) who nonetheless highlighted a significant limitation of the model due to the inability of decision makers to have perfect knowledge. He suggests instead that they are subject to what he called ‘Bounded Rationality’, such that it is impossible for an individual or group to achieve any high degree of rationality in policy decision making since the bounds of any given problem are far greater than the ability of that person or group to conceive of them. There are always so many alternatives, so much information to process that a wholly rational objective decision is not possible. Simon suggests instead that decision-makers are rational to the extent that they can conceive of a problem, within the bounds of cognitive ability, scientific understanding and the organisational environment in question. Bounded rationality is just one example of the many criticisms attempts at rational decision making have provoked. More recently, a range of further criticisms have emerged in light of a growing realisation of the uncertainty, complexity and value-based nature of many contemporary policy problems. Perhaps one of the most important has been the characterisation of many policy issues, including climate change (Head, 2008b), as 'wicked'.

The concept of wickedness, first proposed by Rittel and Webber (1973), refers to the difficulties of objectively understanding very much at all about policy problems and the necessarily subjective nature of any decisions made in relation to their management[14]. Thus it is argued, the aforementioned steps of rational policy making cannot be completed sequentially in an impartial way that could ensure a transparently rational approach (Hertin et al., 2009; Head, 2008b; Oreskes, 2004; Sutton, 1999; APSC, 2007). In any case, knowledge performs many more roles than the simple linear problem-solving role ascribed by the rational model (Hertin et al., 2009; Weiss, 1979) (See section 3.7). Across academic disciplines the broad characteristics of rationalism have been subsumed under various related concepts such as "Instrumentalism" (Parsons, 2004) or "Deficit Theory" (Irwin, 2006). All refer to the expectation that the principal limiting factor for policy development and implementation is appropriate information or technical assessment which experts can and should provide in an objective and timely manner to rational decision makers.

Amongst contemporary theorists, Keller (2009: p. 29) and Grundman (2006) highlight an important distinction between rationalist (or linear) and positivist (or technocratic) models; a distinction that is often lost in theoretical discussions of the use of evidence for decision making as scholars refer to one or the other when actually talking about a combination of both[15]. Rationalist policy making, they argue, relies on normative or political choices to define the goals and priorities of policy makers, whereupon science then provides technical answers as to how those ends may be achieved or identifies issues associated with their technical feasibility. By contrast, positivist policy making is predicated on the view that science can resolve what might otherwise induce political

[14] See Chapter 5 for a detailed description of the characteristics of wicked problems in relation to climate change adaptation.
[15] Grundmann (2006) suggests that this combined model should be referred to as the 'Linear-Technocratic Model'

debates by providing definitive answers about the correct allocation of resources and can therefore resolve conflict over policy choices and even goals. This latter model also assumes that the principal limiting factor of evidence-based policy is robust information, yet leaves even less room for the possibility of friction between the political and the scientific elements of policy making. The positivist model advocates a form of technocracy justified on the basis that science can apprehend objective reality, not just in terms of how to achieve a given policy goal, but also in terms of defining that goal in the first place. This technocratic view of policy making suggests that "if scientific uncertainties are resolved, political debate will follow suit" (Keller, 2009: p. 29). In its contemporary form, Keller believes that the positivist model manifests itself as "soft positivism" (Keller, 2009: p. 29), whereby policy players believe that science can sufficiently constrain the scope of political choice so as to make it significantly easier to reach policy consensus.

However, as Keller (2009) also notes, the positivist ideal appears as unrealistic as rationalism during incremental policy processes (discussed below) since incrementalism is principally motivated by the pursuit of consensus formation rather than on apprehending reality as a pre-requisite for policy decisions. Nonetheless, as my research demonstrates, a rationalist-positivist model, or perhaps more appropriately the *linear-technocratic model*, is particularly prevalent for understanding policy debates concerning climate change and climate adaptation policy, since it is still used as the default heuristic for evidence-based policy making and still represents the views of many (though not necessarily most) policy players about the validity and potential utility of climate science and the reducibility of adaptation policy problems. As I describe in detail in Chapter 7, the linear-technocratic model is inscribed within government guidelines and decision making prescriptions for understanding and managing environmental risks such as those presented by climate variability and change. This model is problematic for the development of adaptation policy, I argue, because it allows for significant political priorities to be covertly determined during the development of supposedly objective expert evidence, and thus bypassed by democratic processes of political debate and policy making.

Although there has been considerable focus by the academic community on the role and use of evidence for policy making, there are other branches of policy theory that do not directly prioritise the use of evidence and which consider policy making as a largely deliberative or political process. These models are important, I argue, for understanding the role of various policy players in the development of policy evidence as will be described further in section 3.6 below. One of the most significant debates concerning policy making during the twentieth century relates to the viability of the rational 'comprehensive' model that assumes that decision makers have a complete understanding of their goals, the policy problem in question, the options available to resolve it and can rationally weigh up the costs and benefits of each as a comprehensive decision making procedure. Lindblom (1959: p. 81) rejected this approach. Instead, he suggested that policy making does and should proceed by gradual incremental changes through "successive limited comparisons" which build from the current policy arrangements, step-by-step and by small degrees, without any major shift or step-change in policy direction.

Lindblom's description of incrementalism as a pragmatic means of overcoming the difficulties of managing an excess of available information and uncertainty, and of limiting value positions, I argue, suggests that policy making may be strongly driven by political considerations. This is because incrementalism appears to provide a limit to the information requirements of policy makers while simultaneously making it easier to reach consensus on a preferred policy option since the required steps are considerably less significant and therefore less contentious than might be required under a rational comprehensive approach. Perhaps as importantly for this research however, Lindblom (1959: p. 81) proposed that issue identification (along with the clarification of values, goals and priorities implicit in this) is a process that runs concurrent to and is elaborated by the analysis of options and the choice of a preferred policy, rather than a required step which precedes rational choice. In other words, he argued that the discrete steps set out in the rational linear model do not occur in reality. Decisions about means often precede those about ends, and values and objectives are clarified along the way.

One of the most significant criticisms of incrementalism as a normative model of policy making came from Etzioni (1967) who argued that the type of consensus reached through incremental change is likely to be overtaken by inequalities of political power between policy players. Etzioni argues that incrementalism is likely to ignore the influence of societal innovation and result in the propensity for political inertia and the path dependence[16] of policy options. Instead, he proposed a 'mixed-scanning' model of policy development which combines both fundamental or transformative decisions as well as incremental change; the former setting policy directions while the latter anticipates those transformative changes and ensures their effective functioning after they have been taken.

Hall (1993: p. 275) provides an important elaboration of these ideas by arguing that the common assumptions of both rationalism (i.e., that it is possible to clarify value positions, or what he calls a "national interest", in advance of setting policy) and incrementalism (i.e., that "policy legacies" determine the course of subsequent policy and result in path dependence) may be overly simplistic notions about the policy process. Although he never actually quotes Etzioni, Hall seems to suggest that the mixed-scanning model may have some descriptive validity for the policy process. Hall (1993) suggests that policy makers work within a framework of ideas and standards which direct policy goals, the kinds of instruments used, and the nature of the problems they are addressing through a process of 'social learning' by the state. Like Etzioni, he suggests that both incremental and comprehensive changes occur, but under different circumstances, arguing that there are three types of policy making change:

- *First order change* occurs when the settings of existing policy instruments are adjusted, although the overall policy goals and instruments remain the same;
- *Second order change* occurs when the overall goals of policy and their relative priority remain the same, but the instruments and techniques used to achieve them are changed; and,

[16] Path dependence generally refers to the tendency for policy decisions to be constrained within the limits of a prevailing policy paradigm or the constraints set by preceding policy making choices.

- *Third order change* involves simultaneous changes to instrument settings, the instruments themselves, and the hierarchy and content of policy goals.

Thus, Hall (1993) suggests that first order change occurs incrementally, second order changes may also, but contain an element of strategic action; while third order change is more attuned to a form of comprehensive policy change in line with Kuhn's (1962) idea of a "paradigm shift". Unlike Etzioni, Hall intends his model of policy making as a descriptive, rather than a normative one. He makes the point however, that the process by which policy paradigm shifts occur is likely to be more sociological than scientific, which seems to reject the rational 'comprehensive' model in favour of comprehensive approaches through political processes of deliberation and consensus formation rather than on the basis of scientifically or technically derived solutions.

If there is descriptive validity to Hall's (1993) thesis for the purposes of climate adaptation, then such policy making dynamics occur despite the fact that linear-technocratic approaches are still commonly prescribed and used by liberal democratic government under the evidence-based mandate (Nilsson et al., 2008). The popularity of such linear-technocratic heuristics reflects pervasive public and political expectations for the role and utility of science in policy making that still exist. As Nilsson et al. (2008) and Owens et al. (2004) point out, and as I elucidate further in Chapter 7, these rationalist prescriptions can be found to varying extents in a wide variety of policy appraisal tools in many developed economies, under the guise of methods such as cost-benefit analysis and risk assessment.

3.2.2 Policy making as politics

Although, Lindblom and Hall acknowledged the possibility of political influence in their descriptive models of policy making, they also appeared to assume that, despite political influence, impartial technical analysis and rational decision making have a role to play in policy making. In comparison, Allison (1971) suggests that it may not be possible to understand the exact processes by which policy is made. He describes three different models as ways to consider the decisions made and the interplay between government institutions to arrive at policy ends. One of these, a Bureaucratic

Politics Model considers decision making as a process of political bargaining amongst a range of decision makers within government hierarchies. Allison (1971: p. 144) suggests that:

> *the […] Bureaucratic Politics Model sees no unitary actor but rather many actors as players […] who make government decisions not by a single rational choice but by the pulling and hauling that is politics.*

Under this model, evidence appears to be a secondary or incidental concern. Policy decision making is shared between a set of decentralised government actors, usually under the control of a central authority, who may disagree about what needs to be done, thus necessitating a political process whereby one group of actors committed to a particular course of action, triumphs over another group; or equally likely, different groups pulling in different directions produce a result distinct from what any individual or group intended.

Similarly, the Game Model of policy delivery, advanced by Bardach (1977; cited by Parsons, 1995: p. 470) conceptualises government organisation as structures of groups and individuals seeking to maximise their power and influence. What results is a political policy making process, in line with Allison's (1971) bureaucratic politics. Both Allison and Bardach argue that politics extends beyond the formal political process of government elites, and that policy implementation is just another form of politics under the domain of unelected power. However, deliberative processes of policy making of this type are not without potential drawbacks. As Etzioni (1967) and Lane et al. (2004) highlight, political forces outside of legitimate democratic forums can result in domination by the powerful and articulate, policy paralysis or inertia as a result of time-consuming discourse and conservatism as a result of compromise that only allows for incremental change.

Sabatier (1988) builds upon many of the aforementioned ideas to suggest that policy making is influenced by a combination of exogenous 'macro' social and economic factors as well as the political machinations of policy 'subsystems' relevant to specific fields of interest. Policy subsystems are characterised as comprising various 'advocacy coalitions' which form and compete on the basis of shared values, beliefs and resources. The membership of these coalitions includes, not just administrative or government sponsored agencies and interest groups, but players from all levels of government, the media, academia and policy analysts "who play important roles in the generation, dissemination, and evaluation of policy ideas" (Sabatier, 1988: p. 131). Advocacy coalitions are also mediated by 'policy brokers' who seek to find compromise between potentially entrenched positions of competing coalitions. Further, Sabatier (1988) divides macro socio-economic influencing factors into two categories of parameter, stable and dynamic, which dictate the rules of the game: the constraints and resources of competing advocacy coalitions. Stable policy parameters relate to those unlikely to change within the timescales of 10 years or more and which are so entrained that they are unlikely to become the object of strategy yet which affect the resources and belief systems of policy players. Dynamic parameters, on the other hand, can vary substantially over the course of a few years and present an ongoing challenge to policy players to anticipate, influence and respond to them.

For the purposes of the comparative political and case-study analysis presented in Chapter 4, I adhere (albeit somewhat loosely) to Sabatier's (1988) model of stable versus dynamic system parameters as a convenient means of describing the characteristics of the liberal democracies of Queensland and the UK, and the case-study examples (Southeast Queensland and Southeast England) described therein. My research is also in line with the idea of 'advocacy coalitions' competing in order to influence policy making. There is considerable evidence from both the research presented here in Chapters 6 and 7, and in the existing literature (e.g., Howes et al., (2013, 2014)) to suggest that advocacy groups, similar to those coalitions described by Sabatier (1988), have been a substantive contributor to climate adaptation policy making. In both Queensland and in the UK, the climate change adaptation policy 'subsystem' has competed with concurrent subsystems relating to disaster risk and natural resource management, amongst others.

While deliberately drawing on Sabatier's (1988) conceptual framework I argue that there is some validity to many of the aforementioned theoretical models. The dynamics of policy making, I argue, align to a greater or lesser extent with the frameworks of rationalism, technocracy, incrementalism and bureaucratic politics, depending on the norms and socio-economic parameters and circumstances influencing policy players, and the available resources of any given policy subsystem. Which of these conceptual frameworks is most accurate may depend on a range of internal and external factors and in many respects such an understanding is hardly relevant for my research, beyond recognising that there are competing forces at play in policy making processes. Understanding these models allows for important insight into the dynamics that influence, not just the development of adaptation policy, but the development of policy evidence as well.

My research demonstrates how the various characteristics and potential difficulties of policy making described above are not just relevant to the act of policy decision making as envisaged through the interactions between advocacy coalitions, bureaucracy and the political executive. The limitations of rationalist and incrementalist approaches and the presence of political influence in bureaucratic decision making appear increasingly instrumental in the development of evidence as well, in light of changing perspectives about what policy evidence can and should be, and a broadening understanding amongst policy players of the nature of expertise (Head, 2013; Maasen and Weingart, 2005; Jasanoff, 2005). For instance, in the context of 'post-normal' science (see section 3.3 below), Wesselink and Hoppe (2011) argue that contemporary calls for more participatory approaches to evidence development may constitute simply another form of deliberative politics between various expert and non-expert policy players and the public regarding the interpretation and underlying values of public knowledge that may have a significant bearing on policy decisions. This raises important questions about what constitutes legitimate policy knowledge, a subject to which I now turn.

3.3 What is evidence for policy? Science, appraisal and the coproduction of policy evidence

Despite rationalist assumptions to the contrary, evidence for policy is no longer considered by policy scholars to be the sole responsibility of scientists, economists and other experts. As Head (2008a), Collins and Evans (2002) and Solesbury (2002) amongst others argue, concepts of what constitutes policy evidence have changed dramatically since Price's (1965) invocation of science as a means to 'speak truth to power'. This evolution of ideas about what constitutes evidence appears to have resulted from a gradual realisation, as argued for instance by Karl Marx and Thomas Kuhn amongst others (Restivo, 1995), that scientific research and expert analysis are themselves types of social interaction and that problem framing and characterisation have a necessarily normative constituent (see for example, Douglas and Wildavsky, 1983). These insights have resulted in the increasing popularity of constructivism as a means to conceptualise and understand the epistemology of public decision making (Jasanoff and Wynne, 1998).

One of the most influential contributions in helping to understand the constructivist theory of science for policy came from Weinberg (1972). Weinberg coined the term "trans-science" to argue that science for policy often cannot or does not provide definitive answers and that judgements are usually required about the use and presentation of facts. Trans-science addresses questions that are asked by or of the scientific community, yet which require such significant subjective or normative interpretation that their attempted resolution for policy making transcends the pursuits of objective observation and hypothesis-testing that characterise 'normal science' (Kuhn, 1962):

> *I propose the term trans-scientific for these questions since, though they are, epistemologically speaking, questions of fact and can be stated in the language of science, they are unanswerable by science; they transcend science. In so far as public policy involves trans-scientific rather than scientific issues, the role of the scientist in contributing to the promulgation of such policy must be different from his role when the issues can be unambiguously answered by science* (Weinberg, 1972: p. 209).

Although a somewhat limited characterisation, given that subjective or normative interpretation is a component of all scientific endeavour to some extent (Guston, 2001), Weinberg's concept highlights the importance of understanding that scientific evidence for policy is not a homogeneous set of objective truths derived by the same basic means. For instance, when considering future climate change, normative choices can make a significant difference to the conclusions we subsequently make. For adaptation policy, trans-science seeks answers to questions such as "what will the climate be like in 2050?" or "what will the impacts from a 2 degree Celsius rise in global temperature be?" As explained further in Chapter 5, climate change involves such complex interactions between bio-geophysical and socio-economic systems that experts' understanding of the dynamics of these systems through the "virtual science" (Kellow, 2009) of climate change models requires a range of subjective or normative assertions and interpretations.

Jasanoff and Wynne (1998) have argued that the proliferation of scientific modelling in the last few decades has ensured that the answers to many trans-scientific questions sit within the remit of experts and the production of model output, even though many of the inputs and outputs of such modelling involve interpretations of how the world is, or ought to be, about which the lay community may arguably have equally valid opinions. In a similar vein, Fischer (2009) suggests that evidence for policy such as prepared by the climate science community requires both technical reason – as utilised in the pursuit of pure science – and a 'socio-cultural' reason, relating to the interpretation, evaluation and choice of norms and values that are an inevitable component in the development and choice of evidence for policy (Fischer's ideas are discussed in more detail in section 3.4 below).

The concept of trans-science highlights the limits of conventional reductionist science for informing adaptation policy. However it also alludes to the inadequacy of scientific expertise on its own when directly addressing complex, contentious, pluralistic and location-specific problems. Trans-science cannot objectively resolve many of the value-based questions posed in the development of climate-related evidence for policy. Funtowicz and Ravetz (1993) proposed the concept of 'post normal science' to account for the relevance of viewpoints outside the field of conventional expertise in the provision of evidence, in circumstances where uncertainties and decision stakes are high. Post-normal science brings the spheres of science and policy much more closely together by arguing that valid technical interpretations of social problems cannot be separated from value commitments that underpin their assessment. As such, post-normal science must be produced by a range of relevant stakeholders: experts, bureaucrats, politicians and the public, who can and should contribute to the production of policy knowledge. The concept of post-normal science has not gone without criticism. Wesselink and Hoppe (2011) argue that post-normal science, although presented as a new way of doing science, is actually just another form of politics that advocates for the democratisation of evidence-based policy making. Collins and Evans (2002: 282) meanwhile argue that post-normal science is unhelpful because it treats different types of expertise and knowledge as interchangeable and therefore does not help to overcome the 'problem of extension': the tendency to extend the concept of expertise too far, and thus for the boundary between expertise and politics to be blurred to such an extent that it is difficult to understand where expert authority begins and ends.

While accepting much of the criticism levelled at the post-normal thesis, I argue nonetheless that the term provides a useful conceptual frame for understanding the ways in which lay knowledge appears increasingly important for understanding the context-specific technicalities of environmental problems (Juntii et al., 2009). In particular, as I explain in detail in Chapter 5, the concepts of post-normal and trans-science help to elucidate the characteristics of the differing components of scientific knowledge concerning climate change, the extent to which climate science can ever be considered wholly objective, and the extent to which policy is ever actually evidence-based in the ways expected by linear-technocratic models. Distinguishing between different forms of scientific expertise through the use of these concepts also helps to understand why it is difficult to discern where exactly expert authority ends and political authority begins when considering climate adaptation policy (Fischer, 2009; Hertin et al., 2009; Dryzek, 1993).

The evolution of theoretical perspectives in relation to expert knowledge and authority has been described by a number of scholars in terms 'modes' or 'waves'. For instance, Gibbons et al. (1994) described alternative concepts of knowledge production for policy by comparing a traditionally assumed Mode 1 form of knowledge production with a more contemporary and realistic Mode 2. Mode 1 conceptualised knowledge production as purely scientific, largely dictated by the outputs of theoretical and experimental science and governed by assumptions that scientists and their institutions dictated their own research agendas. Under Mode 1, science can and should "speak truth to power" (Price, 1965) as per, for example, the linear-technocratic model. By contrast, Mode 2 conceptualised knowledge production in the context of its application to decision making. Whereas Mode 1 is homogeneous and situated within specific scientific disciplines, Mode 2 is necessarily transdisciplinary and heterogeneous. Mode 2 broadens the concept of expertise to include a wider range of practitioners and stakeholders and is applied to specific contexts and locations. The characteristics of Mode 2 knowledge production, mirrored in the concept of post-normal science described above, suggest that for contemporary policy issues – characterised by high levels of uncertainty and complexity – both expert and non-expert policy players and stakeholders can contribute relevant knowledge and should be involved in the development of policy evidence.

These concepts are also mirrored in notions of the coproduction of policy knowledge, a similar brand of constructivist theory developed by the science and technology studies (STS) community:

> *[C]o-production is shorthand for the proposition that the ways in which we know and represent the world (both nature and society) are inseparable from the ways in which we choose to live in it. Knowledge and its material embodiments are at once products of social work and constitutive of forms of social life […]. Scientific knowledge, in particular, is not a transcendent mirror of reality. It both embeds and is embedded in social practices, identities, norms, conventions, discourses, instruments and institutions* (Jasanoff, 2004: p. 2,3).

The concept of coproduction appears to have much in common with the aforementioned ideas of post-normal science and Mode 2 knowledge production as a means of conceptualising the social construction of policy evidence. Coproduction does not argue for a completely relativist view of science, but rather should be viewed as a critique of realist ideology and positivist methods of evidence development that envisage nature, facts, reason and policy as separate from culture, values and politics (Jasanoff, 2004). Under this model, science is another component of society and the production of science is a social endeavour.

Mimicking the terminology of Gibbons et al. (1994), Collins and Evans (2002) summarise these various yet similar perspectives on the nature of science, evidence and public knowledge by suggesting that science studies has undergone three waves of academic development. The first wave aligned with positivist ideals and Mode 1 science that was incontrovertible and could apprehend objective reality. The second wave sought to address what Collins and Evans (2002: 237) called the

"Problem of Legitimacy" whereby scientists cannot justifiably claim politically legitimate privileged access to a universal truth in matters relating to science and society, since scientific endeavour concerning society and its relationship to the natural world is itself a social process of knowledge construction. The second wave therefore showed that "the basis of technical decision-making can and should be widened beyond the core of certified experts" (Collins and Evans, 2002: p. 237), thus resolving the problem of legitimacy but creating in its place a "Problem of Extension", by which it is difficult to know where to draw the bounds of expert authority for rationalising democratic policy making. The third wave of science studies therefore has sought to address this problem of extension and to find a balance between expert and political authority in a way that utilises traditional forms of expert knowledge while ensuring the democratisation of expertise.

These theoretical conceptions of technical evidence for policy suggest that the privileged position of science for policy making has long been overstated and yet, scientific expertise and evidence are still clearly a necessary and desirable contribution for informing policy debates given the enormity of their contribution to contemporary society[17]. However, as Head (2008b), Hertin et al. (2009) and Solesbury (2002) argue, there are other forms of evidence, besides the natural sciences, that are increasingly relied upon to inform policy. Sociological research in particular has been utilised since the resurgence of evidence-based policy making in the late 1990s. Such evidence has been increasingly used to understand public policy issues in line with increasing confidence in applied social sciences, and amid increasing calls for the democratisation of evidence-based approaches that conceives of expertise in broader terms, accounting for multiple perspectives and forms of valid knowledge (Irwin, 2006; Maasen and Weingart, 2005; Solesbury, 2002).

Alongside social scientific research, e*x-ante* policy assessment and appraisal have also been increasingly utilised by liberal democratic governments that pledge allegiance to the evidence-based mandate, in an attempt to effectively bridge the divide between science and policy making (Nilsson et al., 2008; Hertin et al., 2009; Owens et al., 2004). Such ex-ante assessments are the subject of

[17] Notwithstanding the arguments of Beck (1992) and Giddens (1990) regarding the reflexive modernisation of contemporary society whereby science and technology are both the causes of and solutions to societal problems

contrasting views in the academic literature in terms of their status as expert evidence or whether they do in fact sit at the science-policy divide. Some, such as Keller (2009: p. 12) suggest these assessments are the principal product of technical expertise, distinct from risk management which addresses the politics of risk; whereas Jaeger et al. (2008) and Owens et al. (2004) suggest that technical ex-ante assessments have an inherent and unavoidable normative, political component. Owens et al. (2004: p. 1943) define *policy appraisal* as: "ex ante techniques and procedures that seek to predict and evaluate the consequences of certain human actions", by which they are principally referring to environmental impact assessment (EIA), strategic environmental assessment (SEA) and sustainability appraisal (SA) used for the purposes of urban planning. Hertin et al. (2009) and Nilsson et al. (2008) discuss ex-ante assessment in broader yet similar terms that include cost benefit analysis and risk assessment alongside less formal heuristics, checklists and decision trees.

These assessments seek to bridge the science-policy divide through the provision of salient science and technical knowledge to inform and justify policy making. However, they also involve processes of problem definition, framing and prioritisation that are subject to influence from the values and priorities of those undertaking such assessment. Thus, ex-ante assessment may be delivered and framed in such a way that seeks to ensure a preferred course of action is taken (Owens et al., 2004: p. 1946):

> *In many cases, […] the output of particular assessments is invoked – perhaps even deliberately manipulated – in order to rationalize decisions that have been reached on other grounds. The use of appraisal techniques as "post demonstrations of preconceived judgements" has been widely documented […]. More insidiously, techniques that are ostensibly neutral may in fact have an in-built tendency to support particular outcomes […] ethical and political choices masquerade as technical judgements, reinforcing prevailing norms and existing structures of power.*

In summary, the various literatures identify many bodies of knowledge as suitable evidence for policy making: science, social-science (including economic appraisal), the local and contextual perspectives of relevant stakeholders, as well as the outputs of policy assessment such as risk and impact assessments that may utilise all of the above. Although the linear-technocratic model may consider these forms of evidence in a hierarchical fashion that prioritises supposedly objective science over all else (Marston and Watts, 2003), the manner in which evidence is developed and used suggests that policy knowledge must be considered much more than just objective technical research and assessment or the linear interpretation of science.

For the purposes of my research, I propose a distinction between the general concepts of 'evidence', versus a more specific idea of 'policy evidence'. Evidence can be considered the outputs of expertise and systematic research developed and used under the scrutiny of peer-review. This concept aligns with both the outputs of the scientific and social-scientific communities (those traditionally assumed to hold expertise), as well as with 'third wave' ideas relating to the democratisation of expertise (Maasen and Weingart, 2002) whereby local and contextual knowledge may constitute valid forms of evidence under the peer review of various interested parties in the development of public knowledge and decision making (Collins and Evans, 2002). By contrast, I propose that 'policy evidence' may be considered a sub-set of this evidence, developed specifically for the purposes of policy decision making. Policy evidence, often summarised and collated in the form of ex-ante policy assessments, may utilise various forms of expertise and evidence, including those from the academy, from those versed in local and contextual perspectives as well as the views of policy makers themselves who claim expertise over the socio-cultural context of developing policy subsystems. As the following sections demonstrate, policy evidence appears to involve political as well as expert input and is used in many more ways than described by the linear-technocratic model.

3.4 Issues of demarcation: the science-policy interface

There has been an ongoing debate amongst academic communities concerned with the interactions between science and society in relation to identifying the bounds of science and expertise and how to identify the limits to their legitimate decision making authority. In reference to the second wave of science studies, Collins and Evans (2002: p. 239) note:

> *[S]ociologists have become uncertain about how to speak about what makes [scientific knowledge] different; in much the same way, they have become unable to distinguish between*

> *experts and non-experts. Sociologists have become so successful at dissolving dichotomies and classes that they no longer dare to construct them*.

Scholars such as Gieryn (1995) and Guston (2001) argue that debates concerning what demarcates science from non-science have been characterised by a dichotomy between two fields of thought: essentialism and constructivism. Essentialists are pragmatic in the sense that they have developed demarcation criteria in the course of their practice of using science for decision making – what Gieryn (1983; p. 1995) calls 'boundary work' – in ways that constructivists consider to be subjective, value-based, ambiguous and contextually contingent. Constructivists argue that there are no universally valid demarcation criteria and that what constitutes science for decision making depends on the decision making context at hand. However, issues of what constitutes science are also intertwined with what constitutes expertise. Both issues are relevant to this research since, I argue, climate adaptation policy is shaped by the credibility of both experts and the evidence they produce for policy making.

Collins and Evans' (2002) influential thesis addresses the issue of demarcation between expert and political authority by suggesting that expertise should be bounded on the basis of the practical experience or proximity of experts with a problem in question. By attempting what they call a "normative theory of contributory expertise", they seek to address the joint problems of 'legitimacy' and 'extension' by suggesting that expert authority should be granted on the basis of an individual's contribution to the field of knowledge in question. The problem of legitimacy relates to distinguishing what constitutes legitimate expertise. Collins and Evans (2002) argue that the second wave of science studies (described above) addressed the problem of legitimacy through social-constructivist views of evidence in the public domain, arguing that scientific endeavour is a social process and therefore subject to normative influence such that experts can never be wholly objective or have access to incontrovertible truth. This view of expertise and evidence however raises a subsequent 'problem of extension'. Collins and Evans (2002) describe how a third wave of science studies has sought to address this latter problem: if scientists do not have privileged access to a universal truth, as revealed by the second wave, then how far should the democratisation of expertise extend?

Collins and Evans' (2002) paper prompted a series of counter-arguments by scholars such as Wynne (2003), Rip (2003) and Fischer (2009) which suggested amongst other arguments that Collins and Evans were ambiguous in explaining their understanding of what constitutes technical decision making and the circumstances under which such decisions may be relevant to the public domain. For example, in response to Collins and Evans (2002), Fischer (2009) argues that as soon as scientific experts extend their expertise beyond the 'hard sciences' of investigation, observation, data collection and analysis, toward the application of this knowledge to propositional questions about what is a problem, why and how it may be resolved, then a different form of rationalism applies. Fischer (2009) argues that under these circumstances, it is a 'socio-cultural' rather than a technical reasoning that comes into play, and the qualifications for legitimate participation in such reasoning may be extended to a broader range of stakeholders, rather than on the basis of technical qualifications or even experience of the problem in question.

These issues of demarcation also relate to a parallel problem of locating the science-policy interface for the purposes of policy making. Or, in other words, locating where exactly expert authority ends and political authority begins in the policy making process. As I argue further in subsequent chapters, this problem is an important consideration for understanding the tensions between expert and political authority, for understanding the dynamics of evidence-based policy making and therefore important for understanding the credibility, legitimacy and salience of adaptation policy evidence and the role of experts in this regard. For instance, this problem relates directly to the validity of ex-ante policy assessment techniques such as risk and impact assessment, described above, where both traditionally identified experts and non-experts engage in the development of policy evidence. As I describe for the case of climate adaptation in this thesis, questions about what constitute evidence for policy are not easily answered and for climate change there appears to be considerable overlap between expert and political authority during the coproduction of policy evidence. This overlap has also been the subject of analysis by Cash et al. (2002, 2003) in their investigation of effective knowledge systems for sustainability and relates to their conceptual framework which I use in Chapter 6 to help understand the role of experts and evidence for adaptation policy. It is to this framework that I now turn.

3.5 Knowledge Systems for Sustainability

The term Knowledge Systems, coined by Cash et al. (2002), describes the institutional arrangements and interactions that seek to harness science and technology for environmental decision making. In two seminal papers Cash et al. (2002, 2003) suggest that effective knowledge systems are created by managing the boundaries between knowledge and action through effective communication, translation and mediation to provide useful, usable science for sustainable development policy. They suggest three subjective criteria by which to judge the effectiveness of this knowledge:

Credibility: whether an actor perceives information as meeting standards of scientific plausibility and technical adequacy;

Salience: the perceived relevance of information for an actor’s decisions, or for the decisions that affect that actor; and,

Legitimacy: whether an actor perceives the process of knowledge production by the system as unbiased and meeting the standards of political and procedural fairness; that the knowledge production system considers appropriate values, interests, concerns and specific circumstances from multiple perspectives.

The criteria of *credibility*, *salience* and *legitimacy* are interdependent characteristics that must be balanced against one another. Efforts at enhancing one may diminish the other two. When addressed appropriately at the science-policy interface, effective knowledge systems must be designed in ways that minimise conflict between these criteria as much as possible while maintaining an adequate level of each. Cash et al. (2002) suggest that traditionally the focus of both sides of the science-policy interface has been on credibility as the principal determinant of useful, usable science for policy, often at the expense of its salience and legitimacy.

This focus on credibility can be seen for example in the development of the Intergovernmental Panel on Climate Change (IPCC). Cash et al (2002) citing Agrawala (1998) suggest that in the early stages of the development of IPCC outputs stakeholders complained of a lack of inclusiveness of scientists and climate change modelling from developing countries. It appeared that considerations of evidence legitimacy were neglected in favour of scientific credibility. Although the eventual inclusion of climate change models from developing countries expanded the range of uncertainty associated with the IPCC's conclusions, the legitimacy of the knowledge production process was ultimately enhanced for a wider range of users of IPCC outputs. Likewise, Tang and Dessai (2012) suggest that the perceived lack of salience of the UK's Climate Projections 2009 (UKCP09) for many users contrasted with the perceived credibility of that evidence as being the foremost source of climate change science available at the time of their study (ca. 2011), even if it was not perceived to be particularly usable or relevant for decision making.

The interactions and interdependencies between these criteria are complex and relate to important interactions and tensions between expert and political authority in the development of evidence for policy decision making, which this research seeks to elucidate. Cash et al. (2003) concluded that society still doesn't know how to design effective knowledge systems due to the difficulties of balancing competing needs for credibility, salience and legitimacy. Their analysis draws attention to a key difficulty encountered in the design of knowledge systems that is illustrated by the tensions and complementarities between these criteria, and that relates to the difficulties of finding an appropriate balance between expert and political authority (Irwin, 2006; Jasanoff, 2005; Collins and Evans, 2002). Namely, that in order to produce good policy evidence, it is necessary to maintain the privileged status of expert authority while simultaneously engaging a range of non-expert stakeholders in its design and development.

Cash et al. (2002) argue that it is necessary for the science-policy boundary to be bridged by either scientist or non-expert policy player in order to ensure the salience and legitimacy of the evidence produced, that is, to produce policy-relevant evidence in a way that is fair and unbiased and representative of a range of values, interests and perspectives. Bridging this gap is presumably achieved through negotiation between expert and non-expert policy players concerning user needs and the subsequent content of that evidence. As an example, this process has been described by Hulme and Dessai (2008) for the case of the UK Climate Projections as a process of post-normal evidence generation to ensure the usefulness and usability of climate science outputs; a process which appears to have largely failed according to the analysis of Tang and Dessai (2012) who conclude that this evidence ultimately lacks salience[18]. Cash et al. (2002) argue that too much emphasis on providing legitimate evidence through engagement with a wide range of stakeholders can compromise salience and credibility by producing evidence that fails to address the needs of any particular set of decision makers.

See table 3.2 below for a summary of some of the mechanisms by which Credibility, Legitimacy and Salience may adversely affect each other.

Table 3.2. Potential interactions between evidence credibility, legitimacy and salience

Lack of Evidence:	**Can result in:**	**Mode:**
Credibility	Reduced Legitimacy	Expert authority over policy making is weakened. Evidence lacks legitimacy since experts have unfair representation in the development of evidence.
Legitimacy	Reduced Credibility	A cognitive dissonance between the values and priorities of policy makers (those with political authority) and the conclusions of experts (those with expert authority)
Enhancing Evidence:	**Can result in:**	**Mode:**
Credibility	Reduced Legitimacy	Under a linear-technocratic schema, credibility is congruent with notions of expert authority that preclude the input of non-expert perspectives or local/contextual knowledge in evidence development; enhancing credibility in this way for complex & pluralistic policy problems may be considered unrepresentative or unfair and therefore evidence may lack legitimacy
Salience	Reduced Credibility	Efforts to enhance salience may make it less credible as uncertainties and complex expert conclusions are over-simplified for evidence users
Legitimacy	Reduced Credibility	Credibility (and expert authority) is diminished as attempts toward the democratisation of

[18] A conclusion that is confirmed by the research I present in Chapter 6

		expertise are extended too far (i.e., the problem of extension)
Legitimacy	Reduced Salience	Salience is diminished as broader participation in evidence development in order to enhance legitimacy results in knowledge that fails to be useful for any particular advocacy coalition or interest group (see Chapter 6)

The criteria of salience and legitimacy speak to the aforementioned need to ensure that a variety of both expert and non-expert policy players have a say in the underlying values from which evidence is derived (Maasen and Weingart, 2005). Yet, in contrast to these requirements, the credibility of policy evidence appears to still be dependent on privileged expert knowledge that aligns with ongoing public and political expectations for the objectivity of science and which seems to discourage the influence of non-expert input in evidence development (Hertin et al., 2009; Nilsson et al., 2008). For instance, as I demonstrate in the course of this research, climate change adaptation advocates have often sought to ensure and to promote the credibility of privileged expert knowledge due to the (at times highly) contested political landscape surrounding climate change.

Effective knowledge systems must account for the norms and values that constitute a fundamental component in the development of evidence due to adaptation's 'wicked' characteristics. Yet Cash et al.'s (2002, 2003) framework, I argue, appears rather ambiguous and under-specified in terms of addressing these norms and values and the interactions that occur between expert and political authority in the development of policy knowledge. For instance, they never specify the mechanisms by which effective knowledge may influence policy decision making. Further, as described in detail in Chapter 6, although they state that the departure point for their framework is that "effectiveness" should be gauged on the basis of how policy issues are defined and framed (and not just on the basis of what actions are subsequently taken to address policy issues), the definitions they provide for their criteria of credibility, salience and legitimacy fail to adequately and unambiguously address this issue of framing. Their criteria of salience and legitimacy in particular appear to only partially account for the influence of prevailing political views that can have an important influence on the framing, development and use of policy knowledge.

Furthermore, while their discussion makes frequent mention of the influence of politics upon evidence, their proposed criteria appear to only address relevant values, interests and perspectives within the bounds of a knowledge production process envisaged as the direct interactions between experts and non-expert policy players. In Chapter 6 I investigate in more detail the framework proposed by Cash et al. (2002) and argue that their criteria are subject to significant ambiguities and limitations both in terms of their original definition and in terms of experts' and non-experts' perceptions of these attributes. I propose an adjustment to these criteria, in order to adequately describe the ongoing tensions between expert and political authority in the development and use of evidence for policy.

My argument is that effective knowledge systems are not just dependent upon the knowledge production system as conceptualised by Cash et al (2002), that is, as a fair, unbiased and sufficiently representative interaction between expert and non-expert policy players to produce credible and salient knowledge. In a liberal democracy, effective knowledge systems are also ultimately dependent upon the broader political acceptability of available sets of evidence. To fully account for this political influence in the knowledge system I propose an adjustment to Cash et al.'s (2002) framework and use it to demonstrate how climate science and policy evidence lack salience, legitimacy and at times even credibility for the two cases examined for this research.

Given the tensions between expert and political authority and the need for "socio-cultural" as well as technical reason in the development of effective evidence (Fischer, 2009), a significant question arises therefore as to how we design effective knowledge systems. If there is any validity to Cash et al.'s (2002) framework, under a linear-technocratic schema this must be done in a way that ensures that the boundary between expert and political authority is appropriately observed by policy players, that is, ensuring credibility, while facilitating mechanisms that allow this boundary to be effectively bridged to ensure the salience and legitimacy of that evidence through coproduction processes.

The task of designing effective knowledge systems through the balancing of credibility, legitimacy and salience cuts to the heart of the tensions between expert and political authority and the contrasting problems of legitimacy[19] and extension described above (Collins and Evans, 2002). Achieving such a balance seems a particularly daunting task given that the bounds of the science-policy interface, or where expert authority ends and political authority begins, is often difficult to identify. Yet, only by effectively balancing the competing needs of these three criteria can we also avoid processes of deliberate politicisation that mask values and preferences within the provision of supposedly objective evidence, or avoid the subsequent suppression of normative debate through scientisation (Sarewitz, 2004).

Cash et al.'s (2002) framework suggests that policy players are inevitably forced to address this ongoing conflict of interest in their development, interpretation and use of evidence for policy. Both expert and non-expert policy players may be motivated to work on either side of the science-policy divide and appear to pursue, implicitly or otherwise, two opposing goals in the development and use of evidence. Policy players:

1) Seek to separate expert and political authority in order to "shore up their claims on cognitive authority" (Cash et al., 2002: p. 7); and simultaneously,
2) Seek to bridge the science-policy divide in order to make useful, usable science, and/or to expedite normative priorities within an increasingly contested political space.

In the absence of any strict prescription for its use I argue that, with some adjustment, Cash et al.'s (2002) descriptive framework can help to elucidate these relationships and motivations more clearly. This apparent science-policy paradox facing policy players is an indication of the complex and highly political influences on policy players' perceptions of credibility, salience and legitimacy. Yet, as I argue in Chapter 6, these criteria – as currently defined – fail to account for all relevant political influences upon the knowledge used to inform policy making.

[19] Note that Collins and Evans' (2002) understanding of legitimacy appears to relate to the public and political acceptability of evidence for policy making, whereas Cash et al.'s (2002) definition relates to the fair and unbiased nature of the knowledge production process. In Chapter 6 I explain further the importance of reconciling these contrasting definitions of the term and propose a composite definition for that purpose.

Evidence development for policy is influenced not just by how experts and other policy players interact, the governance structures they are subject to, and the policy and decision making norms to which they must adhere. Evidence is also influenced by prevailing political values and priorities of democratic government in a way that, I argue, is not fully accounted for by these criteria. Although, in order to be effective, the knowledge production process must be perceived as sufficiently fair, unbiased and inclusive of appropriate values, concerns and perspectives, so too must the evidence produced. In other words, I argue that legitimacy is not just a characteristic of the knowledge production process (as suggested by Cash et al. (2002)), legitimacy (or political acceptability) is also an important characteristic of evidence itself. Indeed, as the cases examined for this research demonstrate (see Chapters 4 and 6), a broader political acceptability for the available evidence appears to be as important an attribute for effective knowledge systems as perceptions about its fair and unbiased production.

The potential conflict of interests encountered in the creation and use of policy evidence suggests that Cash et al.'s (2002) criteria may be informative beyond their intended use for understanding what constitutes useful, usable science for policy, but also as a means to understand the political landscape of the science-policy boundary and the tensions between expert and political authority in liberal democracies. These criteria can be helpful for investigating a number of science-for-policy outputs located at varying points along the continuum of evidence development for policy (described for the case of climate adaptation in Chapter 5), and upon which both expert and non-expert policy players have varying levels of input to and legitimate authority over. I argue that the extent to which policy players consider (supposedly expert) policy evidence to be credible, salient and legitimate varies relative to the degree to which that information aligns or conflicts with their own norms and values as well the prevailing values and priorities of the political executive. Perceptions of evidence in terms of these criteria can inform our understanding of the tensions between expert and political authority which arise during the coproduction of policy evidence.

Tang and Dessai (2012) in their analysis of UKCP09 identify an obvious point at which to apply Cash et al.'s (2003) criteria to establish the usability and usefulness of climate science for policy. Climate change projections are used by a range of both expert and non-expert policy players for informing decision making. And yet, given the fluid nature of the science-policy interface, there appear to be other obvious points of analysis which, in some respects, could just as easily be viewed as marking its locus and whose outputs are equally in need of satisfying the criteria of credibility, salience and legitimacy for a range of policy players, particularly in light of calls for the democratisation of expertise.

Tang and Dessai (2012) use Cash et al.'s (2003) three criteria without ever addressing the question of what constitutes science. The implicit assumption made is that we will know it when we see it. Yet, at the science-policy interface, as demonstrated by the available literature above, it is not always easy to distinguish between the outputs of privileged expertise and the normative deliberation that occurs between lay policy players who may be advocating the agendas of their respective ministerial departments, democratically elected executives (which may be different from their government's party line) as well as policy players' own political or normative priorities. Analysing different products along the science-policy interface, as undertaken as part of this research can, I argue, elucidate the science-policy interface more clearly by helping to understand how norms and values interact with technical expertise and thus help to explain the ongoing tensions between expert and political authority.

Although ex-ante policy analyses may not be entirely scientific in their derivation (Owens et al., 2004), they are utilised as evidence for policy making while their very existence points to the necessity for values and subjective interpretation in the development of policy knowledge since, otherwise, policy players would simply be able to use the direct outputs of scientific research. Some policy players interviewed for the purposes of this research considered risk and impact assessments for adaptation policy to principally be the product of technical expertise (UK-Policy Players 2,3,7; UK-Policy Scientists 9,10), while others considered them as what one interviewee termed "the political presentation of science" (UK-Policy Scientist 5; UK-Policy Player 4). I argue that both experts and lay policy players claim ownership over ex-ante assessments as constituting either expert evidence or the political appraisal of evidence for policy, depending on their perspectives and their location along the science-policy continuum.

Irrespective of policy players' opinions in regard to the status of such assessment for climate adaptation, as I demonstrate in Chapter 7, there seems little doubt that these assessments are ultimately utilised by policy makers (i.e., the political executive) and many other policy players and the public as objective evidence to inform policy decisions (see for example, DEFRA, 2012a: p. 7; UK-Policy Players 2,3; UK-Policy Scientists 6,7,8,9,10). In which case, what might an analysis of the outputs of risk and impact assessment using the criteria of credibility, salience and legitimacy tell us? As my research demonstrates, such an analysis can help to characterise the normative landscape of the science-policy interface, the extent to which expert and political decision making authority overlap, and thus inform how experts and evidence do and should inform adaptation policy making.

3.6 The role of differing policy players in policy evidence development

3.6.1 The role of bureaucrats

The prevalence of political influence in bureaucratic policy making such as argued by Allison (1971) and Bardach (1977) appears to be particularly important to developing policy evidence in light of the 'wicked' nature of contemporary policy issues such as climate change (Head, 2008a); increasing public and political expectations for the democratisation of expertise (Irwin, 2006), and in light of the inevitable limitations of science when attempting to fulfil the role expected of it by linear-technocratic models of decision making (Keller, 2009). It is important, therefore, to consider the role, not just of experts, but of various policy players in the development and use of evidence. Since the Enlightenment there have been recurring expectations amongst government and the public that evidence and expertise should inform policy to ensure that policy making is pursued through objective, systematic processes of accountability (Kitcher, 2011). This expectation was perhaps first institutionalised in nineteenth century Britain, one of the pioneering nations in the development of a supposedly neutral expert bureaucracy designed to implement the wishes of the political executive[20] (Bayley, 2004; Gerth and Mills, 1970). In theory, the role of bureaucratic institutions is both as advisors to government on policy matters, as well as being responsible for the administration and implementation of policy directives from elected government. As Parsons (1995: p. 7) notes,

> *The idea of a rational, hierarchically arranged non-political form of administration [i]s central to the idea of liberal democracy.*

Many argue that, in reality, bureaucracies hold considerable policy making power (du Gay, 2005; Page, 1985). Max Weber was one of the first to describe the role of bureaucracy in his 'rational control' model of bureaucracy which suggests a 'top-down' approach whereby policy making is considered to be a discrete task completed by elected government executives (Parsons, 1995: p. 463–465). The executive are advised by and pass decisions on to neutral (i.e., disinterested), objective administrators (i.e., bureaucratic institutions) who administer these complete policies. This simplistic model assumes an effective and clearly defined chain of command, a capacity to co-ordinate and control within governance systems, and perfect communication in and between units of government organisation. It places considerable emphasis on policy making at the top of government hierarchy, even though in reality, as discussed for instance by Lindblom (1959), policy making does not come to an end once a policy is set out or approved by government (Peters, 2003; Parsons, 1995: p. 465; Page, 1985).

In practice, bureaucrats are not neutral servants of the state. They have ideas, values, beliefs and interests which also shape policy. Indeed Peters (2003) and Page (1985: p. 32) argue that Weber's view of bureaucracy was not as apolitical as it is often depicted and that he was also aware that bargaining over values was inherent in the public sector and that policy was also made by public servants. Although the forms and interpretations of the role of bureaucracy have changed considerably from the Weberian ideal, in particular since the 1980s as a result of reforms often

[20] See Chapter 4 for further details

referred to as New Public Management[21] (NPM) (Head, 2008b; Bevir et al., 2003), bureaucratic institutions still fulfil key government functions in relation to the development and collection of policy-relevant evidence (Peters, 2003; Bevir et al, 2003; Gerth and Mills, 1970: p. 196). And despite numerous predictions to the contrary, bureaucratic structures have yet to be replaced by other forms of policy administration (du Gay, 2005: p. 1). Thus, bureaucracies may be considered to be at the interface between political and expert authority, even though their original conceptualisation was as a source of expertise itself (Hoppe, 2005; Bruner and Steelman, 2005: p. 23; Leiss, 2000: p. 50). Dye (2005: p. 52) argues that policy implementation is the continuation of politics by other means in line with the views of Allison (1971) and Bardach (1977). He argues that although bureaucracy is not constitutionally empowered to decide policy questions, it does so nonetheless, as it performs its task of implementing the wishes of the political executive.

My research demonstrates that, given the uncertain, complex and contentious nature of climate adaptation, the role of bureaucrats as policy mediators, advisors, designers and administrators takes on particular significance in adaptation policy development whereby they are also involved in decisions concerning what constitute the facts about future climate change, how we should understand the associated risks and benefits, and how they should be portrayed to ensure their political acceptability under an evidence-based mandate. Maasen and Weingart (2005) make an interesting point in this regard, relevant to climate adaptation and climate change policy more generally. Whereas the mode of communication and activity of science is designed toward questioning existing knowledge in order to advance systematic knowledge production, the mode of politics, by contrast, is toward closing public dispute through argumentation, consensus and compromise using knowledge as required. It is convenient if that knowledge supports consensus or compromise and very inconvenient when it conflicts with and therefore de-legitimises past or future

[21] New Public Management refers to efforts to reform policy making institutions that began in the 1980's under the influence of neo-liberal economic reforms (see Appendix A – Glossary) that called for a reduction in the size of government (Harvey, 2007). NPM manifested itself in varying ways but most bureaucracies under neo-liberal political influence became more dependent on arms-length government institutions and consultancies for the provision and interpretation of evidence and the development of policy solutions. This process has been referred to as the 'hollowing-out of government' whereby ministerial departments increasingly relinquished responsibility for knowledge production for policy making (Head, 2008b; Bevir et al., 2003)

decisions or present consensus. Thus the continued production of science continually irritates politics in unpredictable ways and ensures that bureaucratic policy players are incentivised to engage with the production of policy evidence. In this vein too, Chapter 4 will demonstrate how historical, political and socio-economic factors impact upon the legitimacy of climate change as a policy issue and as a result, the legitimacy of experts and evidence and the types of roles they are expected to play in the policy making process relative to bureaucratic policy players.

These ideas concerning the role of bureaucracy also add weight to the arguments of Schon and Rein (1994) and Lyles and Thomas (1988) that the way that governments choose to define and characterise a problem dictates how they attempt to resolve it, and ultimately influences the effectiveness of their response. Given the complexity and uncertainty concerning issues of climate change science and climate adaptation and the common modes of policy evidence development (described in Chapter 5), I argue that government is not just involved in the framing of scientific conclusions but also in the development of those conclusions in a way that suggests considerable overlap between expert and political authority. The relationship between these forms of authority is also of principal concern in understanding the role of experts and evidence in climate adaptation policy.

3.6.2 The role of scientists and other experts in policy making and evidence

Although various social science disciplines have described numerous ways in which evidence may inform policy making; there is some consensus of interpretations of the role of scientists and other experts in policy making which appears to sit in contrast to the rhetoric of evidence-based policy making practice. Perhaps a good starting point for understanding the various possible roles for experts in policy making is in the work of Pielke Jr. (2007). Pielke Jr. suggests four idealised role-types for experts in this regard:

1) **Pure scientist:** views the expert as providing discrete bodies of facts in the course of his/her pursuit of knowledge and nothing else, assuming that what the policy maker subsequently does with that information lies beyond the remit of scientific advice.

2) **Science arbiter:** this suggests that the expert waits at the behest of the decision maker ready to provide objective facts as required.
3) **Issue advocate:** this role suggests that the expert uses his/her expertise to advise the decision maker in favour of a particular course of action, based on the expert's values and normative interpretation of the facts.
4) **Honest broker:** this role suggests that the expert provides all the facts relevant to the decision maker's choice. The expert attempts to clarify the scope of choice in a way that helps the decision maker reduce that choice in line with his/her preferences and values.

A recent paper by Spruijt et al. (2014) has taken a considerable step in clarifying these roles, demonstrating through a cross-disciplinary literature review how, despite a general scarcity of supporting empirical evidence, there is general agreement across social-science disciplines that the role of experts depends on:

- the type of problem being addressed (simple or complex; wicked versus tame); and,
- the influence of other parties (bureaucrats, other policy players and the public).

Despite agreeing on these two fundamentals, there is still some variation in interpretations of how these factors interact and their influences upon experts in policy spheres.

For instance, the science and technology studies (STS) literature continually stresses the myopia of policy makers in relation to the nature of expertise and evidence for policy making, advocating for a better understanding amongst policy players of the limitations of scientific expertise and its inability to unequivocally or objectively understand the science of policy issues (Nowotny, 2003; Jasanoff, 1990, 2003b). It is suggested therefore that knowledge production must move away from conceptions of reliable knowledge toward socially robust knowledge, embracing the idea of the democratisation of expertise (Nowotny, 2003) and the need for legitimate, salient policy evidence (Cash et al., 2003). Much of this literature appears to have taken its lead from sociologists such as Beck (1992) who argues that although scientific understanding has brought about undoubted benefits to society, its use is also the cause of many problems, including increasing uncertainty and a need to contain and manage risks endemic to its utilisation in modern society.

Scientific endeavour is both the cause of and proposed solution to many contemporary problems associated with modernity. On this basis, STS scholars argue that societal risks are not merely (or necessarily) empirically measurable and reducible quantities, but "part of the modern human condition, woven into the very fabric of progress" (Jasanoff, 2003b: p. 224)[22]. Spruijt et al. (2014) agree, suggesting that in order to ensure the acceptability of policy measures it is necessary to acknowledge the validity of many potentially contradictory expert viewpoints about what constitutes a risk (or what Collins and Evans (2002) refer to as 'propositional knowledge' about what constitutes a problem).

These ideas also align with the views of science-policy scholars. For instance, Weingart's (1999) ideas about the scientification of politics[23] and the politicisation of science, and Sarewitz's (2004) thesis on the scientisation of policy debates illustrate how norms and values are a recurring component in both the development and use of policy evidence under the evidence-based mandate. This is not just because of the necessarily value-based, normative decisions required when developing evidence but also due to how multiple disciplines of scientific expertise can align with numerous contrasting normative viewpoints about highly complex and uncertain systems such that there are multiple valid and potentially contradictory 'facts' about the world which compete for attention in the spheres of policy making and politics[24]. At best these ideas appear to complicate the simplified picture provided by Pielke Jr. (2007) above, by suggesting that facts are rather fluid ideas when it comes to policy evidence, particularly for complex or wicked policy problems; that other policy players can provide valid input to policy evidence, and that experts may never be able to provide wholly impartial advice (Juntii et al., 2009; Jasanoff, 2005; Oreskes, 2004; Sarewitz, 2004).

---

[22] See Chapter 7 for a more in-depth discussion of the nature of risk and risk assessment.

[23] An idealised and unrealistic technocratic model of policy making that would "not only render problematic the legitimacy of irrational [i.e., purely political or ideological] decisions, but reduce the range of options to an objectively determined single best decision" (Weingart. 1999: p. 154)

[24] See Chapter 7 for a more in-depth discussion of the politicisation of science and the scientisation of policy debates.

Fischer (2009) argues that this failure of first wave concepts of expertise is because there is simply “no [epistemological] bridge which connects the hard sciences to the public domain sciences” that allows experts to objectively address propositional questions (Fischer, 2009: p. 144). Likewise, Jasanoff (2005: p. 211) argues that the questions policy makers ask of science are not answerable within the parameters of their home disciplines. These ideas appear to rule out any consideration of experts as fulfilling Pielke Jr.’s (2007) suggested roles of ‘pure scientist’ or ‘science arbiter’ when informing policy making. Instead experts are expected to act as persons with analytical skills grounded in practice and experience, rather than those with “unmediated access to ascertainable facts”. Although they are expected to have mastery of a particular area of knowledge, they are also expected to be able to size up bodies of heterogeneous knowledge and to offer opinions based on imperfect understanding, on issues that lie within nobody’s precise disciplinary competence:

> *Judgment in the face of uncertainty, and the capacity to exercise that judgment in the public interest, are the chief qualifications sought today from experts asked to inform policy making.* (Jasanoff, 2005: p. 211).

Jasanoff makes the point that although the practice of science has attempted to evolve in order to integrate with the political realities of policy making, the rhetoric around policy science has not caught up with the realisation of the partiality of experts and expert evidence. The general call is still for objective, untainted knowledge as a means of justifying policy decisions. In light of these difficulties, there is general agreement across the available literature on the need for greater public participation in the development of policy knowledge for complex uncertain policy issues, both as a means of generating knowledge itself and as a means to “facilitate learning and mutual understanding and prevent unnecessary conflict” (Spruijt et al., 2014: p. 21). The extent of influence of the traditional core-set of experts (scientists and social-scientists) would therefore appear to depend on the extent to which public participation in developing policy knowledge actually occurs.

Maasen & Weingart (2005) and Irwin (2006) suggest that renewed calls for evidence-based policy have been characterised by an interesting paradox in this regard. On the one hand, the mandate has called for, and largely received a large increase in the production and use of evidence for policy. On the other, it has been accompanied by a commitment from policy makers for greater inclusivity of stakeholders and the public, speaking to ideas of the democratisation of expertise. Irwin (2006: p. 301,302) suggests that policy documents from the UK and the EU have demonstrated a degree of contradiction in their policy rhetoric whereby:

> *[A] dominant 'inclusive' voice stresses public dialogue, and a second, 'scientistic' voice tells the reader that the public can only make its contributions if it is properly instructed and educated.*

Thus policy makers appear to be seeking to partially substitute the old 'deficit model' (i.e. a deficit of understanding) with a deficit of public trust in the available science while nonetheless maintaining a rhetoric advocating for the value of impartial and robust science. Irwin (2006) suggests that we should be cautious of such commitments to inclusivity as a result, and that we need new epistemological and political understandings in order to change the science-public relationship in a way that can meaningfully achieve the democratisation of expertise while maintaining its decision making authority. It would appear from the available literature therefore that the role of experts is far from clearly delineated, and indeed that policy makers have held to the notion of objective, value-free expertise in the absence of a more useful model of evidence-based policy making and because sometimes such a pretence is politically expedient for protecting both experts and policy makers (Owens et al., 2004; Cash et al., 2002).

Despite the persistence of rational approaches to evidence use and policy making, Maasen and Weingart (2005) point to some interesting trends in the pursuit of the evidence-based mandate. In particular, the tendency for partisan expertise and knowledge to be utilised and provided by think-tanks advising government under NPM structures. They suggest that expertise has become a commodity whereby NPM institutions are producing knowledge irrespective of demand in order to demonstrate their credentials should their advice be sought:

> *As expert knowledge has grown in importance as a political resource, actors in the political arena attempt to obtain and control the knowledge that is relevant to their objectives. This competition for knowledge, which already represents 'democratization by default', has resulted in the loss of science's monopoly on pronouncing truths. At the same time, scientific knowledge has often been revealed to be uncertain, ambiguous and incomplete.*

> *Intermediate types of knowledge, expertise specifically developed for the solution of particular problems, hence, not generalizable, gain in importance.* (Maasen and Weingart, 2005, p. 7)

Thus, bureaucracy appears to be capable of picking and choosing which knowledge to use, even though they may have increasingly less responsibility for its production than they once had. This also suggests that there may be limited space for Pielke Jr.'s 'honest broker' than might at first seem to be the case since there are so many experts and so much public knowledge to choose from that expert authority may not be chosen on the basis of credentials or qualifications but on the degree of congruence of their expert views with the values and goals of policy players. Therefore, given the uncertain, ambiguous and incomplete nature of expert knowledge for policy, the remaining persona of expertise described by Pielke Jr. (2007), the 'issue advocate', appears to be a real possibility; one that speaks to the deliberate politicisation of expertise within the market place of ideas. As described in Chapters 6 and 7, my research provides some indication for the existence of this role for experts in contemporary policy making.

3.7 A last note on the role of evidence in policy making

Accepting a constructivist view of evidence use for policy making, it seems clear from the preceding review that the extent to which experts and evidence influence a policy decision depends on a variety of factors, including:

- The type of policy problem and decision being made;
- The prevailing political influences on the decision making process;
- The policy options available; and,
- Policy players' conceptions of what constitutes evidence.

However, given the potential influence of bureaucrats and other policy players in the development of policy evidence as suggested in section 3.6.1 above, it seems useful to make a distinction between the role of evidence in policy making as distinct from the role of experts, in order to help understand the tensions that clearly exist between expert and political authority. Weiss (1979) has outlined a series of models describing the ways in which social-science can influence policy making, which presumably result from varying combinations of the factors listed above, and which therefore have varying relevance depending on these interactions. However, I argue that Weiss's categorisation also appears appropriate to describe a range of potential uses of policy evidence more generally (not just relating to the social sciences) and therefore it seems appropriate to describe her proposed models here to understand the potential uses of policy evidence for climate adaptation:

1) A **knowledge-driven model** whereby scientists identify an opportunity for public policy advancement for which they have developed, in a linear fashion, the requisite evidence to both understand and address that policy gap. This appears to have parallels with the soft-positivist policy making described by Keller (2009) above.
2) A **problem-solving model** which equates to the rational policy making model whereby evidence can linearly inform the means by which to achieve an identified ends.
3) An **interactive model** where policy players seek information from a range of practitioner sources as well as the academic community. This model does not follow any linear order of evidence provision to satisfy demand but rather is interactive such that all relevant sources of information are pooled to try to make sense of a problem alongside political considerations, practitioner experience and judgement. It assumes that agreement or common ground between participants can be achieved.
4) A **political model** assumes that the interests and positions of policy players have hardened to the extent that alternative sets of evidence are used to bolster existing political positions. This model appears to align with concepts of the scientisation of policy debates (Sarewitz, 2004) which will be discussed further in Chapter 7, as well as the models of political bureaucracy described by Allison (1971) and Bardach (1977) discussed above.
5) A **tactical model** suggests that policy players may not actually use the evidence provided for its content, but rather use the presence of an evidence base or a research program as leverage to achieve political aims, to deflect criticism, to demonstrate their responsiveness to policy issues or to delay taking action.

6) An **enlightenment model** suggests that evidence is used by policy players not for the specific outcomes of research projects, but rather for the concepts and theoretical perspectives which those results engender and which can influence the views and conceptual frameworks of policy players.

An example from the available literature of these varying roles can be seen in the study undertaken by Grundmann (2006) comparing the use of evidence to affect policy making for climate change and ozone depletion in the US. Grundmann describes how climate change science was expected to fulfil a problem-solving/knowledge-driven role in order to legitimise policy action on climate change while the lack of appropriate evidence was used tactically by both advocates and opponents of policy action to bolster their arguments; advocates used uncertainty to argue for a precautionary approach, while opponents used the same uncertainty to argue for inaction. Both sides agreed on the funding of further research but for opposing reasons. The research presented in subsequent chapters here seeks to understand such political forces in the development and use of policy evidence.

3.8 Conclusion

Policy evidence is a type of knowledge that is at once both desirable – to ensure consistent and robust decision making – and a source of ambiguity and conflict for those who would seek to use it, due to the difficulties of drawing boundaries between expert authority and political influence. These difficulties are compounded when seeking to address wicked problems like climate adaptation. Not only are the bounds between expertise and politics difficult to draw under a constructivist view of evidence for public decision making, such that the available science is inevitably influenced by normative choice and reasoning when used in the public sphere; but because the nature of the problem is such that the facts themselves are illusory and dependent on context, perspective and a wide array of intractable uncertainties that we can never hope to resolve, at least not to the satisfaction of policy makers within the timescales relevant for political decision making.

This chapter has described many of the difficulties associated with developing and using evidence for policy. Given the nature of policy processes and the available evidence, this review of the literature suggests that politics may be an inevitable component of policy making at all levels of government, and as a result, may also be a component in the development of policy evidence given the complex, uncertain and contentious nature of the latter. What constitutes adaptation policy evidence is itself unclear and dependent on where one sits at the interface between science and policy making. Furthermore, how that evidence is subsequently used may be far from the ideal espoused by policy makers under an evidence-based mandate, or as described in the various policy making guidelines and procedures devised by bureaucracies of contemporary liberal democracy. Perhaps a useful means of understanding the context-dependent nature of policy evidence and expertise, and the tensions between expert and political authority, therefore, is to understand the perceptions of a range of policy players involved in policy making and implementation in relation to the usefulness and usability of policy evidence. By doing so, this research seeks to understand the manner in which these two forms of authority relate to one another and the ways in which context and politics influence both its derivation and interpretation for policy making.

This chapter lays a foundation for understanding the subsequent analyses of climate adaptation as a policy issue. Chapter 4 describes the historical, political and socio-economic context for the comparative cases of Australia and the UK, while Chapter 5 describes the technical and epistemological characteristics of climate adaptation evidence and policy making. This chapter also provides the context for understanding the subsequent qualitative analysis in Chapters 6 and 7 that will describe policy players' perceptions of the usefulness and usability of different types of policy evidence, the propensity for adaptation policy evidence to become politicised and therefore the nature of the science-policy interface and the role of experts and evidence in climate adaptation policy making.

Chapter 4. Australia and the UK – comparing the pursuit of climate adaptation between liberal democracies

Whatsoever each man desires, that for his part he calleth good – Thomas Hobbes

4.1 Introduction:

This research seeks to understand how political attitudes toward climate science influence the development of climate adaptation policy in mature liberal democracies. As detailed in Chapter 3, the nature of science and other forms of evidence and the interactions between bodies of expertise and policy making often defy long-established political expectations regarding the application of rational decision making or the ability of evidence to apprehend objective reality. The difficulties of developing and using evidence and expertise in a linear-rationalist or positivist way are, I argue, compounded for contemporary policy issues such as climate adaptation due to their 'wicked' characteristics and the prevalence of political influence in their management as a result.

As I will demonstrate in Chapter 5, climate adaptation problems are very difficult to definitively and impartially understand, address or to resolve. The difficulties of deriving robust and usable policy evidence mean that politics may play an active role in its development and use and calls into question what the role of experts and evidence for policy making is and should be. Before discussing adaptation policy's wicked characteristics in more detail however, it is important to understand the historical, socio-economic and political context of the cases examined here. This context is important for understanding the established roles for evidence and expertise and how they have been influenced by prevailing political and socio-economic forces to date.

This chapter describes these contextual factors for the contrasting cases of Queensland, Australia and the UK. These cases have similar forms of three-tier liberal democratic government, have both sought to address the climate adaptation problem and both cases advocate an evidence-based approach. Yet, I argue that Queensland has framed the adaptation issue in terms of addressing climate exposure and avoided the issue of climate change, while the UK has framed the problem in terms of climate *change* vulnerability. Queensland's exposure-based approach has allowed policy makers to effectively ignore climate change science and to exclude consideration of climate change from the evidence-base. By contrast, the UK's vulnerability-based approach has mandated the use of climate change science in a way that, I argue, has resulted in the development of policy evidence for adaptation in ways that seem contrary to the transparent functioning of liberal democracy.

These contrasting strategies have resulted in a curious irony relating to the use of scientific expertise for climate change. Framing the adaptation problem in terms of society's exposure to climate has allowed Queensland government to effectively ignore the climate change problem and therefore to maintain its socio-economic priorities (associated with mining and fossil-fuel intensive industry) while still seeking to enhance the resilience of this region to climate variability and extremes. Despite this apparently short-sighted approach, I argue, resilience building activities in Queensland appear equivalent to, and have in some respects surpassed, the comparable efforts of the UK, particularly in relation to their preparation and response to extreme events and the development of community resilience to climate hazards.

In the UK, by contrast, a vulnerability-based approach has placed great emphasis on the development of an institutional framework capable of managing the somewhat abstract risk of future climate change. This approach is dependent on the use of climate science under a linear-technocratic policy making schema that has resulted in the politicisation of policy evidence; further, this approach has created a scientised policy process that allows for tacit approval of important values and political priorities that are covertly addressed during the development of supposedly independent and impartial evidence. These cases demonstrate how complex, uncertain and contentious expert knowledge relating to climate change may be problematic when used to inform policy in a linear or rationalist way.

This chapter demonstrates that the similarities and differences between these cases provide a useful point of comparison to allow generalisations to be made concerning the appropriate use of science and evidence for climate adaptation in developed liberal democracies. The research presented here and in subsequent chapters comprises a comparative political analysis between Queensland and the UK, alongside case-study comparisons from specific regions. In particular, examples of climate adaptation policy are drawn from Southeast Queensland (SEQ), an administrative region of the State of Queensland, while in the UK, research has principally been drawn from the administrative region of Southeast England (SEE) (see section 4.5). While much of the comparative analysis undertaken here relates to the broad structures and functioning of two similar liberal democratic governance structures, the regional research focus of these case-studies is useful for understanding the interactions between levels of governance and the influence of climate on adaptation policy.

This chapter begins by describing some of the geographic characteristics and stable governance structures of these two cases and how their similarities in this regard provide a useful point of comparison for understanding the policy making challenges of developed liberal democracies more generally[25]. I then describe the historical and socio-economic contexts for adaptation policy, first in Queensland and then in the UK, and how these factors have influenced approaches to climate change policy. Finally, utilising the regional case-studies of SEQ and SEE, this chapter addresses the political development of legitimacy for climate adaptation policy and how perceptions of policy legitimacy appear to have affected the development of adaptation evidence to date. This analysis will provide the necessary contextual setting for understanding the wicked characteristics of adaptation policy problems in Chapter 5, as well as the political forces influencing

[25] For the purposes of comparative political analysis, this chapter follows the work of Sabatier (1988) by broadly distinguishing between stable and dynamic factors that influence the policy making process. Given the political influences on evidence development for policy that I seek to demonstrate with this research, I contend that it is also useful to distinguish between stable and dynamic factors influencing the development of evidence for adaptation. Stable factors influence evidence development and use but are not easily altered due to their established nature or the timescales over which they are likely to change. By contrast, dynamic factors change more readily within policy making timescales and are conducive to influence by advocacy coalitions involved in the development and use of policy evidence.

evidence development and the inevitable tensions between expert and political authority in chapters 6 and 7.

4.2 The comparative cases of Queensland, Australia and the UK

Both Queensland and the UK possess characteristics that make them important case-studies for understanding the adaptation policy problem. To begin, both may be considered leaders in the field of climate adaptation, albeit for very different reasons.

Many of the climate challenges presently faced in Queensland, in terms of the frequency, variability and severity of extreme events, are similar to those expected to be faced in the future in many other parts of the world, due in part to the prevailing influence of non-annual climatic cycles on the east coast of Australia (McDonald et al., 2010; Flannery, 1994: p. 8). As such, this tropical/sub-tropical region provides a view into the types of climate adaptation challenges that many other developed liberal democracies in temperate climates have yet to encounter. Elsewhere, climate adaptation is often considered in the context of relatively benign, temperate conditions, as for example in Western Europe, such that climate adaptation is synonymous with climate *change*, primarily through abstract notions of future risk informed by the scenarios and projections devised by the climate science community. The impacts arising from extreme events under temperate climate regimes, I argue, relate as much to existing societal vulnerabilities associated with heavily urbanised and over-populated communities, as they do to the severity of the existing climate conditions (EA, 2010a), which pale in comparison to those climate impacts experienced in Queensland (Head et al., 2014).

As a result, policy assessments of existing and future climate vulnerability in the UK, such as for Southeast England, have been undertaken with limited practical exposure of communities and government to the challenges potentially faced in managing frequent extreme and unpredictable climate events. In contrast, Queensland has a long history of coping with persistent, variable and contrasting climate extremes associated with the El Nino/ Southern Oscillation and Inter-decadal Pacific Oscillation climate patterns. Queensland governments' approach to climate adaptation has been born through the concurrent policy fields of disaster risk management (DRM), natural resource management and urban planning, not as an abstract risk based on projections of future climate, but as an ongoing need to manage climate extremes. I argue that climate risk management in Queensland addresses a level of immediacy of climate extremes that does not exist in most other developed liberal democracies at this time, but may in the future as a result of climate change. Queensland's approach to climate adaptation policy making can, therefore, be usefully understood by framing the problem as one of climate exposure, rather than a problem of climate vulnerability (as in the UK).

Although the UK hasn't had the same experience of managing climate extremes as in Australia, it has emerged as an international leader in the development of climate change policy in the last decade, both in terms of efforts to reduce greenhouse gases (GHGs) and in adapting to future expected impacts (Preston et al., 2011; Keskitalo et al., 2010; Christoff, 2008; Grubb, 2002). This, despite the fact that the country has a reputation for environmental policy neglect, and was long considered by its neighbours as the "dirty man of Europe" (Porritt, 1989). The reasons for this supposed policy neglect have been debated at length and the answers proposed here also point to why now, in terms of climate change at least, it has emerged in the twenty-first century as a policy champion, despite its relative lack of experience in dealing with extreme climate.

Both cases advocate an evidence-based approach to policy making, at least in theory. Both regions also have a long history of incorporating 'rationalist' ideals into government policy, and indeed the UK was one of the pioneers of the contemporary trend of "evidence-based" policy (Head, 2008b; Solesbury, 2001), making it an ideal case-study for understanding the development of adaptation evidence. Geographically too, these two regions have interesting similarities. In terms of the specific case-study examples of SEQ and SEE, both are heavily urbanised, rapidly expanding and are particularly vulnerable to potential future climate change due to their particular geographies.

SEQ is Australia's fastest growing region. With an increasingly urbanised, expanding, coastal population stretching 200km from the Sunshine Coast in the north to the Gold Coast in the south, this region has been identified as a potential climate change 'vulnerability hotspot' by the IPCC (Hennessy et al., 2007: 50). Incorporating a total of eleven local government councils, seven of these have, since the 1970s, begun to merge into a single urban agglomeration that has been coined the "200km City" (Spearritt, 2009). The 200km city concentrates approximately 90% of SEQ's 3.05 million inhabitants along the coast in an area comprising about 20% of the region's 22,420 km^2 (ABS, 2012; Spearritt, 2009). SEQ's population is expected to exceed 4.4 million by 2031 (Queensland Government, 2009c, 2011a; Louca, 2009).

Figure 4.1. Queensland and Southeast Queensland

By comparison, SEE is the UK's most populated of nine political regions, with 8.6 million residents in an area covering about 19,000 km^2, making it approximately twice as populous as SEQ by total area, but equivalent in terms of urban density to SEQ's 200km city. The SEE region, excluding London, is the second largest economic contributor in the country, after London itself (ONS, 2014) and is expected to grow considerably over the coming decades with a further 670,000 residences expected to be accommodated by 2026 and the population to increase by 500,000 by 2016 (EA, 2010b). SEE's extensive urbanisation, low-lying topography and high population density mean that it has also been identified as being particularly vulnerable to climate change, due to the potential for water resource shortages and drought, flooding and sea level rise. Meanwhile its underlying geology makes its coastline particularly vulnerable to erosion (EA, 2010a; Keskitalo, 2010).

Figure 4.2. The United Kingdom and Southeast England

Both regions are served by a three-tier system of governance which, as will be described in detail in Chapters 5 and 6, is a particularly important consideration for how environmental policy issues are governed. Queensland is served by federal, state and local governments that have their origins in structures created in the nineteenth century. Described as the "Washminster mutation" (Thompson, 1980: p. 32), Australia follows a Westminster style of cabinet government at both federal and state level, while having constitutional oversight by a high court and a senate, reminiscent of the US political system.

In the UK, government structures in relation to cabinet, parliament and House of Lords have been in place for considerably longer, although existing bureaucratic government structures in the UK have also only developed since the nineteenth century (Bayley, 2004). UK governance is divided into local, national (Westminster) and trans-national (EU) levels, with the latter contributing a swathe of environmental legislation from the European Commission which the UK are legally mandated to implement. However, the UK has also recently embraced a model of administration for Northern Ireland, Scotland and Wales which devolves much of national government's democratic representation to sub-national cabinet and parliament. Although these devolved structures have taken on considerable responsibility for climate adaptation-related policy, SEE does not fall within a region of devolved administration and so is still subject to only three levels of government.

Queensland and the UK make a useful point of comparison as leading examples in the management of climate extremes and climate change. As this chapter makes clear, both Queensland and the UK have encountered significant and ongoing difficulties in managing contemporary policy problems across multiple levels of government. These cases have similar three-tier systems of liberal democratic governance which allow comparisons to be made in relation to how bureaucratic policy players and experts perceive the development of evidence for policy. Yet, as will be presented here, these cases have demonstrated quite different approaches to developing climate resilience and adapting to climate change which highlights the importance of historical, socio-economic and contextual factors in the development and use of this evidence. Indeed, a number of these differences have also been manifest in these cases' approaches to environmental policy more generally. These differences suggest a degree of generalisability in the results of this research for liberal democracies around the world.

4.3 Stable policy making parameters: historical, political and socio-economic influences on adaptation policy

4.3.1 Queensland

The Australian approach to environmental management and policy, much like the UK, appears to be characterised by deeply entrenched and conflicting forces relating to socio-cultural norms, identity, economy and the rationality of the evidence-based mandate. Across three levels of government, there has rarely been a consistent approach to environmental management in Australia[26]. This is because, although individual states are dependent on federal government for a share of national tax revenue and certain sets of guidance, responsibility for the provision of services and infrastructure largely falls to state government. Similar to environmental management between EU member states in relation to the UK case-study, the six states and two main territories of the federation, more often than not, have pursued independent strategies in a way that has been problematic when faced with issues that transcend these jurisdictions (Mercer et al., 2007; Walker, 2002).

This difficulty is compounded by a general lack of integration, coordination and ineffective devolution of authority between governance structures that has undermined relations between federal, state and local levels (Howes, 2008; Christoff, 2005). Cross-level governance has been characterised by power struggles, conflict and mistrust as a result of overlapping jurisdictions, a lack of constitutional recognition for local government and accusations of cost-shifting[27] (Howes and Dedekorkut-Howes, 2010). These characteristics have inevitably resulted in some policy fragmentation and a lack of integration between governance levels and across jurisdictions that can exacerbate ongoing difficulties in Australia associated with achieving political consensus for environmental issues like climate change (Howes, 2005; Toyne, 1994). In these circumstances,

[26] Despite considerable efforts at better integration. For example, the development of the *Intergovernmental Agreement on the Environment* (1992), the establishment of the *National Environment Protection Council Act* (1994) and more recently moves towards cooperation by the Council of Australian Governments on climate change adaptation (COAG, 2007) and DRM (COAG, 2011).

[27] The practice of shifting policy responsibility to lower levels of governance without the corresponding devolvement of funds necessary for effective policy response.

adaptation policy problems may look very different from the perspectives of differing governance levels, which in turn suggests that evidence development does also.

Similar to the UK, Queensland's governance also relies on linear, rationalist approaches to disaster risk management (DRM), urban planning policy and climate adaptation (Heazle et al., 2013). This approach is demonstrated, for instance, by government guidance for assessing natural disaster risks (NEMC, 2010), the operation of its natural resource and disaster risk mitigation assets (Heazle et al., 2013), and its use of Annual Exceedance Probabilities as flood risk management thresholds for urban planning (QFCI, 2012). Alongside governments' contemporary adherence to this rationalist policy model, and its explicit pursuit of evidence-based policy (Productivity Commission, 2010), Queensland's diffuse rural settlement patterns, socio-cultural history and prevailing political landscape suggest a rather conservative set of attitudes toward the natural environment, the role of experts in understanding how to manage it, and therefore the extent to which expert authority does or should have authority over environmental policy.

For instance, despite advocating an evidence-based approach, the public and the media have in recent times often eschewed, or at least been apathetic toward, the advice of the scientific community in relation to how best to manage environmental problems (see for example, Mercer et al., 2007; Devine, 2002; Dovers, 2000: 9). This attitude appears to be particularly relevant to the public and political acceptability of scientific expertise. Expertise concerning the management of the natural environment has moved beyond anthropocentric notions about our ability to control environmental variables and dominate ecosystems, toward an increasing acceptance of the need for *ecological modernisation* that would seek to work within the thresholds of what any given social-ecological system can sustain (Curran, 2011; Howes et al., 2010; Bell, 2006). Nonetheless, the public has always relied heavily on the provision of infrastructure and engineering (and the expertise associated with such technology) to reduce the public's exposure and/or vulnerability to climate extremes and variability, with the expectation that state government should support and protect the public from any and all environmental risks (Heazle et al., 2013; Mercer et al., 2007). It would appear that the Australian public is therefore reliant on technical expertise for the elimination of environmental risk, yet sceptical and reluctant to heed expert advice when it suggests the need for restraint or the existence of limits in relation to how society can and should interact with the natural environment.

This apparent contradiction in public attitudes to expert authority may be explained in part by their traditional relationship with political authority. Australia has had a long tradition of interventionist government and reliance on an expansive public sector (Mercer et al., 2007; Wanna and Weller, 2003). This tradition originated from the difficulties of colonising such a large land mass with a diversity of hostile climates and landscapes (Evans, 2008: p. 28; Johnston, 1988). Such circumstances prompted a sort of "colonial socialism", or as it was subsequently described "statist developmentalism"[28] (Crowley and Walker, 2012; Walker, 2002: p. 255). The private enterprise of European settlers heavily relied on state support for the social and economic infrastructures necessary to establish viable yet disparate communities. Mercer et al. (2007) argue that statist developmentalism has driven natural resource use since the very beginnings of European settlement of the continent in 1788, largely to the exclusion of broader considerations of sustainability or the contribution of ecosystem services in sustaining socio-economic prosperity. Statist developmentalism not only included state investment in the infrastructure of communication, transport and public utilities but also ownership of many commercial activities and even state-sponsored marketing for primary producers. Reliance on the state was so pervasive that Queensland had the largest public sector per capita in the world during the 1920s and there was an expectation of state protection for private enterprise from both market forces and endemic climate hazards (Wanna and Weller, 2003; Walker, 2002; Fitzgerald, 1984).

Queensland's statist developmentalist tradition, its reliance on infrastructure and engineering for environmental management and its seemingly contradictory position on the

[28] Walker 2002 suggests that *statist developmentalism* is a more appropriate term than *colonial socialism* since there was no socialist ethic of equality associated with government's statist policies. On the contrary they were designed to preserve and facilitate private property rights.

legitimacy of expertise also speak to a key characteristic of Australian identity: the colonial culture of "the stoic battler, surviving through hard work and persistence in a battle against the environment" (Bell, 2006: p. 562). Alongside government-led exploitation and management of natural resources, there has been a long tradition of applying European attitudes and practices to the management of the Australian landscape (Fitzgerald, 1984: p. 71). Throughout much of Australia's colonial history, nature was considered something to be overcome, something that could be "made over" (Walker, 2002: p. 252). Native flora and fauna were considered inferior, an impediment to development and growth, and to be replaced with European species (Mercer et al., 2007). There was a corresponding unwillingness to recognise the ecological limits of the Australian landscape, the nature of prevailing climates, or any possible restrictions on socio-economic growth.

For instance, although drought, bushfires and flooding are frequent occurrences in SEQ (McDonald et al., 2010), they are still considered by the public and the media as somewhat exceptional occurrences; something to be overcome rather than adapted to, and spoken of in terms of 'natural disaster' rather than 'natural event'. As Walker (2012) argues, this cultural ethos originated from the tradition of governments offering support such as drought 'relief' that helped to perpetuate the myth that bad weather years were exceptional. Further, he has argued that this resulted in severe ecological degradation of landscapes and in repeated attempts to control social-ecological systems through major infrastructure and engineering provisions, right up to the current day, despite contemporary recognition within the scientific community that such an approach is unsustainable (Mercer et al., 2007; Bell, 2006; Devine, 2002). These anthropocentric values appear to be a significant impediment to the ecological modernisation of Australian society promoted by recent Labor governments whereby commercial and state enterprise would operate within social-ecological limits rather than attempting to overcome them (Curran, 2009).

The interventionist governance paradigm was universally prevalent for all areas of environmental management across Australia until the 1980s, at which point ‘neo-liberal’[29] or ‘economic rationalist’ policies caused a policy shift away from previous priorities of state protectionism, with a corresponding increase in reliance on the distributive powers of the market (Pusey, 1991). This trend related to the prevailing forces of neo-liberal economics and globalisation worldwide (Harvey, 2007) and, to some extent, the pressure on Australian government for economic integration with its international trading partners (Pusey, 1991). In particular, successive governments in recent years have relied on market-based strategies for agri-environmental management that speak to conservative notions of small government, individual freedom and private property rights alongside notions of community empowerment and the development of social capital (Lockie and Higgins, 2007; Higgins and Lockie, 2002). However, these market-based strategies have also been criticised as being contradictory given that they seek to provide freedom and competitiveness to farmers while simultaneously expecting participants to put community interests ahead of their own (Lockie and Higgins, 2007).

Notwithstanding the international pressures for adopting market-based devices in a globalised economy, their introduction appeared attractive as a means of overcoming the ongoing governance difficulties that have plagued Australian government in recent decades, such as those associated with the traditions of statist developmentalism across conflicting levels of government (Lockie, 1997: p. 31, 32). While market-based strategies for environmental management are here to stay, and were explicitly advocated by the Garnaut Climate Change Review to federal government in 2008, the review also recognised the limitations of such approaches and the need for government intervention for climate adaptation (Curran, 2011; Garnaut, 2008: p. xxxii, xi). Some also argue that neo-liberal economic theory fundamentally prioritises private property rights and therefore may lack

[29] “[A] theory of political economic practices that proposes that human well-being can best be advanced by liberating individual entrepreneurial freedoms and skills within an institutional framework characterized by strong private property rights, free markets, and free trade” (Harvey, 2007, p. 2)

strategic understanding and effective management of natural resources and (by implication) social-ecological systems (CSIRO, 2003: cited in Lockie and Higgins, 2007).

Despite recent moves toward market-based strategies, Australia's statist developmentalist tradition of natural resource use, DRM and climate adaptation prevails to this day (Heazle et al., 2013; Mercer et al., 2007). This tradition can be seen, for instance, in DRM policy in SEQ where there remains a heavy reliance and expectation of appropriate state infrastructure (such as dams, levees and reservoirs) to eliminate exposure to extreme climate events. This propensity toward state intervention also speaks to rationalist interpretations of policy making (Heazle et al., 2013) and to policy making interpretations of climate resilience as – what Holling (1996) termed – *engineering resilience*: the ability to retain and ensure the viability of existing man-made assets, infrastructure and the socio-economic systems they support[30]. These socio-economic traditions appear to conflict with contemporary environmental experts' views of climate resilience and ecological modernisation (Davoudi, 2012; Howes et al., 2010; Holling, 1996), and suggest a conflict between certain sets of evidence and the underlying norms and values of policy players.

The prevailing culture of embattlement over the environment for survival, and the public's subsequent mistrust of contemporary scientific advice for sustainable social-ecological management suggest the existence of an important tension between expert and political authority in Queensland that has developed as a result of an entrenched conflict between the public's socio-economic values and priorities and the warnings from experts. This conflict is a recurring theme of Queensland policy making that appears to have been maintained and enhanced by two particular characteristics of Queensland. The first characteristic is the nature of the region's climate itself which is considerably more unpredictable and prone to extremes than those which the first colonists, primarily from Great Britain and Ireland, were used to (Evans, 2007; Johnston, 1988). Conditions of drought, flooding and bushfires are significantly more prevalent in Queensland than in Western Europe, and are subject to greater unpredictability and non-annual variability as a result of the influences of the El

[30] See Appendix B for a discussion of the varying conceptions of climate resilience

Nino/Southern Oscillation as well as longer term Inter-decadal Pacific Oscillation episodes. While the concept of embattlement over nature is understandable in the context of the region's colonial history, it takes on considerably greater significance in this region than in many other parts of the world, due to the fact that annual variation is not the most significant contributor of weather variability and given the scale of its subsequent exposure to contrasting climate extremes relative to similar developed economies in other parts of the world (McDonald et al., 2010; Flannery, 1994).

The second characteristic is the historical reliance of the region's export economy on agriculture and mining that has promoted a continuation of government-supported exploitation of natural resources, state provision of engineering and infrastructure, and has made successive governments mistrustful of international agreements or expert advice that might endanger this economy through, for example, concessions to environmentally sustainable practices (Mercer et al., 2007; Walker, 2002). These characteristics underline the difficulties being faced in this region in achieving political legitimacy for the scientific consensus on climate change, for international agreements such as the Kyoto Protocol or for domestic policy responses that might compromise key industry sectors (Curran, 2011).

It appears therefore that Queensland's socio-cultural and economic history has propagated a rather conservative view of the natural environment as hostile and destructive and which must be controlled and tamed in order to ensure the prosperity of its citizens (Hutton and Connors, 1999; Toyne, 1994). This has resulted in a clear contradiction in terms of public attitudes toward the value of expertise and scientific evidence and the development of sustainable environmental management practices such as for climate adaptation. On the one hand, the statist developmentalist tradition advocates a reliance on government-led infrastructure and engineering to exploit natural resources and to eliminate risks from natural hazards such as climate extremes – a task that is presumably reliant on scientific and technical expertise and which aligns with federal governments' explicit advocacy for the evidence-based approach. On the other hand, when scientific expertise contradicts the 'embattlement over nature' paradigm or related socio-economic concerns, suggesting instead a need to live within ecological limits, experts appear to hold reduced legitimacy as advisors to government. This certainly appears to be the case with the issue of climate change.

While the credibility of climate change science has been subject to considerable public and political debate (see for example, ABC, 2007), there is, nonetheless, public consensus on the existence of climate change and, to a lesser though still significant extent, its anthropogenic origins (Reser et al., 2012). Even so, expert authority on climate change policy and evidence appear to hold relatively weak legitimacy in circumstances where it conflicts with the socio-cultural norms and values or the economic development of Queensland, and of Australia more generally. As will be discussed in sections 4.4 and 4.5, climate change policy measures continue to be subject to considerable political opposition that suggests open defiance to the authority of scientific expertise and to an apparent consensus amongst the public about the dangers of inaction. This suggests a difficulty in utilising climate science to legitimise policies as suggested by the evidence-based approach, and raises questions over what the role of climate experts can and should be in circumstances of such weakened authority.

4.3.2 The UK

> *The British approach to environmental policy is notable for its contradictions* (McCormick, 2002: p. 121)

Unlike the comparative case of Australia, the UK has a rather more mixed history of reliance on government and state services, and yet has encountered similar difficulties to Queensland when attempting to integrate policy between three levels of governance. Richards and Smith (2002) and Harling (2001) tell the story of how, during the nineteenth century, the UK had adopted a *laissez faire* economic liberalism whereby government lacked functional ministerial departments and policies were, as often as not, developed either by ministers themselves or by ‘policy boards’, the latter being increasingly criticised for their lack of democratic legitimacy. Up until the 1860s, government’s role was limited to maintaining individual freedoms, property rights and the market economy, and ensuring protection from external threats. It was as a result of the country’s rapid and increasing industrialisation during the nineteenth century that an expansion of the state was ultimately deemed necessary. Industrialisation brought problems of health, social welfare and urban planning that necessitated increased state intervention. Such intervention became even more pronounced as a result of the first and second world wars, due to the need for careful control of the production and utilisation of resources during these periods.

After World War II the Labour government of the time embraced Keynesian economic policy that was accompanied by a form of statism, for example through the nationalisation of many infrastructure and key state service providers. However, in response to an economic downturn in the early 1970s that culminated in economic 'stagflation'[31] under the Heath government, in 1979 Thatcher embraced an ethos of neo-liberal economics that sought to reduce the size and influence of government, to privatise national infrastructure and service providers and to deregulate industry in order to facilitate the 'free hand' of the market (Harvey, 2007; Harling, 2001). In contrast, Queensland's embrace of neo-liberal ideology during the same period had not stymied its statist developmentalist norms of rationalist climate risk management policy that had fomented an expectation on government to eliminate climate risks[32]. In the UK, however, Thatcher oversaw the shrinking of government under the auspices of a New Public Management (NPM) regime that sought to farm out many public services to private enterprise (Lane, 2000), including those most relevant to climate adaptation, such as the privatisation of water companies in 1989 (OFWAT, 2014b).

The extent of neo-liberal politico-economic influence has remained high since Thatcher's first move in this direction, despite an expansion of non-departmental government agencies under the Blair government's approach to NPM in the 1990s and 2000s. Since 2010 Labour's expansion of government has been scaled back by the Cameron (Conservative) government (Taylor-Gooby, 2012), mirroring neo-liberal 'austerity' policies across Europe at this time (Dunn, 2014). As will be described in relation to the acid rain problem and in sections 4.4.2 and 4.5.2 below, neo-liberalism played a significant part in the legitimacy granted to environmental policy issues during the twentieth century

31 A term used in economics to describe a situation in which inflation and unemployment rates remain high, while the rate of economic growth slows down
32 See for example, Heazle et al.'s, (2013) description of the management of the Wivenhoe Dam in Queensland

and has also influenced contemporary legitimacy for evidence-based adaptation policy at local government level in the UK.

The UK's approach to environmental policy, planning and regulation as well as its more recent enthusiasm for climate change policy can thus be explained in the context of this history of rapid and extensive industrialisation and urbanisation in the nineteenth and twentieth centuries; the influence of two world wars that fomented a socio-political culture that placed significant value on resource independence and self-sufficiency, alongside the contemporary prevalence of neo-liberalism (Richards and Smith, 2002; Sheail, 2002; McCormick, 2002; Hajer, 1995). Despite its poor international reputation, the UK has one of the oldest and most established bodies of environmental law in the world, along with one of the world's oldest and largest professional environmental lobbies, and a public with very high levels of environmental awareness and interest in the amenity value of nature (McCormick, 2002; Sheail, 2002; Garner, 2000; Gray, 1997).

Sheail (2002: p. 2) explains how Britons have long been keen to tell the story of their country's landscapes and that this knowledge and understanding strengthened public opinion in favour of the need to conserve and protect the natural environment in the face of rapid urbanisation and industrialisation. As a result, natural limits to social and economic growth have also long been recognised in the UK. The industrial revolution had caused severe degradation of the British landscape along with a huge increase in the proportion of the expanding population living in urban locations. Whereas every second person was an urban dweller in 1851, by 1911, four out of every five people were urban dwellers. Both rural and urban locations were reshaped both in terms of their physical and social make-up. As a result, town and country planning provisions developed incrementally from local to regional and eventually to national policy provisions from the 1930s onwards (Rydin, 2003). Likewise, woodland areas were set aside not just to increase the provision of timber resources during the wars, but also for the benefit of rapidly expanding environmental and natural heritage advocacy groups that had sprung up all over the country since the 1850s, and which continue to expand their membership to this day (Evans, 2003; Sheail, 2002). As Sheail (2002: p. 103) argues: "The spread of the factory system, and subsequent growth of huge towns, had strengthened rather than weakened, the love of things rural."

In this context it seems unsurprising that UK policy players have granted considerable legitimacy to the task of climate change adaptation policy, and by association, legitimacy for the consensus evidence base for anthropogenic climate change. And yet, despite the value placed on the natural environment and heritage by its predominantly middle-class population, existing political-historic analyses suggest that UK governments, much like their Australian counterparts, have rarely placed environmental issues at the top of the political agenda (relative to say, the economy, healthcare or crime), taking a reactive rather than proactive approach and often failing to consider environmental issues in a strategic way (Jordan, 2002b). This intransigence is demonstrated for example in the UK's management of the acid rain problem during the 1970s and 1980s described below, and it is perhaps for this reason that Britain has a less than imperious reputation when it comes to environmental policy on the international stage (McLean, 2008; Lowe and Ward, 1998; Porritt, 1989).

Environmental policy in the UK cannot be understood without an appreciation of its tense relationship with the European Union (EU) (Lowe and Ward, 1998). The UK joined the EU (what was then the European Economic Community (EEC)) in 1973 at a time when the few environmental policies that existed at EU level were adopted by member states in an ad hoc fashion in accordance with their individual economic and political circumstances. However, following recession in the 1970s European integration stalled, particularly in relation to economic policy, and the European Commission (EC) (the EU's civil service) sought to inch forward integration through the pursuit of technical issues and 'low politics' such as environmental policy where they could effect integration in the relative absence of scrutiny from member states and interest groups (Jordan, 2002a). Sharp (1998) suggests that such incremental policy advancement received little scrutiny from the UK government during this time. However, as issues such as acid rain presented themselves on the international agenda, this incremental advancement of environmental policy gained greater traction, fuelled by the environmental leadership of countries such as Denmark, the Netherlands and Germany. As a result, pressure on the UK to implement EU environmental policy gradually increased during the 1970s and 1980s, so that by the beginning of the 1990s, the UK's department of environment had become increasingly concerned about the prescriptions being sent from Europe and had established a special coordinating division for EU legislative work (Garner, 2000; Sharp, 1998).

The UK has often had an awkward and rather luke-warm relationship with European policy makers, particularly in relation to regulatory integration. Indeed the UK has often vociferously opposed EU integration on environmental policy, often as a result of attempts to establish a common set of associated European ideals (McCormick, 2002; Garner, 2000; Lowe and Ward, 1998). Part of this tension with Europe may be as a result of the UK's legacy as a former global power, whereby acceptance of European integration would have come with a concurrent recognition of its status as merely a middle-ranking EU member state (Lowe and Ward, 1998). Furthermore, as an island state the UK appears to have failed to understand the impetus of its neighbours toward integration relating to border security and trans-boundary co-operation, and it has been unsympathetic to economic integration initiatives that seek to maximise benefit across the land mass of continental Europe. The perceived benefits of initiatives such as the EU's Common Agricultural Policy have rarely been as clear-cut to UK diplomats as to their European neighbours (Rydin, 2003: p. 123; Lowe and Ward, 1998). The UK's atypical adversarial political system and widely recognised bureaucratic efficiency may also have meant that it was ill-prepared for the requirements of coalition and consensus building that characterise EU policy making or the prescriptive nature of the EU's regulatory control (Jordan, 2001).

Garner (2000) and Jordan (2002b, 2001) suggest the UK's difficulty in Europe was primarily as a result of this conflict in policy tradition. The UK approach to industry regulation avoided prescriptive policies and often involved voluntary, pragmatic agreements which have received criticism for failing to effectively regulate polluters. McCormick (2002: p. 125) calls this the UK's "directionless consensus" between industry and the state[33]. By contrast, the European approach involved relatively rigid prescriptions and standards to be met by all member states through an evidence-based approach which has been a source of ongoing conflict amongst UK policy makers (Jordan, 2002b).

The oft-quoted example in this regard is the issue of acid rain which caused significant tension between the UK and its northern European neighbours during the 1970s and 1980s (Lean, 1998). Although a different order of environmental problem (in terms of geographic and temporal scale, as well as their levels of comparative complexity and uncertainty), the UK's management of the acid rain problem is a useful example for understanding governments' subsequent approach to climate change since these two issues bear a number of important similarities. Both are cross-border issues requiring international pollution control, both depend on the UK's energy portfolio and regulation for their resolution, and both have been instrumental in shaping Britain's international relations and reputation on the environment. Furthermore, the example of acid rain explains some of the difficulties that the UK has encountered with cross-level governance, in particular between national policy making and the directives of the EU.

Since first brought to the attention of the EU community (then the EEC) in 1972, it became increasingly clear that sulphate emissions from coal-powered electricity generation in the UK were causing significant acid deposition in countries such as Sweden and Germany (McCormick, 2002; Garner, 2000; Gray, 1997; Hajer, 1995). Yet, despite the considerable evidence to indicate the origins of this pollution, the UK refused to introduce controls to limit sulphate emissions until the late 1980s, at which point more enticing economic and ideological incentives for restrictions on the coal industry finally swayed government. These new incentives made political space for hitherto unacceptable regulation of an energy source that was, in any case, already on its way out (McCormick, 2002; Hajer, 1995).

---

[33] Most recently demonstrated by the Cameron government's repeal of the statutory reporting requirement on state infrastructure and public service providers under the *Climate Change Act (2008)*, in favour of a voluntary reporting scheme (see section 4.5.2)

The UK's reticence in managing the acid rain problem related principally to two political-economic and cultural issues. First, the country's post-imperial political culture of self-sufficiency in relation to natural resources and agriculture, which had developed as a result of its involvement in two world wars, had been exacerbated by the global oil supply crises in 1973 and 1979 when dependence on OPEC[34] oil producers had become increasingly and worryingly apparent. Such concerns ensured the UK's obstinate reliance on its abundant coal resources during the 1970s (alongside a developing nuclear energy portfolio) and its rejection of calls for environmental controls that could endanger the economic viability of the energy industry. Second, during the 1980s the Thatcher government, seeking to advance neo-liberal ideals, was even more reluctant to introduce regulatory controls on the energy industry that were seen as contrary to reforms that sought to roll back the state (Sheail, 2002; Hajer, 1995).

These political imperatives appear to have held significantly greater political capital than the need to appease its European neighbours or to address the considerable evidence-base suggesting the need for air pollution control (Hajer, 1995). However, by the 1980s the political landscape in the UK was changing, and thus, so too would its relationship with Europe. As part of its neo-liberal agenda, the Thatcher administration sought to rationalise government, to privatise industry and to break the power of industrial unions. A significant step in achieving these goals was to reject the demands of one of the strongest unions in the country, the National Union of Mineworkers, and to close a number of coal mines in northern England with the loss of 20,000 jobs. This resulted in considerable civil unrest and a significant reduction in union membership, but also a need to move toward alternative energy resources (BBC, 2004; Harling, 2001). Thus, at the same time as fossil fuel imports were rapidly increasing due to these mine closures, Thatcher privatised the gas industry and made a major policy shift toward using abundant gas resources in the North Sea (National Gas

[34] Organisation of the Petroleum Exporting Countries (OPEC): a consortium of 12 oil producing countries from the Middle East, Africa and South America that coordinates the pricing and production policies of its members' oil supplies

Museum, 2013). Natural gas presented a cleaner and more economically enticing alternative to coal[35] (Gray, 1997).

Furthermore, much like in Australia during the same period, the UK public were becoming increasingly concerned about environmental issues as a result of a range of high profile environmental disasters such as the Chernobyl nuclear meltdown (1986) and the Exxon Valdez oil spill (1989), as well as a number of new environmental threats including photochemical smog, ozone depletion and climate change (McCormick, 2002; Garner, 2000; Gray, 1997). This shift in public attitudes meant that there were increasing calls for a move away from coal-fired electricity generation.

As the public and political mood was shifting it is little surprise that, toward the late 1980s Thatcher became interested in environmental issues almost overnight[36]. Existing environmental policy and regulation were revamped and consolidated through the establishment of Her Majesty's Inspectorate of Pollution (HMIP) in 1987 and the National Rivers Authority (NRA) in 1989. In 1988 Thatcher proclaimed the Tories to be a party of conservationists, as the natural guardians of the environment, and made specific mention of climate change during her Conservative Party Conference speech that year. Thus, in 1988 Thatcher also finally ceded to the demands of EU neighbours by agreeing to implement the EC Air Quality Standards Directive that would ensure a reduction in sulphate emissions from the UK's existing suite of coal-fired power stations, as well as control a range of other dangerous atmospheric pollutants (Garner, 2000; Gray, 1997; Hajer, 1995). This example demonstrates how socio-economic priorities and established or prevailing norms and priorities superseded the legitimacy of expert evidence and environmental legislation that conflicted with those priorities.

Nonetheless, Lowe and Ward (1998: p. XV) argue that the EU has had "a profound and pervasive influence on [British] environmental policy". Although its influence has not gone so far as

[35] The UK's abandonment of coal as a principal energy source contrasts with Queensland's ongoing dependence on coal for both its own energy needs and as a lucrative export commodity, e.g., to China's booming economy.

[36] This may have been aided by Thatcher's scientific training (she held a degree in chemistry) which may have contributed to her understanding of the newly realised threats of climate change and ozone depletion and the need for policy action to address them.

to prompt a root and branch reform of the UK's environmental governance structures – which have often been criticised for their inability to strategically manage environmental issues[37] – it would appear that the EU has been instrumental in transforming the UK from an environmental laggard into a relative leader (Gray, 1997; Garner, 2000; McCormick, 2002; Rydin, 2003). In particular, the advent of EU framework directives such as the *Water Framework Directive (2000)* that seek to take a more holistic approach to managing environmental resources has made a significant difference in the approach of UK government to environmental management (Rydin, 2003; Garner, 2000).

However, since the early 1990s, there has been a significant reduction in EU environmental activity, with the *Water Framework Directive (2000)* the last truly prescriptive piece of legislation to emerge[38]. The biggest casualty of this reduction in legislative activity at EU level during the 1990s may have been efforts to reduce GHGs. In particular the EU failed to implement a carbon tax during this period as part of a European strategy to meet its commitments under the Kyoto Protocol (Garner, 2000). However, since that time there has been considerable progress in this regard, in no small part as a result of the influence from the UK (Grubb 2002; Oberthur and Ott, 1999). As will be described further in section 4.4.2, the UK's progressive stance on climate change is also related to its socio-cultural and economic norms that value self-sufficiency and international recognition in geo-political affairs.

The UK's tense relationship with the EU in relation to the issue of acid rain, and conversely its progressive stance on climate change suggests that the legitimacy of both policy and the associated evidence is ultimately dependent on the prevailing values and priorities of government. Those priorities of energy independence and international standing explain why the evidence and policy from the EU was in one case rejected, and in the other embraced and promoted, as a result of their respective congruence with those prevailing values and politics. Further, the aforementioned historical, political and socio-economic forces provide context for understanding the similarities and

[37] Much like the criticisms of state-level environmental management in Australia detailed in section 4.3.1 above
[38] I was one of the authors of the UK government's final regulatory impact assessment for the Water Framework Directive (DEFRA, 2007)

differences between Australia and the UK in their development and use of policy evidence to be explained in later chapters. These cases have been subject to similar challenges of cross-level governance yet their historical and socio-economic backgrounds have led to very different sets of political imperatives and policy framings. These differences suggest good reasons for why Queensland and the UK have approached the climate adaptation problem in such different ways and have such divergent levels of legitimacy for climate science.

4.4 Dynamic policy making parameters: the developing politics of climate change policy

This research is concerned with how the politics of climate adaptation policy influence the role of experts and evidence in the policy process. I argue that there is an important link between prevailing perceptions of the legitimacy of evidence and of policy issues themselves relating to how politically acceptable these issues are deemed to be for policy making. In that vein, my research suggests that the extent to which climate *change* adaptation policy making is legitimate relative to other forms of climate adaptation-enhancing policy (such as DRM and urban planning policy) is directly correlated to the legitimacy granted to climate change science and evidence. It seems appropriate, therefore, to review here the historical development of climate change politics and policy in Australia and the UK, from the ratification of the UN Framework Convention on Climate Change (UNFCCC) to the subsequent development of domestic policy initiatives for both mitigation and adaptation. By understanding more effectively the legitimacy of climate change as a policy issue, we can garner a greater understanding of the reasons for these cases' existing approaches to climate adaptation policy, and for their approaches to the production and use of the associated policy evidence concerning climate change.

4.4.1 Queensland

Australian international and domestic policy on climate change is characterised by conflicting political forces. The Australian federal government demonstrated considerable eagerness to address the issue at the signing of the UNFCCC in 1992 (Griffiths et al., 2007; Christoff, 1998), suggesting that there was some political will domestically to address the problem. The Hawke-Keating government's optimism may have reflected, to some extent, its lack of understanding of the truly wicked character of the climate change problem, as would be discovered by subsequent Australian governments. At the time, their response also reflected a wave of public concern for environmental issues as a result of a number of high profile international environmental issues. Ozone depletion, acid rain, whaling, the sinking of the Rainbow Warrior in Auckland, New Zealand and growing concern about global warming had all contributed to an enhanced policy legitimacy for environmental action both domestically and internationally (Curran, 2011; Christoff, 2005).

Yet only five years later at the third Conference of the Parties (COP 3) in 1997, Australia (under the Howard administration) had made a u-turn, refusing to accept legally binding targets, and as Christoff (1998) argues, appearing to exploit the diplomatic strife which occurred between major Annex 1 (developed) countries in the dying hours of the conference to achieve a considerably better position in relation to its committed targets: an eight percent increase in GHG emissions above 1990 levels by 2012. In so doing, Australian negotiators appeared to be playing to a domestic corporate lobby that were increasingly concerned about economic imperatives at the expense of environmental priorities as a result of the recession (Head et al., 2014; Herbohn, 2012; Curran, 2011). Yet this action, while appeasing the political executive and the industry lobbies looking over their shoulders, contradicted state-led GHG reduction initiatives and the concerns of the Australian public, a majority of who were increasingly concerned about climate change, despite the state of the economy (Marris, 2007).

Christoff (1998) argues that Australia's enthusiasm for addressing climate change in the lead up to the signing of the UNFCCC in 1992 reflected not only the prevailing public concern for the environment, but also the level of executive influence held at the time within Cabinet by the then Prime Minister (Bob Hawke) and the ministers for environment relative to those ministers holding briefs responsible for natural resources and economics. However, as Australia was signing the UNFCCC under a new Prime Minister (Paul Keating), the tide was turning as a result of the oncoming recession and an anti-climate change backlash by energy and primary industry which had begun to realise the importance of lobbying government on the issue. The Labor government's signature on the UNFCCC was largely the result of an acceptance of the international consensus for a substantial commitment, and domestically was seen as inconsequential in any case as it placed few policy demands on the Keating government within political timescales (Crowley, 2007).

However, as the Coalition (Liberal-National) government came into power in 1996 and in the lead up to Kyoto negotiations at COP 3[39], economic concerns that appeared to have diminished the public's concern for environmental issues during the early 1990s were beginning to recede again. Yet, at this point industry lobbies were paying attention and although opinion polls suggested the Howard government's intransigence toward GHG reduction was out of step with the electorate's views about climate change (Bulkeley, 2001; Curran, 2009; Crowley, 2007) it was more difficult to legitimise amongst a political executive under the sway of a powerful industry lobby advocating for economic interests above environmental concerns (Curran, 2011). Indeed, since signing the UNFCCC, it appears that Australian governments on both sides of the divide have actively pursued the development of the energy and other GHG-intensive industry sectors and then used those advancements to achieve dispensations from restrictive emissions targets on the basis of resulting economic hardship (Curran, 2011; Christoff, 2005; Christoff, 1998).

The original domestic policy response prompted by the UNFCCC, the Ecologically Sustainable Development (ESD) Strategy was left impotent in dealing with climate change under the terms of a National Greenhouse Response Strategy (NGRS) set up by the chairs of the ESD process in 1992. This was due to industry lobbies' ability to effectively redefine what constituted 'no regrets' measures for GHG reduction. Under the ESD Strategy, such measures had originally been proposed through a collaborative process of consultation between all relevant stakeholders. However these were subsequently discarded under the NGRS amid widespread condemnation (Bulkeley, 2001) and the NGRS itself was replaced by the Howard government's National Greenhouse Strategy (NGS) in 1998

[39] Conference of the Parties to the UNFCCC

(Talberg et al., 2013). In the run-up to the Kyoto Summit in 1997, Senator Robert Hill (Minister for Environment) had stated: “The adoption of a uniform reduction target at the upcoming Kyoto conference would have a devastating impact on Australian industry and its ability to create jobs” (Talberg et al., 2013: p. 7).

Thus it appears that an ongoing dependence of the export economy on ‘rocks and crops’ (mining and agriculture) has been a pervasive and overriding influence on Australia’s international and domestic climate change policy (Head et al., 2014). Although Australia signed the Kyoto Protocol, the Howard government refused to ratify it, despite an increasing shift in public opinion in favour of climate change policy. The Howard government consistently opposed any environmental policy activity that could have diminished Australia’s economic growth, or that might have endangered an economy that was believed to be particularly vulnerable to external economic market forces due to its narrow export portfolio (Crowley, 2007; Marris, 2007; Christoff, 2005).

The Howard government’s decision not to ratify the Protocol appears to have been related to these economic influences, as well as broader concerns over its competitiveness in the Asia-Pacific region, and its trading relationship with the US. Many of its trading partners were exempt from (or in the case of the US had opted out of) the agreement (Crowley, 2007; Marris, 2007). The terms of the Protocol allowed for any country who had undertaken land clearing in 1990 to include the equivalent emissions in its baseline GHG accounting. Crowley (2007) argues that this clause allowed the Howard government a useful half-measure in addressing climate policy: to pledge a realistic commitment to the first reporting phase of the Protocol (an 8% increase in emissions from 1990 by 2012) without actually ratifying the Protocol so that Australia would be tied into a legally binding agreement or any subsequent reporting phase. Ultimately this may have been their undoing as, ten years later, it has been suggested that the Coalition was out of touch with the electorate’s views on the environment. A significant contribution to the Labor victory in 2007 appears to have been related to their apparently strong policy position on climate change relative to the incumbent Howard government (even though the latter had also promised to establish a national emissions trading scheme if re-elected), thus reflecting the public's increasing concern over this issue (Beeson and McDonald; 2013; Talberg et al., 2013; Rootes, 2008).

Within weeks of being elected to office in 2007, the Rudd government had ratified the Kyoto Protocol and established a new ministry of climate change. It subsequently developed a Carbon Pollution Reduction Scheme (CPRS) after a great deal of community consultation, however the bills that would have brought it into being were blocked by the Senate in 2009, highlighting the political difficulties alluded to by previous policy initiatives of attempting to address climate change in Australia. As Curran (2011) convincingly argues, Rudd couldn't match his potent political rhetoric – centred on a discourse of ecological modernisation – with the realities of the energy-intensive nature of Australia's export economy. The CPRS attempted to appease both those looking for a strong policy stance on carbon mitigation, and those industry lobbies seeking to maintain international competitiveness. What resulted was a watered down version of a long-awaited emissions trading scheme (ETS) that fully satisfied no one (Curran, 2011; Christoff, 2010). It granted major concessions to industry, thus conflicting with Rudd's previously potent rhetoric of climate justice and ecologically sustainable development, while it was nonetheless considered an active threat to industry. The resulting loss of public credibility appears to have played a significant part in his inevitable political demise at the hands of his deputy prime minister, Julia Gillard in 2010 (Head et al., 2014; Curran, 2011).

Rudd's *CPRS Bill (2009)* was rejected by the Senate in August 2009. Upon reintroduction to the House of Representatives in October that year, an agreement between Liberal Party opposition (led by Malcolm Turnbull) and the Rudd government to ensure it passed through the Senate was scuppered by Turnbull's Liberal Party leadership defeat at the hands of Tony Abbott, which ended this agreement and the Bill was once again defeated in December 2009. The CPRS was then introduced a third time in early 2010, but following Rudd's ousting from Labor leadership at the hands of Julia Gillard, the Bill lapsed after 7 months due to the beginning of a new parliament, begun under a minority Gillard government. However, Gillard eventually succeeded in passing *The Clean*

Energy Act (2011) which included the establishment of a national ETS, the carbon price for which came into force in 2012. Yet, a year later, in 2013, the newly elected Abbott government began the process of dismantling the *Clean Energy Act (2011)* (Talberg et al., 2013). At the time of writing, Abbott has replaced this legislation with his Direct Action Plan (ABC, 2014a).

The lack of congruence evident between Australia and the UK in relation to the legitimacy of policy and evidence is clearly not correlated with public opinion on its own. The contrasting legitimacy for climate change between these cases points to the influence of contrasting political priorities of government and industry. As demonstrated by the policy approach of the Rudd government from 2007 to 2010 and subsequent efforts by the Gillard and Abbott administrations, political legitimacy for climate change policy is some way off and the issues highlighted in addressing climate change appear to have had a considerably greater influence on policy and evidence legitimacy than in the comparative case of the UK. While a majority of the Australian public are clearly concerned by the problem, and are in favour of policy to address it (Reser et al., 2012), the inability of policies such as ETS's to counter the deeply-rooted dependence of the economy on mining and fossil-fuel dependent industry, mean that the politics and value positions surrounding climate change policy are extremely difficult to resolve at a most fundamental level.

Discourses around ecological modernisation appear to be largely redundant when it comes to the value of fossil-fuel dependent industries for stabilising the Australian economy against the backdrop of a global financial crisis (Curran, 2011). No wonder then that incumbent Prime Minister Rudd, in his pre-election 2013 debate with then Coalition leader Tony Abbott, stressed the importance of diversifying the Australian economy to reduce its reliance on mining and the export of fossil-fuels (Rudd, 2013). And it appears to be due to this same difficulty of addressing the challenges presented by climate change that the Coalition's successful election campaign in 2013 was based on an abandonment of this policy priority, a political strategy that was clearly successful. Abbott promised to remove the 'carbon tax'[40] introduced by Labor shortly before the 2013 general election which was designed to replace the original CPRS, and to disband the Department of Climate Change when they won the election (Abbott, 2013; Maher, 2011). At the time of writing, the Abbott government has made good on these promises, while also scrapping two of government's climate change advisory bodies, the Climate Change Authority and the Climate Commission (ABC, 2014b; Talberg et al., 2013). In place of the *Clean Energy Act (2011)*, government is establishing a *Direct Action Plan – Emissions Reduction Fund* that will seek to purchase carbon-abatement schemes and encourage "practical ways of reducing emissions" without directly impacting upon industry (ABC, 2014a).

Similarly, within the State of Queensland, the Newman (Liberal-National) government has largely dismantled climate change as a policy priority, dissolving the Office of Climate Change and withdrawing much of the climate change policy which had been developed by the preceding Bligh (Labor) government (See section 4.5.1 for details). As I argue further in section 4.5, the international and domestic politics of climate change appear to have strongly influenced the task of climate adaptation policy making in Queensland. Much of the aforementioned state policy under the previous Bligh (Labor) government related to the explicit task of climate *change* adaptation, yet in the absence of a mandate to mitigate GHG emissions at state or federal level, alongside a concurrent ongoing need to adapt to Queensland's climate extremes, it seems unsurprising that the Newman government would remove all commitments to climate *change* adaptation from its policy portfolio, focusing instead on the management of existing climate variability. In turn, I argue that this has had an equivalent effect on the legitimacy of climate change science and evidence for adaptation policy.

As will be discussed in section 4.5.1, there has been much development within the narrower policy field of climate adaptation to suggest that, although political support for climate change may wax and wane depending on partisan political power, there has been and continues to be considerable policy development under the guise of concurrent policy priorities (e.g. DRM and water

[40] A deliberate misnomer by Abbott; the *Clean Energy Act (2011)* incorporated an ETS, not a tax, with a fixed price for the first 3 years.

resource management) that fall under the remit of climate adaptation. While this may preclude much of the explicit hand-wringing about future climate associated with climate *change* adaptation, I argue that the nature of climate change and the types of responses available to address it in the face of intractable uncertainties mean that SEQ's policy responses hold many parallels to the comparable case of the UK. SEQ and Queensland more generally appear to have well developed climate-related policy in terms of the management of existing climate variability and extreme events that has considerably enhanced the regions climate resilience generally, even if the UK has made more progress in terms of developing an appropriate policy making process for climate *change* adaptation.

4.4.2 The UK

Similar to the management of the acid rain problem during the 1970s and 1980s, climate change policy in the UK appears heavily influenced by a history of self-sufficiency and resource independence, alongside neo-liberal ideals concerning economic rationalist policy making. This socio-political backdrop, alongside successive governments' continuing ambitions toward global political leadership helps to explain why, in the case of acid rain, the UK avoided the available evidence and EU policy mandate, whereas in the case of climate change UK governments have been at the forefront of progressive politics and policy since the development and negotiation of the Kyoto Protocol (Grubb, 2002). During negotiations at the Kyoto summit in 1997, the UK played a significant role to effectively bridge the diplomatic gap between the conflicting political-economic positions of two of the most central actors, the US and the EU (Damro and Mendes, 2005), to ensure a global agreement could be reached (Grubb, 2002; Oberthur and Ott, 1999). Furthermore, although considered to be a laggard in the development of environmental policy during the 1970s and 1980s by its EU counterparts as described in section 4.3.2 above, it was Prime Minister Margaret Thatcher who was one of the first political leaders globally to express concern over the threat of climate change during her Conservative Party conference speech of 1988. This eagerness for climate policy can also be explained by domestic political developments and policy priorities over the preceding decade.

While the Thatcher government sought to weaken the influence of industrial unions, privatise the energy industry and switch from coal to gas for a combination of economic, political and ideological reasons described above, it had not sought to move away from the use of coal for environmental reasons, or as a result of the available expert evidence in that regard. Indeed, the Thatcher government had steadfastly opposed international pressure to do so (Hajer, 1995); it had demonstrated almost no concern for environmental issues until the late 1980s at which point it became clear that a certain political cache had developed around the environment that could enhance the Tory party’s standing in the polls (Gray, 1997). By 1997, it had become evident that the government’s manoeuvrings in relation to energy policy would likely be fortuitous in relation to the UK’s international standing on climate change and during the Kyoto Summit the UK was one of the few countries that could report static or declining emissions from a 1990 baseline due to its ‘dash for gas’ over the preceding decade (Benedick, 2001; Oberthur and Ott, 1999; OECD, 1999). Although the Major government of the 1990s had shown little interest in environmental issues, Labour’s election victory under Tony Blair in 1997 ensured a strong diplomatic presence in the run up to and during the Kyoto Summit, with John Prescott, the new environment minister, working to promote an agreement not just between the US and the EU, but also amongst its Commonwealth partners Australia and New Zealand (McCormick, 2002; Oberthur and Ott, 1999).

Even so, promises for action on climate change domestically received little attention during the Blair government’s first term in office. McCormick (2002) has suggested that this was mostly due to their ambitious policy commitments in relation to priorities for addressing crime, healthcare and education, as well as to the fact that its aspirations toward being the ‘greenest UK government ever’ (Assinder, 2000) were stymied (in a rather similar fashion to the failure of Rudd’s climate change rhetoric following Labor’s 2007 election victory in Australia) by the political realities of introducing environmental policies that conflicted with existing political and economic priorities. Although there is strong support for climate change policy in the UK and the legitimacy of its science, political efforts in this regard have still faltered in terms of finding what McLean (2008) calls ‘economically literate’ policies. He concludes that for this reason environmental issues, and even climate change, remain an issue of only medium importance in the UK. Nonetheless, Blair’s attention was drawn more toward environmental concerns in his second term in office, particularly in relation to climate change (McCormick, 2002). In 2006 the Labour government commissioned the Stern Review of the economics of climate change mitigation (Stern, 2006) which received global media attention, and in 2008 the *Climate Change Act (2008)* was passed through parliament with an overwhelming parliamentary majority, thus demonstrating its widespread political support[41] (Moore, 2013a).

A pioneering piece of legislation, the likes of which had not been seen anywhere in the world up to that point, the *Climate Change Act (2008)* is principally designed to ensure a legislative mandate for the reduction of GHG emissions in a way that will effectively bypass the short-termism of partisan political cycles, committing successive governments to achieving a 80% reduction in emissions by 2050. Despite significant criticisms in terms of its feasibility and the achievability of its targets (Pielke Jr., 2009; Anderson et al., 2008), the bill is significant because it definitively demonstrated, perhaps for the first time, considerable political will within the UK to strategically address the problem of climate change. This bipartisan policy legitimacy appears in stark contrast to similar efforts up to that point in relation to the environment (e.g. for acid rain), both domestically and at EU level where the UK had traditionally lagged behind and followed the leadership of countries such as Germany and the Netherlands (McCormick, 2002). The UK’s leadership on climate change also sits in contrast to the case of Australia where attempts to establish emissions reduction policy have met with persistent political opposition (ABC, 2014b).

Nonetheless, as Pielke Jr. (2009) and McLean (2008) have argued, even the presence of a legislative mandate in the UK may not provide sufficient political motivation for GHG reduction in the presence of stronger economic and political signals. The *Climate Change Act (2008)* appears

[41] Notably, only 5 MPs voted against it.

unlikely to achieve its objectives given that population and per capita GDP in the UK are both increasing year on year, while initial calculations of annual emissions as part of the Act's GHG accounting requirements, although demonstrating a decline in the rate of emissions, still reflect the UK's switch to gas as a principal energy source, as well as the effects of economic recession caused by the global financial crisis (Pielke Jr., 2009).

The Tory/Liberal Democrat coalition government, under David Cameron had come to power in 2010 with the promise of continuing the UK's commitment to tackling climate change. In the preceding years, Cameron had used environmental issues, and climate change in particular, as a device for 'brand decontamination' of the Tory party in an attempt to move away from its reputation as the 'nasty party' (Carter, 2009). High profile stunts such as cycling to work with a media entourage (BBC, 2006a), a trip to melting glaciers in Norway (BBC, 2006b), and a new party logo with environmental connotations and the slogan "vote blue, go green" had increased the party's (and his own) standing in the polls (BBC, 2012b). The Tory's had also drawn attention to Labour's poor domestic record on environmental issues to enhance its own position (Carter, 2009).

Although Blair had taken leadership on climate change on the international stage, the party's record on domestic GHG reduction was poor, and Blair's successor as Labour leader Gordon Brown had demonstrated little or no interest in such issues (BBC, 2012b). Labour's response to the Tories' enhanced public image was to begin implementing a range of policies that appeared to have originally been advocated by the opposition Tories. At this point too, Cameron appeared to be reaching the limits of political legitimacy on the environment as the more conservative element of his party became increasingly annoyed by the leadership's embrace of green issues. As a result, in the run up to the 2010 election, he stepped back from environmental messages and concentrated on traditional conservative priorities of crime and healthcare, as well as on issues of public debt and the economic fallout from the global financial crisis since 2008 (Grice, 2009; Carter, 2009).

In this way, Carter (2009) alludes to a rather ironic twist in the environmental story of the UK. The Labour governments' development of a renewable energy strategy anticipated a massive increase in the development of both onshore and offshore wind power in order to meet the obligations of the *Climate Change Act (2008)*. Yet this strategy was likely to encounter public opposition, particularly from conservative voters, as a result of opposing environmental claims about the defilement of the British landscape. In essence the difficulties of meeting the Act's GHG targets may be strongly influenced by an ongoing fight between two opposing sets of environmentally conscious political positions: conservatives seeking to maintain the British landscape, versus those seeking to mitigate the global environmental problem of climate change. In fact, the Cameron government's first environment secretary Caroline Spelman had previously called for a moratorium on the construction of wind farms in Scotland (Toynbee, 2007).

Such vehement local opposition is further testament to the difficulties faced in matching climate change rhetoric with effective policy action, even where there is bipartisan political will in favour of action. These difficulties are also ironically reminiscent of the motivations of the first environmental groups in the UK to protect the landscape from nineteenth century industrialisation. Despite these difficulties, cross-party consensus concerning the need to tackle climate change remains[42] (Carrington, 2015), and the *Climate Change Act (2008)* is still in place, which obligates an evidence-based approach to both the regulation of GHGs and the management of risks associated with climate change adaptation. The evidence-based requirements of the Act also appear to legitimise the use of climate science for policy evidence through this legislative mandate.

4.5 The development of climate adaptation policy

4.5.1 Southeast Queensland

The issue of climate change, just as in other parts of Australia, has been politically contentious in SEQ. While at national level the Abbott government has largely dismantled climate change policy provisions and deprioritised climate change as a policy issue, it has nonetheless established a

[42] A recent declaration, signed by the three main political party leaders, states: "Climate change is one of the most serious threats facing the world today. It is not just a threat to the environment, but also to our national and global security, to poverty eradication and economic prosperity […] Acting on climate change is also an opportunity for the UK to grow a stronger economy, which is more efficient and more resilient to the risks ahead" (Carrington, 2015).

Climate Change Adaptation Program to facilitate adaptation research and to provide funding for climate adaptation plans for local government (Australian Government, 2014a). At state level, the Office of Climate Change, established by the Bligh (Labor) government in 2007, was disbanded by the Newman (LNP) government in 2012, alongside a review of all climate change and related policies at state and regional levels (Norman, 2012). At local level, climate change policy and planning has been under similar pressure, as demonstrated by Gold Coast City Council's decision to axe its climate change staff (Killoran, 2012) and state government's removal of any legal requirement for local councils to incorporate climate change-induced sea level rise into their planning schemes. Indeed, most recently Queensland's Minister for Infrastructure and Planning Jeff Seeney issued a formal order to Moreton Bay council to remove all reference to anthropogenic sea level rise from their regional plan (ABC, 2014c), referring to climate change as a "semi-religious belief" (ABC, 2015).

This apparent dwindling of legitimacy may be explained, I argue, by the conflict between the conclusions of climate science and the prevailing values and aforementioned dependence of SEQ on fossil-fuel intensive industry and mining, as well as on ongoing trends of coastal urbanisation in the region. Yet, more than ever before, SEQ appears to require climate adaptation policy, as evidenced by a series of extreme climate events in recent years (Howes et al., 2014). Despite the political difficulties and apparent lack of legitimacy for addressing the issue of climate change, there have been a surprisingly large number of policy and planning initiatives in the past decade at all governance levels to address climate adaptation in SEQ.

Therefore, although climate *change* adaptation policy has been the victim of partisan politics, climate adaptation nonetheless proceeds, without discussing anthropogenic climate change, often under the guise of DRM and urban planning provisions which don't carry the same political divisiveness as climate change and climate science. In this thesis I investigate the extent to which this apparent lack of legitimacy for climate change policy reflects a lack of legitimacy for the associated consensus evidence-base or the knowledge production system. My research also indicates the extent to which climate adaptation policy making through DRM and urban planning can effect climate *change* adaptation. I conclude that SEQ's policy responses focus on enhancing the resilience of communities to existing climate extremes rather than seeking to legitimise policy using climate change science because of a lack of political legitimacy for climate change. This approach has, I argue, yielded considerable benefits for the region's adaptation to climate change.

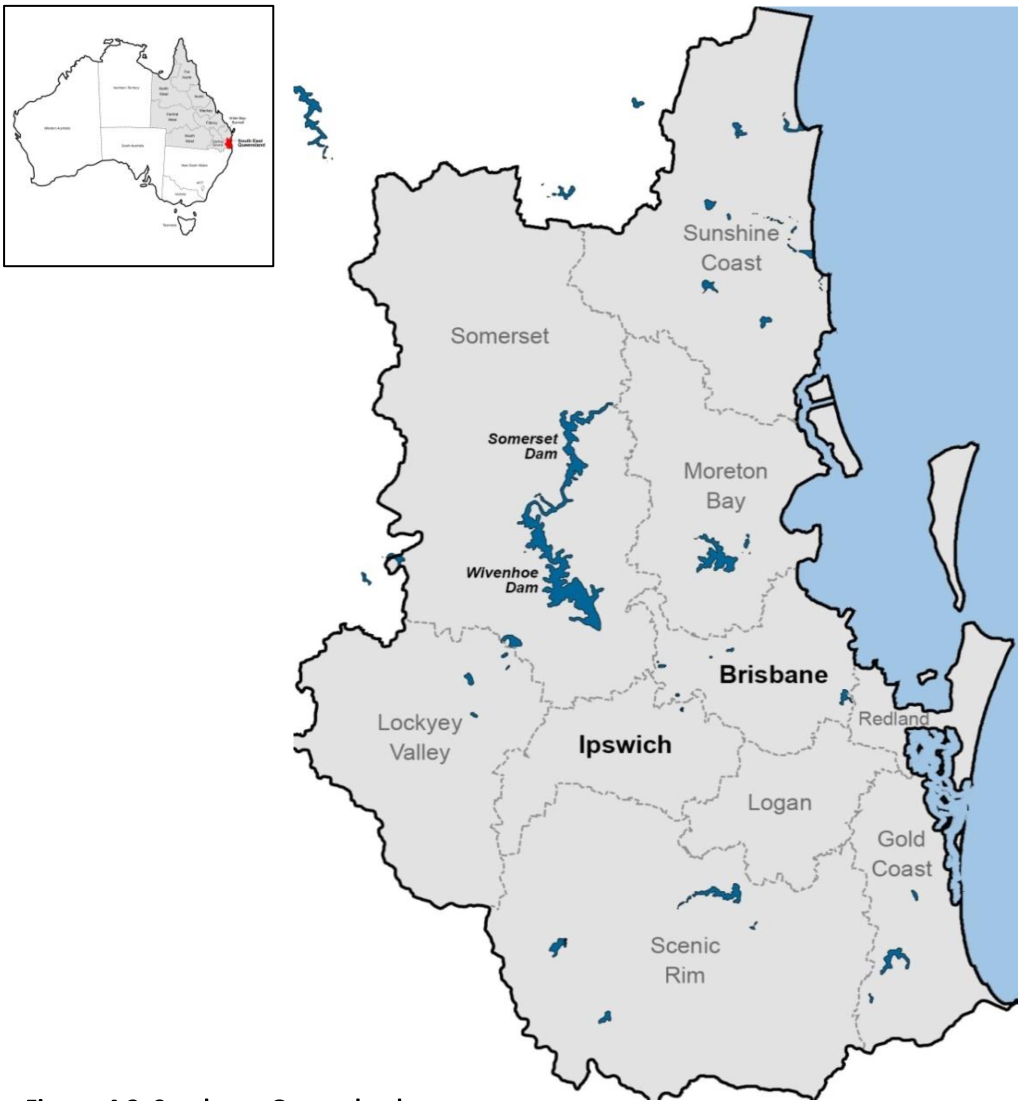


Figure 4.3. Southeast Queensland

Adaptation goals that are principally achieved through concurrent policy priorities have ensured a range of institutional and community resilience-building provisions that under a different regime (such as in the UK) would usefully be described as climate *change* adaptation. The SEQ region's attempts to adapt to existing climate extremes have seen considerable development. The suite of extant adaptation policy initiatives currently committed to by state and local governments also underline the lack of explicit policy action for climate *change* adaptation, beyond commitments toward more and better research and the reduction of uncertainty surrounding future climate (Dedekorkut-Howes et al., 2010) which, I argue, are rarely used for policy making itself[43].

The development of explicit climate change adaptation policy:

The federal government's Department of Climate Change, which existed between 2008 and 2013, prior to the election of the current Abbott government, set out a policy paper in 2010 entitled *Adapting to Climate Change in Australia: An Australian Government Position Paper*. This paper describes federal government as the facilitator of climate change adaptation policy but largely assigns responsibility for adaptation to state and local governments since they are the principal providers of services and infrastructure and already coordinate concurrent priorities such as DRM and planning (DCC, 2010). The Council of Australian Government's[44] (COAG) *National Climate Change Adaptation Framework 2007* (COAG, 2007) meanwhile sets out a strategy to reduce uncertainties through coordinated research provision and dissemination, and as a result to reduce the vulnerability of key sectors to climate hazards. This strategy has been implemented by the National Climate Change Adaptation Research Facility (NCCARF) since 2008. The Abbott government, although removing climate change as a named priority from ministerial departments (Talberg et al., 2013) and repealing the *Clean Energy Act (2011)* (ABC, 2014b), appears to have continued on with these research and support initiatives through its Climate Change Adaptation Program (Australian Government, 2014a). NCCARF was initially funded by federal government from 2008 – 2013 and then, following a year of fiscal uncertainty, was also refunded by the Abbott government's Department of Environment at a lower level from 2014 (NCCARF, 2015). However, as will be outlined here and in Chapters 6 and 7, initiatives to develop climate change and adaptation science research belie a lack of actual use of this science for adaptation policy at state and local levels.

---

43 This interesting tactic of invoking the need for more and better information mirrors similar commitments in the US, used as a means to avoid more substantive policy measures that would be politically divisive (Grundmann, 2006).

44 The Council of Australian Governments (COAG) is the principal intergovernmental forum of Australia. The council comprises the Prime Minister, State and Territory Premiers and Chief Ministers as well as the President of the Australian Local Government Association: "The role of COAG is to promote policy reforms that are of national significance, or which need co-ordinated action by all Australian governments" (COAG, 2015).

At state level, climate change adaptation policy has undergone major shifts in recent years as a result of changing political leadership and prioritisation, and here too, its currency as a policy issue appears to be dwindling. Queensland's Office of Climate Change was established by the Bligh (Labor) government in 2007 within what was then the Department of Environment and Resource Management. In 2009 the state government published their climate change strategy *ClimateQ: Toward a Greener Queensland* (Queensland Government, 2009b) which included 62 adaptation actions relating to water planning and services, agriculture, human settlements, natural environment, emergency services, human health and tourism, business and industry. Most of these actions focused on research initiatives and capacity building (Dedekorkut et al., 2010). This was complemented by the *Queensland Coastal Plan* in 2012 (Queensland Government, 2012a), pursuant to the *Coastal Protection and Management Act (1995)*. Originally drafted under the Labor government in 2009, the Coastal Plan seeks to address issues of coastal erosion, sea-level rise and the concurrent pressures of population growth and urban development. The plan was designed to inform regional and local government plans, planning schemes and development applications in the State of Queensland, in order to prevent development in areas at risk of coastal hazards such as erosion, storm surge or sea-level rise. Following state election success for Cambell Newman's Liberal-National Party in March 2012, the *ClimateQ* strategy was scrapped. The Coastal Plan was reissued as the Department of Environment and Heritage Protection's *Coastal Management Plan* (Queensland Government, 2013) which, although referring to climate variability and sea-level rise, makes no mention of climate change or global warming. Clearly, the Newman government had downgraded climate *change* adaptation as a policy priority.

From a planning perspective, Queensland is divided into 14 regions, each of which is guided by a statutory regional plan. *Southeast Queensland's Regional Plan 2009 – 2031* (Queensland Government, 2009c) was drafted in accordance with the *Integrated Planning Act 1997* which was subsequently replaced by the *Sustainable Planning Act* 2009 (Dedekorkut, 2010). The plan itself was redrawn from a previous (2005 – 2026) edition as a result of greater than expected increases in population, and following the IPCC's identification of the region as being particularly at risk from future climate change impacts (Hennessy et al., 2007). The plan was supported by a range of further regional planning initiatives required under the *Sustainable Planning Act (2009)* to be aligned with the regional plan. At the time of writing, there is considerable uncertainty as to the status of this legislation due to the recent state elections (in January 2015) which brought Labor back into power. The Act had been under review by the Newman (LNP) government and was due to be replaced by a *Planning and Development Bill* (Queensland Government, 2014c). In its review, the Newman government explicitly stated a need for reform to account for political and economic priorities:

> *New generation regional plans are intended to have an increased focus on economic development, and will be shaped by the government's policy and planning reform agenda, meaning there is now a need to review the regional plan for South East Queensland* (Queensland Government, 2014c).

Revisions to the original plan under development by the previous Bligh (Labor) government, for example the Draft *SEQ Climate Change Management Plan* had been scrapped under the Newman government. However, the *SEQ Water Strategy* (Queensland Water Commission, 2010) survived[45]. This latter strategy describes the region's plan to secure future water supply amidst existing and future climate pressures of drought and flooding and a rapidly growing population. The strategy examines options for future supply and requires participation from a range of organisations responsible for water resource management in the region. It is also one of the few extant policy documents which make specific mention of the use of climate change science for the purposes of water resource planning. And yet, despite these provisions, as described in detail in Chapter 7, climate change science has not been incorporated into water resource management, DRM and urban planning provisions for the city of Brisbane.

Therefore, although significant ground had been made in incorporating consideration of climate change adaptation into national, state and regional/local policy and planning by the previous Labor government, the absence of bipartisan consensus on the issue of climate change makes adaptation a difficult policy focus to explicitly address over the long term, at least until many of the

[45] Even though the Water Commission did not (Queensland Government, 2014b)

broader issues applicable to climate change – such as the economy's dependence on mining and fossil fuel intensive industry – are resolved. Interviews with policy players in SEQ as part of this research reveal that the incumbent Newman state government's Department of Environment and Heritage Protection had been producing a new climate adaptation plan, but one which would have contained limited mention of anthropogenic climate change or any use of climate change science (Australian Policy Players 2, 3).

At the level of individual local governments, the aforementioned plans and strategies were designed to inform local government planning schemes, while there are also a number of guidance documents at national and state level to direct those planning schemes. *Climate Change Adaptation Actions for Local Government* (Australian Government, 2007), the Local Government Association of Queensland's (LGAQ, 2007) *Adapting to Climate Change, a Queensland Local Government Guide,* and the federal government's *Climate Change Adaptation Program* (Australian Government, 2014a) all aim to help local government understand the potential impacts of climate change. Bajracharya et al. (2011) suggest that the design and focus of adaptation actions at local scale goes some way to bridging the policy gap between national, state and local levels of government. There had been, for instance, individual strategies and plans prepared by Brisbane (BCC, 2007) and Gold Coast (GCCC, 2009) city councils. However, the latter has now lapsed and the status of such plans in light of changes of state government is as yet unknown. Interviews conducted with local and state policy players as part of this research suggest a trend of increasing responsibility being passed to local government for adaptation-related policy, a level that has the least capacity or interest to utilise the available evidence. For instance, the current Liberal-National majority in Brisbane City Council has (according to two interview participants) no interest in the issue of climate change or adaptation. This appears to have been confirmed by LNP councillors' refusal to be interviewed for the purposes of this research (Australian Policy Players 1, 2; Australian Policy Scientist 6).

Concurrent policy priorities for Southeast Queensland:

The aforementioned policy and planning activities introduced by the Bligh government between 2007 – 2012 sought to deal specifically with the task of climate *change* adaptation, to improve our understanding of climate change impacts and risks and to integrate climate change into existing policy and planning. Due to the aforementioned lack of bipartisan legitimacy for climate change, these policy initiatives have been scrapped by the Newman government (2012 – 2015), yet the nature of the task at hand means that concurrent policy and planning priorities in SEQ often address climate change adaptation, even where it is not mentioned or intended. In this regard, SEQ is in a relatively unusual situation. Given the existing frequency, variability and severity of climate extremes in the region, existing infrastructure provision, urban planning and emergency management organisations and governance mechanisms already deal with a range of climate-related threats with sufficient frequency that they have significant first-hand experience of managing them.

Climate change adaptation is ultimately about enhancing the resilience of communities and the social-ecological systems of which they are a part to ensure they can withstand the impacts of future climate change[46] (Nelson et al., 2007). However, many of the activities at all levels of SEQ's government, as well as within communities themselves that are being undertaken to ensure sustainable development and community safety, appear to enhance the resilience of the region, not just to existing climate, but to climate *change* also. In particular, long-standing policy priorities of DRM have increasingly sought to enhance community resilience and to reduce communities' vulnerability to existing climate variability, as well as to address the ongoing pressures of natural resource shortage and population growth. Climate change adaptation is clearly very relevant to these policy and planning priorities.

Governance of climate hazards has been the focus of significant public scrutiny, as well as academic research across Australia in the last five years (QFCI, 2012; VBRC, 2009; Ross and Dovers, 2008). Queensland in particular has been subject to a series of climate-related natural disasters that

[46] See Appendix B for a discussion of the concept of climate resilience

have tested existing governance institutions and mechanisms to their limit, highlighting the difficulties of managing disaster risk from a range of potential hazards and in the context of the particular governance characteristics of the state (Heazle et al., 2013). An extended period of drought between 2001 and 2009, the La Nina-related flooding events of 2010/2011, the subsequent impacts from Cyclone Yasi shortly afterwards, followed by further flooding events as a result of Cyclone Oswald in 2013 have provided ample demonstration of the destructive force of existing climate variability in the state, and in the SEQ region in particular.

DRM is managed by individual states and territories in the Australian commonwealth, without any constitutional remit for federal government except where major national disasters require coordinated actions. The role of federal government therefore is primarily to facilitate and promote effective DRM through the provision of funding, national guidance and risk assessment and to coordinate state and territory arrangements where necessary. In this way, Emergency Management Australia (EMA, 2004) is the principal federal organisation responsible for DRM. It promotes an 'all agencies', 'all hazards' approach which means that individual hazards should not be managed in isolation from others, or solely by individual government bodies. EMA advocates a model of disaster management centred on the Prevent, Prepare, Respond, Recover (PPRR) model first developed in the US and utilised in Australia since 1989 (Cronstedt, 2002, EMA, 2004). This model has been subject to significant criticism, particularly in light of its apparent shortcomings when managing a number of recent natural climate disasters (Heazle et al., 2013; Cronstedt, 2002).

Queensland's *Disaster Risk Management Act (2003)* is the principal legislative mechanism underlying disaster risk and emergency management in the state. The Act mandates the formation of disaster management groups at state, district and local level and the preparation of disaster risk management plans and guidelines (Bajracharya, 2011). Local governments are responsible for identifying and evaluating hazards and risks in collaboration with the emergency services, voluntary interest groups and community organisations. This is achieved through local disaster management groups and their derivation of local disaster management plans to enhance communities' preparedness for, and response to, extreme events and thus their climate resilience. All relevant participants in the disaster risk management process are guided by the *National Strategy for Disaster Resilience* (COAG, 2011) and the *National Emergency Risk Assessment Guidelines* (NEMC, 2010). Alongside these measures, the Queensland Reconstruction Authority (QRA) was established by the Bligh government in 2011 in the aftermath of state-wide flooding events of 2010-2011, in order to oversee the reconstruction of infrastructure and other public assets in the aftermath of extreme events. As described further in Box 4., Chapter 5, although the QRA's motto is 'build it back better', in practice this rarely includes consideration of the future hazards presented by climate change.

The Sustainable Planning Act 2009 underpins all State Planning Policies (SPP) for Queensland. The policy most relevant to climate change has been *SPP 1/03 Mitigating the adverse impacts of flood, bushfire and landslide* (Queensland Government, 2003) that seeks to reduce community exposure and vulnerability to natural hazards. Local governments are required to follow this policy in their planning schemes and in assessing new developments. According to McDonald et al., (2010) SEQ is currently attempting to manage a legacy of poor planning decisions which have situated a significant proportion of urban and suburban development in flood plains and in vulnerable locations near the coast. As a result, planning priorities have stressed the need to minimise vulnerability to such risks by avoiding settlement in exposed areas. This priority competes, however, with the demands of a rapidly growing population.

It is important to note that the policy and planning issues being addressed under the headings of DRM and urban or land-use planning are many of the same issues that are specifically branded under the heading of Climate Change Adaptation in other countries, and in particular in the UK. Such examples include the provision of flood risk management assets (such as levees and barriers) and adaptation guidelines for local government planning (see for example, EA, 2010a,b). What remains in question, however, is whether the climate adaptation actions implemented under

Queensland's alternative policy brandings are less effective due to any failure to consider the outputs of scientific predictions or projections of future climate change in the design of that policy.

I argue that although the provision of public assets and infrastructure and the development of planning guidelines may certainly be less effective in this regard over the long term (as evidenced by the difficulties encountered in SEQ, described above), policy making efforts toward enhancing community preparedness, response and resilience are not disadvantaged in the same way, and are equally important components in the development of effective climate change adaptation in the face of persistent and unpredictable extreme events. If, as I argue in Appendix B, social-ecological resilience can be best achieved through a balancing of the flexibility and stability of social-ecological systems, then I argue, the development of communities' social capital associated with effectively managing and responding to climate variability and extremes is as valuable a form of climate change adaptation as traditional forms of climate risk management associated with infrastructure provision and planning. On this basis, it seems fair to conclude that SEQ's efforts to adapt to existing climate extremes is ensuring significant progress toward climate *change* adaptation which, over the medium term at least, is equivalent to efforts in the UK toward adaptation. Indeed, in terms of the development of community awareness and resilience to extreme events and the management of emergency services, Queensland appears to be considerably more advanced than the comparative case of the UK.

4.5.2 Southeast England

The UK is generally seen as a leader in the field of climate change adaptation policy (Keskitalo, 2010) and perhaps as a result the development of climate adaptation policy has been considerably less convoluted. Efforts toward the development of adaptation policy began in the 1990s when the government first commissioned climate change scenarios to inform policy. Two iterations of scenarios produced by a government-sponsored *Climate Change Impacts Review Group (CCIRG)* were followed by the establishment in 1997 of the *UK Climate Impacts Program (UKCIP)*, a boundary organisation (Guston, 2001) assigned the task of making climate change science outputs relevant for government, business and public users, “to co-ordinate and integrate a stakeholder-led assessment of the impacts of climate change at a regional and national level and to help organisations plan for climate change.” (Hulme and Dessai, 2008; McKenzie Hedger et al., 2000: p. 3).

Figure 4.4. Southeast England

UKCIP has been at the forefront of climate change adaptation policy making since its inception, reflecting the legitimacy given to climate science by successive UK governments for informing policy at national and local levels. One of the principal advisees of UKCIP has been local government. Between 1997 and 2010, under the Blair and Brown governments, climate change was a component of the governance provisions of local authorities, under the remit of a national set of indicators of local authority performance. National Indicators (NI) 188, 187 and 186 were established as part of a *Local Government Performance Framework* to assess and report local authorities’ annual performance on developing adaptation policy to national government (DEFRA, 2010). The Coalition government under David Cameron has since abolished these indicators, reflecting its political priority to reduce burdens and increase the independence of local government (Taylor-Gooby, 2012).

At national level, a UK Climate Change Programme was first put in place by the Blair (Labour) government in 2000, and updated in 2006, with provisions to address both mitigation and adaptation (DETR, 2000; DEFRA, 2006). The 2006 revision of this programme announced the development of an Adaptation Policy Framework to ensure a consistent approach to incorporating adaptation into existing policies and the development of adaptation strategies across all levels of government. Keskitalo (2010) notes that much of the effort toward this policy framework was subsequently channelled into the adaptation provisions of the *Climate Change Act (2008)*. Under the Act, government is obliged to assess the risks from climate change and to develop and implement a national climate change adaptation plan, to be revised at 5 yearly intervals.

The Act also provides governments with the power to oblige key public service and infrastructure providers to undertake a similar assessment of risks and to develop plans to adapt every 5 years. In addition, the Committee on Climate Change – the organisation responsible for monitoring governments' progress on meeting the commitments of the Act – has established a subcommittee to assess government's progress on adaptation. Meanwhile, in 2005, the Environment Agency[47] began considering climate change adaptation in their responsibilities to government (EA, pers comm, 2010) and since 2008 the Environment Agency has had a climate change adaptation strategy as well as a series of adaptation plans covering the major themes of its responsibilities to government (EA, 2008). These plans have subsequently been incorporated into their reporting requirements under the *Climate Change Act (2008)* (EA 2010a)[48].

The Department of Environment, Food and Rural Affairs (DEFRA) commissioned a *UK Climate Change Risk Assessment* (UKCCRA) as part of its aforementioned obligations under the *Climate*

47 The Environment Agency of England & Wales is the principal institution responsible for the regulation and implementation of environmental policy in the UK, alongside the Scottish Environmental Protection Agency and the Northern Ireland Environment Agency

48 I was the lead author of the Environment Agency's Marine Climate Change Adaptation Plan (2009), as well as lead author of the Environment Agency's report to government required under the terms of the *Climate Change Act (2008)* (EA, 2010a)

Change Act (2008), which was completed in 2012. The assessment involved a number of stages of analysis, beginning with an initial assessment of 700 risks, with more in-depth analysis of a short list of 100 risks (DEFRA, 2012c). Further to this assessment, DEFRA subsequently published a National Adaptation Programme designed to address the risks outlined in the UKCCRA, alongside separate programmes relating to matters devolved to Scotland, Wales and Northern Ireland (DEFRA, 2013a). However, the current Coalition government has shown less interest in adaptation activities than its predecessor and has been clear that it will only address the issue where there is a clear economic signal advocating for action (UKCIP, pers comm, 2013; Climate UK, pers comm, 2013). No surprise then that both the UKCCRA and NAP were accompanied by extensive economic appraisal (DEFRA, 2013b). More significantly perhaps, has been how the Cameron government has dismantled the national indicator set for local government (including those relating to climate adaptation) and has downgraded the obligation on key service and infrastructure providers to report their climate risks on a voluntary basis only (DEFRA, 2014). As such, the legal obligations on sub-national government or industry to explicitly incorporate climate change adaptation into what they do has diminished.

Nonetheless, there are a variety of other policy levers and drivers to ensure that both industry and local government consider their climate vulnerability and resilience. These drivers primarily originate from the regulatory powers of the Environment Agency and the Water Services Regulation Authority (OFWAT) that continue to incorporate climate change adaptation into their regulatory and policy implementation activities (OFWAT, 2010; EA 2013). The Cameron government's revised planning policy regime also retains a requirement for local government to address climate change adaptation even though there are no longer any reporting requirements to demonstrate such policy action (DCLG, 2012: p. 23). Furthermore, there are a range of government-funded organisations tasked with the consideration of climate change adaptation. The first such organisation was UKCIP, as discussed above. This has since been followed by Climate UK, a public-private partnership organisation established to maintain a network of nine regional stakeholder engagement initiatives to consider climate change at local government level. More recently, the

Climate Ready programme was established, which has taken over UKCIP's substantive role to help stakeholders understand potential climate change impacts, and which is managed by the Environment Agency (DEFRA, 2014).

Similar to the Australian case, adaptation plans developed to date by DEFRA, the Environment Agency and other government institutions focus on the reduction of uncertainty relating to potential climate change impacts, and both cases have undertaken significant adaptation under the guise of concurrent policy priorities such as water resources management and urban planning (Tompkins et al., 2010). However, these policy provisions have largely been relabelled as climate change adaptation actions under the *Climate Change Act (2008),* at least when it is convenient to do so. Through the establishment of organisations such as UKCIP, Climate Ready and Climate UK, as well as the reporting and evidence development mandated by the Act, I argue that the UK's tangible efforts toward climate change adaptation have principally been focused on enhancing adaptive capacity within and between governance institutions, which the Australian case has paid less attention to due to dwindling legitimacy for climate change more generally (Tompkins et al., 2010; Dedekorkut-Howes et al., 2010).

Importantly however, as described in detail in Chapter 7, the UK approach to adaptation has placed considerably greater emphasis on the use and usability of climate change science for informing policy in a linear way than the comparable case of Queensland. This reflects, I argue, the greater legitimacy granted to climate change as a policy issue in the UK and, therefore, upon the associated evidence. As Chapters 6 and 7 will discuss in more detail, there has long been an expectation in the UK that adaptation should be informed by robust climate science and successive governments have placed significant priority on the development of usable science outputs in this regard. The UK approach thus sits in stark contrast to that of Australia which has progressed adaptation policy without significant recourse to climate science, focusing instead upon the resilience of communities and governance institutions to extreme events.

4.6 Conclusion

The analysis provided in this chapter suggests that the legitimacy of different types of evidence for climate adaptation policy is related to a broader legitimacy for the task of climate change and climate change adaptation; the extent to which climate change science and its knowledge production system are considered fair, unbiased and inclusive of various policy players' values and interests appears to be strongly correlated with the political acceptability of the climate change adaptation issue itself. Second, this analysis indicates that the cases of Queensland and the UK, and more specifically SEQ and SEE are useful comparative case studies for understanding the challenges for mature liberal democracies when using evidence and expertise for climate adaptation policy. Both cases have similar and stable, three-tier governance systems and both encounter ongoing challenges in relation to the management and integration of policy across these levels. Both have a history of legitimising and using evidence for environmental policy making only to the extent that evidence is congruent with the socio-economic and cultural norms and priorities of both the public and the political executive.

In Queensland, these norms and priorities have ensured that climate change science has remained a contested issue for the legitimacy of climate adaptation policy. Although, as I argue at length in Chapter 6, anthropogenic climate change may be accepted as scientifically credible[49], the use of climate science for policy making conflicts with the foundations of society and the economy of Queensland in relation to the recovery, sale and use of fossil-fuels, and popular expectations that society must control and overcome environmental risks. In the UK too, environmental policy has a history of only relying on evidence where it is politically expedient to do so. Therefore, just as the issue of acid rain was a victim of this selective recourse to the facts, the issue of climate change and climate change adaptation has been a beneficiary. Climate change and the use of climate science align with fundamental historical and socio-economic values and priorities relating to energy independence, a love of the environment and conservation amongst a large proportion of the

[49] Formally at least, though not necessarily in open political or parliamentary debate

population, and a desire for continuing leadership amongst the international community despite its contemporary diminutive stature as a sovereign power.

In terms of tangible policy outcomes, however, I conclude that the cases of Queensland and UK are largely comparable. While the UK has focused its attention on the development of usable evidence and institutional structures that can manage the future risks from climate change in an efficient and incremental way, Queensland has focused on managing existing climate extremes and the ongoing development of societal and community resilience and adaptive capacity to climate. In both cases climate change adaptation lacks legitimacy at local government level, and in both cases there is a dearth of tangible climate change-specific infrastructure or service provision. This comparability of policy outcomes between cases reveals an interesting point about the use of evidence for adaptation policy. The existence (or otherwise) of political acceptability for climate science may not actually have a substantial impact upon the outcomes of adaptation policy making, in as far as it enhances society's climate resilience or reduces its climate vulnerability, at least over the short to medium term.

As I demonstrate in Chapter 7, however, what this political acceptability for climate science (and therefore for the derivative policy evidence) can do is facilitate the politicisation of evidence and the scientisation of adaptation policy making. Although political acceptability for climate science may influence the role of and interactions between experts and non-experts in the development and use of policy evidence, this conclusion about climate science suggests that such complex, uncertain and contentious evidence has limited utility for policy making in practice, at least in the ways expected by the linear-technocratic model. This conclusion is substantiated by interview evidence presented in Chapter 6 suggesting that policy players in both the UK and Australia perceive climate science as a secondary evidence priority in the development of effective policy, relative to an understanding and management of the vulnerabilities of society, economy and ecology to climate variability and change.

This chapter demonstrates the varying legitimacy for climate change adaptation policy – and by association the legitimacy of the available climate change science – between these two cases, as a result of relatively stable geographic, socio-economic, cultural and historical factors, as well as due to the prevailing dynamics of partisan climate change politics. This contextual background will be used in later chapters to understand the varying means by which climate change adaptation policy making has become scientised. In Australia, this scientisation occurs principally through varying political legitimacy for different sets of evidence. In the UK, scientisation occurs principally through the politicisation of an established evidence base.

Chapter 5. Climate adaptation evidence and policy

The good thing about science is that it's true whether or not you believe in it

– Neil deGrasse Tyson

5.1 Introduction

This chapter explains the development and character of adaptation evidence, the epistemological character of adaptation problems, and how these problems present themselves to and are subsequently constructed by policy players for the purposes of policy making. This characterisation will provide a point of comparison with policy players' perceptions of climate science and policy evidence to be described in Chapter 6, and the linear-technocratic expectations of policy making methods in Chapter 7. Comparing the characteristics of adaptation problems and evidence with policy players' perceptions of them can, I argue, demonstrate how evidence is susceptible to processes of politicisation[50] within a linear-technocratic policy making schema. In turn, this chapter will provide the reader with the relevant context to understand the alternative mechanisms of politicisation and scientisation present in the policy making approaches of the UK and Queensland in Chapter 7, and thus help clarify the tensions between expert and political authority in the development of adaptation policy, that are summarised in Chapter 8.

As Hoppe (2005) and Owens et al. (2004) argue, knowledge utilisation studies suggest that policy evidence is often used selectively or tactically to legitimise an extant political position and any expert findings that favour an alternative position are often lost or dropped from the evidence-based narrative or argument. This tendency, I argue, is particularly relevant for areas of policy development such as climate adaptation that are highly uncertain and complex and for which experts often cannot provide definitive evidence. If, as I argue, governments pursue adaptation policy only to the extent that the evidence aligns with prevailing norms and politics, then it follows

[50] Either a 'politicisation-by-process' associated with the inevitable normative/subjective decisions required in the development of climate change policy evidence, or a 'politicisation-by-agency' which is a deliberate influence in the development of evidence to support policy players' preferred values and politics.

that the legitimacy of evidence (i.e., its political acceptability and the extent to which it is considered fair and representative of relevant perspectives) and the legitimacy of policy issues themselves are interconnected in important ways.

The difficulties of establishing and maintaining legitimacy for specific policy issues may be considered an ongoing challenge for policy advocates, particularly in relation to environmental issues that have rarely topped the political agendas of Australia and the UK (Jordan, 2002; Walker, 2002). It would appear from both the literature and the research presented here that issues like climate adaptation must compete for attention with a range of other social and environmental issues that do not preoccupy the minds of the political executive with the same frequency or intensity as, say, the economy, education, crime or health services. Maintaining legitimacy for an ancillary policy issue like climate adaptation, I argue, relates not just to its palatability in normative or political terms, but is dependent on the ability of the corroborating evidence to demonstrate that it is worthy of scarce political resources; that is, associated evidence must demonstrate credibility, legitimacy and salience. As one UK interviewee suggested in the course of this research:

> *[If] it's too uncertain an issue to deal with, you only have to drop out of the top ten priorities to really not be doing very much at all* (UK-Policy Scientist 7).

This argument, echoed by a number of interview participants, highlights the difficulties of maintaining policy legitimacy for an issue like climate adaptation in the absence of legitimate, credible and salient evidence (UK-Policy Scientists 6,7,8; UK-Policy Players 2,3,7).

Within liberal democracies that advocate an evidence-based policy making approach, this policy legitimacy requires support from both expert authority (derived from privileged understanding of objective facts) and political authority (derived through democratic representation). My research demonstrates how establishing and maintaining legitimacy, credibility and salience for expertise and evidence has become increasingly difficult for contemporary social and environmental problems that display 'wicked' characteristics (Rittel and Webber, 1973), particularly in the face of severe budgetary constraints that seem to cause policy makers to prioritise fiscal concerns (and thus, fiscal evidence) over all others. And yet, paradoxically, where legitimacy, credibility and/or salience for the available evidence has been established, I argue, experts have the opportunity to extend their policy making authority beyond what they can legitimately claim privileged expertise about.

This chapter begins by clarifying why climate adaptation is such a useful research focus for understanding the role of experts and evidence in policy making and the tensions between expert and political authority therein. My argument is that the broad scope of the remit of climate adaptation speaks to fundamental values and ideals relating to how we view society, economy and the environment and what we want for the future. However, unlike the broader issue of (and scientific consensus for) anthropogenic climate change, the nature of adaptation problems allows policy players to embrace the evidence-based mandate while simultaneously rejecting (when convenient) a large proportion of the available evidence in pursuit of their political ideologies. This is because, as demonstrated for Queensland in chapter 4 and again in chapter 7, the task of climate adaptation can proceed without consideration of climate science when it is politically expedient to omit it from the evidence-based decision making process.

I then provide a characterisation of the development of climate adaptation policy evidence, and why it is important to distinguish between different types of science and the subsequent derivation of policy evidence to understand its normative or political character. I also describe the epistemological nature of climate adaptation issues as 'wicked' problems and the importance of these characteristics for understanding the task of adaptation policy making. Finally, I describe how these wicked characteristics manifest themselves in practice and how differing types of adaptation challenge have differing uncertainties and evidence needs. Understanding how the characteristics of adaptation evidence and policy compare with policy players' perceptions of that evidence will, I argue, help to demonstrate the political/normative landscape of adaptation policy making and its susceptibility to forces of politicisation and scientisation.

5.2 Why study climate adaptation?

Adaptation is an interesting policy problem, epistemologically speaking, because of its broad political and policy scope, because of its wicked characteristics that make it tricky to adequately understand and resolve, and because of the types of expert knowledge available for informing it:

> *The thing about adaptation is that you can hang it on anything, you know, anything you're interested in, anything that you care about, or any decisions you're going to have to make where you'll have to live with the consequences for years or decades or more, it applies* – (UK Policy Player 1)

Climate adaptation, I argue, is an issue that relates to a broad range of political goals and policy objectives at multiple levels of government and across multiple scales of governance[51]. It is relevant to many of the prevailing and contested politics and norms of society and economy, as well as to the resilience[52] of individual communities and government jurisdictions. As such it requires both strategic and context-specific management. In this sense, I argue, climate adaptation may be described as a "glocal"[53] problem (Rhodes, 2006). The contrasting strategic and contextual characteristics of climate impacts and climate change risks mean that understanding adaptation issues can be problematic not only for policy making across multiple government levels, but also suggest that the politics of the broader problem of climate change inevitably influence how governments address climate adaptation.

As I seek to demonstrate in this chapter, climate adaptation is a useful and interesting point of focus because the climate relates to almost everything humans do, and so climate adaptation policy relates to a large proportion of existing governance portfolios. Yet, unlike the broader issue of climate change, I argue, climate adaptation can be framed in ways that align with existing political priorities and goals, and claim legitimate allegiance to the evidence-based mandate, while still taking

---

[51] For the purposes of this research, *scale* refers to the spatial, temporal, or otherwise quantitative or analytical dimensions used to measure governance. *Level* is the unit of analysis located at different positions on any given governance scale. Therefore, for instance, 'local', 'national' and 'international' describe levels of governance on a jurisdictional and/or geographical scale. In the course of this research I also refer to a temporal scale of governance and associated levels relating to political electoral cycles (i.e., 3 or 4 years), decadal climate influences (i.e., 10 years), as well as longer term climate change (30+ years).

[52] See Appendix B for a discussion of the varying concepts of resilience and their relevance to adaptation evidence use and decision making.

[53] "…the meeting, intersection, overlap and coexistence of the particular and the universal." (Rhodes, 2006: p. 81)

a partisan or sceptical position in relation to climate change science and its much-lauded expert consensus (Skeptical Science, 2015; Cook et al., 2013). Climate adaptation is a useful focus of study because it is a problem that exemplifies the difficulties of negotiating the uncertainties and epistemologies of wicked policy problems and that presents complex challenges for understanding the interactions and tensions between expertise and politics in the absence of definitive (or wholly objective) evidence about the future.

As described in Chapter 4, the ways in which Australia and the UK have constructed and seek to understand the climate adaptation problem tells us much about the influence of these countries' differing politics and socio-economic norms, goals and values on this policy issue. These priorities originate from contrasting historical and cultural development between these countries, which has resulted in varying attitudes and approaches to building climate resilience and ensuring present and future economic prosperity. These priorities relate to the political economy of natural resource use, public and political expectations for the permanence of society and its infrastructure, and the relative priority given to addressing and maintaining the resilience of socio-economic communities. The political divisiveness of anthropogenic climate change described by the comparative analysis of Chapter 4 sits in contrast to both cases' adherence to the evidence-based mandate. Yet, these cases show the different ways the adaptation issue can be addressed using evidence, depending on their government's political position.

In Australia the adaptation problem has become a victim of partisan politics, something of a political hot-potato, whereby state governments have sought to either create distance between climate adaptation and the issue of anthropogenic climate change (as has occurred with the current Liberal-National government of Queensland), or sought to bring them closer together (as occurred under the previous Labor government) depending on prevailing politics. The Newman (LNP) government (2012 – 2015) ensured Queensland's lack of climate change-specific policy, and ensured that there has been little or no connection between adaptation and anthropogenic climate change. It has been important for the political executive to create this distance, I argue, because failure to do so would have resulted in a clear contradiction between government's socio-economic priorities (relating to mining and fossil-fuel intensive industry) and the ongoing and increasing imperative to manage climate risks. This contradiction would manifest itself when acknowledging and addressing these risks on the one hand (via climate *change* adaptation) and failing to address them on the other (via climate change mitigation). Thus, adaptation is framed in terms of climate exposure to avoid such obvious conflict, facilitated by the inherently variable and extreme nature of Australia's existing climate[54].

Meanwhile, in the UK legitimacy for climate change has been achieved in large part, I argue, because it aligns with a number of the political and socio-economic values and goals of policy makers on both sides of the political divide[55], as well as its political and socio-economic circumstances since climate change was brought to the attention of governments around the world. This legitimacy is enshrined in the *Climate Change Act (2008),* which means that adaptation policy proceeds through the explicit pursuit of climate *change* adaptation, despite a counter-current that has developed in recent years seeking to extinguish adaptation priorities outside of the remit of the Act. Nonetheless, while this legislative framing has ensured continuing support for the available climate science as a means of informing adaptation policy at all levels, it has also highlighted the difficulties of doing so. Adapting government and governing institutions to potential climate *change* has been problematic because, I argue, the available climate science lacks salience[56] for decision making. As will be demonstrated in Chapters 6 and 7, this lack of salience is accentuated when the science is used in combination with linear-technocratic methods of evidence-based policy making. Climate science often lacks salience because of the difficulties of using it to understand adaptation problems at both

---

54 Although climate change and its associated evidence-base are generally not granted legitimacy for policy making in Australia, Queensland's state government does accept that the climate is changing (Moore, 2013b) even though not necessarily accepting the full extent of its anthropogenic origins (Hurst, 2012b). Meanwhile, at federal level government explicitly accepts the credibility of the anthropogenic climate change theory and the associated consensus climate science (Australian Government, 2014b), even though it has limited political leverage (or desire?) to address climate change adaptation and has sought to downplay the importance of reducing GHG emissions by highlighting the uncertainties in climate science (Bourke, 2014; Readfearn, 2014).

55 These ideals relate to the retention of political and resource independence, a popular public awareness and concern for environmental issues, and ambitions toward the UK retaining its post-colonial status as an influential player on the world stage.

56 Salience: the perceived relevance of information for an actor's decisions, or for the decisions that affect that actor local and strategic scales, or for incorporating it into the most established tools of evidence-based policy making[57]. These difficulties are symptomatic of the 'wicked' characteristics of adaptation problems, which mean they are difficult to understand or address in a way that is meaningful and/or agreeable to all (or even most) relevant stakeholders.

I argue that adaptation policy making under an evidence-based mandate has become highly susceptible to becoming deliberately politicised and/or scientised, whereby, policy players use evidence to legitimise extant political positions in ways that can supress explicit political debate (Sarewitz, 2004). An adequate understanding of adaptation problems for effective policy seems to require an understanding of both the local and the strategic elements of the problem across multiple levels of government (local, state and national) and across multiple scales (geographic, temporal and jurisdictional). The technical, financial and logistical difficulties of achieving this mean that, instead, policy makers often present evidence from a limited range of perspectives, often from a single governance level:

> *The drive to frame issues at a single level comes from the need to both simplify and control. Governments, for example, frame problems so that they become tractable within their jurisdictions.* (Cash et al., 2006)

As such, policy evidence necessarily incorporates a normative position that manifests itself in the choice of evidence and the framing and characterisation of climate risks from a particular governance level or scale and according to prevailing politics; that is, policy evidence is constructed for political purposes. Under a linear-technocratic policy model which views policy evidence as largely impartial and objective, I argue that this political/normative framing and characterisation can result in either the prioritisation of certain types of evidence over others, in line with prevailing politics – as in Australia – or result in the politicisation of a consensus evidence base – as in the UK. These two modes of scientisation[58] of the adaptation policy problem present a significant challenge to government's development of 'robust' policy evidence as envisaged by a linear-technocratic schema, and therefore provide for a useful and interesting focus for investigating the relative roles

[57] Risk assessment and cost-benefit analysis are the central methods of UK government's regulatory impact assessment and policy appraisal (DBIS, 2011; *The Climate Change Act*, 2008)
[58] See Chapter 7 for an in-depth discussion of the concept of *scientisation*

of expertise and politics in policy making. In order to fully understand how norms and politics can infiltrate policy evidence, I will now explore the means by which that evidence develops.

5.3 The development of climate change science and policy evidence

In Chapter 3, I described the importance of the work of constructivist scholars for understanding the role of expertise in policy decision making and the nature of the tensions between experts and non-experts when developing evidence for adaptation. In this chapter I use these constructivist arguments to provide a characterisation of the epistemology of information available for adaptation policy making. This characterisation will clarify important distinctions between climate science, adaptation science and policy evidence to facilitate an understanding of how the available evidence for climate adaptation may become politicised and, laterally, how the adaptation policy process may become scientised.

It is worth noting that this characterisation is currently more relevant to the UK case-study in this research since, as argued above and in Chapter 4, in the UK climate change science has been legitimised through the development of political and expert consensus under the *Climate Change Act (2008)*. As a result of this consensus between expert and political authority, I argue, policy evidence develops based on the same pool of available climate science. In the Queensland case, by contrast, this characterisation is less relevant due to the lack of legitimacy for climate change policy, and by association climate science. The process by which climate adaptation becomes scientised in Australia relates more to the selective use of alternative sets of credible evidence rather than varying interpretations of the same evidence, as in the UK. Nonetheless I argue that this characterisation of the development of evidence for policy would be equally accurate for Queensland and Australia if it were to pursue climate *change* adaptation policies.

Policy evidence, I argue, is neither directly nor wholly scientific in its derivation. As suggested by the work of Hertin et al. (2009), Nilsson et al. (2008) and Owens et al. (2004), the knowledge used to rationalise and legitimise decisions is often an interpretation of data that is open at various points to normative and even political influence, even though it is mostly provided by the scientific community and, where possible, follows the principals of scientific inquiry[59]. This normative influence comes from underlying subjective choices required in the development of climate science (see section 5.3.1 below); in the focus and development of subsequent *adaptation science* (Preston et al., 2013), as well as from the interpretive nature of policy evidence development (Nilsson et al., 2008; Owens et al., 2004). Yet, under a linear-technocratic policy making schema this final output is nonetheless construed as impartial expert evidence (see for example, DEFRA, 2012a: p. 3, 7; NEMC, 2010: p. 4). Because of the processes by which adaptation policy evidence develops, it is a type of knowledge, I argue, that seems particularly vulnerable to deliberate politicisation. Since climate and adaptation science is uncertain about the future and is often uncertain about the precise nature of local climate impacts, and because its messages are so contingent on how that uncertainty is understood and presented, climate adaptation policy is particularly dependent on interpretive 'evidence' to untangle the scientific knowledge available. This evidence has, I argue, necessarily contingent and subjective components. The propensity for subjective, normative and even political influence in the preparation of policy evidence is important to understand why and how, as I argue, both climate science and resulting policy evidence may lack credibility, legitimacy or salience (or all three) for adaptation policy (see Chapter 6).

Here I propose a three step process by which policy evidence develops for climate change adaptation:

1) Climate change modelling (Trans-science);
2) Producing climate change science outputs (Post-normal science); and,
3) Developing policy evidence (Knowledge coproduction).

This process explains the extent to which climate science can be considered wholly objective; the important distinctions between climate science and policy evidence, and how policy players balance facts with norms and political values to produce evidence to rationalise and inform policy making.

[59] For example, the processes of peer-review

5.3.1 What is climate science?

The field of climate science has a long and chequered history. As Edwards (2010) and Miller and Edwards (2001) have described in much detail, climate science has been developing since the nineteenth century and was, for most of this time, a practice of record keeping and statistical analysis from a rather disparate and disjointed global community of both professional scientists and hobbyists. Climatology (what subsequently became known as climate science) has always found patronage from governments, often for military purposes. However, a number of factors have ensured that climatology has always had difficulties maintaining statistically compatible and geographically consistent records across the globe: global politics, two world wars, uneven socio-economic development and the evolution of concurrent science and technologies such as transport and telecommunications. As such what we know about past climate, and the influence of anthropogenic forcing upon it, has been built from a patchwork of data that has required innovative means of statistical integration to provide global and regional coherence. As Edwards (2010) describes:

> *We have not one data image of the global climate, but many. The past, or rather what we can know about the past, changes. And it will keep right on changing […] Global data images have proliferated, yet they have also converged. They shimmer around a central line, a trend that tells us that Earth has already warmed by about 0.75C […] since 1900* (Edwards, 2010: p. xiii).

It was not until the 1970s that climate science was transformed through the use of computers. The advent of computer technology allowed data to be used and developed through modelling to create global knowledge in ways that revolutionised how the concept of climate was interpreted and understood. Although the precise details of how these models and modelling techniques developed are beyond the scope of my research (see instead, Edwards, 2010; Miller and Edwards, 2001), it is worth noting that the term 'modelling' refers to a number of different practices. Modelling involves the interpretation and manipulation of readings from weather instruments, the simulation of climate systems, the simulation of Earth's bio-geophysical systems more generally, and the integration of weather forecasting methods, climate simulations and socio-economic data in ways that allow climate scientists to present internally consistent simulations of future climate.

Computer modelling has become the 'virtual' laboratory of climate science through which theories of anthropogenic climate forcing can be tested (Kellow, 2009). However, when it comes to anticipating future climatic change, these models can only be verified or validated in a *post hoc* way; we only know that climate models are accurate by investigating their accuracy at simulating past climate over meaningful timescales, due to the complex and chaotic nature of Earth's planetary systems (Frigg et al., 2013; Oreskes et al., 1994). What the climate science community produces for policy decision makers therefore consists of strong evidence of past anthropogenic influence on the Earth's climate, alongside scenarios or projections that present potential future climates at various points in the future under alternative sets of assumptions concerning the emission of GHGs and the geographical and social-ecological characteristics of Earth (Edwards, 2010). These scenarios and projections are developed using what are known as General Circulation Models (GCMs) and more recently, through the advent of more complex Earth System Models (ESMs) that create simulations of global climate and potential future climate change.

For the purposes of this research I describe GCMs, ESMs and experts' use of them as 'trans-scientific' (Weinberg, 1972). That is, climate scientists ask what appear to be scientific questions through the use of these models, which inevitably require more than science to answer. What is normal climate? How will the global climate change over the coming century? At what point will climate change become dangerous? These questions are asked by or of the climate science community and require not just a range of subjective assumptions and assertions given the many uncertainties about the complex ways in which bio-geophysical and social-ecological systems interact (Edwards, 2010), but also normative ones regarding how things are (or ought to be) and how we envision the future (Hulme, 2009). These trans-scientific questions cannot be answered through observation (in advance of climate change impacts actually occurring), by falsifying hypotheses or by actual repeatable experiment other than through the development and interpretation of models which themselves cannot be verified or validated in advance of future climate change (Frigg et al., 2013; Oreskes et al., 1994).

The concept of a climatic baseline can be useful for understanding models' trans-scientific character. Climate change models are designed to inform our understanding of climatic changes relative to some baseline of what is considered to be 'normal' climate. In the case of IPCC modelling, normal climate is currently based on statistical assessment of a 30 year time period between 1986 and 2005 (Stocker et al., 2013: p. 79). However, climate is both a statistical and a cultural construct. Edwards (2010: p. xiv) describes climate as "the history of weather", but as suggested by Hulme et al. (2009), Strauss and Orlove (2003), Fagan (2000) and Glacken (1990) amongst others, climate is much more than simply an aggregation of weather statistics. Climate is a concept that pervades the stories we tell, the lives that we lead and is a central but often unstated constituent of the many cultural traditions of human societies. Interpretations of 'normality' are ultimately based on opinions about how the climate ought to be, which the laity could justifiably claim to have equally valid input to, since such a concept of normality pervades everything we do and not just the realms of science. Model input such as this can have a significant bearing on both expert and policy makers' interpretations about the range and severity of potential climate change impacts (Hulme et al., 2009). Therefore, although presented as objective science, and primarily driven by scientific methods of data analysis and modelling, climate science is trans-scientific; it involves subjective, normative choices in the selection and interpretation of data that involve socio-cultural as well as technical reasoning (Fischer, 2009).

This is not to suggest that such partiality diminishes the usefulness of climate change models, or necessarily calls into question their authority or legitimacy as expert evidence for informing decisions. The accuracy of GCMs/ESMs in recreating past climate and the influence of GHGs has been largely validated (Stocker et al., 2013), and indeed without the necessary subjective, normative choices in the use of climate data and the construction of climate models, we would not know very much at all about the global climate or the phenomenon of anthropogenic warming. However, the trans-scientific nature of this form of investigation does highlight the largely intractable uncertainties associated with climate science, such that these models cannot be wholly objective in their derivation, and cannot provide unequivocal facts about future climate (Edwards, 2010).

The concept of trans-science for climate science is useful because it highlights the limits of conventional reductionist science for informing adaptation policy and hints that there may be difficulty in clearly demarcating the boundaries between science and politics. Trans-science also alludes to the inadequacy of scientific expertise on its own when seeking to understand contentious, pluralistic and location-specific adaptation problems. Indeed, even with hypothetical advancements that could ensure their near-absolute accuracy, climate models could not resolve the types of contingent and contextual questions posed in the development of climate change evidence for policy. The scenarios and projections produced using GCMs/ESMs are, in themselves, of limited use for decision making. As detailed in Chapter 6, my research indicates that policy players are only likely to find a global projection of future climate useful and usable in the sense that they can begin to understand that a problem exists, and at that, in a rather abstract way, since trends of variables such as global average temperature are difficult to conceptualise and understand at regional or local levels and scales (Wilbanks and Kates, 1999). So it is that climate scientists must begin to consider the needs of decision makers in order to make this information more usable (i.e., salient, if not also legitimate) to the broadest range of users.

A first step in making more usable science from GCMs/ESMs is a process known as 'downscaling' whereby model outputs are manipulated to provide climate change projections at finer resolutions and for smaller geographical areas. Such regional projections are potentially more useful and usable than the direct outputs of GCMs/ESMs. However, my research suggests that they remain rather abstract and meaningless to many users trying to understand precisely what climate change has in store for them. What may ensue at this point is a process of post-normal scientific development (Hulme and Dessai, 2008; Funtowicz and Ravetz, 1993) whereby climate science outputs are co-designed between scientists and both expert and non-expert users of this science, to ensure that it provides the types of information that can be most meaningful or salient for understanding climate impacts and making decisions at relevant geographic, jurisdictional and temporal scales (Mullan et al., 2013; Cash et al., 2003).

As argued by Cash et al. (2003, 2002), salience is an important characteristic of effective knowledge for decision making and delivering salient evidence often requires one or both sides of the knowledge-action (or science-policy) interface to bridge the divide, in order for experts to effectively understand the needs of knowledge users. For instance, the UK Climate Projections 2009 (UKCP09) utilise downscaling techniques to provide projections at regional and even local scales (25 km^2 grid-squares) and in a probabilistic format that would provide decision makers with likelihoods of change of a range of climate variables. These projections, derived from an ensemble of GCMs, were developed through a 'post-normal' scientific approach (see Chapter 3 and section 6.5.2) that sought the views of potential users of this information to understand the format and content of this scientific output to make it most usable for them (Hulme and Dessai, 2008).

The epistemological distinction between the trans-science involved in the development of GCMs/ESMs and the 'post-normal' science of downscaled climate change scenarios and projections may be best characterised in terms of the contribution of experts and non-experts in their development. Whereas the subjective/normative decisions involved in trans-science are (for the most part[60]) taken by the various climate-related experts who contribute to the development of these complex models, the subsequent post-normal science of scenarios and projections involves consultation and co-design between climate experts, other environmental experts as well as non-expert users of this information. Nonetheless, this post-normal science often requires even further interpretation in order to provide meaningful knowledge to guide decisions. My research suggests that this information, of itself, still lacks salience and so is rather limited in the ways in which it can directly inform decision making. As will be described by interview participants in Chapter 6, climate

[60] The exception being the provision of GHG emissions scenarios that aid climate experts' understanding of future climate change. Known as Representative Concentration Pathway (RCP) scenarios in the IPCC's 5th Assessment Report, they are derived using Integrated Assessment Models including economic, demographic, energy and simple climate components (Stocker et al., 2013, p. 79, 80). However, given my arguments above about the nature of 'climate' as both a scientific and cultural construct, I argue that the non-climatological experts involved in the development of RCPs may also be classified as climate experts.

projections such as those developed for UKCP09, are often too complex, too abstract and/or simply too uncertain for policy players to use directly.

5.3.2 What is policy evidence?

For the purposes of this research, I define policy evidence as the form in which science and other expert knowledge is presented to government decision makers to allow them to understand a problem like climate change in terms that they can relate to and understand. What distinguishes policy evidence from other forms of knowledge for decision making is that it is overseen and/or commissioned by government for the purposes of informing policy and is usually coproduced between experts and non-expert policy players. Developing policy evidence, I argue, involves a variety of processes by which policy players seek to make often complex and uncertain expert knowledge sufficiently salient and legitimate for policy making. Adaptation policy evidence relating to climate change impacts and risks is derived through trans- and post-normal scientific modelling and analyses, in combination with scientific and socio-economic data sets of environmental quality indicators, standards or thresholds, alongside policy-players' judgements about how to understand how climate hazards may impact upon particular receptors and/or government jurisdictions.

The trans-scientific component of this policy evidence relates to the development and interpretation of GCMs/ESMs by the scientific community to understand the hazards presented by climate change globally and regionally. The post-normal scientific element then relates to how those GCM/ESM outputs can be best presented whereby a broader range of expert and non-expert input is sought for the development and presentation of technical evidence to enhance its salience and legitimacy. This post-normal science is then further interpreted by experts in the development of adaptation science, and through coproduction processes between experts and non-experts for the development of policy evidence. For instance, Preston et al. (2013) describe how the UK water industry and the Environment Agency of England and Wales (a non-departmental government regulatory body) have utilised downscaled climate projections (post-normal science) in conjunction with hydrological data to forecast how river flows might be affected by a changing climate at various points throughout the twenty-first century. This constitutes what Moss et al. (2013) and Preston et al. (2013) refer to as *adaptation science*.

Adaptation science, as conceptualised by this literature is principally undertaken by the research community in tandem with climate science outputs and is also subject to normative decisions by both experts and non-experts about research focus and where investments in science should be allocated (Preston et al., 2013; Meyer, 2011), and as such often constitutes post-normal science. However, adaptation science such as this may also be a core constituent of policy evidence alongside climate science, and may be overseen by government in order to inform the design and implementation of policy. In the case presented by Preston et al. (2013) above, the design of water resource management plans was overseen by a government body as part of the regulatory cycle of the water industry. As such, adaptation science may fall into the category of either post-normal (academic) science or coproduced policy evidence. The cases described in this research suggest that these scientific research outputs are often used by policy players either directly or indirectly (i.e., through further interpretation using methods such as risk assessment) in the development of policy evidence.

Some policy evidence, however, is less obviously scientific in nature and requires considerably more obvious reliance on subjective and normative deliberation and interpretation. Variously described as “policy appraisal” (Owens et al., 2004), “policy assessment” (Hertin et al., 2009) or simply policy “evidence” (DEFRA, 2012b; NEMC, 2010), this type of knowledge involves the quantitative or semi-quantitative assessment of risk, costs and benefits of a changing climate on government’s objectives and priorities. This type of policy evidence may use the outputs of climate and adaptation science as well as processes of deliberation between experts and non-experts, and is usually the final hurdle allowing complex expert evidence to be used for policy making. That is to say, this type of policy evidence requires a degree of subjective and normative development and interpretation, in the imposition of limits of scale (jurisdictional, temporal and/or geographical), in both the choice and use of science and other expert research, arguably much more than its trans-and post-normal scientific antecedents, that can have significant political implications. Owens et al. (2004, p. 1943) appear to concur with the idea of policy evidence as partly political in its derivation when they argue that:

> *… an important role for [policy] appraisal (by design or by default) may be that of providing spaces for dialogue and learning in the making of policies and decisions.*

Indeed as will be described for the case of the *UK's Climate Change Risk Assessment* (UKCCRA) (DEFRA, 2012a,b) and the derivation of Q100 flood metrics in Queensland in Chapter 7, the means by which this evidence is derived constitutes what the STS community refer to as 'coproduction' between expert and non-expert participants (Jasanoff and Wynne, 1998).

Policy evidence takes a number of different forms, but in most cases its development involves a prescribed process of data collection, interpretation and appraisal to enable policy makers to understand important considerations when making a decision (Owens et al., 2004). Policy evidence is often produced through the assessment of risk and opportunity from a potential hazard, or to understand the costs and benefits of a proposed action to address them. Importantly, such evidence has, to date, been developed and used within a linear-technocratic schema of policy making so that these evidence outputs are construed (intentionally or otherwise) as objective impartial research and advice to government (see for example NEMC, 2010: p. 4). However, these scientific and economic analyses require not simply authoritative expert input, but also a socio-cultural reasoning to understand the implications of potential hazards upon society, economies and ecologies that suggests that either:

a) Non-experts are involved in the development of what is ultimately interpreted as objective authoritative advice; or
b) Experts may be extending their authority (inadvertently or otherwise) beyond their legitimate field of expertise (i.e., that which they have privileged knowledge and expertise about).

Policy evidence development, as described in the literature (Hertin et al., 2009; Nilsson et al., 2008; Owens et al., 2004; Clark and Majone, 1985) and further in Chapters 6 and 7, speaks to notions of the inherently political nature of climate adaptation evidence. This is because of the contingent nature of adaptation problems (described in section 5.4 below) and the deliberative nature of policy evidence development, which require inevitable subjective and/or normative judgements in the assessment of risks, costs and benefits concerning the vulnerability, adaptation and resilience of what and for whom. Policy evidence, I argue, involves the development of consensus between available science and assessors' norms and implicit values about the world, as well as potentially involving their political priorities.

As will be described in greater detail in Chapters 6 and 7, the processes of policy evidence development outlined in this research, suggest that policy evidence development is a process of negotiation and coproduction between a range of expert and non-expert policy players about what the climate problem is, who it affects and how, and what can be done to resolve it. Further, as my research demonstrates, policy evidence does not necessarily correlate with the views of the experts contracted to develop it, yet relies upon their expert authority for its legitimacy. Therefore, it appears that a disconnect can emerge between experts and their evidence as the latter is made relevant for policy making. As described in detail in Chapter 7, this disconnect is at the heart of understanding processes of politicisation and scientisation that occur during adaptation policy making and is a key characteristic for understanding the tensions between expert and political authority for policy making in liberal democratic government.

5.3.3 A conceptual framework for understanding climate change policy evidence

This thesis proposes that, rather than a simple linear relationship between expert evidence and policy making as espoused by linear-technocratic policy models, adaptation policy evidence is derived through a three step deliberative process (see Figure 5.1). First, climate experts provide a body of trans-scientific evidence in the form of climate change models about the future trajectory of global and regional climates. This evidence is based on consensus expert understandings of the planet's bio geophysical systems, the anthropogenic influences on them and a range of assertions and assumptions about how those influences will affect climate in the future (Edwards, 2010).

Importantly, this trans-scientific component is developed within the climate modelling community itself, with minimal input from a broader range of experts or non-expert evidence users.

Second, as described by Hulme and Dessai (2008), a process of post-normal scientific development begins whereby climate experts negotiate with other expert and lay policy players the means by which climate change model outputs will be presented and portrayed to make them most meaningful for users of this information. However, as Preston et al. (2013) describe, the research

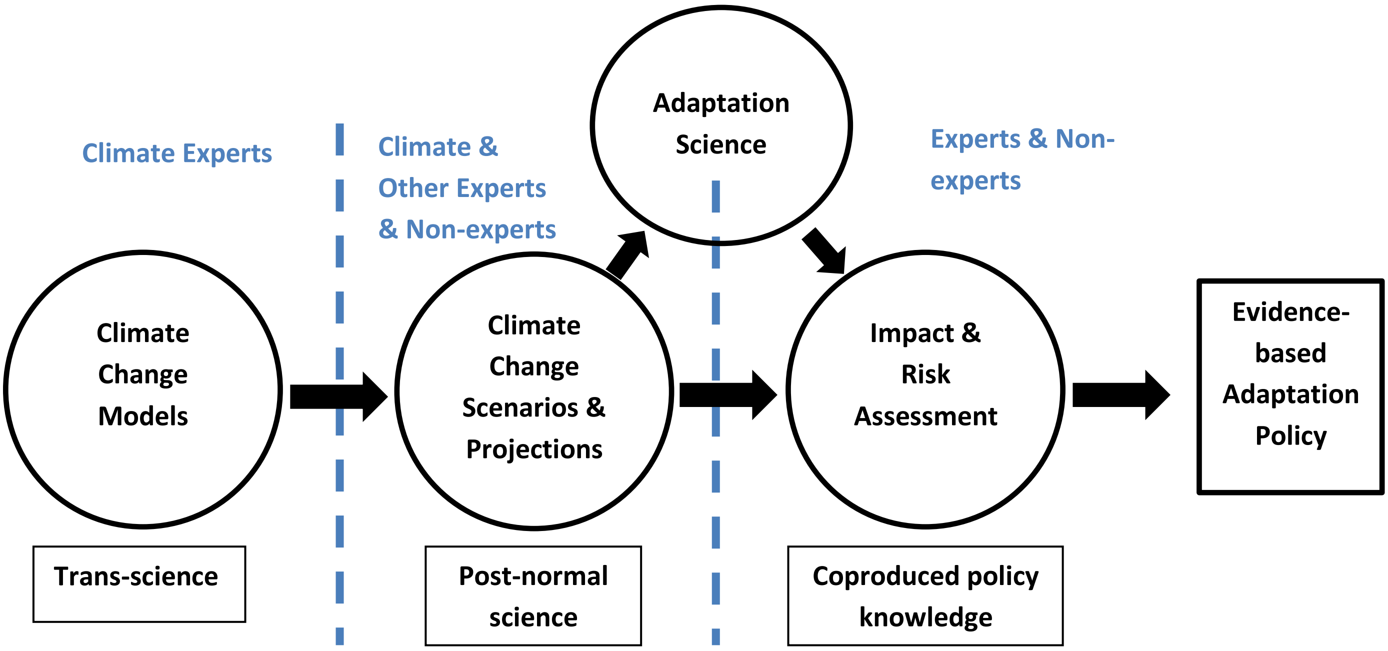


Figure 5.1. Knowledge Coproduction for Adaptation Policy

community also coordinates the development of impact, receptor or vulnerability-specific information about potential harm. Post-normal climate science involves the development of climate change scenarios and projections while adaptation science involves the development of other forms of adaptation science (e.g., impact models) to help understand the potential hazards and impacts from climate change.

Third, a process of knowledge coproduction ensues whereby those negotiated climate change model outputs and related adaptation science are used by expert and lay policy players to assess the likely impacts from climate change on policy objectives. This knowledge coproduction process may incorporate both the outputs of adaptation science and/or climate projections and scenarios directly. What results from this final stage is a body of internally consistent coproduced and negotiated policy knowledge to inform the political executive. In the cases of the UKCCRA and the development of Q100 metrics in Australia, this knowledge coproduction process played out through a combination of technical modelling, 'expert elicitation' workshops, and a process of negotiation and review between experts, technical contractors and bureaucratic policy players about what constituted potential (or at least politically acceptable) impacts from future climate (see Chapter 7).

Under this model, a significant challenge to the legitimacy of evidence-based policy appears to be to define just what constitutes immutable (or at least credible and politically acceptable) evidence for climate adaptation. If the evidence used by policy makers is coproduced between expert and lay policy players through layers of normative decision making, deliberation and consensus formation, this suggests that politics, overt or otherwise, has a role to play in the generation of policy evidence (Preston et al., 2013; Wesselink and Hoppe, 2011; Owens et al., 2004); a contribution that has largely gone unrecognised by the political executive in their pursuit of evidence based policy or the rationalist linear-technocratic heuristics prescribed by government, and one that calls into question the ability to 'correctly' (i.e., rationally) define and characterise adaptation impacts and risks.

A significant problem then arises, I argue, because governments tend to assume that adaptation problems are discrete, bounded issues that can be objectively understood and that decision-makers can make effective pre-emptive decisions based on the linear provision and use of sound scientific evidence (see for example, DEFRA, 2011a, 2009; NEMC, 2010; APSC, 2007). However, in reality adaptation problems often defy this rationalist logic (Adger et al, 2011; Head, 2008b; Reilly and Schimmelpfennig, 2000). Although a broad and uneasy consensus may be reached about the strategic character of many adaptation problems, I argue here that they are, nonetheless, contingent on the perspective provided by the level and scale of governance from which any given policy player or group of players seeks to address them.

5.4 The nature of climate adaptation policy problems

Our understanding of the nature, scale and timing of future potential climate change hazards is, and likely always will be, partial and uncertain (Frigg et al., 2013; Mearns, 2010). As discussed above and again in Chapter 6, scientific output describing these hazards provides no definitive answers and can be difficult to interpret by decision makers (Mullan et al., 2013; Dessai et al., 2009; Hall, 2007). The planet's bio-geophysical and social-ecological systems are highly complex, interdependent and only partially understood in many cases (Scheffer, 2009; Folke, 2006), so much so that we have a very limited understanding of the potential scale, frequency and severity of climate change impacts on those systems, and where thresholds and tipping points may exist (Schneider, 2004). The non-linear dynamics of planetary systems means that it is also unwise to use past trends and present characteristics as the basis of predictions of future impacts (Adger et al, 2011). These uncertainties mean that climate change evidence is of a variety that is often problematic when used to produce the types of policy evidence provided by *ex-ante* appraisal such as cost-benefit, risk and impact assessments that seek 'correct' answers to questions concerning what any particular problem is, how it should be resolved and why (see for example, Willows and Connell, 2003).

Climate change evidence is often conceptualised in terms of risk (see for example IPCC, 2014: p. 3). For the purposes of government policy appraisal, climate risk has, to date, often been assessed on the basis of two key components: evidence describing potential consequences of anthropogenic climate forcing, and estimates of the relative likelihood of those consequences at a given point in the future (UKCIP, 2009; Australian Government, 2006; Willows and Connell, 2003). However, when seeking to understand climate risks, the uncertainties relating to climate and Earth-system science highlighted above mean that such discrete assessment of risks are difficult to produce because of the need to navigate the cascading uncertainties relating to GHG emissions → atmospheric GHG concentrations → global climate processes → regional climate responses → local climate responses → impacts on a given receptor (New et al., 2007; Moss and Schneider, 2000) (see Figure 5.2).

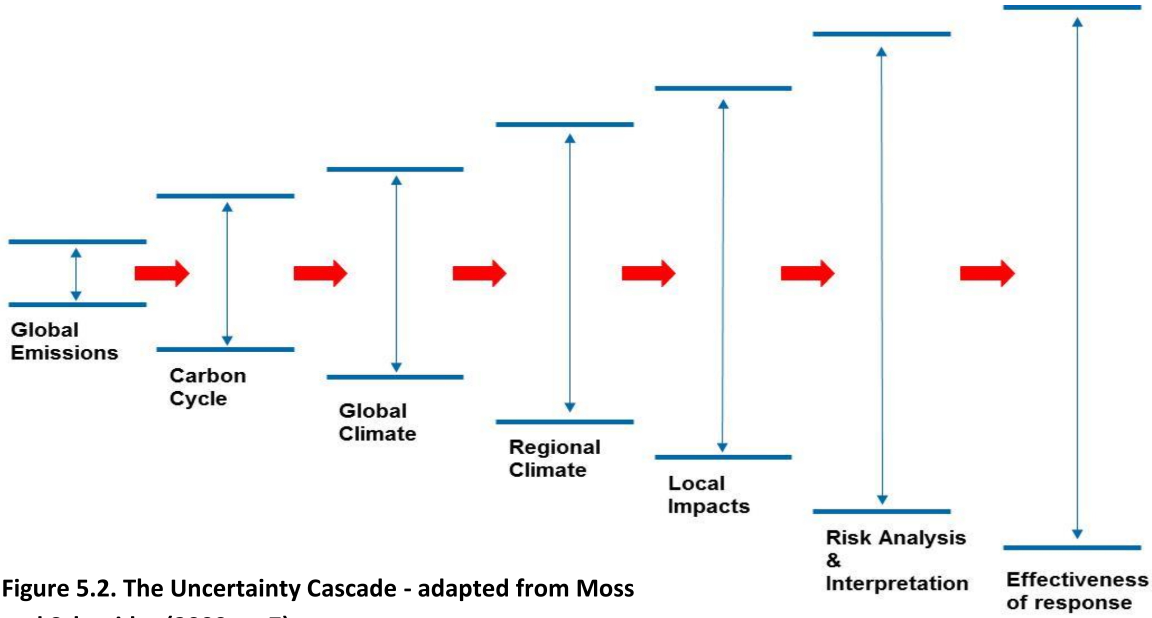


Figure 5.2. The Uncertainty Cascade - adapted from Moss and Schneider (2000: p. 7)

Probabilities associated with such risks cannot be objectively assessed and are heavily dependent on subjective evaluation, either through degrees of congruence of a given outcome with model output (Bayesian probabilities[61]), or on the basis of experts' and decision makers' judgement (IPCC, 2007a; Dessai and Hulme, 2003; Grubler and Nakicenovic, 2001). Empirical or semi-empirical risk assessment – the product of likelihood and consequence – as instructed by linear-technocratic policy making rhetoric and guidelines (DEFRA, 2011a; NEMC, 2010; DEFRA 2009; Willows and Connell, 2003) is particularly problematic. Frequentist estimations of likelihood of occurrence of specific weather events or climatic states appear increasingly invalid due to the non-stationarity of an anthropogenically-forced climate system, and subjective assessments of probability by the scientific community have not provided the types of answers sought by policy makers when using empirical risk assessment methods. The Bayesian techniques used for subjective probabilistic assessment of climate outcomes cannot provide discrete probabilities of future climatic states (UKCIP, 2009). These techniques are also hindered by significant uncertainties relating to GCM

[61] See section 6.5.3 for a detailed description. Bayesian probabilities are subjectively (rather than objectively) derived based on a prior assumed probability of occurrence, which is then updated as new observations are made (Bertsch McGrayne, 2011).

downscaling techniques used to understand climate hazards at regional and local scales (Mearns, 2010). For instance, in the UK downscaled GCM output in the form of probabilistic projections are expected to be used to elicit policy preferences in relation to ranges of probable climatic states, yet are hindered by considerable limitations in their use[62] (UKCIP, 2009; Hall, 2007, Dessai and Hulme, 2003). Meanwhile, GCMs cannot wholly account for the non-linearity of potential outcomes from anthropogenic forcing on the climate system, casting some doubt on the very scope of Bayesian probability distributions when accounting for potential outcomes (Frigg et al., 2013; Schneider, 2004).

Irrespective of these knowledge limitations for understanding climate change hazards and their likelihood, the complexity and interconnectivity of social-ecological systems makes it difficult to adequately understand the nature and scale of resultant impacts within a given jurisdiction, or to objectively define the boundaries of any adaptation problem. Global environmental problems with localised impacts such as climate change are relevant to, and require management across varying scales and levels of governance (Cash et al, 2006; Cash and Moser, 2000). Effective policies (and presumably policy evaluation also) therefore require integration across levels since any particular policy may be apparently successful for one individual, organisation or government level, while simultaneously ineffectual or maladaptive for another (Corfee-Morlot et al, 2011; Urwin and Jordan, 2008; O' Brien et al, 2004). Conversely, risk analysis derived from single problem framings is likely to overlook significant characteristics of any particular adaptation problem. Cash et al. (2006) highlight the paradoxical nature of environmental assessment and management across levels of governance in this regard.

Top-down problem formulations and policy implementation, those designed at national or international levels, are too blunt and insensitive to local conditions and constraints. Meanwhile, bottom-up approaches are insensitive to strategic considerations or larger social-ecological

[62] For instance, the UK Climate Projections 2009 allow such probabilistic sets to be used for individual 25km^2 grid squares but warn against aggregation or averaging of adjacent grid squares to understand potential impacts for a user-defined area (UKCIP, 2009).

problems and are not easily generalisable (see Figure 5.3). One potential resolution to these difficulties of top-down and bottom-up approaches to policy appraisal is the utilisation of governance networks, which may be effectively used to bridge the interpretive gap between local and strategic governance levels and their contrasting understandings of climate risks for adaptation policy making (Howes et al., 2014). However, as my research indicates (see Chapter 7) such approaches may still struggle to incorporate the evidence provided by experts which often does not align appropriately with any governance level.

The difficulties of varying contextual understandings of potential climate impacts and risks are often compounded by a mismatch of scale between those potential impacts and how climate change hazards are described through projections and scenarios. My research appears to confirm the work of Wilbanks and Kates (1999) who argue that there is a significant discrepancy in evidence provision between how we understand potential climate change hazards using the available scenarios and projections, and how we interpret and respond to climate risks. The resolution of GCMs/ESMs and their regionalised derivatives are often incompatible with the scale at which climate expresses itself and the location-specific characteristics of adaptation problems. My research demonstrates that this is a principal reason for why climate change model outputs lack salience for decision makers.

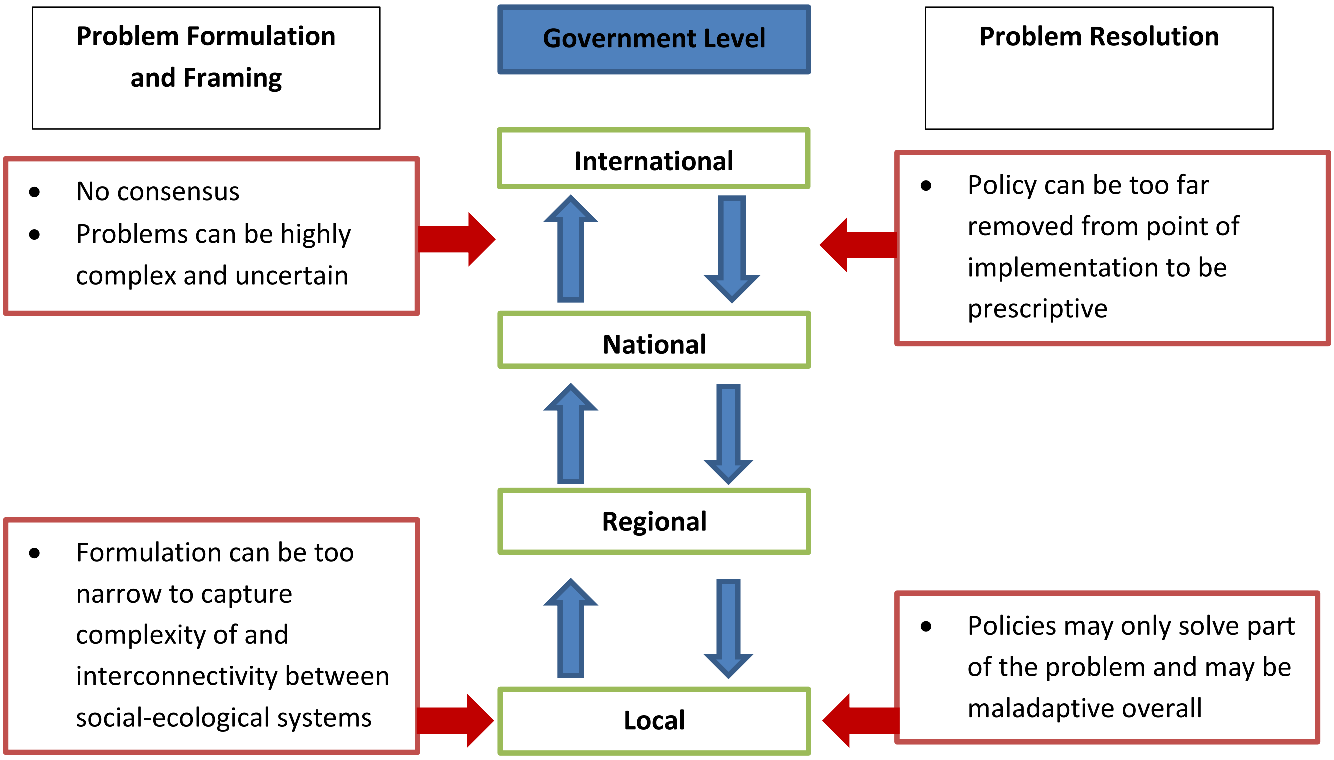


Figure 5.3. Formulating and resolving adaptation problems across scales and levels

These difficulties raise significant questions about existing linear-technocratic policy making approaches that rely upon risk assessment and cost-benefit analyses; that overly depend on the available climate change science (or at least try to[63]), or that depend upon mono-scalar characterisations of climate risk. These methods largely assume an ability to objectively delimit and thus clearly formulate any adaptation problem, and assume the validity of modelling outputs at a particular scale to characterise risks and direct policy across governance levels (DEFRA 2011a; NEMC, 2010; Willows and Connell, 2003). However, location-specific risks may be entirely different to those suggested by top-down risk assessments or by climate change projections that only provide hazard information at global or regional scales. And since climate change impacts are unlikely to fall neatly within existing governance levels (on geographical, jurisdictional or temporal scales) (Young, 2002), so problem definition, evaluation and resolution are largely dependent on the viewpoint of the decision maker rather than being objectively reducible by the expert community (Adger et al, 2011; Roome, 2001).

[63] In practice, as will be described in Chapters 6 and 7, this has proven to be a rather difficult task.

I argue that existing approaches to the development of policy evidence cannot meet expectations of linear-technocratic policy making rhetoric that advocates the use of robust objective evidence for understanding and managing climate risks. The difficulties of reconciling contrasting yet equally valid problem framings across multiple governance levels make claims toward the apprehension of fact or reality in the formulation of policy problems seem rather fanciful. Assessments of climate risks from a single governance level are necessarily subjective and contingent and likely to be influenced by inevitable political inequalities present between policy players across levels and types of governance during stakeholder participation in policy evidence coproduction. And yet, as I will demonstrate for the cases of Queensland and the UK, governments have constructed and promoted such assessments as fulfilling the linear-technocratic expectations of policy evidence. In Chapter 7 I will demonstrate how the use of linear-technocratic policy making becomes intentionally scientised, as policy makers legitimise political decisions with the use of supposedly objective (but actually deliberately politicised) expertise.

The difficulties of balancing linear-technocratic expectations with the political nature of policy evidence suggest a rather ironic twist encountered in the comparison between Queensland and the UK and their use of expert evidence. While my research demonstrates how adaptation efforts in the UK have encountered forces of deliberate politicisation when using expert evidence to fulfil requirements of the *Climate Change Act (2008)* (see Chapters 6 and 7), the UK is considered internationally to be at the vanguard of robust evidence use and policy development for climate change adaptation (Keskitalo, 2010). Conversely, in Queensland climate science and policy evidence are considered by leading partisan policy players to be uncertain, contingent and prone to politicisation and so this evidence often lacks sufficient legitimacy to inform prevailing politics (Bourke, 2014). And yet, although my research appears to at least partially validate the ambivalence of Australian policy makers towards the science of future climate change and its status as absolute fact, these political views are considered by the international community to be regressive, perhaps even myopic (see for example, Readfearn, 2014). Granted this may have as much to do with partisan politics and economic interests rejecting the issue outright, as it has to do with their understanding of the contingent nature of the available evidence, but the alternative attitudes presented in these two cases toward evidence and expertise nonetheless provide an intriguing comparison of the role of expertise and evidence, and public and political expectations in this regard. The contrasting politics and interpretations of evidence described in these cases help to explain the differing ways in which governments may address the particular uncertainties and complexities associated with climate adaptation policy. It is to these 'wicked' characteristics that I now turn.

5.4.1 Climate adaptation's wicked characteristics

In order to understand the potential for political influence upon policy evidence for climate adaptation it seems sensible at this point to take a step back from the specific characteristics of climate science and policy evidence and to look instead at the characteristics of adaptation policy problems from a theoretical perspective. The characteristics of both the science and the policy of adaptation may be usefully summarised through an understanding of what makes a policy problem 'wicked'. Rittel & Webber (1973) assigned wicked problems ten attributes which, they argue, make them remarkably difficult to understand, address and resolve:

1) Wicked problems have no agreed or definitive formulation;
2) Wicked problems have no stopping rule or end point (since the process of solving a wicked problem runs concurrent to the process of understanding its nature);
3) Solutions are not true-or-false, but good-or-bad (in other words, there are no agreed criteria to assess a 'correct' response);
4) There is no immediate or ultimate test of a solution to a wicked problem, since responses have potential for numerous unforeseen consequences;
5) Every response to a wicked problem is consequential and leaves impacts that cannot be undone;
6) There is no describable number of possible solutions to a wicked problem since there are no criteria to enable one to establish that all possible solutions have been identified;
7) Every wicked problem is essentially unique and therefore there is no suitable precedent to guide decision makers;
8) Every wicked problem is a symptom of, or interconnected with, some other problem;

9) The choice of explanation of a wicked problem determines the nature of the problem's attempted resolution;
10) The decision maker has no right to be wrong, since he/she is liable for the responses he/she generates and mistakes in either action or inaction can be very costly.

As so succinctly described by Prins (2011), wicked problems such as climate change are 'open problems' – they are so complex and interconnected with everything else that we cannot know all the things we need to know in order to be able to fix them, nor can we know when we have enough knowledge about these problems to start fixing them. Having described at least some of the specific characteristics of the science and evidence of adaptation policy above, that relate to the tensions between expert and political authority, in this section I frame adaptation problems in terms of their wickedness. This analysis will shed light on the characteristics of adaptation problems as faced by the policy making community and demonstrate how politics can contribute to the development of both adaptation evidence and policy. However, this section will also reflect on the utility of Rittel and Webber's (1973) characterisation for understanding the characteristics of contemporary policy problems.

1) Wicked problems have no agreed or definitive formulation:

The differing characteristics of the climate adaptation policy problem, as exemplified by the two cases used for this research, attest to its susceptibility to divergent formulations. However there is an important distinction to be made between scientific formulation and policy formulation.

For policy makers, adaptation problems can be interpreted in a variety of ways that focus in contrasting ways on societal resilience, vulnerability and exposure to climate. For instance, adaptation problems may be considered in terms of an ongoing necessity for managing society's exposure to climate variability in the present and the future without fully considering future susceptibility to harm, that is, society's vulnerability to climate change (as in the case of Queensland). Alternatively, adaptation problems may be constructed as a new challenge that necessitates the development of institutional and governance resilience to shore-up societal vulnerability to the looming threat of anthropogenic climate change (as in the UK). However, even from the perspective of experts, within a given jurisdiction or geographical area, adaptation problems can be constructed differently or look considerably different to different sets of experts.

As described in Chapter 6, experts involved in the assessment of risks for the UK's climate change risk assessment had in some cases markedly different assessments of risk to those expressed by the final consensus views of a national assessment. In terms of both climate and adaptation science too, varying assumptions and interpretations of uncertainties are required to understand the characteristics and dynamics of social-ecological systems. As argued by Sarewitz (2004), how environmental problems are constructed by experts is subject to a myriad of varying yet equally valid interpretations and uses of available sets of evidence. This has been demonstrated, for instance, in relation to climate science by Hulme et al. (2009), by using a number of equally valid climatic baselines in climate models to produce significantly different climate futures.

2) Wicked problems have no stopping rule or end point (since the process of solving a wicked problem runs concurrent to the process of understanding its nature):

Climate adaptation is a process of managing the risks presented by a complex, dynamic natural system and its interaction with the socio-economic systems of contemporary society. Government and society will always be subject to the vagaries of climate and thus will always have to adapt (Strauss and Orlove, 2003; Glacken, 1990). However, the prospect of anthropogenic climate change presents even greater uncertainty and risk, and because experts will never be able to provide definitive answers about the future, so the task of adapting must occur despite this uncertainty and alongside ongoing attempts to better understand the characteristics of our changing climate. As described by Lindblom (1959) amongst others, it is in the nature of policy making that attempts to resolve policy issues often run concurrent to policy players' developing goals and priorities and their identification and understanding of those issues.

Further, just as adaptation problems have no definitive formulation, they also have no definitive end point in terms of spatial or temporal scale[64]. Where and how policy makers delimit adaptation problems are often decisions based on normative/political priorities and/or the bounds of existing governance jurisdictions that are unlikely to align with the social-ecological and bio-geophysical bounds of any adaptation problem (Young, 2002).

3) Solutions are not true-or-false, but good-or-bad (in other words, there are no agreed criteria to assess a 'correct' response):

Adaptation is a process of prioritisation in the use of scarce public resources, using the best available evidence (Howes et al., 2014). Governments and communities must decide where to invest resources and to answer essentially political questions relating to the resilience 'of what and for whom'[65]. Furthermore, the uncertainties relating to climate change and our understanding of bio-geophysical and social-ecological systems as described above mean that we can never have unequivocal answers about what a correct response to climate risk may be. As Adger et al. (2011, p. 758) notes:

> *Responses to one risk alone may inadvertently undermine the capacity to address other stressors, both in the present and future.*

As such there are no correct adaptation actions, only good or bad ones depending on one's perspective on any given adaptation problem. Even the use of standard public policy criteria such as appropriateness, effectiveness and efficiency requires normative choice that cannot be assessed in terms of objective 'correctness'.

4) There is no immediate or ultimate test of a solution to a wicked problem, since responses have potential for numerous unforeseen consequences:

---

64 For example, according to current projections, sea level may continue to rise for many centuries to come, yet policy makers in UK, for instance, have chosen to delimit this problem for the Southeast of England to the year 2100 (see Box 1).

65 See Appendix B for a discussion of the concept of climate resilience.

Due to the complexity of climatic and bio-geophysical systems and the resulting intractable uncertainties surrounding future climate (Stocker et al., 2013), as well as the complex and uncertain dynamics of social-ecological systems (Scheffer, 2009), it is not possible to unequivocally understand the extent to which a given adaptation response is likely to be effective in the future, or indeed whether it is likely to ultimately prove beneficial or detrimental to communities in the long run (Adger et al., 2011, p. 758):

> *Dealing with specific risks without full accounting of the nature of system resilience leads to responses that can potentially undermine long–term resilience.*

Indeed, given the intractable uncertainties, it may be argued that what constitutes a good adaptation response in the present relates to prevailing political and normative views and priorities which may have changed by the time it becomes possible to understand the efficacy of any adaptation response. In this regard, adaptation is strongly correlated with contrasting normative concepts of climate resilience (see Appendix B).

5) **Every response to a wicked problem is consequential and leaves impacts that cannot be undone:**

This characteristic is particularly relevant to pre-emptive climate change adaptation actions that may tie communities and their governments into particular types of response. For example, the construction of large scale infrastructure may lead governments down a path of continually attempting to eliminate climate change risks through more and better infrastructure defences, or through the balancing of priorities in the operation of a given infrastructure asset[66], and thus failing to address other potential indicators of climate resilience such as adaptive capacity, social capital or 'social capacity' within communities that may be required for effective climate hazard response (Kuhlicke et al., 2011). Levin et al. (2007) explain that care is needed when designing and implementing new policy approaches that may confine future adaptation activity into pathways which are difficult to diverge from. However, as exemplified by the Thames Estuary 2100 project in SEE (EA, 2012b) (see Box 1),

[66] See Box 3 below for a description of the challenges faced in the operation of the Wivenhoe Dam in SEQ in this regard.

and the conceptual work of Heazle et al. (2013) in relation to disaster risk management in SEQ, this type of policy *path-dependence* may be minimised or avoided through careful hedging strategies that attempt an evidence-based 'wait and see' approach that utilises careful planning and adaptive management to delay risky capital investment until absolutely necessary. Nonetheless, whether an adaptation response involves the building of infrastructure, or the restructuring of policy making arrangements (e.g., through the UK's introduction of the *Climate Change Act (2008)*), adaptation policy responses can leave lasting impacts upon policy making and the communities served by it that can be difficult to undo.

6) There is no describable number of possible solutions to a wicked problem since there are no criteria to enable one to establish that all possible solutions have been identified:

Again, given the uncertainties surrounding the trajectory of future climate, the task of adaptation is open to innumerable possible solutions which are likely to be more or less effective depending on the ultimate outcomes of climate change over the coming decades and stakeholders' conceptions of what it means to be climate resilient. Adaptation options are likely to be chosen, I argue, not just on the basis of the legitimacy given to alternative sets of available evidence, or the legitimacy for adaptation policy making more generally, but rather in relation to policy makers' risk management strategies which will relate to underlying norms and priorities about how they value the present over the future, and how they seek to preserve what is valuable to them. However, it is worth noting that this so-called wicked characteristic is evident in many, if not most policy problems and therefore may be considered a lesser characteristic within Rittel and Webber's (1973) typology of wickedness.

7) Every wicked problem is essentially unique and therefore there is no suitable precedent to guide decision makers:

Although national and state governments often attempt to address adaptation strategically through generic policy evidence – for instance, using global or national climate projections – it is an innate feature of environmental management issues such as climate adaptation that their characteristics are determined by local and contextual circumstances. This is because climate vulnerabilities are unique to any given locale, community or jurisdiction, depending on their geography, economy and the features of their particular social-ecological systems (Adger et al., 2011). Adaptation problems are also unique within any given locale because of how climate manifests itself at individual locations, which can vary widely in ways not accounted for by climate change projections or strategic climate impact assessments (Wilbanks and Kates, 1999; New et al., 2007). This means that although adaptation responses in other locations can provide useful sources of learning for policy makers, most adaptation problems are essentially unique and cannot rely on a one-size-fits-all approach.

8) Every wicked problem is a symptom of, or interconnected with, some other problem:

Similarly, because adaptation problems tend to be defined in terms of governance jurisdiction rather than according to their physical bounds (if such bounds could ever be clearly defined), they often relate to the behaviour of overlapping social-ecological and economic systems which means that the characteristics of an adaptation problem encompass a range of inter-related issues associated with the vulnerability and resilience of communities. As Adger et al. (2011, p. 758) note:

> *Policy approaches to climate risk which stress short-term benefits and seek simple technological fixes to complex problems fail to significantly address multiple and interacting factors which affect system resilience and the needs of vulnerable populations.*

For instance, in the UK case, as described in Chapter 4, adaptation problems relate as much to the vulnerabilities created by the urban development and over-population of particular locations (such as SEE) as they do to the severity of existing or future climate events. Similarly, in SEQ adaptation problems are interconnected with problems of population growth, urban development, disaster risk and natural resource management.

Image has been removed.

9) The choice of explanation of a wicked problem determines the nature of the problem's attempted resolution:

This characteristic is strongly related to the issue of problem formulation described above. How an adaptation issue is formulated depends on the perspectives of those experts and other policy players responsible for the construction of adaptation evidence. In turn this formulation and how it is framed by policy makers determines how they attempt to resolve it. This is demonstrated by the cases of Queensland and the UK who have framed the adaptation problem in terms of the contrasting perspectives of exposure and vulnerability respectively.

As described in Chapter 4, in Queensland the framing of climate adaptation aligns with existing policy objectives relating to disaster risk management, urban planning and natural resource management, as well as to rationalist, statist-developmentalist traditions that prize the provision of infrastructure to overcome the state's ongoing exposure to climate extremes. Thus adaptation is principally pursued through the reduction or elimination of present risks and through the enhancement of the resilience of communities that are persistently exposed to climate extremes, though with limited consideration of future climate change.

By contrast, in the UK, adaptation is principally pursued through the explicit pursuit of climate *change* adaptation, a risk that has, as yet, largely failed to materialise (or at least, the causal linkages between recent climate extremes and climate change remain inconclusive). In the UK climate change is largely perceived through abstract notions of future risk as described by climate projections and scenarios and through governments understanding of the UK's intense vulnerability to climate. This framing of the adaptation problem has resulted in their principal focus being on the bolstering of institutional and governance arrangements to ensure the future resilience of socio-economic systems in the event of future extreme climate change (e.g., through the requirements of the *Climate Change Act (2008)*), as well as upon practical measures such as the enhancement of existing infrastructure. These measures are, I argue, largely prompted by the intense vulnerabilities that exist in relation to the UK's over-populated and heavily urbanised society, which means that even relatively minor events can have a dramatic impact.

Infrastructure provision in the UK has, to date, been largely divorced from the kind of frequent and contrasting extreme events of the kind often experienced in Australia (Head et al., 2014). Although this may have begun to change in recent years as extreme events have become more frequent (BBC, 2014b), risk management infrastructure exists here as a result of its highly vulnerable urbanised society more than due to its experiences of extreme events of the type seen in Queensland or as anticipated as a result of climate change. And yet, although the construction of risk management assets is prompted more by existing societal vulnerability as due to persistent exposure to extremes, due to the policy legitimacy provided to climate change in the UK this infrastructure has in many cases been upgraded to cope with future climate change (EA, 2012b). However, very few infrastructure projects have been designed or built solely as a result of climate change, and the UK still lacks the experience that Queensland has earned in terms in disaster risk and emergency management. This experience has originated from Queensland's exposure to persistent and contrasting extremes and means that it appears to have made considerable progress in terms of enhancing a 'social capital' associated with community resilience to climate (QFCI, 2011) (see also Chapter 4 and Appendix B).

The contrasting perspectives of exposure and vulnerability which frame these cases approach to adaptation policy provide a useful conceptual distinction for understanding the contingent nature of adaptation problems and their resolution, and also why (as described in Chapter 7) the scientisation of adaptation policy proceeds by differing paths between these two cases.

10) The decision maker has no right to be wrong, since he/she is liable for the responses he/she generates and mistakes in either action or inaction can be very costly:

This characteristic relates to many contemporary policy problems given the impracticalities (and political barriers) of attempting a trial and error approach to policy making. For adaptation this difficulty is compounded by adaptation policies' attempts to manage inter-related socio-economic and ecological systems which mean that failed adaptation policies may have unforeseeable effects. However, politically, the importance of policy making accountability may be even more prevalent in the UK case as a result of the *Climate Change Act (2008)* which ensures that climate change policies must be considered beyond the timescales of the political electoral cycle. There is, therefore, added impetus on policy makers to ensure that they don't tie in ineffective policy actions that cannot be undone at a later stage.

Levin et al. (2007) have identified four further characteristics with which they characterise climate change as a 'super wicked problem'. Although primarily aimed at the broader issue of climate change, these characteristics also directly relate to the specific task of climate adaptation:

11) Time is running out:

Given the intractable uncertainties associated with understanding future climate (Stocker et al., 2013), changes may occur swiftly and with little warning as a result of unforeseen tipping points in the Earth's bio-geophysical systems. This possibility is important in light of the timescales required to construct certain types of disaster risk management or climate adaptation infrastructure. The ability of governments to provide appropriate risk management may be constrained by such time limits. An example from the UK in this regard relates to plans for the construction of flood defences for the city of London and surrounding areas of SEE (see Box 1.). The Thames Estuary 2100 project was established as a result of a realisation by the Environment Agency of England & Wales and its partners that any upgrade to existing flood defences would require time to construct, time which may not be available in the event of a rapid climatic change causing an increase in sea-level rise, storm-surge events, fluvial flooding or a combination of all three. Such climatic changes would likely overcome the existing defences, since they are already at the limit of their capacity. This project sought to develop a plan whereby the city could systematically improve those defences throughout the twenty-first century in line with the available evidence and the expected impacts provided by climate change models, ensuring that the increased pressure on flood defences on the Thames from climate change could be managed in a timely manner, without unnecessarily or prematurely tying government into such significant investment should it not seem to be required (EA, 2012b).

12) There is no central authority with responsibility to resolve the problem:

Again, although this characteristic principally relates to the task of reducing GHG emissions globally, it is also relevant to both Australian and UK case-studies in relation to the task of climate adaptation across government levels. In both cases, the difficulties encountered when managing adaptation problems across jurisdictional borders relate to the difficulties described in Chapter 4 of governing environmental problems across government levels. In Australia, this can be seen in relation to the interactions within and between states when managing cross-border environmental issues (Steele et al., 2012). Federal government has passed most adaptation responsibilities to state government, who in turn appear to have left most responsibility for adaptation policy to local government councils (Preston et al., 2013). In circumstances where adaptation problems transcend state borders, there appears to be no central authority with responsibility to provide authoritative governance, depending instead on the achievement of some form of political consensus to be reached by participating state policy players[67]. In the face of anthropogenic climate change, this could potentially result in considerable difficulties for the achievement of coherent adaptation responses.

[67] Although tentative steps toward such coordination have been made through the Council of Australian Government's Climate Change Adaptation Framework (COAG, 2007)

Similarly, in the UK, much like for the issue of acid rain in the 1970s (see Chapter 4), adaptation issues that transcend sovereign borders can cause difficulties for neighbouring member states of the EU, where there is little political or economic incentive for one party to act. Although the possibility for such issues to arise in relation to the UK's climate adaptation may be limited by its geography, since the UK is an island state, it is nonetheless possible to foresee significant trans-boundary issues relating to, for example, climate change-induced immigration.

13) Those seeking to solve the problem are also causing it:

In relation to adaptation problems, this characteristic speaks to the theoretical work of Beck (1992) and Giddens (1990) relating to the reflexive modernisation of contemporary society, whereby the trappings of modernity may increase the vulnerability of society to climate-related events. Socio-economic priorities of government relating to economic growth, increasing urbanisation and rapidly growing populations increase the risks from and cumulative vulnerability of society to climate change. Economic growth, traditionally conceptualised as 'more of everything', can exacerbate problems such as flooding, drought, deteriorating water quality, biodiversity loss and bushfires. This is due to both the form and location of associated urbanisation and population growth that, in the cases of SEQ and SEE, have increased the vulnerability of communities to climate events. As such, it may be argued that governments seeking to remedy problems associated with climate variability and change are also largely responsible for the policy and planning decisions that exacerbate such problems. This is particularly applicable to the case-studies in question for this research since both SEE and SEQ are rapidly growing regions with an increasingly urbanised landscape.

14) Decision makers and the public tend to make decisions that reflect very short time horizons and therefore discount the future beyond what is required to solve a long term problem like climate change:

> This is an important issue in relation to climate adaptation policy making, and to the legitimacy of policy evidence relating to the potential future impacts of climate change. As will be described in further detail in Chapter 6, one of the reasons why climate science lacks legitimacy and salience for adaptation decisions is that it does not provide information relevant over the time-scales of political and policy decision making. The levels of uncertainty associated with the available evidence mean that, although often perceived as credible, in practice this evidence may lack legitimacy and/or salience relative to more deterministic or short-term information related to developing a business case for short term policy action. In effect, this lack of salience and legitimacy in climate science is symptomatic of a mismatch between the timescales over which adaptation problems must be considered and the timescales of political decision making; it also reflects a conflict between the available evidence and economic-rationalist norms that prioritise a short-term business-case over the available evidence-base.

The aforementioned 'wicked' and 'super-wicked' characteristics of climate adaptation problems mean that both climate science and subsequent policy evidence are heavily constrained when it comes to their ability to meet linear-technocratic expectations for the objectivity of expert knowledge or its ability to linearly inform decision making. These wicked characteristics also mean that adaptation policy problems are extremely difficult to address and resolve in a way that is acceptable to all, or even most, policy players and stakeholders. The development, presentation and use of policy evidence require subjective, normative choices concerning the framing and characterisation of climate risks and the use of this evidence for policy making. As I demonstrate in subsequent chapters, the contingent, wicked nature of adaptation problems mean that science and policy evidence often lack legitimacy, salience and even credibility for policy making and is susceptible to becoming politicised, while adaptation policy is highly susceptible to processes of scientisation that seek to suppress explicit normative debate concerning adaptation priorities. In order to understand how these wicked characteristics manifest themselves in practice, the next section will provide some examples to help understand the varying challenges presented to policy players by climate adaptation problems and the evidence available to understand them.

5.5 A typology of adaptation policy problems

In this section I outline a simple typology for categorising adaptation issues as a means to demonstrate their wicked characteristics as they present themselves to policy players, and to help understand evidence needs for addressing them. This typology shows how adaptation problems can engage players' evidence needs in different ways depending on what types of uncertainty are most prevalent and where complexity exists in relation to priorities, problems and responses. It will also help to explain the tensions between expertise and politics that arise in terms of achieving sufficient legitimacy and/or salience of the available evidence for policy players.

Kirchoff et al. (2013) suggest that the choice and use of evidence sought by adaptation decision makers is principally determined by their perceptions of climate risk. In turn, they argue, risk constructions are determined by past experiences, the decision making context and the cognitive processes allowed or preferred in that context. However, in the context of policy making such determinants are, I argue, heavily circumscribed by the political executive and by the prescriptions of the evidence-based mandate. Perceptions of risk, or at least, politically legitimate (i.e., acceptable) interpretations of risk largely depend on the mandate of prevailing politics upon the policy making community. Cognitive processes meanwhile are, if not largely prescribed, then certainly constrained by the imperative to use rationalist methods of ex-ante policy analysis advocated by many liberal democracies, including the two cases in question for this research (see for example, NEMC, 2010; Willows and Connell, 2003). Even without such prescriptions, bureaucratic policy making seems generally more amenable to careful considered analysis of evidence, than intuitive, experiential responses[68].

[68] Kirchoff et al. (2013) cite Nobel Laureate Daniel Kahneman's seminal work relating to the distinction between 'coherence' and 'correspondence' forms of cognition, summarised in the book: "Thinking, Fast and Slow" (Kahneman, 2011)

Under the evidence-based mandate, I argue, the choice and use of available information is largely determined by prevailing politics (or political context) and the uncertainties associated with any given adaptation problem. As described in Chapters 4, 6 and 7, prevailing stable and dynamic political factors do appear to have a significant bearing on what types of evidence are used. In Australia, climate change science has largely been eschewed for state and local government climate adaptation planning in favour of economic evidence demonstrating a viable business case for policy action. In the UK, under the remit of the *Climate Change Act (2008)*, there is an expectation by government that the best available climate and adaptation science should inform adaptation policy, while outside of this remit, local government has returned to a 'business-case' model. Within the limitations of these comparative circumstances then, I argue, the presence and locus of decision making uncertainty can play a decisive role in understanding evidence needs and policy responses for climate adaptation.

Uncertainties relating to the management of adaptation policy problems may broadly fall into three categories:

1. Uncertainty of policy goals and objectives – what we want to achieve and why;
2. Uncertainty of adaptation problems themselves – why and how are they a problem and how can we understand the associated risks and opportunities; and,
3. Uncertainties relating to policy responses – how can and should we respond to these climate problems and what are the implications of any proposed response?

Interestingly, there appear to be very few policies, plans or climate-related policy assessments across the two case-studies that systematically address all three of these characteristics. These uncertainties are not fully addressed, I argue, because of the nature of the adaptation policy challenge. Adaptation is the response to a stimulus, and adaptation policy relates to the adjustment, removal or replacement of existing policies or policy objectives to ensure the achievement of underlying goals. However, many adaptation-related risk assessments and plans do not state which underlying policy objectives and goals are being assessed, the assumption being that these relate to a well-accepted status quo, to explicit policy priorities of government or to the preservation and stability of existing socio-economic systems and the communities they serve (see for example, COAG, 2007; 2011). However, as described in Appendix B, such goals and objectives often relate to normative interpretations of climate resilience that are fundamental to how we view the task of adaptation and tell us much about how we view the nature of communities and the economy.

Most strategic climate risk assessments, adaptation plans and guidelines appear to concentrate their analysis on climate hazards and impacts and what government seek to do to address them, while underlying policy objectives and goals remain largely implicit (see for example, Queensland Government 2012b; COAG, 2007). One exception is the 2010 climate change risk assessment by the Environment Agency of England & Wales. I will use this example to demonstrate the utility of the typology presented here and how the three types of uncertainty described above may combine and relate in the practice of adaptation policy making. However, I will also use three examples of adaptation problems from SEQ as a comparative case to demonstrate the typology's generalisability. The underlying goals and objectives relating to SEQ's adaptation problems are generally less well described in policy literature, or at least not as unambiguously as for the Environment Agency's risk assessment, and as such, the typology makes an assumption concerning state and local governments' risk-specific policy objectives, based on governments' broader policies relating to state and federal emergency and disaster risk management, and community disaster resilience (Queensland Government, 2012b; COAG, 2011).

The Environment Agency seems a useful case-study for this purpose, given that it is the largest non-departmental government body responsible for managing the natural environment in the UK (indeed, the largest of its kind in Europe) (EA, 2010a). Not only has the Agency clear and explicit goals and objectives that it is obliged by government to follow, and a long tradition of pursuing evidence-based approaches, it also has wide-ranging responsibilities relating to:

- Flooding and coastal erosion management;
- Water resources and water quality management;

- The environmental regulation of industry;
- Land quality;
- Wildlife and habitats;
- Riparian navigation and recreation; and,
- Sustainable urban and rural planning guidance.

In 2009, the Environment Agency was asked by DEFRA[69] to report its risks and opportunities from climate change, and its plans to address them, as a requirement under the so-called Adaptation Reporting Power of the *Climate Change Act (2008)* (DEFRA, 2009). Given its extensive responsibilities, the Environment Agency was asked to provide a benchmark report that would serve as a guide to more than one hundred other statutory authorities, infrastructure and service providers with reporting obligations under the Act[70] (EA, 2010a).

Using the uncertainty criteria above, I demonstrate four indicative types of adaptation problem, with reference to the Environment Agency's responsibilities listed above, alongside three of the principal climate-related risks to the SEQ region: flooding, drought and storm/cyclone wind damage (Risk Frontiers, 2012). These risks and their categorisation using these uncertainty criteria are outlined in Table 5.1. below:

[69] The UK's Department of Environment, Food and Rural Affairs, which sponsors the Environment Agency.
[70] I was the lead author of the Environment Agency's report to government, as well as principal assessor of the Agency's climate change risks, opportunities and responses for this report.

Table 5.1. A typology of uncertainty for common adaptation policy problems:

Type	Policy objectives	Risks & Opportunities	Policy responses	Example
1	Low uncertainty: Clear adaptation objectives	Low uncertainty: Few competing risks	Low uncertainty: Established options	**SEE:** Flood Risk and Coastal Management **SEQ:** Cyclones and storm management
2	Low uncertainty: Clear adaptation objectives	Medium uncertainty: Many competing risks	Medium uncertainty: Competing options	**SEE:** Water resources & quality management; Industry regulation; Riparian management & infrastructure provision
3	High uncertainty: Uncertain or ambiguous adaptation objectives	High uncertainty: Many competing and uncertain risks	High uncertainty: Few well-established options, many possibilities	**SEE:** Wildlife & habitat management;
4	High uncertainty: Ambiguous adaptation objectives	Medium uncertainty: Continually competing risks	Medium uncertainty: Competing options in a zero-sum game of risk management	**SEQ:** Flood risk and water resources management – (Operation of the Wivenhoe and Somerset Dams – see Box 3)

Thus, ***Type 1*** adaptation problems are those for which there is general consensus (at least at face value) about the nature of the problem and what government seeks to achieve in addressing it. For the issue of both inland and coastal flooding for instance, although individual communities may perceive the risks differently depending on their particular location and circumstance, government and its arms-length bodies such as the Environment Agency have long pursued a coherent strategy to manage these combined risks and vulnerabilities to ensure the stability of UK society and the economy. Broadly speaking, this strategy seeks to ensure that risk is minimised for those communities already situated in vulnerable locations and that climate vulnerability should be minimised in the future by minimising the amount of new development in flood risk prone areas (EA, 2010a). There are, however, exceptions to this policy that highlight the contentious and context-specific nature of adaptation problems (see Box 2.), but for the most part government has a set of strategic policy objectives that are coherent at the level of national governance; these objectives exist irrespective of climate change.

Furthermore, the risks from climate change (sea-level rise and the increasing intensity and frequency of fluvial and coastal flooding events) are an exacerbation of existing risks and therefore do not present new forms of risk that are likely to compete for the Environment Agency's attention. Thus, those policy responses such as infrastructure or planning provisions that address extant climate vulnerabilities and pressures are the same types of infrastructure and planning provisions that are expected to be needed to minimise the risks from climate change. Established options for the management of flood risk are unlikely to be replaced with alternative risk management options since so few alternatives exist. That is not to suggest that the Environment Agency fully understands those risks or how effective their adaptation responses will ultimately be in the face of climate change, but that the strategy and tactics for addressing these risks are unlikely to change.

In this sense, there may well be a degree of path dependence associated with responses to Type 1 problems which means that poor decisions in relation to infrastructure provision and planning responses are likely to be costly to both communities and government. The established options are also often subject to cost-benefit assessment that discount the future over the present, making some risks, such as those faced by the residents of Happisburgh (see Box 2.), less amenable to capital investment than others because the costs of infrastructure provision outweigh the benefits to one small community.

Box 2. The contingent nature of adaptation problems: The case of the disappearing village of Happisburgh in southeast England

On the southeast coast of England[1], the village of Happisburgh sits along a coastline that is eroding at a rate of 12 metres per year. A policy of 'managed retreat' or 'managed realignment' has been implemented by government and the Environment Agency for coastal communities such as Happisburgh, given that no amount of infrastructure is said to realistically (or at least cost-effectively) be able to prevent the combined forces of coastal erosion and sea-level rise. Indeed, attempts at providing such infrastructure in the past have exacerbated erosive forces elsewhere along the coast (Adger et al., 2011). Thus, such coastal communities face the potential for literal obliteration in the coming century since government no longer intend on maintaining existing infrastructure under the Shoreline Management Plan for this location, nor providing any financial compensation to property owners from the destructive forces of the sea (North Norfolk District Council, 2012). Unsurprisingly, residents of Happisburgh are not necessarily happy with government's policy priorities and objectives, their interpretation of the associated risks from coastal erosion and climate change, or their proposed policy response to them (BBC, 2014, 2012a; Whiteside, 2014). This case is useful for demonstrating the contingent nature of adaptation problems such that their framing, risk characterisation and 'best' resolution depend on the perspective of any given stakeholder.

[1] Happisburgh is located in Anglia, adjacent to the governance region of Southeast England, but is nonetheless located in the southeast of England.

Figure 5.5. Happisburgh Coastal Erosion (CC BY-SA 2.0)

Figure 5.6. Happisburgh shown within Anglia (CC BY-SA 3.0)

Likewise, for the case of cyclone and storm management in SEQ, policy objectives, although often not explicitly stated, seem to relate to maintaining the stability of existing communities and their socio-economic systems (see for instance, COAG, 2011: p. 5; NEMC, 2010: p. 4) which refer to the concepts of self-reliance, social capacity and the creation of "safer, more sustainable communities"). In the context of addressing the risks from extreme winds, Australian federal government's 2007 report on local government adaptation actions[71] suggests that there are few competing risks (Australian Government, 2007: p. 16 – 21). Flooding is the principal concurrent risk, the dynamics of which is well understood and is dealt with concurrently by emergency services and the communities they serve in the aftermath of an event. Meanwhile, established preparation and response options may relate to climate-proofed design of public buildings and amenities, public information programs, community preparedness plans and effective emergency response through local, district and state disaster management groups, in adherence with a PPRR (Prevent, Prepare, Respond and Recover) model (Queensland Government, 2012b; Australian Government, 2007; EMA, 2004). Again, there is considerable uncertainty about the future risks from climate change in relation to cyclone and storm frequency and intensity, but it appears to generally be expected that existing established responses will continue to be relied upon (Australian Government, 2007).

Type 2 adaptation problems are also subject to relative consensus and certainty in relation to policy objectives. For the case of water management or industry regulation for instance this is because those objectives have been established through regulatory or legislative prescriptions for the management of environmental hazards that seek to ensure that the public have access to clean, abundant water supplies and an unpolluted landscape. In the UK case, many of the legislative prescriptions come from the EU and thus government are obliged to pursue certain environmental quality standards, even though the manner of the underlying legislation allows some freedom of interpretation in its implementation. However, climate risks can be challenging to understand for Type 2 problems and the spectre of climate change complicates our understanding of extant and

[71] This report is no longer available online and appears to have been scrapped by the Newman government (2012- 2015)

concurrent environmental risks to water resources and quality, and from industry. For example, there is considerable uncertainty concerning what the net effect that warming fresh waters will have upon water quality already threatened by increasing urbanisation, over-abstraction of water resources and intensive agricultural practices (EA, 2010a). Climate change also challenges the means and extent to which existing policy prescriptions and objectives may be achieved, in ways that seem considerably more complex than Type 1 adaptation problems. That is either because these legislative and policy provisions may be considerably less achievable under a changed climate regime (e.g., in the case of existing water quality objectives), or because potential adaptation policies have not yet been devised that can counter the worst impacts of potential climate change, and so there is some uncertainty regarding the best available response options (as, for instance, in the case of water resources provision in the UK) (EA, 2010a). Unlike Type 1 problems, the best options available for Type 2 problems may not be the ones that have conventionally been relied upon in the past. For example, climate change may result in a dependence on desalination plants or increasing reliance on regional transfers of water resources, rather than the UK's traditional reliance on water abstraction licensing and reservoirs.

Type 3 adaptation problems relate principally to the management of species, habitats and eco-systems, and are perhaps subject to some of the most intractable uncertainties relating to the viability of objectives, our knowledge of climate change and concurrent risks, and therefore our understanding of how best to manage those risks. In the UK case, the policy objectives associated with Type 3 problems also tend to come from EU legislation and relate to the conservation of habitats and ecosystems and the preservation of particular species that may be endangered, have significant economic value attached to them, or both. However, the objectives of habitat conservation and species preservation may not necessarily be compatible in the presence of a changing climate or the effects of concurrent anthropogenic pressures such as increasing urbanisation. For example, the species-specific objectives of EU legislation in relation to the preservation of *Salmonid* fish species may not be achievable if climate change results in conditions that are not conducive to their preservation (i.e., there is little or no contingency for what to do if Salmon or Trout simply cannot survive in warmer waters resulting from climate change). Furthermore, it is possible that some habitat conservation tactics in the face of climate change may be helpful for a given habitat as a whole, but be detrimental to the preservation of particular species. These difficulties in agreeing policy objectives and responses are compounded by the considerable uncertainties associated with the dynamics and functioning of social-ecological systems which mean that it is very difficult to understand the potential affects from climate change.

Finally, ***Type 4*** describes an adaptation problem relating to the flood and drought risk management strategies for SEQ, which highlights the dangers of rationalist approaches to adaptation policy and the propensity for policy responses to become path-dependent. As described in Box 3., the Wivenhoe and Somerset dams in SEQ manage both water resources and flood risk. As such, these two climate risks and adaptation goals are in perpetual conflict as a result of the dual purposes for which these assets were designed and the resulting dual and opposing operational modes of the dams. In the face of climate change, these management difficulties may become even more acute.

Box 3. The dangers of rationalism and path-dependency: Operation of the Wivenhoe and Somerset dams in southeast Queensland:

Both flood risk and water supply in the Brisbane area of SEQ are managed via the Wivenhoe and Somerset dams on the Brisbane River, which are required by policy makers to fulfil dual and often conflicting roles in the face of contrasting weather events. Flood risk management capacity is restricted to facilitate water storage for supply, or vice versa, which effectively reduces dam management to a zero-sum game between water security and flood mitigation. In the event of anticipated flooding, pre-emptive reductions in water levels below the dams' 'full supply level' – to allow space for storing flood waters and thus mitigate extreme flooding – increases vulnerability to water shortages during drought by reducing supply (QFCI, 2011). Decisions made about the appropriate use of the dams during extreme events necessarily involve, therefore, political decisions about which hazard presents a greater threat, particularly in the absence of the data needed to reliably forecast the risk of flooding versus drought.

Such difficult decisions involving necessary trade-offs in the management of climate-related risk highlight the dangers of relying on rationalist 'predict-then-act' approaches to climate adaptation in the face of intractable uncertainties concerning future weather extremes and climate change. In actuality, such approaches require political prioritisation about competing risks and (potentially) vulnerable groups and locations that no amount of evidence or adherence to strict management protocols can avoid. Further, this case highlights the dangers of path-dependency that can result from a reliance on infrastructure to eliminate climate risk, whereby the construction of assets such as the Wivenhoe and Somerset dams can tie governments into policy prescriptions that can be very difficult to deviate from. In the case of SEQ, in the absence of further considerable capital investment, the city of Brisbane is now dependent on infrastructure that cannot provide optimal, or even wholly robust, risk management in the face of unpredictable and contrasting climate extremes. Policy decisions in relation to flood risk and water resources management for Brisbane are dependent on the management of these dams and the zero-sum game played in balancing competing risks.

Figure 5.7. The Wivenhoe Dam - SEQ (CC - Public Domain)

An important limitation to consider with this typology's ability to account for the wicked characteristics of adaptation problems is that the characteristics described by it are themselves contingent; they are described from a particular governance level from a particular policy player (or set of players). So, for instance, the uncertainties and conflicts described above for the Environment Agency are specific to their own management difficulties. However these problems become even more intractable when considered across governance levels. As described using interview data in Chapter 6, the consensus achieved at one particular governance level may not necessarily exist across them. Therefore, although there may be consensus of policy objectives between the Environment Agency and DEFRA in such a way that is congruent with EU legislative requirements, there may still be conflicts between these objectives and those of local authorities or communities who can feel disenfranchised by objectives and policy responses decided at national or international levels that fail to consider their specific needs and circumstances. The case of the village of Happisburgh in SEE described in Box 2 above is a useful case in point. In the context of such difficulties of cross-level governance, as well as the considerable uncertainties associated with mono-scalar assessment and management of climate risks, it seems reasonable to suggest that political or normative considerations are a necessary and important component of determining the nature of adaptation problems (including what counts as legitimate evidence) as well as adaptation policies and their underlying objectives.

However, this typology also fails to account for another wicked characteristic of adaptation policy problems relating to the non-linearity of policy making. As suggested by Lindblom (1959) amongst others, issue identification, understanding, objective setting and policy responses often run concurrently rather than consecutively as suggested by linear-technocratic schema. These limitations are indicative of the difficulties of understanding, characterising and resolving adaptation problems at individual governance levels or through a linear-technocratic policy making schema, and therefore have important implications for how we seek to understand these problems and how we commission and use expert evidence. It is to these issues I now turn.

5.6 Perceived evidence needs for climate adaptation

The four types of adaptation problem outlined above, taken from the Environment Agency's portfolio (EA, 2010a) and three of the most damaging and costly climate risks in SEQ (Risk Frontiers, 2012) are indicative examples of adaptation problems, but do not necessarily represent all types of problem using this typology. The typology is useful simply for understanding how policy players encounter different types of adaptation problem and the potential inadequacies of linear-technocratic models of policy making. Linear-rationalist approaches to adaptation are often problematic because policy goals and objectives are often unclear or underspecified at a time when evidence is available for use, and so the development of policy responses over-depends on the availability of this evidence and how it is made, rather than upon political priorities. And yet, purely technocratic policy making (whereby experts could reduce policy problems to technical analysis) as described by Keller (2009) and Weingart (1999) also appears problematic since, as discussed in section 5.4 and 5.5 above, adaptation problems clearly require political decisions at various points when seeking to resolve them, in relation to normative priorities concerning the climate vulnerabilities and resilience of what and for whom. Further, technocratic approaches are limited by a general lack of useful, usable evidence that could fulfil technocratic ideals.

Because of its rationalist underpinnings, the typology described above should not be used to identify evidence needs for adaptation problems or to prescribe certain types of evidence over others. However, it can nonetheless help to understand policy players' perceived evidence needs and the problems inherent with linear-technocratic policy models in relation to those perceptions. Crucially, the identification of evidence needs is dependent on input from decision makers themselves and should not be a role that is assumed by the expert community alone. The necessity for input from decision makers into the focus of research and the development of policy evidence has been identified by Cash et al. (2003) and more recently by Kirchoff et al. (2013), Preston et al.

(2013) and Asrar et al. (2012) and speaks to concepts of post-normal science and the co-design and coproduction of evidence for effective decision making, described in section 5.3 above. Caution is nonetheless needed that policy players' rationalist preferences do not result in attempting to develop or use evidence that would inevitably be incapable of fulfilling these preferences due to the wicked nature of adaptation problems. The necessity for user input also reminds us that evidence for adaptation policy can be used to legitimise extant political and policy priorities, that is, that adaptation policy can become scientised, and therefore that the evidence that aligns with those priorities is more likely to be developed and used than evidence that does not.

As Kirchoff et al. (2013) and Preston et al. (2013) suggest, adaptation decision makers perceive that there is a deficit of adequate information for adaptation policy making and practice in developed countries. This view sits alongside a growing criticism of the information that is already available. Preston et al. (2013) argue that those critiques suggest that adaptation science is growing without adequate understanding of how it can or should contribute to effective adaptation. In the face of the ongoing and increased frequency of extreme events and climate change, the wicked character of adaptation problems and the lack of clearly articulated policy goals and objectives, I conclude that adaptation options develop concurrently with the development and use of expert evidence, not as a result of it. This conclusion suggests a need to reconsider long-held expectations for how and what evidence and expertise can provide for policy decision making.

Despite the aforementioned difficulties of adequately knowing about adaptation problems, rationalist interpretations of adaptation policy continue to be pursued, as exemplified by climate change adaptation plans in the UK (DEFRA, 2012d) and past plans under previous Labor governments in Australia (Dedekorkut-Howes et al., 2010). The principal focus of these plans has been on the development of more and better evidence to linearly inform policy making. Conversely, there has been a relative absence of expression of underlying goals in relation to the resilience of society and the economy, or tangible objectives in relation to the adaptation of particular jurisdictions, receptors or government portfolios to climate change to direct the development of this evidence, other than bland statements relating to maintaining the structure and function of existing socio-economic and ecological arrangements. This may be one of the contributing factors to accusations of a lack of actual policy making for climate change adaptation, irrespective of the presence of a considerable number of plans and programmes (see Chapter 6). Indeed, as Grundmann (2006) has demonstrated, the promise of more and better evidence has, in the past, been a useful compromise between partisan political views on climate change in the US. This is because, in the eyes of those opposing climate change policies, the foreseeable result of more and better evidence is a near-term lack of policy action, while the rationalist expectations of those who advocate climate change action also necessitate more and better evidence.

The potential lack of immediate clarity of goals and objectives in relation to climate resilience and adaptation, and the need for user input into identifying research focus and evidence development are issues that highlight the importance of understanding coproduction processes and the possibility of political influence in the development of adaptation science and policy evidence (Preston et al., 2013). In the absence of clear objectives, policy players may seek to influence evidence development as a means of influencing whatever policy action may follow. Thus, Meyer (2011) advocates for more open acknowledgement of the values and priorities implicit in both research funding and in research itself, given the uncertainties, contingencies and politics of the available knowledge.

The typology described in section 5.5 does suggest, on the face of it, that certain evidence sources are more useful for some types of adaptation problem than for others. For example, where objectives and response options are well understood and relate to the elimination of risk or vulnerability through the establishment, upgrading or maintenance of infrastructure or engineering provisions – as in Type 1 and Type 2 problems. In such cases rationalist policy making processes would suggest a need for 'top down' approaches to adaptation through the use of climate change projections (Dessai and Hulme, 2004). This approach would seek to understand potential changes to a limited number of key variables relating to the tolerances and thresholds of infrastructure and engineering to climate variability.

However, where objectives, risks and response options are less clearly defined or understood or more contested, due to the wide variety of impact and response variables at play, and the many associated uncertainties, as in Type 3 problems, climate change projections appear to be less useful. For such problems, evidence needs appear to be directed more toward understanding the vulnerabilities of individual receptors, locations or communities, so-called ‘bottom up’ approaches (Dessai and Hulme, 2004). Further, in such circumstances where policy objectives are considerably less clear, or ambiguous, as for Type 3 and Type 4 problems, it may not be possible to understand precisely how to respond without a better understanding of the thresholds and tipping points inherent in social-ecological systems (Moss et al., 2013), irrespective of how good the available climate science may be.

Although the typology above points in the direction of certain evidence needs, to make such assumptions on the basis of these ‘known unknowns’, I argue, nonetheless plays to rationalist ‘predict-then-act’ expectations for evidence use in policy making. These expectations depend on a linear view of evidence provision and use which does not reflect the lack of clarity of underlying values or any lack of political will for adaptation responses that might be prescribed as a result. These values and ideals often relate, for example, to policy players’ conceptions of climate resilience and society’s place within social-ecological systems. As described in Appendix B, concepts, norms and values in relation to climate resilience and risk may determine much about how we choose and use evidence and derive adaptation policy.

Because understanding adaptation problems often runs concurrent to managing them, both understanding and response may ultimately depend on the normative preferences of policy players and the consensus they are able to achieve in this regard during the coproduction of policy evidence. This normative, contingent character of climate adaptation highlights the importance of explicit goals and priorities about climate adaptation and resilience in the development of policy evidence as well as the dangers of a scientised policy making process that would seek to legitimise policy on the basis of objective, impartial and adequate technical knowledge. More fundamentally, the normative, contingent character of knowing and resolving climate adaptation problems speaks to the ongoing tensions between expert and political authority during liberal democratic policy making.

5.7 Conclusion

Climate adaptation presents an intriguing problem for evidence-based policy making. It is at once both a contingent problem necessitating subjective, normative consideration and choice in both evidence development and policy response, while also being dependent on (supposedly objective) expert authority for its political legitimacy as an extant policy priority. Adaptation problems must also be considered by governments at both local and strategic scales, and the tendency for varying formulations and framings of these problems depending on the level of government at which it is considered, suggests that norms, values and even political deliberation have a role to play, not just in the development of adaptation policy, but in the evidence used to inform and legitimise it also.

In this chapter, I have shown how climate science is just one component in a complex process of evidence development for adaptation policy. As this science comes closer to government decision making, processes of interpretation and coproduction are necessary since, as Cash et al. (2003) argue, in order for evidence to be salient and legitimate as well as credible it must consider the norms and values of decision makers and the applications for which they seek to use it. Understanding how adaptation policy evidence develops is also important for understanding how the nature of expert authority may have changed dramatically since it was considered capable of 'speaking truth to power' (Price, 1965). Although adaptation evidence is not, and cannot, be wholly objective, expert authority has traditionally been legitimised on the basis of its ability to access objective truth. Adaptation evidence development, therefore, raises questions about whether the concepts of credibility and legitimacy proposed by Cash et al. (2002, 2003) to describe effective knowledge systems and expert authority should continue to be defined and prioritised in the ways expected by those who have traditionally produced and used science for decision-making. In Chapter

6, I propose an alternative reading of these criteria in a way that, I argue, can help to account more effectively for the inevitable tensions that arise between expert and political authority during the development of evidence for adaptation policy.

This chapter demonstrates how the entire suite of problems associated with climate adaptation seems to present a series of difficulties that make them exceedingly difficult to understand and resolve. Using the theoretical framework provided by Rittel and Webber (1973) and Levin et al. (2007) along with examples from the case-studies examined in this research, I have highlighted adaptation's wicked characteristics and its contingent nature, strongly suggesting the possibility for political influence in how adaptation problems are understood through evidence development. These characteristics raise important questions about the extent to which adaptation evidence can maintain legitimacy (i.e., political acceptability) across levels of government or across the bipartisan political divide alongside credibility and salience to ensure it is useful and usable.

Finally, I have highlighted the ways in which uncertainty manifests itself when seeking to address adaptation problems within a particular context, and from a particular government position. These uncertainties suggest that the evidence needs and contingencies of policy players may vary considerably depending on any particular problem, context or governance level and point to the ongoing challenges for the expert community in preparing salient evidence for policy makers, without falling into a linear-technocratic trap that would foment processes of politicisation and scientisation.

In Chapter 6, I seek to elaborate on these difficulties of developing credible, legitimate and salient evidence through an analysis of policy players' perceptions of evidence. This analysis will further demonstrate the contingent nature of climate adaptation problems and their susceptibility to processes of politicisation and scientisation (to be described in Chapter 7). These perceptions, in comparison with the analysis presented here, will ultimately allow for a more complete understanding of the tensions that arise between expert and political authority in the development of adaptation evidence and policy making.

Chapter 6. Perceptions of the usefulness and usability of climate science and evidence for policy

We live in a society exquisitely dependent on science and technology, in which hardly anyone knows anything about science and technology – Carl Sagan

6.1 Introduction

This chapter uses a series of 34 research interviews conducted in the UK and Australia to assess policy players'[72] perceptions of climate science and policy evidence, in order to understand the tensions between expert and political authority. Tang and Dessai (2012) and Rickards et al. (2014) have demonstrated how the knowledge systems framework developed by Cash et al. (2002, 2003) can help to understand perceptions of the usability of science for climate adaptation. Building on this work, the analysis presented in this chapter shows how, given the nature of the available climate science, the subsequent policy evidence, and the adaptation problems they seek to understand, norms, values and politics are important constituents in the development, use and perception of evidence by policy players for climate adaptation policy.

My research demonstrates that where policy players perceive evidence to lack credibility, legitimacy and/or salience conflicts exist between the values and ideals implicit or inscribed within the available evidence and the values of policy players, policy makers and the policy making norms and rules by which they abide. Investigating perceptions of evidence credibility, legitimacy and salience can, I argue, tell us much about the tensions that exist between expert and political authority at the science-policy interface for climate adaptation policy making.

My analysis of UK and Queensland policy players' views is not presented here as a direct comparative analysis between these cases. For the sake of simplicity and to avoid excessive compartmentalisation of my analysis, I present interview results in relation to Cash et al.'s (2002,

[72] Throughout this thesis I refer to *policy players* rather than *policy makers* when referring to the broad group of expert and non-expert participants in the policy making process. Where I use the term policy makers, it has been used in reference to the political executive (i.e., those democratically elected members of government).

2003) knowledge systems criteria. This presentation, I argue, allows for a simple and effective examination of the specific political factors involved across the science-policy interface during evidence development. Even so, important comparisons between the cases of Queensland and the UK are also made in the course of this analysis that help to explain the relative importance of Cash et al.'s (2002) criteria for determining evidence usefulness and usability.

This chapter begins with an analysis of the knowledge systems framework proposed by Cash et al. (2002, 2003) and which is described in some detail in Chapter 3. Here, I argue that the criteria of credibility, legitimacy and salience as described by Cash et al. (2002) are an incomplete characterisation of the normative characteristics of, and influences upon, effective knowledge for sustainable development policy. These descriptive/perceptual criteria, I argue, can often be ambiguous in practice and do not adequately account for the normative/political tensions that arise at the science-policy boundary between expert and political forms of authority. My analysis, therefore, suggests an amendment to the criterion of legitimacy in particular, in order to account more appropriately for political influences on climate adaptation science and evidence for policy making. I then use this amended framework to present and analyse the interviews conducted as part of this research, in order to elucidate the tensions that arise between expert and political authority during climate adaptation policy making.

The interview analysis presented in this chapter consists of two stages. First, an investigation of the use of the available *climate science*, comprising projections and scenarios that describe potential changes in climate variables at global, regional and even local scales. Second, an analysis of *policy evidence*: the risk and impact assessments which use this science and which seek to inform government decision making about the potential implications of climate change for government policy. My research confirms the findings of previous analyses that climate science lacks salience for policy making purposes in both the UK and Australia (Rickards et al., 2014; Tang and Dessai, 2012). My analysis, however, reflects an increasing awareness in recent years by both expert and non-expert policy players of:

1) The nature and extent of the uncertainties associated with climate science;
2) The need for other forms of evidence as a priority for effective adaptation policy (e.g., understandings of climate vulnerability and resilience);
3) The normative components of science and policy evidence and how they can conflict with the norms, values and perspectives of policy players;
4) The difficulties of using climate science in the ways expected by linear-technocratic policy models and the policy making rules by which policy players must abide; and,
5) The strongly political arena of climate change policy making.

In contrast to previous analyses, my findings suggest that there are ways in which climate science often lacks legitimacy in ways not fully accounted for by the definition provided by Cash et al. (2002, 2003). Climate change uncertainties, the underlying values inscribed in climate science, and the characteristics of adaptation policy itself mean that climate science often cannot compete with prevailing political priorities and ideologies in policy decision making. These political factors, I argue, colour not just policy players' perceptions of the relevance of the available science (i.e., its salience), the extent to which they consider the knowledge production system to be fair and unbiased (i.e., its legitimacy), but also its suitability in terms of a broader political acceptability in line with prevailing values and political priorities.

Alongside climate science, however, this chapter also investigates policy evidence outputs such as impact and risk assessments in both the UK and Australia[73]. This analysis describes the contingent character of adaptation policy evidence in comparison to the climate and adaptation science from which it is often derived, thus helping to understand the overlap that can exist between expert and political authority for policy making. My analysis suggests that impact and risk assessments for climate adaptation are often deficient across all three criteria of salience, credibility and legitimacy for many stakeholders involved in adaptation policy making. Interview participants also explain how policy evidence may be subject to covert politicisation facilitated by the linear-

[73] See Chapter 5 for a description of the important distinctions between types of policy knowledge.

technocratic nature of assessment methods. I argue that how policy players perceive the effectiveness of policy evidence often relates to the extent to which they agree with the values underpinning evidence framing, development and presentation, and reflects the difficulties of objectively understanding climate adaptation problems for the purposes of cross-level governance.

6.2 Knowledge Systems for Sustainability

As described in detail in Chapter 3, Cash et al. (2002, 2003) coined the term "knowledge systems" to describe the institutional arrangements and interactions that seek to harness science and technology for environmental decision making. They suggest three criteria by which to describe the effectiveness of knowledge:

Credibility: whether an actor perceives information as meeting standards of scientific plausibility and technical adequacy.

Salience: the perceived relevance of information for an actor's decisions, or for the decisions that affect that actor.

Legitimacy: whether an actor perceives the process of knowledge production by the system as unbiased and meeting the standards of political and procedural fairness; that the knowledge production system considers appropriate values, interests, concerns and specific circumstances from multiple perspectives.

These criteria are interdependent characteristics that must be balanced against one another. Efforts at enhancing one may diminish the other two. When addressed appropriately at the science-policy interface, effective knowledge systems must be designed in ways that minimise conflict between these criteria as much as possible while maintaining an adequate level of each.

Cash et al.'s (2003) analysis draws attention to the difficulty of effectively balancing the needs of good policy evidence in a way that preserves the privileged status of expert authority (and thus its technical credibility), while simultaneously engaging a range of non-expert policy players and stakeholders in its design and development to ensure it is salient and legitimate and therefore acceptable to those with political authority. These conflicting goals also relate to the competing problems described by Collins and Evans (2002) of legitimacy (i.e., the need to bridge the bounds between experts and non-experts to ensure that evidence is representative, unbiased and politically acceptable to relevant policy players) and extension (i.e., knowing how far it is reasonable to dilute expertise with lay and contextual knowledge) (see Chapter 3). Cash et al.'s (2002) framework, therefore, relates in important ways to the tensions that arise between expert and political authority in the development of adaptation policy.

Cash et al. (2002) argue that it is necessary for the science-policy boundary to be bridged by either scientist or non-expert policy player, or by an intermediary (e.g., a boundary organisation) in order to ensure the salience and legitimacy of the evidence produced. That is, to produce socially and/or policy-relevant science in a way that is considered "fair" and representative of appropriate values. However, too much emphasis on providing legitimate evidence through engagement with a wide range of stakeholders can compromise salience and credibility by producing evidence that fails to address the needs of any particular set of decision makers. Further, even though salience and legitimacy require a variety of both expert and non-expert policy players to have a say in the underlying norms and values from which evidence is derived, the credibility of adaptation policy evidence is dependent on privileged expert knowledge which aligns with public and political expectations for the objectivity of science and which seems to discourage the influence of non-expert input in evidence development.

Given the conflicting need for useful, usable policy evidence that requires both "sociocultural" as well as technical reason in its development (Fischer, 2009), a significant question arises, therefore, as to how we design knowledge systems in a way that ensures that the boundary between expert and political authority is appropriately observed, thus ensuring credibility, while facilitating mechanisms that allow this boundary to be effectively bridged to ensure salience and legitimacy. This seems a particularly daunting task given that, as was explained in previous chapters, the bounds of the science-policy interface, or where expert authority ends and political authority begins in the development of adaptation policy evidence is often difficult to identify. Yet, as I demonstrate further in Chapter 7, it would seem that only by effectively balancing these competing needs can we also avoid processes of covert politicisation that mask norms and values within the provision of supposedly objective evidence, or avoid the subsequent suppression of normative debate through the scientisation of policy making (Sarewitz, 2004).

In the absence of any strict prescription for its use, I argue that Cash et al.'s (2002) framework can help to elucidate these conflicting relationships more clearly. The apparent paradox arising from the competing problems of legitimacy and extension in the coproduction of policy evidence described by Collins and Evans (2002) suggests that both explicit and implicit political influences can determine the decision making authority of science, evidence and experts. Evidence development and use for policy is not just influenced by how expert and non-expert policy players interact within bureaucratic institutions, the governance rules they are subject to, and the political norms to which they must adhere (Dilling and Lemos, 2011). Evidence development is also influenced by the prevailing values and priorities of the political executive in a liberal democracy. The potential conflicts of interest encountered in the creation and use of knowledge suggests that, with some adjustment[74], Cash et al.'s (2002) criteria can be informative beyond simply understanding what constitutes useful, usable knowledge for policy. These criteria may also be used as a means to understand the normative landscape of the science-policy boundary and the tensions between expert and political authority.

Further, as my research demonstrates, these criteria can be helpful for understanding a number of science-for-policy outputs located at varying points along the continuum of evidence development for policy (described for climate change adaptation in section 5.3.3), and upon which both experts and other policy players have varying levels of input to. In the next section, I discuss these three criteria in more detail and explain why, in order to fully account for the tensions

[74] Cash et al.'s (2002) criterion of legitimacy does not quite align with the concept of legitimacy described by Collins and Evans (2002).

between expert and political authority in evidence development and use, they require some adjustment to account for prevailing political priorities and ideals.

6.3 The importance of political acceptability for the legitimacy of effective knowledge systems

As described in chapter 5, there is no simple or linear interaction between science and policy for climate change policy making. As climate science approaches the spheres of policy making and politics, it is manipulated in ways that ensure it is comprehensible and normatively acceptable for policy makers to use. Experts must address normative/political questions in the development of their research outputs and evidence, just as other policy players must provide important subjective and normative input to expert evidence to make it useful and usable. My analysis investigates the perceptions of various policy players in relation to two points in the development of evidence-based adaptation policy making.

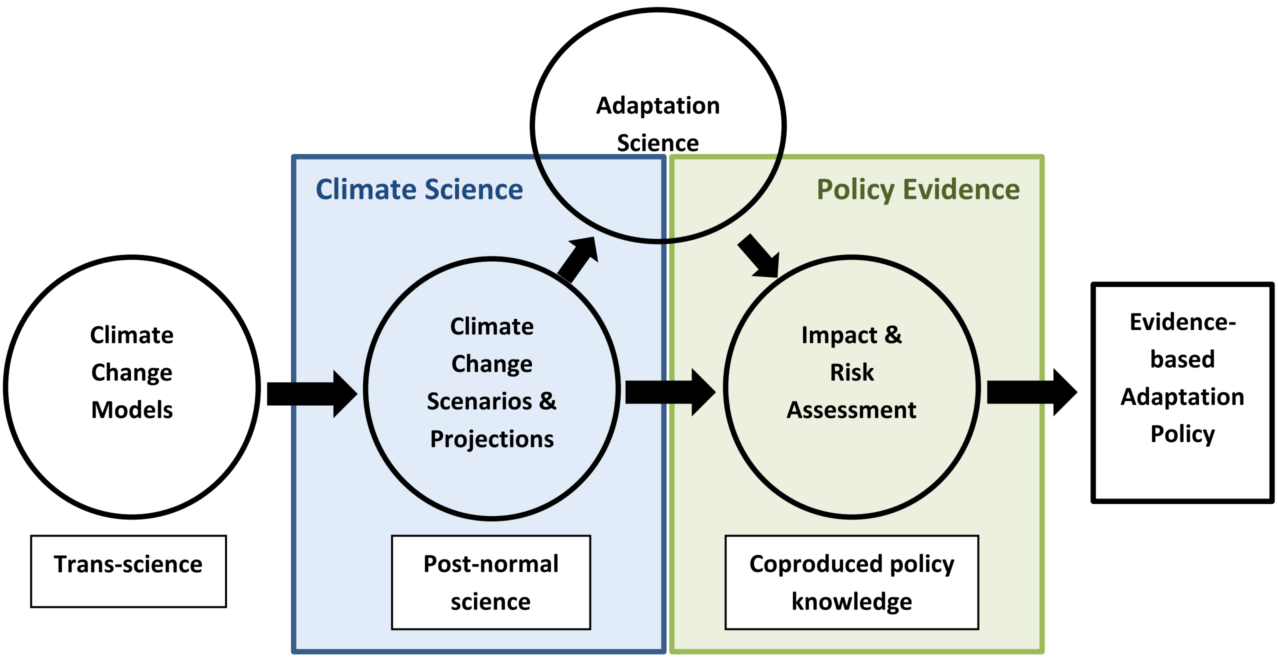


Figure 6.1. Climate Science versus Policy Evidence – a two stage analysis

First, an analysis of climate science as it is presented to the policy making community, and second, an analysis of the policy evidence that is derived from this science alongside a range of other information relating to issues of vulnerability, resilience, and socio-economic and political prioritisation. However, in the context of investigating these two types of policy knowledge, it is useful to examine Cash et al.'s (2002) framework in more detail to understand some of the difficulties it encounters as a descriptive model of the ways in which norms and values influence evidence development and use for climate adaptation policy making.

Cash et al.'s (2002: p. 1) paper explores "how effective boundary work involves creating salient, credible, and legitimate information simultaneously for multiple audiences". In doing so, however, their characterisation appears to involve a range of ambiguities and uncertainties relating to the interdependent relationships between their proposed criteria, as well as the interactions between knowledge production systems and the broader sphere of policy making. While interdependencies between these criteria are inevitable, some of the ambiguities that are largely left unaddressed by Cash et al. (2002, 2003) suggest a need to rethink their precise definitions. In particular, I argue that Cash et al.'s (2002) criteria fail to adequately address the extent to which effective knowledge production occurs (or can occur) in isolation from the prevailing political forces that act upon climate adaptation policy making.

For instance, the concept of evidence salience as defined by Cash et al. (2002) raises important questions about its interaction with the political acceptability available for that evidence and for the particular policy issues evidence seeks to inform. Their characterisation of salience, I argue, fails to fully elucidate this relationship between expert knowledge and political priorities during evidence development for policy making. In a liberal democracy we might expect expert authority, generally speaking, to be relevant (i.e., salient) for use in policy making since the absence of expert advice would result in purely ideological decision making that would suffer from a deficit of rationality and therefore of public acceptability (Weingart, 1999; Jasanoff, 1990). Yet, granting expertise a seat at the policy making table does not mean that individual sets of evidence will necessarily be salient. Salience for specific types of evidence will depend upon the political acceptability of particular policy issues to which that evidence aligns, or upon the acceptability of normative/political positions which are contained within, or ascribed to, that evidence by policy players/makers. As Weingart (1999: p. 156) notes: *"If scientific knowledge is linked in any way to 'interests' (in policy-making), it is evaluated as supportive, contradictory, or even dangerous"*.

For example, in the case of climate adaptation policy making, we can say that issue identification and framing (e.g., in relation to the political acceptability for anthropogenic climate change – see Chapter 4) is a necessary precondition for the salience of climate change science[75]. However, in turn, making evidence more salient through processes of 'post-normal' science, consultation and coproduction may enhance the political acceptability of available knowledge and therefore enhance the legitimacy of associated policy issues. As McNie (2007: p. 20) notes: "Production of salient, and thus relevant, information increases the likelihood that future decisions will be embraced". Without knowledge of the framing of a policy issue like climate adaptation, and the political acceptability of experts' conclusions about this issue, I argue, it is impossible to fully understand or perceive the salience of evidence for a problem like climate adaptation.

Salience, as defined by Cash et al. (2002), however, seems to relate to the specific and practical utility of evidence for informing the decision making process once a policy issue has already been identified and its framing has already been agreed upon[76]. In this situation salience is dependent on processes of consultation and negotiation between evidence producers and users to understand their information requirements (see for example, Hulme and Dessai, 2008). This concept of salience, I argue, is at least partially dependent upon the prior and ongoing political acceptability of a given policy issue and therefore upon how it is framed by the political executive, since policy issues can often be framed in ways that make important sets of evidence irrelevant to begin with. Weingart (1999: p. 157) envisages the issue of agenda-setting for policy issues with scientific underpinnings in terms of a 'recursive model' rather than the usual linear alternative of "problem perception-expert advice-political decision". This recursive model involves the following stages:

[75] For example, note the contrasting frames under which this policy problem has been cast in Queensland and the UK; alternatively note the UNFCCC's framing of climate change as a man-made phenomenon which resulted in significant problems for its resolution through the Kyoto protocol, as well as a central preoccupation upon GHG mitigation to the neglect of climate change adaptation (Pielke Jr. et al., 2007)

[76] Note for example the interpretations of salience made by Tang and Dessai (2012) and Wilbanks and Kates (1999) amongst others when highlighting the problems of developing relevant climate change science.

> *Perception of the problem may come either from the scientific community or from policy-makers. In the political process it is transformed according to political criteria of relevance. As a political programme funding research for further clarification of the initial problem, it is handed back to the scientific community. The scientific community, in turn, executes the pertinent research whose results become the basis for continuous adaptation of the initial problem perception* (Weingart, 1999: p. 157).

Salience as described by Cash et al. (2002, 2003), that is, a characteristic that encompasses only the latter part of this model, therefore, seems somewhat limited in the context of understanding its relationship with the criteria of legitimacy and credibility, since it does not fully account for its relationship with a broader political acceptability for the underlying policy issue and its framing.

Similarly, while Cash et al.'s (2002) definition of legitimacy refers to the importance of accounting for values, interests and specific circumstances from multiple perspectives within the knowledge production process and therefore appears to doff its cap to political influence and the need for political acceptability for the resultant evidence, this definition is worded in a way that confines this political influence to the production process itself and not also to perceptions of the knowledge produced. As a result, I argue, the concept of legitimacy as Cash et al. (2002) define it appears very similar to their concurrent definition of credibility; if a knowledge production process is not fair or is thought to be biased, then presumably the resulting knowledge lacks technical credibility in the eyes of those who seek to use it. Cash et al.'s (2002, 2003) distinction between credibility and legitimacy also appears, rather perversely, to lack usability itself, as demonstrated by its application in the studies of Weichselgartner and Kasperson (2010) and Tang and Dessai (2012) whereby these terms have been commonly conflated and confused by interview participants asked about the utility of evidence for policy.

Cash et al. (2002, 2003) fail to explain why their description of legitimacy (as a characteristic of knowledge production rather than the knowledge itself) is important and distinct from the concurrent idea of credibility as a determinant of effective knowledge systems and evidence for policy, while the political legitimacy (or acceptability) of the resulting evidence is not. One reason may be that it is not easy (perhaps not even possible) to purposefully design effective knowledge systems in a way that can produce evidence that will be both politically acceptable and wholly credible. As Dilling and Lemos (2011) argue, it is not possible for experts to control the context in which their evidence will be used. However, this focus may also arise from a desire to understand the knowledge system and not simply the resulting knowledge.

Weichselgartner and Kasperson (2010) suggest that knowledge systems are more usefully conceptualised from an actor and institution focus than from an information focus. Yet, as a descriptive model rather than a prescriptive one, I argue that an effective knowledge systems framework should seek to adequately account for the tensions between expert and political authority during evidence development and therefore must account for the relationship between the knowledge system and prevailing political influences. In a liberal democracy, these tensions are strongly prevalent for both the development and use of evidence for policy making, particularly for issues as contentious, uncertain and complex as climate change. As such, the criteria of credibility, legitimacy and salience as defined by Cash et al (2002) appear somewhat limited because they fail to fully account for this broader influence from politics.

I argue that a broader concept of evidence legitimacy, interpreted as a political acceptability for the evidence itself, can more effectively inform us about the tensions inherent between expert and political authority within liberal democratic government. This revised concept encapsulates and transcends issues concerning the fairness or unbiased nature of the knowledge production process. When conceived of as a broader political acceptability, the legitimacy granted to evidence for policy making is, I argue, derived from a combination of expert authority (itself derived from the credibility, salience and legitimacy (as defined by Cash et al. (2002)) of the available evidence) as well as the prevailing values and priorities of political authority (derived from democratic representation). If we assume that good policy decision making (and therefore effective knowledge systems) is dependent upon some combination of expert and political authority[77] (Ezrahi, 1990), the absence of one form of authority will likely have adverse effects upon the acceptability of the other and therefore upon the acceptability of any subsequent decisions. This definition also aligns more appropriately with the

[77] Since, a lack of political authority would result in technocracy, and a lack of expert authority would result in purely ideological decision making.

concepts of legitimacy and extension used by Collins and Evans (2002) when seeking to explain the ongoing tensions between expert and political authority.

I propose, therefore, the following revised definition of legitimacy to help describe effective knowledge systems for climate adaptation policy making:

> **Legitimacy: The degree to which information for policy making is considered politically acceptable and the process of knowledge production considered to be unbiased and inclusive of appropriate values, interests, concerns, and specific circumstances from multiple perspectives.**

The concept of legitimacy as both a characteristic of evidence itself and the knowledge production process, one that encapsulates a broader political acceptability for evidence in decision making relates in important ways to evidence credibility since a lack of political acceptability for certain evidence sets may well reflect in policy players' subsequent perceptions of evidence credibility (Kahan et al., 2012). Yet, I argue, this concept is less ambiguous with concurrent understandings of credibility than Cash et al.'s (2002) original definition of legitimacy seems to be. Likewise, this revised definition of legitimacy relates in important ways to the concept of salience; political acceptability is an important precondition for the salience of particular tranches of expert knowledge (e.g., climate change science) as well as for subsequent endeavours to make that expert knowledge more salient for policy making. Thus, this revised definition also appears to align usefully with Weingart's (1999) concept of a recursive model of agenda-setting for evidence-based policy.

6.4 How can perceptions of Credibility, Legitimacy and Salience inform our understanding of the science-policy interface?

On the basis of this revised definition of legitimacy, I outline here some of the reasons that we might expect climate science and policy evidence to fail the tests of credibility, salience and legitimacy, which emerge from the analysis of preceding chapters. As shown in figure 6.2 below, there are a variety of potential reasons why the usefulness and usability of science and evidence, as measured by these criteria, may be perceived as deficient as a result of the conflicting and contrasting norms, values and perspectives of policy players.

Credibility:

Given the technical difficulties of producing accurate projections of future climate change (Frigg et al., 2013a,b), as well as the difficulties of objectively understanding the likelihood and consequences of specific climate change hazards and resulting impacts and risks (see section 5.4), the potential exists for scientifically literate policy players to question the credibility of climate science and subsequent policy evidence on the basis of its technical failings when attempting to adequately and impartially inform policy decisions[78]. Conversely, we might expect policy players who are not scientifically literate to question its credibility, given the politically divisive nature of the climate change problem and the presence of intractable uncertainties. However, scientific literacy may not necessarily be a determinant of the perceived credibility of the available science. As indicated by a recent US study, a perceived lack of credibility in the available climate science does not necessarily relate to an ignorance of that science, but rather, may actually result from a cognitive dissonance[79] between the norms and values of policy players and the conclusions of the available expert knowledge (Kahan et al., 2012).

Legitimacy:

Given the contingent nature of climate adaptation problems (see sections 5.3 and 5.4), it seems reasonable to expect that climate science and policy evidence may suffer a lack of legitimacy as a result of its implicit conflict with prevailing socio-economic values and priorities (see Chapter 4). Legitimacy may also be deficient for those stakeholders and policy players not involved or consulted in the derivation of those knowledge outputs. This lack of legitimacy seems likely to be most acute amongst policy players at levels of government that differ from those at which policy evidence is

[78] Given the increasing stigma associated with climate change scepticism and denial, policy players may be unwilling to openly question the theory of man-made global warming, however, they may still question the ability of available climate change scenarios and projections to accurately depict the future.

[79] Cognitive dissonance is the mental conflict experienced by an individual who holds two or more contradictory beliefs, ideas, or values at the same time, or is confronted by new information that conflicts with existing beliefs, ideas, or values.

derived, or amongst those concerned with geographical, jurisdictional or temporal levels of governance that do not correlate with the levels at which climate science and policy evidence is presented.

Further, policy players may perceive a lack of legitimacy where the available science and policy evidence does not correlate with the temporal scale[80] relevant to their decision making, or that is not easily used with tools or methods such as risk assessment and cost-benefit analysis prescribed by government. In such cases the available evidence may be technically incompatible but may also conflict with prevailing norms and values that strive to:

a) Establish a short term economic business-case for policy measures (thus aligning with economic-rationalist ideologies that prevail in both Australia and the UK); or,
b) Establish determinacy in the effectiveness of proposed policy measures to justify action (thus aligning with rationalist or linear-technocratic norms concerning the utility of expert evidence for policy making) (see sections 3.2, 5.4).

Finally, it may be expected that policy players may perceive a lack of legitimacy when the available science and policy evidence is not sufficiently useful for addressing their normative concepts of climate and/or societal resilience. As discussed in Appendix B, alternative concepts of resilience can have a considerable impact on the types of policy responses attempted by policy players (Prosser and Peters, 2010). Contrasting adaptation problems relating to, for example, ecosystem services, wildlife conservation, disaster risk management and water resource provision (see section 5.5) invoke differing disciplinary lenses of expertise which have their own established norms, values and concepts of resilience. These alternative expert viewpoints relating to the dynamics and functioning of social-ecological systems may make certain types of science and evidence more legitimate for policy players than others depending on their congruence with policy players' own resilience-based norms and values.

[80] In this case, it may be said that there are different types of temporal scale: political, climatic, economic, each of which have their own varying levels (e.g., annual, political (i.e., 3 – 4 year term), regulatory (e.g., the UK water industry is regulated on a 5 year cycle), decadal, climatic (i.e., 30+ years)).

Salience:

Given the interconnected nature of these three criteria (Cash et al., 2003), we can expect that some of the reasons for a lack of salience in the available knowledge may mirror those reasons for a lack of legitimacy and/or credibility described above. In particular, although differences between scales and levels of governance and of evidence provision may impact upon perceptions of knowledge legitimacy – due to conflicting norms and values between those of users and those inherent in the available knowledge – they are also likely to impact upon the salience of that knowledge since such a disconnect of scales and levels is likely to provide technical difficulties in meeting users' evidence demands. In other words, climate science and policy evidence provided at any given scale (geographical, jurisdictional, temporal) or associated level may be problematic in practice for users concerned with decision making at alternative scales and levels. Likewise, although policy evidence may lack credibility due to its inability to account for the complexities and uncertainties of certain adaptation problems, this also means that the evidence that is produced may also lack salience for decision makers (see sections 5.4 and 5.5).

The preceding analysis also suggests that the salience of climate science and policy evidence may be compromised where policy players cannot use that knowledge in the ways expected by linear-technocratic policy prescriptions (see section 3.2). For instance, where the available evidence is not provided in deterministic formats (or at least using objective probabilities of occurrence), or is expected to be used in a linear way to inform policy decision making yet requires coproduction that runs concurrent to policy making processes, then such knowledge may be perceived to lack salience.

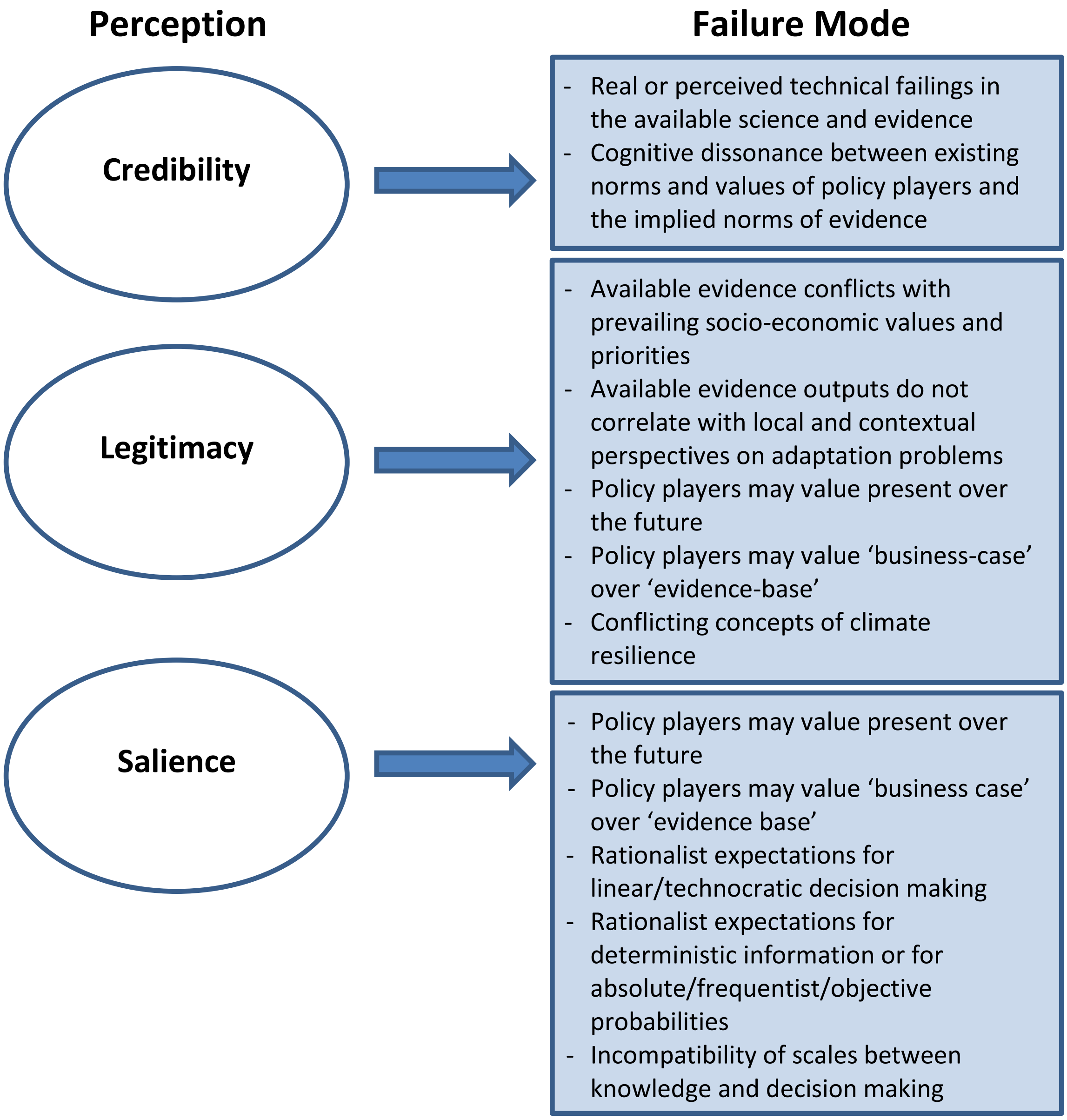


Figure 6.2. How credibility, legitimacy and salience may be compromised by the norms and values of policy players

Thus, we can see how the credibility, legitimacy and salience of climate science and policy evidence may be influenced by the normative landscape of the policy making sphere (see Figure 6.2. above). It is against these anticipated potential normative conflicts that I now test the perceptions of policy players.

6.5 The credibility, salience and legitimacy of climate science – climate change projections and scenarios

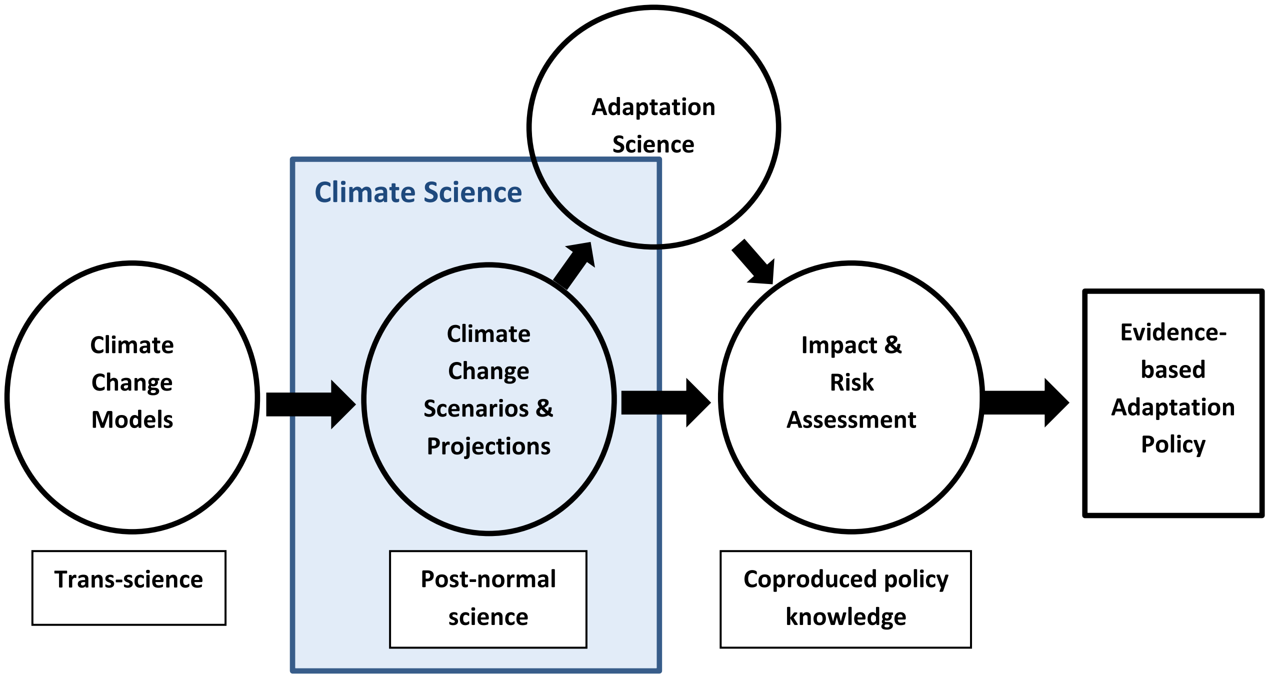


Figure 6.3. Part one analysis – The credibility, salience and legitimacy of climate science

Successive UK governments have invested considerable resources in the development of a portfolio of usable climate science to inform decision makers. This investment has principally been coordinated and developed since 1998 by the UK Climate Impacts Programme (UKCIP) (Hulme & Dessai, 2008). UKCIP's scientific products have received strong government backing, aligning with an ongoing bipartisan commitment to evidence-based policy and an expectation that climate science should be used for statutory reporting requirements mandated under the *Climate Change Act (2008)*, as well as for informing policy making and implementation more generally (DEFRA, 2009; UK Policy Scientist 1; UK Policy Players 1,4). In the Queensland case, by contrast, there has been much less concentration on the production of standard evidence outputs for policy making, perhaps as a result of the lack of political consensus concerning climate change policy (see Chapter 4). Queensland policy players have relied on varying sources and methods to understand the science of future climate change; for the most part, policy players have relied on the outputs of the IPCC and scenarios and projections developed by CSIRO, the Bureau of Meteorology, and by external consultancy, amongst others (Rickards et al., 2014).

While the credibility, legitimacy and salience of science and evidence in policy making may be at least partially interdependent, these concepts can also be difficult to differentiate for policy players (Tang and Dessai, 2012; Weichselgartner and Kasperson, 2010). For instance, in the course of my research, participants' views of the credibility of the science were often tied up with ideas about the degree to which that science adequately incorporated contextual viewpoints, was developed in a fair and transparent manner and was therefore considered legitimate. My analysis will differentiate between these concepts where interviewees made clear they were referring to one concept over another, but will speak about these issues in tandem in circumstances where these criteria were engaged simultaneously by interview participants.

6.5.1 Credibility:

Overall, interview participants in both the UK and Australia supported, explicitly at least, the view that the available climate science is credible and technically robust. It is worth noting however that if, as recent studies suggest, a principal reason for a lack of credibility in climate science relates to a cognitive dissonance between the implied values of climate science and pre-existing norms and values (Kahan et al., 2012), then there appears to be an important link between the credibility of climate science and its legitimacy.

Given this link between credibility and legitimacy, it also seems possible that those who do not consider climate science credible may have been reticent to participate in this research. If the problem of climate change suggests a major market failure (Stern, 2006), this would suggest that those on the left who tend to be more critical of the market are less likely to experience cognitive dissonance concerning the credibility of climate change science than those on the right who place greater faith in market rule. This conclusion is supported by the fact that, in the Australian case, those who identified themselves as being on the left of the political spectrum appeared to be more willing to participate in this research than those on the right. This interaction between prevailing political and socio-economic values and the credibility of the available evidence appears to support my conclusion here that perceptions of expert authority (in terms of Cash et al.'s (2002) criteria) cannot be separated from the norms and values of political authority.

Climate science is credible, yet it has technical inadequacies

Although when asked, interview participants almost universally agreed that climate science is credible, some participants subsequently appeared to call this credibility into question when pressed about their views about climate science usefulness and usability. For instance, some policy players suggested that attempts to make climate science more salient had weakened its credibility (Aus-Policy Scientists 1,2; UK-Policy Scientists 3,10). As one UK policy player commented in relation to UKCP09's attempt to provide probabilistic climate change projections:

> *I think [UKCP09] tried to answer what the practitioners said they wanted but […] in no other field do you try to quantify the unquantifiable. To a certain extent the scientists, i.e. the UKCIP fraternity, tried to provide the answer even though the question may not have been answerable* (UK-Policy Scientist 10).

Two other expert participants (one from Australia and one from the UK) openly questioned the credibility of climate change models as a determinant of pre-emptive policy making in the ways that it had been used to date[81]:

> *My opinion is that the projections are nowhere near good enough […] as a modeller, I believe in climate change, I believe something is happening, but I don't believe the models. […] it's a really complex thing to cover, and to try and build all the micro-physics based rules to projections in the long term to say we definitely know what's going to happen in 50 years' time* (Aus-Policy Scientist 1)

> *I think there's also a growing recognition that the very traditional top-down way of doing climate projections is not necessarily the most appropriate way* (UK-Climate Change Scientist 5).

Indeed, these views have recently been supported by the work of Frigg et al. (2003a,b) who have demonstrated how structural model errors and downscaling methods used in the UKCP09 outputs make their use as a predictive tool in a linear or top-down fashion for adaptation planning unwise since there are significant unresolved (and perhaps unresolvable) questions about the validity and accuracy of model output, particularly toward the end of the twenty-first century.

---

81 That is, under a linear-technocratic policy making schema

Other interviewees suggested that the credibility of climate change projections was principally maintained on the basis of the famously universal expert consensus on climate change, rather than on the strength of the available evidence per se (UK-Policy Scientists 9,10) – a view that aligns with recent contentious views expressed from within the climate science community itself (Curry, 2013). These interviewees also suggested that common simplifications used by policy players in the UK concerning the conclusions of the available evidence such as the oft-used mantra 'warmer wetter winters; hotter drier summers' (Carrington, 2014; The Met Office, 2009) often failed to adequately account for the strength of that evidence and the uncertainties involved.

A number of both Australian and UK participants expressed concern that climate science was unable to account for the full range of uncertainties associated with potential future climate change (Aus-Policy Scientist 1; UK-Policy Scientists 9,10; UK-Policy Player 4). Some expressed the view that the outputs from UKCP09 in particular lacked credibility as assessments of probability of future climate outcomes because they did not cover the full range of uncertainty nor provide a credible estimation of likelihood of occurrence (UK-Policy Scientists 7,9,10). As one UK participant noted:

> *We often went down the route of looking at some of the finer resolution projections coming out of UKCP09 but the problem is that it seemed to then cause a false level of certainty in peoples' minds around what they actually know, and then when you took a step back and said well actually the error bars are so huge it could be plus or minus then in a way it invalidates that level of precision they were looking for, so we've all had to take a step back and look at the gross changes* (UK-Policy Scientist 7).

Meanwhile, both Australian and UK participants stated that it is becoming increasingly difficult to maintain the credibility of climate change projections amongst non-expert policy players and the public given the lack of congruence between projections and the observational weather and climate record over the past 15 years (Aus-Policy Scientist 2). For example, in the UK drier summers and warmer winters are projected by UKCP09 even though there has been a recent trend of wetter summers and a series of very cold winters[82] (UK-Climate Change Scientist 5).

[82] Notwithstanding perceptions of policy players and the public in this regard, recent research suggests that the recent trend of cold winters may actually be due to anthropogenic climate change (Mori et al., 2014)

6.5.2 Legitimacy:

Following a revised interpretation of legitimacy to that first proposed by Cash et al. (2002, 2003) – that is, legitimacy interpreted as a measure of the political acceptability of the available evidence, rather than simply a measure of the unbiased nature of the knowledge production process – interview participants suggested the following related reasons for a lack of legitimacy in the available climate science:

- Conflicting values and political partisanship in relation to the broad issue of climate change; and,
- A lack of participation from users in evidence development.

Legitimacy as political acceptability: conflicting values and political partisanship

In Australia a number of interviewees suggested that scientific uncertainties can be used by policy players to fortify political positions that conflict with the conclusions of experts (Aus-Policy Scientists 1,2,3). As one participant suggested:

> *Stakeholders who have got a position, select [interpretations of] science to suit their position, not to make a decision* (Aus-Policy Scientist 1).

Interviewees advising and working in government departments at various levels indicated that the science of climate change is often insufficiently legitimate to alter conflicting political priorities or to meaningfully inform or direct relevant policy issues as a result (Aus-Climate Change Scientists 2,6; Aus-Policy Scientists 4,6; Aus-Policy Player 1,2; UK-Policy Scientist 8). This is not to suggest that climate adaptation does not occur in Australia under the guise of concurrent policy portfolios. As discussed in Chapter 4, again in section 5.4.1 for the case of Queensland, and as one prominent climate scientist noted in interview, what this lack of legitimacy for climate science means in practice is that conservative Australian governments at all levels have continued to pursue climate adaptation either explicitly or through concurrent policy priorities such as disaster risk management, while simultaneously calling into question the legitimacy and/or credibility of climate science and the acceptability of climate *change* policies as a result:

> *Whether we have political bipartisanship or partisanship affects how people view climate science, […] people will believe something because the politicians are saying [it] rather than because of their understanding of climate science* (Aus-Climate Change Scientist 2).

Confirming the analysis presented in Chapter 4, interviewees suggested that policy players in Australia often do not question that the climate is changing, or even that humans have an influence upon it, but may question the legitimacy of scientific conclusions concerning the extent of human influence and will therefore use the associated uncertainties to legitimise their own political positions (Aus-Climate Change Scientists 2,6):

> *Once [climate change] enters the political realm, people seem to be able to turn off the rational part of their brain that says […] the science is telling me this and I should believe it, and they flip to 'I follow that political party or that line of [political rhetoric]' […] and for whatever reason that seems to over-ride any rational understanding* (Aus-Policy Scientist 2).

Thus it appears that climate science has held limited legitimacy for policy making in Queensland in recent years. This reflects, I argue, an ongoing conflict between the values underlining climate science and evidence and those policy priorities of conservative state government. This conflict of values has also resulted in policy makers in state government passing adaptation issues to local government where issues of salience ensure that climate science is unlikely to be used:

> *The political system is pushing the decision making on how to implement the evidence to the lowest level [of government], a level that has the least capacity and ability to be able to understand and apply it […] the planning scheme […] probably doesn't give them the ability to consider climate change and what it's true impact is* (Aus-Policy Player 2).

These findings suggest that policy and evidence legitimacy is determined principally by political values and preferences than by any objective rationality that might be provided by expert authority.

In the UK, a similar lack of legitimacy has become manifest in the Cameron government's position on climate change. Although adaptation policy is required from central government and amongst government regulators mandated under the *Climate Change Act (2008)*, the requirements placed on local government for the reporting of adaptation policy development and implementation were scrapped in 2010:

> *If there's different messaging from the very top, again it gets picked up by the people we might be wanting to work with, and it does make it harder in some respects to win the argument that they need to do things differently* (UK-Policy Scientist 8).

This shift reflects a relative downgrading of adaptation and climate change policy more generally by the Cameron government (UK-Policy Scientist 5; UK-Policy Players 1,2,4) (see also Chapter 4).

Interviewees in the UK also suggested that a perceived lack of salience for the available science (see 6.5.3 below), has been used to delay policy action in a way that also suggests an increasing lack of legitimacy for climate science. As some participants argued, rather than helping people to understand the nature of climate change and the associated uncertainties, and therefore to address adaptation problems more effectively, climate science as provided by UKCP09 may actually foment the propensity for inaction on the basis that people don't know how to deal with the uncertainties and so decide to do nothing or ask for more and better research (UK-Policy Player 4; UK-Policy Scientist 4,5).

As discussed in Chapter 5, this tendency toward inaction on the basis of inadequate evidence is reflected in the content of many existing adaptation plans in the UK, as well as the various (now defunct) climate change adaptation plans in Queensland, whose principal focus has been on the further reduction of uncertainties in advance of taking substantive policy action, rather than taking decisive measures in the face of that uncertainty (see for example, EA, 2010a; Dedekorkut et al., 2010). Does this tendency toward inaction or delay simply indicate policy inertia due to a lack of salience and the failure of evidence to meet the expectations of policy players? Or does this also indicate that climate science lacks sufficient legitimacy to compel policy decisions?

This latter possibility has been suggested by those interviewed for this research due to a conflict between the types of decisions required for climate change adaptation policy and the underlying norms of government relating to their preference for short term policy priorities and incremental change. In other words, in the UK, although local government policy players may explicitly wish to pursue adaptation policy and, superficially at least, believe climate science is credible, this science is nonetheless insufficiently legitimate or salient to justify substantive policy action in the face of government's preference for the pursuit of short term economic priorities[83] and evidence relating to costs and benefits of action that support those priorities. As one UK interviewee put it:

> *Evidence base is interesting, but in our organisation now, it's the business case, it's the, why should we be doing it, what's the economic benefit? And it's not good enough to say, oh you know if you do it now it's cheaper than having to deal with it in ten years' time, [be]cause again that comes back to the robustness of the 'fact' that you are going to have to deal with it in ten years' time* (UK-Policy Player 2).

Box 4. Failing policy and evidence legitimacy – Seeking financial support for infrastructure improvements in SEQ:

Although the Queensland Reconstruction Authority[1] (QRA) follows the mantra "Build it back better" (QRA, 2011), referring to an intention to make damaged infrastructure more resilient to future extreme climate events, the influence of partisan politics may complicate the achievement of this aim in practice. Alongside the Newman government's decision to scrap all climate *change* adaptation policy in the state[2], there is also a financial disincentive for the QRA to consider any future increase in the severity and frequency of extreme events associated with climate change. Under the National Disaster Relief and Recovery Arrangements (NDRRA) guidelines, federal government provides financial support to state government to rebuild infrastructure on a like-for-like basis, except for essential public assets where the state can demonstrate the cost effectiveness of enhanced measures and their ability to mitigate future natural disasters (Australian Government, 2012). According to one interviewee who has been involved in administering these state funding applications to Commonwealth government, this means in effect that most efforts to adapt to future climate change through the enhancement of infrastructure resilience must be financed by state government alone (Aus-Policy Player 2).

This disincentive, I argue, reflects insufficient legitimacy for climate science to effectively inform policy through the development of a business case. No surprise therefore that the QRA's Strategic Plan 2014-15 makes no mention of climate change (QRA, 2014). Further, the Queensland Newman government (2012 – 2015) handed most responsibility for adaptation planning to local government[3] (Rickards et al., 2014; Preston et al., 2013), who have the least financial resources and technical capacity to deal with adaptation issues. In effect, what this shifting of responsibilities and financial burden means is that there is little or no political space to incorporate climate science into policy making or to consider climate adaptation strategically across the region (Aus-Policy Players 2,3)

[1] The QRA is a temporary government organisation set up in response to flooding events across the State of Queensland in 2010/2011.
[2] Although Queensland's Department of Environment and Heritage Protection (DEHP) is in the process of developing a climate adaptation plan, according to one interviewee it will largely avoid the issue of climate change or the explicit use of climate change science (Aus-Policy Player 3).
[3] Through changes to the *Local Government Act 2009* (Queensland Government, 2014a)

[83] This difficulty also reflects a conflict of temporal scale between the evidence needs of policy players and climate change science.

Similar views were expressed by a number of UK and Australian participants working at the science policy boundary. Just because the science suggests that one ought to take action does not mean that the evidence provides sufficient justification for action amidst a range of competing interests, priorities and competing sets of evidence. The conclusions drawn by climate scientists are based on a set of assumptions that are not necessarily shared by a wide range of stakeholders. One prominent Australian policy scientist described how discussions with civil servants working in Commonwealth ministerial departments on the issue of climate adaptation had revealed how the simple presentation of scientific evidence to those policy players had been insufficient on its own to justify policy, even if the conclusions that could be drawn from that science appeared to be unambiguous and suggested obvious courses of action:

> *What I've just described has arisen out of us taking evidence about climate change to things like the Department of Climate Change and saying 'we ought to be adapting to that and them saying 'eh, why do you think that?' or 'that's not a good enough [justification]' Just saying there's an impact and even that there's an impact and we know what could be done to adapt is nothing like enough to make a convincing case for us to take to Treasury* (Aus-Policy Scientist 4)

Legitimacy as fair and unbiased knowledge production: a lack of participation from users in evidence development

Some interview participants suggested that climate science may lack legitimacy (and/or salience) as a result of insufficient input from the user community in the development of these outputs, in particular in relation to UKCP09 (UK-Policy Scientist 3; UK-Policy Player 4). As argued in Chapter 5, although UKCP09 appears to constitute post-normal science as a result of consultation with a range of expert and non-expert evidence users in its design, a number of those interviewed believed that this consultation did not extend far enough. For example, a number of UK climate scientists interviewed who were on the expert steering group for UKCP09 were also on the User Panel set up to ensure the usability of UKCP09 outputs (UK-Climate Change Scientists 4,5; UK-Policy Scientist 5). These participants suggested that the latter group was only convened after most of the substantive decisions around the format of these projections had already been made. Indeed one key expert contributor to both the steering group and user panel conceded that neither group gave much consideration to the usability of Probability Density Functions (PDFs) and Cumulative Distribution Functions (CDFs) (see section 6.5.3 below) as appropriate formats for salient evidence for decision making:

> *The scientific advisory group and the user panel, by the time that those were set up and we began meeting, a lot of the major decisions had already been made so in some ways we were kind of tweaking things, so I think we did comment a bit on language and terminology but I mean the basic methodology was already in place* (UK-Climate Change Scientist 5).

The PDF/CDF formats were chosen in response to requests from those in agriculture, water and energy sectors for probabilistic information about future climate impacts (UK-Climate Change Scientists 5,4; UK-Policy Scientist 3), even though these stakeholders do not appear to have been consulted any further in the development of those products beyond this initial consultation phase. This lack of representation by the user community in the development of UKCP09 suggests not only a lack of legitimacy in the knowledge production process for users of this information, but also a lack of salience for that evidence where it failed to be relevant for evidence users (see section 6.5.3 below).

6.5.3 Salience:

The interpretation and use of climate change scenarios and projections has been a difficult process for those decision makers concerned with climate adaptation policy, as demonstrated by the testimony of participants in this research. There was general agreement amongst those interviewed in both the UK and Australia that these scientific outputs lack salience for policy making, despite a persistent popular expectation that such evidence was a principal source of information required for effective adaptation policy. The reasons for this lack of salience generally related to the following difficulties:

- Insufficient information about the vulnerability and exposure of receptors[84] to climate impacts;
- Competing types of evidence are considered more salient at relevant temporal and geographic scales;
- Climate science and its related uncertainties are highly complex and prone to misinterpretation or a mismatch of scale/level between what scientists provide and policy makers need or expect; or,
- Climate science is often poorly communicated by the scientific community.

Insufficient information about the vulnerability and sensitivity of receptors

A majority of those interviewed agreed that although the science of future climate change is important, other forms of evidence are also required for policy making. Indeed many interviewees believed that, contrary to popular perceptions, climate science was in fact a secondary concern given the nature of the available evidence and the uncertainties associated with it. This insight was generally provided by those with direct experience of using climate and adaptation science for risk/impact assessments and the development of adaptation plans and policy (UK-Policy Players 1,2,3,4; UK-Policy Scientists 5,6,7,8,9; Aus-Policy Scientists 4,5; Aus-Climate Change Scientist 1):

> *It was never the case that [for] any adaptation decision you have to just go straight to the projections and they'll give you the answer, actually it's much more complicated than that, and in quite a lot of cases you don't need to use them at all* (UK-Policy Player 4).

There was general consensus amongst those interviewed that the salience of climate science is dependent on scientific and technical information being available for other socio-economic and ecological determinants of climate adaptation and resilience:

> *Climate science […] pretty well has done all it can do. And you really have to start at the vulnerability perspective and really understand the vulnerability, at which time climate is a source of information that has to be considered* (UK-Policy Scientist 5).

Evidence relating to future climate change was only meaningful in the context of adequate understandings of this vulnerability and exposure to climate for any individual receptor, community

[84] Communities, institutions and individuals susceptible to climate risk

or government jurisdiction. As one UK interview participant noted of UKCP09 in relation to its use for local government decision making:

> *It's like handing somebody a dictionary, you can start reading the dictionary at page 1 and you'll learn stuff, but it only becomes useful to you when you actually know what you're looking for, and I think with UKCP09 you have to have done a little bit of groundwork to understand what […] kinds of impacts you've already seen, if you're lucky what kind of thresholds you've already seen* (UK-Policy Player 1)

This perspective appears to conflict with long held expectations within policy making circles that climate science is the principal source of evidence required for adaptation policy or that, on its own, climate science can better inform decision making (UK-Policy Scientists 5,9; Aus-Policy Player 1; UK-Climate Change Scientists 4,5; Dessai & Hulme, 2003).

In fact, a majority of those interviewed across both case studies believed that the most important form of evidence required for effective adaptation policy and decision making is an improved understanding of community and organisational vulnerability and exposure to existing climate variability, and to a lesser extent, their vulnerability to future climate change:

> *To understand the climate change impacts first you have to understand this situation with or without climate change in some respects* (Aus-Policy Scientist 6).

Many interviewees stated that these sources of evidence are often missing when making (in particular strategic) adaptation decisions and in order to fill this gap many believed that a range of expert and non-expert policy players need to be involved in the development of evidence. For example, one UK participant who had been involved in the development of both the UKCCRA (DEFRA, 2012a,b) and the subsequent National Adaptation Programme (DEFRA, 2013a) believed that local authorities, and the businesses and communities they serve, constitute a largely untapped information resource for understanding potential climate impacts. These stakeholders had access to valuable data about weather-related damage to both public and private infrastructure and the costs of its repair. If collated appropriately and used in conjunction with the available climate science this data could be used effectively to understand the risks from climate-related extreme events (UK-Policy Player 1). This view was mirrored by an Australian policy player working with local government, businesses and the public, who believed that crowd-sourced data about climate vulnerability and impact was becoming increasingly important for understanding climate change adaptation (Aus-Policy Player 5).

> *Unless you can diagnose that your tooth has decayed you can't even come to considering what options are available, […] it's kind of the precondition to anything actually happening is mounting the case that there is a need to adapt because there is evidence [of vulnerability]* (Aus-Policy Player 5).

However, as some other interviewees alluded to, this type of information is often, as yet, unavailable or systems that have been put in place allowing this data to be collected for the purposes of national adaptation policy are as yet under-developed (UK-Policy Players 2,3). Thus, the difficulties of using applied adaptation science remain, whereby, as described in section 5.4, effective adaptation often requires location and context-specific knowledge that is either unavailable, difficult to use for the purposes of strategic policy making due to its lack of generalisability, and/or too costly to collate (Adger, 2011; Cash et al., 2006).

Competing types of evidence are considered more salient at relevant temporal and geographic scales:

In a similar vein, it seems clear that even where the evidence-based mandate is still strongly adhered to for adaptation policy making, climate science struggles to provide the types of information decision makers seek. For instance in the UK, although this mandate is enshrined in the reporting requirements of the *Climate Change Act (2008)* at national level, it still manifests itself at local government level albeit with increasingly fewer obligations to use climate science. As interviewees advising and working in local government in the UK described the situation, useful, usable evidence for local government policy is increasingly required for the development of a 'business-case' rather than simply an evidence-base. In order to justify efforts toward climate adaptation, policy players must provide decision makers with an evidence-based assessment of the costs and benefits of action derived from what is actually known about socio-economic and ecological systems and for which science and engineering can provide robust estimates. Such fiscal evidence appears to align with the decision making norms and priorities of contemporary government relating to short-term economic concerns (Aus-Policy Scientist 4) and sits in apparent contrast with the available science for future climate change which is necessarily long-term and uncertain. The latter, more often than not, fails to provide the level of salience required on its own amongst competing economic evidence more appropriate for use in economic-rationalist cost-benefit assessment methods (UK Policy Players 1,2,3).

Interestingly, in Australia this sentiment was also echoed by an interviewee in relation to the adaptation of private industry to climate. The policy player in question believed that climate science was only salient to the extent that it could provide a convincing business-case for the adaptation of regulated energy and water companies. Often, climate science does not hold sufficient salience for this purpose, nor sufficient legitimacy (information in line with normative priorities) to inform business planning (Aus-Policy Player 5):

> *CSIRO basically needs to shift the longevity of their modelling so that it is in sync with the regulatory cycles that determine whether or not companies can invest in making energy networks more adaptive, so that requires an investment in science, it requires a conversation between the regulator and the scientists and the organisations that represent the various [regulated] companies* (Aus-Policy Player 5).

Climate science is uncertain, complex and prone to misinterpretation

Irrespective of the availability of evidence related to climate vulnerability and exposure that would make climate change science more usable, or the availability of climate science that would be relevant at appropriate scales, there was almost universal consensus from both Australian and UK interview participants that scientific outputs describing future climate change hazards are simply too complex and uncertain. In the UK, participants complained that the information provided by UKCP09 (climate change projections and scenarios) is difficult to access and to understand; the key messages difficult to discern and prone to misinterpretation or over-simplification; that they provide abstract information about climatic variables that doesn't adequately relate to decision making needs, or the inability of this evidence to provide information about the most pertinent climatic or weather-related variables. As one interviewee stated in relation to the outputs of UKCP09:

> *Very few people use the level of detail it has gone into and for most people they're completely bamboozled by it, including not just the user interface side of things […] but also the projections document, […][and] the sort of high-level findings, […] [be]cause a lot of people, the majority of people going to it are actually looking for something quite simplistic, […] they maybe just want one or two maps and they're not that easy to find,[…] and a lot of the way it's written is from a very technical perspective telling you what you can't do and what's inappropriate* (UK-Policy Player 7).

A number of UK policy scientists and policy players described how the projections are too abstract and don't give a sense of what the weather or climate is actually going to be like in terms of the frequency of extreme events or even what any particular change in average temperatures will actually be like. For this reason many believed that there was too much emphasis placed on UKCP09 as a tool for informing adaptation, when much of the time it lacked practical salience for decision making (UK-Policy Scientists 6,7; UK-Policy Players 1,7; Climate Change Scientist 5):

> *You can be over dependent on projections, I think they're useful for driving a range of scenarios, […] but be careful in not over-interpreting them, even if you are working in the scientific field* (UK-Policy Scientist 7).

In the UK these types of difficulties were attributed by many of those interviewed to the use of probabilistic projections which are a dominant feature of UKCP09, in the form of probability density functions (PDFs) and cumulative distribution functions (CDFs) (see Figure 6.4 below).

Image has been removed

Figure 6.4. Top panel, Cumulative Distribution Function (CDF) of temperature change for a hypothetical choice of emission scenario, location, time period and month. Bottom panel, the corresponding Probability Density Function (PDF) for this hypothetical case (adapted from Murphy et al., 2009: p. 24)

PDFs and CDFs attempt to provide a probabilistic estimate of the range of possible future climatic states. These outputs indicate the level of congruence of potential outcomes with estimates of future climate change provided by an ensemble of global circulation models (GCMs). Such *Bayesian*[85] probability distributions are not equivalent to conventional frequentist or other empirically derived probabilities of occurrence and cannot be used to provide an objective assessment of the relative probability of a particular climatic outcome occurring; rather, they attempt to indicate the range of likely uncertainty based on our current understandings of

[85] After the 18th Century mathematician Thomas Bayes. Bayesian probability is different from other types of probability in that it is subjectively (rather than objectively) derived based on a prior assumed probability of occurrence, which is then updated as new observations are made (Bertsch McGrayne, 2011). In the case of climate change, prior probabilities are provided by the degree of congruence of a particular climatic outcome to the average outputs of an ensemble of GCMs (Frigg et al, 2013b). These probabilities are not objectively assessed in terms of their propensity based on past occurrence of climatic states, or their empirical derivation based on knowledge of all possible outcomes (Crawford, 2005), both of which are impossible given the complexity of the systems in question and the relative non-stationarity of climate due to anthropogenic forcing. Rather they are based on the projections of a series of models of possible future climates that incorporate anthropogenic forcing using a range of subjective assumptions and assertions concerning the dynamics of the Earth's climate system (Frigg et al, 2013b; Edwards, 2010).

anthropogenic forcing of the climate system (Frigg et al., 2013b). As such, although UKCP09 expresses climate change hazards via PDF and CDF outputs for climatic variables such as mean annual temperature, precipitation and humidity (Murphy et al., 2009), UKCIP warns against using specific probabilities from these outputs when developing adaptation plans or understanding impacts. Most non-expert policy players interviewed (along with some experts) who had attempted to use the outputs of UKCP09 agreed that it took some time to understand how to access the information from the online user interface, to understand the nature of the outputs and how they differed from conventional probabilities, and that for many decision making applications they lacked usability. "*I can't imagine how an ordinary user sort of copes really […] it is horrendously complicated I have to say"* (Climate Change Scientist 5).

Notwithstanding the lack of salience of such outputs for policy decision making, many expert participants believed that UKCP09 had been useful, or may yet prove to be useful for technical modelling applications seeking to understand climate impacts, for example in relation to flood risk and water resources modelling. Further, a number of participants suggested that UKCP09 had been useful for helping to understand the nature of the uncertainties associated with climate change. This testimony supports the work of Weiss (1979) discussed in section 3.7 that evidence can fulfil multiple roles besides directly informing or directing policy decisions. In the case of climate science, though not wholly salient for Weiss' (1979) *knowledge-driven* or *problem-solving* models of evidence use, my research suggests that this science may nonetheless fulfil a useful role in ways that align with *enlightenment, tactical* or *political* models of evidence use.

Amongst Australian interview participants there was also consensus that climate science does not provide salient information for decision makers. By contrast however, the climate science outputs available in Australia are less well developed and are of a more deterministic format, providing specific climate change scenarios for specific timescales, emissions trajectories and GCMs at various points to 2100 (e.g., CSIRO, 2013). The reasons given for this perceived lack of salience related most commonly to the spatial (global and regional) and temporal (multi-decadal) levels at which this climate science seeks to describe future hazards, rather than due to the difficulties of accessing and interpreting the available information. The scales and levels at which this information is presented is problematic since they do not generally correlate to the (principally local) governance levels and short (decadal) timescales over which adaptation policies are developed and implemented (Aus-Policy Players 1,2,5; Aus-Policy Scientists 3,6). One policy player in Australia stated that she found some of the messages derived from climate change projections to be:

> *…meaningless, when it's less than a degree centigrade […] no one understands that, […] and sea-level rising of you know 400mm or 600mm […], 400mm that's nothing. No one really had the understanding of the enormity of that incredibly small change across the huge surface of the Earth and what that really meant* (Aus-Policy Player 1).

Participants from both the UK and Australia also suggested that the existing suite of climate science often failed to provide specific types of information that could be most useful for impact and risk assessment for policy making. For instance, interviewees suggested that climate science was lacking adequate projections for the marine environment of the UK (UK-Policy Scientist 4); information relating to the future trajectory and frequency of cyclones and potential changes in the ENSO[86] on the east coast of Australia (Aus-Policy Scientists 1,4); adequate projections of rainfall (Aus-Climate Change Scientist 2), usable information relating to extreme weather events generally (Aus-Policy Scientist 6; UK-Policy Scientist 1), or information relating to short term (decadal) trends and climate variability that would allow users to understand existing and immediate hazards and vulnerabilities (UK-Climate Change Scientist 5).

Climate change science is poorly communicated:

A compounding issue for a number of UK and Australian participants in providing salient policy science was the tendency for poor communication and dissemination of climate change projections by the science community (Aus-Policy Scientists 1,2; UK-Policy Scientists 5,6,7,8,9,10). Producers of evidence such as UKCP09 had not adequately communicated what these products were and how they should be interpreted. In part this difficulty originated due to the nature of the uncertainties

[86] El Nino/Southern Oscillation

and the caveats that scientists placed on their conclusions (described above) which made it difficult to discern clear messages. As one interviewee described UKCP09:

> *the idea that it was probabilistic […] the way they showed the results, […] people exhibiting the results gave caution […] about trying to ignore the central tendency and then they proceeded to show us loads of pictures that were driven by the central tendencies* (UK-Policy Scientist 9)

Another participant described the communication and dissemination of UKCP09 as follows:

> *There was such a preciousness about not saying the wrong thing that actually nobody quite said the right thing […] there was a whole use of language and I struggle even now to try and reproduce it but it's something [like]: it's highly unlikely to be less than X degrees or whatever, which just doesn't trip off the tongue you know, and actually somehow you've got to summon up the courage to […] suggest the mean, or the average is around 2 degrees of warming […] and I think it was a real communication barrier around CP09, the use of language that came in* (UK-Policy Scientist 6).

Finally, an important contrast between the case-studies was that the emphasis placed on the salience (or lack thereof) of the available climate science for adaptation decision making in the course of my interviews was considerably less amongst Australian participants than amongst their UK counterparts. This can be explained by the contrasting political contexts of the two cases, as described in Chapter 4. In particular, the lack of bipartisan political consensus on the issue of climate change in Australia may mean that interview participants considering the use of climate science for policy were generally most concerned with either the political acceptability of pursuing climate change adaptation policy in the first place, or the legitimacy of climate science for decision making in concurrent related policy fields such as disaster risk management, urban planning and water resources management. As such, Australian policy players' priorities were less focused on the practical usability or salience of climate change projections than they were on the political ramifications of using them in the first place. This suggests more fundamental issues relating to the legitimacy of climate science as the priority focus for Australian policy making. Given the climate extremes experienced in Australia and the ongoing focus of public policy on disaster risk management and water resource management as a result (Heazle et al., 2013), interviewees alluded to numerous opportunities for incorporating climate science into the development of existing policy issues but for which there was insufficient legitimacy in that science for its use to be deemed politically acceptable (Aus-Policy Players 1,2,3; Aus-Climate Change Scientist 6; Aus-Policy Scientist 4). This testimony is supported by the case-study of Q100 flood risk management levels described in Chapter 7.

6.6 The credibility, salience and legitimacy of policy evidence – climate impact and risk assessments:

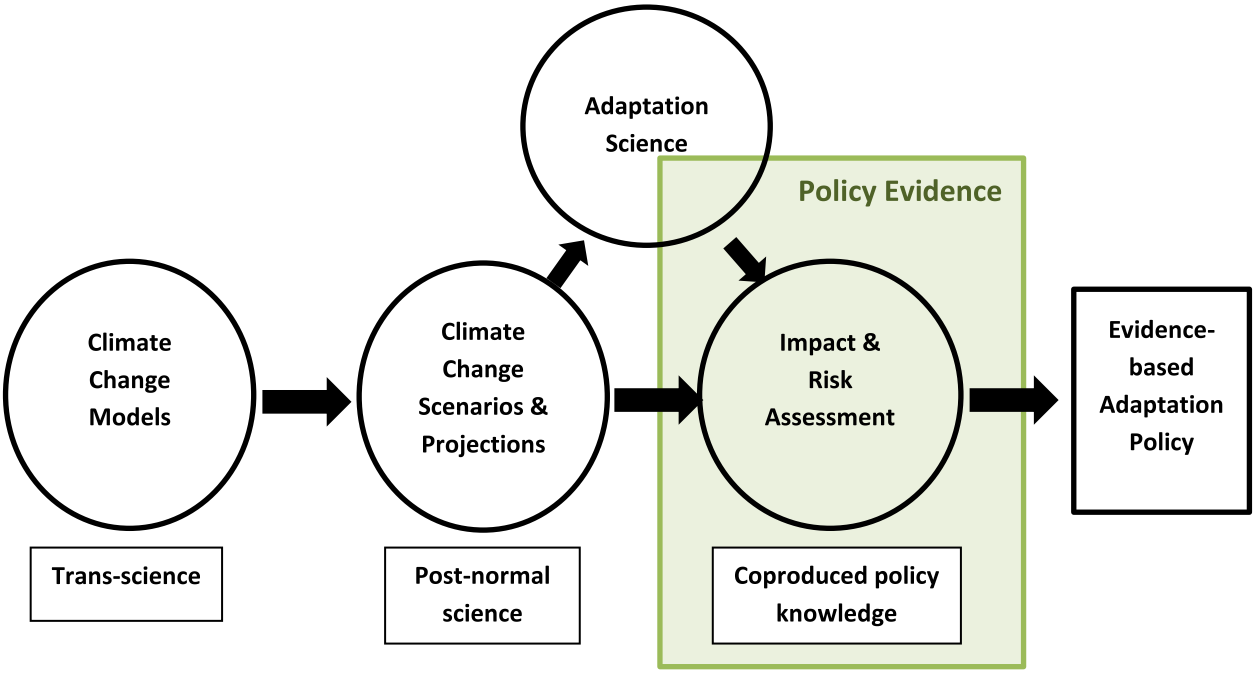


Figure 6.5. Part two analysis – The credibility, salience and legitimacy of policy evidence

Both impact and risk assessments have been used to varying degrees and with varying formats in Australia and the UK. In particular, they are used for the purposes of strategic public policy, for urban and regional planning schemes, for environmental management such as wildlife conservation, and in the provision of public infrastructure such as flood defences and water resource facilities. A number of the issues described here mirror the difficulties encountered in relation to the usefulness and usability of climate science described in section 6.5 above. However the following section highlights the extent of normative influence on the development of policy evidence through ex-ante policy assessment, and illuminates the significant overlap that exists between expert and political authority in climate adaptation policy making when using such methods.

This section also highlights an important distinction between the development of climate change adaptation policy in Australia and the UK. Whereas both political and evidence legitimacy is lacking (and therefore a priority concern for participants) in Australia, in the UK, where legitimacy (i.e., political acceptability) for climate change policy and evidence has largely been established under the *Climate Change Act (2008)*, there is greater concern for the technical adequacy (credibility and salience) of ex-ante policy evidence. The somewhat unbalanced interview analysis presented below reflects this important difference between Australia and the UK in the contrasting focus given by interview participants upon legitimacy versus credibility and salience, depending on their priorities. This contrast is an important indicator for understanding one of the central arguments of my research, namely, that legitimacy holds primacy over credibility and salience in the development of adaptation policy evidence.

6.6.1 Credibility:

Given the contingent nature of adaptation problems (described in Chapter 5), ex-ante policy assessment for climate adaptation necessitates normative and subjective input in the framing, interpretation and presentation of evidence (Owens et al., 2004). I argue that these assessments are particularly conducive to accusations of insufficient credibility as a source of privileged expert authority. Interview participants cited the following inter-related reasons for why they lack credibility:

- Ex-ante policy assessment cannot account for the complexity, nuance and uncertainties associated with many climate adaptation issues and necessarily involve contingent interpretations of science and other expert knowledge; and,
- Decision making prescriptions such as risk assessment methods are often misused and climate risk and impact assessments are often misinterpreted as a result of linear-technocratic assumptions about the role and utility of evidence for policy.

Ex-ante policy assessment cannot account for the complexity, nuance and uncertainties of climate adaptation

A number of interview participants expressed the view that risk assessments that follow a linear model of evidence provision for policy lack credibility because they cannot adequately account for the 'wicked' characteristics of climate adaptation and are therefore insufficient for informing adaptation policy. The interpretation of science through ex-ante policy assessment does not provide wholly credible answers in line with the expectations of policy players and the public about how expert authority should inform policy making (UK-Policy Scientists 5,6,7,8,9,10; Aus-Policy Scientists 1,2,3,4,5; Aus-Policy Players 2,4). For instance, policy scientists involved in the development of the *UK Climate Change Risk Assessment (UKCCRA)* recounted how its credibility had been limited by the pursuit of traditional risk assessment approaches, and by attempts to objectively and definitively apprehend adaptation problems through science and economics. A number of interviewees believed that risk-based approaches attempting to assess climate risk through empirical quantitative or semi-quantitative combination of estimates of likelihood and consequence are inherently problematic in this regard (UK-Policy Scientists 1,4; UK-Policy Players 1,4):

> *Well, you can't do that with climate change […] we don't look at it in terms of probability times [consequence anymore], you know, you have to take a much more qualitative approach to it* (UK-Policy Player 4).

Attempts to follow such an empirical, positivist approach during the derivation of the UKCCRA had met with a number of obstacles.

Most notably, a number of participants recounted how the panel of experts who assessed climate change risks relating to biodiversity and ecosystem services in the UK had rejected the method proposed by those technical contractors who were managing the assessment on the basis that it could not account for the degree of complexity and uncertainty inherent in interdependent social-ecological systems (UK-Policy Scientists 1,2,3,7). As a result, the assessment relied on a mutually agreed narrative description of the likely impacts from climate change. As one policy scientist noted, the assessment for this particular sector was *"qualitative and a far more moderated* *'opinion' based on the evidence rather than an attempt to follow the methodology too closely"* (UK-Policy Scientist 3).

Despite abandoning the linear prescriptions of the UKCCRA's method for this sector, the final assessment for biodiversity and ecosystem services[87] was nonetheless also considered to lack credibility and salience by a number of interviewees on the basis that, in order to reach consensus between experts (thus ensuring the knowledge production process was seen as fair and unbiased, that is, legitimate), climate change impacts were described at such a high level of abstraction that the assessment ultimately failed to provide a technically credible (and salient) assessment that could benefit policy players' understanding of the risks and impacts of climate change (UK-Policy Scientists 2,3,6,7,8,9). As one participant noted:

> *So you know, […] you can get at it from an individual scientific point of view if you're a specialist, but actually putting that into some kind of generic analysis process, we're a way off that yet* (UK-Policy Scientist 2).

A number of UK participants spoke of the uncertainties associated with understanding the complex dynamics of social-ecological systems and then combining climate science with that knowledge to understand potential impacts and risks:

> *We're dealing with a very complicated system in the natural environment and often the uncertainties in the ecological responses to climate change are at least as great if not greater than the uncertainties around the projections themselves* (UK-Policy Scientist 7).

A number policy scientists with expertise in biodiversity and species conservation expressed the view that the risk assessment method used for the UKCCRA overall (see Chapter 7 for further details) had followed an engineering approach that was ill-suited to understanding the risks to social-ecological systems (UK-Policy Scientists 6,7,8,9):

> *It was an approach that was used but was rather forced somehow, I think it was made to work but it was a little stiff, and I think the contractors struggled with that* (UK-Policy Scientist 7).

[87] Adaptation issues relating to biodiversity and ecosystem services broadly align with **Type 3** adaptation problems described in section 5.5 above, for which I had suggested that, on the basis of my proposed typology, climate change projections (such as UKCP09) were less directly usable than for other types of adaptation issue.

These difficulties and the associated lack of credibility in the UKCCRA, however, were not confined to adaptation problems with such high complexity and uncertainty as for ecosystem services. As one policy player involved in the UKCCRA's expert workshop on the built environment noted:

> *It very rapidly descended into people saying, you're missing the point here, everything's cross cutting, you know you can't talk about these things in isolation…I don't want to say it but it was almost a tick box exercise* (UK-Policy Player 2).

These difficulties speak to the wicked characteristics of interconnectedness and inter-relatedness of adaptation problems which make them difficult to definitively define or resolve. These difficulties also relate to the lack of salience of climate science for determining climate risk (see section 6.5.3), which was perceived to be particularly acute for highly uncertain and complex adaptation problems relating to social-ecological management.

Appearing to validate the typology of adaptation problems described in Chapter 5, one prominent UK policy scientist described how the applications for using climate science through impact and risk assessment may be quite different depending on the type of problem being examined and its associated uncertainties. In relation to water resources or flooding, this scientist believed, adaptation problems are described by a small set of affected parameters relating to the viability of infrastructure or the means of managing a resource which a risk/impact assessor can put strict engineering, jurisdictional, geographic and temporal bounds around. These types of adaptation issues are more amenable to using climate science and economic projections to understand specific variables of vulnerability and resilience. By contrast, for problems of biodiversity, ecosystem services and species conservation, it is much more difficult to define and delimit individual adaptation problems. There are so many relevant variables that the principal focus is on the movement of a social-ecological system in a particular direction and how that can be affected by human and climatic influences. The most helpful types of climate science for this type of adaptation policy and planning are indications of the general direction of climate change and broad indications of its potential magnitude:

> *No matter how good the probabilities or scenarios or other climate information in the UKCP[09] or other projections, the real challenge is lack of knowledge about sensitivity of*

> *different elements of the natural environment and potential tipping points, so sometimes it doesn't really matter whether there's a 60% or a 90% chance that it will become 3 degrees hotter because you're often not quite sure at what point something becomes too hot, or too wet or too dry* (UK-Policy Scientist 7).

Further, those interviewed who had been involved in the UKCCRA's 'expert elicitation' workshops recounted how these events, involving a range of scientific, technical and industry experts, had been compromised in terms of its credibility by a tendency toward the selection and prioritisation of risks:

1) That already had a considerable evidence base available about them, rather than on their actual potential severity;
2) About which there was already a legislative provision for their management, which meant that risks were more easily characterisable; and/or,
3) That were already the academic or professional focus of those experts involved (UK-Policy Scientists 1,2,7,9,10; UK-Policy Player 7).

One Australian policy scientist suggested that the use of expert elicitation processes and confidence levels to prioritise climate risks were increasingly inadequate or irrelevant for this kind of assessment because they are based on an assumption of the adequacy of expert's past experience for assessing climate change risks, alongside their knowledge of climate science. The policy scientist believed that experts' knowledge and experience of the natural environment cannot fully account for the chaotic nature of bio-geophysical and social-ecological systems in the face of climate change. Experts cannot be confident about any particular outcome under a non-stationary climate and the deep uncertainties associated with social-ecological systems (Aus-Policy Scientist 5).

Participants cited a number of other reasons for the lack of credibility of ex-ante risk assessment relating to the aforementioned complexity and uncertainties. For instance, a number of policy players suggested that there was insufficient cross-sectoral analysis of risks during the UKCCRA. Each of the 11 sectors covered by the UKCCRA prioritised 10 risks however there was no cross-comparison of those risks that would assess their relative strategic priority (UK-Policy Scientists 3,10; UK-Policy Player 7). As one UK policy scientist noted:

> *I'm not sure they fully thought through the chain of risks […] with the technique they were using there was a risk that you could lose half of Kent [to sea level rise] and still be worried about your pension if you lived in Margate [a town on the Kentish coast]* (UK-Policy Scientist 10).

Some also criticised the assessment for failing to account for international influences, trans-boundary interactions or indirect and compound risks from multiple risk interactions (UK-Policy Scientist 10; UK-Policy Player 7).

The interpretation of climate science through ex-ante policy assessment can also compromise the credibility of such assessments. One prominent UK policy scientist believed that because the UKCCRA had over-relied upon UKCP09, it had only presented the risks from sea-level rise as interpreted through the limited scope of UKCP09. This scientific product however, had only accounted for those aspects of Earth-system science that are well accounted for by the current suite of Global Circulation Models (GCMs), and therefore did not account for *known unknowns* relating to climate change which, although mired in uncertainty, the scientific community still know enough about to understand the relative severity of their potential consequences. UKCP09 and the GCMs that inform it do not account for extreme sea-level rise associated with non-linear climatic and geo-physical changes. The policy scientist in question (a national expert in sea-level rise and associated flood risk on the urban environment) believed that a credible and legitimate[88] risk assessment would have addressed such risks irrespective of their likelihood, due to the potentially catastrophic consequences that could arise from such changes. This expert believed that the UKCCRA had ultimately been subject to political influence in this regard (UK-Policy Scientist 10). Such politicisation was also alluded to by a number of other policy players. For instance, another prominent UK policy scientist agreed with this view, describing the UKCCRA as "*The political presentation of science"* (UK-Policy Scientist 5).

[88] This example demonstrates not only a perceived lack of credibility of the UKCCRA due to its failure to adequately account for uncertainties and its limited use of available evidence sets, but also arguably a lack of legitimacy since a fair and unbiased knowledge production process would have accounted for a range of expert and non-expert perspectives and interpretations of climate change risk. This example highlights the ambiguous character of Cash et al.'s (2002, 2003) knowledge systems criteria.

Political influence, however, may also have been a factor in the choice of experts to deliberate over the evidence in the first place. One participant recounted how DEFRA had objected to their technical contractors' choice of one particular well-known expert, either because they felt he lacked expertise or because his views or political preferences conflicted with that of government[89]. Further, finding and vetting experts had been difficult for certain assessment sectors since representatives from these sectors were not interested in participating:

> *Trying to get any one person, or even a group together that could reasonably represent business interests was very difficult* (UK-Policy Scientist 2);
>
> *The reality is that certain sub-sectors are more responsive than others. And so for example we weren't actually able to hold workshops for the business sector or the forestry sector* (UK-Policy Scientist 1).

The influence of politics in the UKCCRA is discussed further in section 6.6.2 in reference to the failing legitimacy of adaptation policy evidence, and in section 7.3 in relation to processes of evidence politicisation and policy scientisation. Yet, this type of political influence was perceived by many in both the UK and Australia to call into question the technical credibility of these assessments on the assumption that such evidence should principally be the product of impartial analysis and privileged expertise (UK-Policy Scientists 2,7,10; Aus-Policy Player 2,3; Aus-Policy Scientist 5,6).

Another common indictment of the UKCCRA's credibility amongst those interviewed was that it failed to consider the resilience and adaptive capacity of ecosystems, communities, industry and government institutions (UK-Policy Scientists 6,7,8,9,10; UK-Policy Players 1,7):

> *We were just a bit worried there wasn't enough emphasis on the capacity that people would have, because being able to be resilient and your level of climate change risk isn't just about what falls from the sky it's also about your ability to handle it* (UK-Policy Player 1).

As one UK policy scientist noted: "*It was just almost as if we were told to look at risk but ignore risk management"* (UK-Policy Scientist 9). Interestingly, an assessment of adaptive capacity was actually undertaken by the team contracted to prepare the UKCCRA, however, according to one policy scientist involved, this assessment was omitted from the final outputs because of political

[89] The interviewee refused to elaborate or to identify the expert in question. Again, this issue of choosing appropriate experts also speaks to notions of legitimate evidence being fair, unbiased and representative of a range of appropriate views and circumstances.

considerations concerning the scope of the assessment and as a result of a protracted debate between DEFRA and the Adaptation Sub-committee of the UK's Committee on Climate Change about what the UKCCRA should attempt to produce (UK-Policy Scientist 1). These testimonies suggesting significant political influence in the development of the UKCCRA speak to ideas of competing advocacy coalitions interacting in the policy making process, as argued by Sabatier (1988) (see section 3.2.2).

In Australia, there has been less emphasis placed on the production of ex-ante policy evidence such as climate change risk assessments because, as described in Chapter 4, there is greater political debate about the legitimacy (i.e., political acceptability) of climate science and less concentration on its use in risk assessment for policy making. An important imbalance in the comparative analysis of my research is evident here, therefore, relating to the contrasting characteristics of the adaptation policy problem between these two cases. My interview analysis demonstrates how a lack of political legitimacy for climate change in Australia has resulted in a preoccupation with the legitimacy (i.e., political acceptability) of climate science and policy evidence by Australian interviewees, and as a result, less concern for its salience or credibility[90]. Conversely, an established legitimacy for climate change and climate science in the UK (notwithstanding the aforementioned difficulties at local government level – see section 6.5.2) results in a preoccupation with evidence salience, and less concern for evidence legitimacy (i.e., its political acceptability) and credibility. The absence of political and evidence legitimacy for climate change also means that Australian participants generally had considerably less direct experience in the development of ex-ante policy evidence than their UK counterparts, particularly at a strategic (i.e., state or federal) level. Although many Australian participants had some experience of undertaking local and regional assessments of climate change impact and risk, their lack of experience of strategic or government-

[90] There is a danger here that readers may conflate the characteristics of climate science with that of policy evidence using Cash et al.'s (2002) framework. The lack of legitimacy for *climate science* in Australian government is instrumental, I argue, in a reduced concern amongst Australian interviewees for issues relating to the credibility and salience of ex-ante *policy evidence*.

led policy evidence development (such as for the UKCCRA) meant that they were less familiar with the types of cross-scalar and political difficulties described by UK participants.

Nonetheless, a number of Australian interview participants expressed the view that impact and risk assessments lacked credibility (Aus-Policy Scientists 1,2,5,6; Aus-Policy Player 2). Echoing the views of UK participants, one former Queensland state government official noted how ex-ante assessments, informed by climate science and used to set planning and policy guidelines for climate adaptation follow the same methods as traditional rationalist approaches and therefore do not account for the nuance and complexity of adaptation issues:

> *I have yet to see a high level message that's come from the State or Commonwealth, which has the tangible connections to show how it can be delivered on the ground, because you cannot simply say that climate change is going to mean a one metre difference across the country. Every single catchment, every single bit of hydrology in our State is very very different, […] so it's impossible to simply apply a broad brush across the board* (Aus-Policy Player 2).

Decision making prescriptions are often misused and misinterpreted under a linear-technocratic policy model

Most participants agreed that the approach prescribed by risk-based decision making was conducive to assuming a linear approach to evidence use. Ex-ante assessments like the UKCCRA tend to be undertaken as a one-off assignment in a way that assumes an ability to apprehend the adaptation problem with sufficient accuracy and detail to allow policymakers to adequately understand the risks from climate change on the UK. As described above (and in detail in Chapter 5), however, such assessment cannot be achieved in practice due to the complex, uncertain and contentious nature of adaptation issues. As one Australian policy scientist noted: *"That kind of simplistic process, which is a good start, is really wholly insufficient"* (Aus-Policy Scientist 5). Similarly, a prominent UK policy scientist believed that both experts and policy makers have unrealistic and often naïve expectations about the role and use of evidence whereby they assume that the available evidence can inform policy in a linear or rational way (UK-Policy Scientist 5).

This participant felt that one element that contributed to these expectations was the fact that government departments responsible for climate adaptation have a high staff turnover, common within civil service departments whereby policy players are forced to change roles every couple of years. This meant, he believed, that newcomers failed to learn from past ex-ante assessments and often failed to realise the truly 'wicked' nature of adaptation problems and the difficulties of utilising evidence in pursuit of them. He and other UK participants believed that the UKCCRA will ultimately be judged on the extent to which it is used as a first step in an iterative learning process (UK-Policy Scientists 3,5; UK-Policy Player 4). However he believed that the current government appear to have misused the assessment and misunderstood its utility, as demonstrated by the content of the subsequent National Adaptation Programme and the fact that no one who worked for DEFRA on the 2012 UKCCRA will work on the next iteration of the assessment (UK-Policy Scientist 5; UK Policy Players 4,5). Interviewees believed that this situation would severely constrain opportunities for iterative learning, the development of institutional adaptive capacity and thus, ultimately, the credibility and therefore efficacy of adaptation evidence (UK-Policy Scientists 1,5; UK-Policy Player 5).

This view was echoed by Australian participants who believed that using risk assessment in a very precise way to justify a specific course of action is unwise. Such assessments should be used as a means to prioritise risks within a "socially-engaged process" (Aus-Policy Scientists 3,4,5). According to these participants, risk assessment is problematic when used in a linear way whereby an assumption prevails that once completed it will allow policy players to adequately understand risks and therefore facilitate a move to resolving adaptation issues, judged entirely on that single risk assessment. Given the wicked characteristics of adaptation problems, interviewees stressed that the precision of any assessment is less important than how it is used within the overall policy making process. They also believed that a majority of assessments have been misused in this way as a result of rationalist expectations of evidence for policy (Aus-Policy Scientists 3,4,5). One policy scientist noted that the literature often bemoans the lack of action on adaptation, but this inaction actually results from unrealistic expectations on the expert community, whereby they are expected to provide answers that may not exist in advance of policy action (Aus-Policy Scientist 4).

6.6.2 Legitimacy:

Legitimacy as political acceptability: values and interests of experts conflict with those of the executive

An underlying theme of much of the testimony provided in the course of interviews was that there is an ongoing mismatch of norms and values between different groups of policy players in the development of policy evidence. The result of this mismatch is a general perception amongst participants that ex-ante assessments of evidence for policy often lack legitimacy (i.e., political acceptability) for informing policy making decisions across varying scales and levels of governance. There was general consensus that a degree of coproduction is necessary in the development of evidence for adaptation policy, due to the nature of the uncertainties and complexities associated with climate adaptation issues, and as a result of the need for evidence beyond economic and scientific forms. As described in section 6.6.1 above, technical risk and impact assessments for policy making are dependent not just on the outputs of climate change models, but on a variety of information relating to the vulnerability and exposure of a given policy jurisdiction to climate impacts and political priorities in that regard.

While these assessments utilise scientific, engineering and economic evidence, many believed that effective assessment also requires explicit subjective, normative choices about what is valuable, resilient and vulnerable to climate, and what level of climate risk is acceptable (UK-Policy Players 1,2,3; Aus-Policy Scientists 5,6; Aus-Policy Players 1,2; Climate Change Scientist 6). The academic literature suggests that these types of information are sometimes difficult to provide in a way that can be meaningful for policy players across varying levels of government (Cash et al., 2006). And in any case, the political executive is often unwilling to mix explicit normative, political choices with technical assessment due to the perceived need to maintain the objectivity of legitimate expertise, even though this does inevitably and implicitly happen (Keller, 2009; Jaeger et al., 1998).

In the case of the UK, a number of policy scientists believed that the UKCCRA was not entirely technical in its derivation and that it was ultimately a political document; it had been influenced by the political executive in terms of the potency and tone of its messages because the initial technical assessment had not been politically acceptable to government departments. This politicisation suggests not only a lack of political acceptability of expert conclusions, but also suggests a lack of legitimacy in terms of the fair and unbiased nature of the knowledge production process (UK-Policy Scientists 1,2,3,5,7). One interviewee believed that such political influence on what was meant to be a technical assessment was inevitable given that the appropriate minister was expected to sign off on such assessments (UK-Policy Scientist 5).

As discussed at length in Chapter 7, in the case of the UKCCRA, this politicisation appears to have been particularly acute since the assessment began under the reign of the Labour Party and was completed under a Conservative/Liberal Democrat coalition. As the interviewee in question noted:

> *A change of politics does play a role in a document that's going to be laid before parliament […] the way that the information is presented is influenced by politics because it has to be signed off by the secretary of state* (UK-Policy Scientist 5).

This participant suggested that the end result was that the UKCCRA's outputs were essentially trivialised and left unused by the Cameron government, in line with its downgrading of the priority for climate adaptation more generally whereby it had scrapped most statutory requirements for adaptation that weren't legislated by the *Climate Change Act (2008)* since coming into power in 2010; most notably, the removal of all obligations for local government and state infrastructure providers to report their climate change risks and adaptation actions. This example demonstrates both a lack of legitimacy in terms of the knowledge production process being fair and unbiased, and also in terms of the political acceptability of the resulting policy evidence which had been essentially downgraded to a 'tick-box exercise' to fulfil the evidence-based mandate of the *Climate Change Act (2008)*.

Other participants in the UKCCRA confirmed this lack of legitimacy in terms of the political acceptability of the assessment's report. They agreed that a de-prioritisation of adaptation policy was evident in the National Adaptation Programme which, although as originally intended was supposed to be systematically informed by the UKCCRA, in the event had only tenuous links to this assessment. Interviewees believed that this was because the new government changed their focus and prioritisation from direct intervention and management of adaptation issues, to acting as a facilitator to communities and private enterprise (UK-Policy Players 2,5; UK-Policy Scientists 1,5):

> *The whole political climate changed from the point of commissioning the work [of the UKCCRA] to it being published and if there had been a different government in place at the time of publication that may have been more supportive of the climate change agenda, potentially more might have been made of it […] By the time we published the CCRA senior politicians in the UK government didn't really see climate change as such a big issue […] the economy was by far the most important thing; [climate change adaptation] slipped down the agenda and I think it's continuing to be slipped down the agenda.[…]*
>
> *[T]heir focus has been on identifying potential government priority policy areas if you like, to reduce the barriers or to enhance the enablers […]. [W]ith the National Adaptation Programme, I think people assumed that it would end up laying out a programme of actions by government […] and saying why we are doing these actions. It doesn't go that far […] because basically government wants to do the absolute minimum itself. It wants to be demonstrably encouraging business and community to increase its adaptive capacity, but they want to do the minimum themselves. […] That was very poorly articulated at the end of the CCRA as being what they were going to produce* (UK-Policy Scientist 1).

Similarly, as one Australian policy scientist noted, climate change evidence and policy assessment will often have questionable legitimacy in the context of partisan politics and short-term political cycles:

> *When you've got 3 year election cycles or 4 year election cycles and we're looking [at] a 100 year problem, […] very rarely do you see a politician who has the intestinal fortitude to embed 100 year decision making in a 3 year cycle when the science around that 100 years decision making has a band of confidence which is very wide in the out-years;*
>
> *At the end of the day […] if there is any doubt around the evidence and it's politically unpalatable your chances of having a politician make a difficult decision are virtually nil because they're the ones who front up in front of the cameras and have to explain to the general mass why they're making this tough decision. They won't do it if there's any doubt around some of the science* (Aus-Policy Player 2).

Legitimacy as fair and unbiased knowledge production: difficulties of accounting for appropriate values, interests and specific circumstances of all relevant stakeholders

As outlined in section 6.6.1 (and again in section 7.3) in relation to sea-level rise for the UKCCRA, some participants believed that central government bureaucracy may often be reticent to address key risks in a manner suggesting not only a lack of credibility in the pursuit of supposedly technical objective assessments and a lack salience in the resulting outputs, but also a lack of legitimacy for that evidence. This lack of legitimacy relates not just to the political acceptability of these assessments but also to the degree to which such risk assessments consider a range of relevant perspectives and viewpoints in their assessment of risks and therefore the extent to which these assessments are considered fair and unbiased at other levels of government (UK-Policy Scientist 10; UK-Policy Player 2). Others criticised the format followed by the UKCCRA to elicit expert assessment of the available scientific evidence. For instance, a number of interview participants expressed concern that there may have been a tendency for 'expert elicitation' workshops to descend into Groupthink[91] (Janis, 1982) or a scenario whereby '(S)he who shouts loudest is heard the most' (UK-Policy Player 7; UK-Policy Scientists 1,2,5,6,7,8): "*They always see it as an opportunity if you like, to get on their soap boxes*" (UK-Policy Scientist 1).

As suggested in section 6.3, such a lack legitimacy is strongly related to the aforementioned lack of credibility of those assessments. In order to be considered legitimate and credible interview results suggested a need to effectively communicate to stakeholders the scope of analysis of these assessments and where possible to try to capture the views of a wide range of relevant communities, business interests and stakeholders. However, there remains a danger that those assessments will not (or cannot) capture relevant view-points, and will be unable to account for divergent political views in a coherent and legitimate way.

Mirroring policy players' political interpretation of risks from sea-level rise in the UK, an Australian participant cited his experience in the development of impact assessments for sea-level

[91] A psychological phenomenon whereby a group of people arrives at a dysfunctional decision making outcome as a result of a desire for harmony or conformity.

rise and coastal erosion in New South Wales, which were poorly received by the public due to their perceptions of the impact of those assessments on the property market. One of the responses by the public to such assessments, he believed, had been to question the credibility and/or legitimacy of the underlying climate science. This conflict of values between experts and the public also suggests, I argue, the possibility of a lack of legitimacy for subsequent policy evidence in the eyes of democratically elected policy makers concerned with addressing the socio-economic concerns of the electorate (Aus-Policy Scientist 2):

> *We should be in a situation where the science is independent of the political process, or perceived to be, which is not necessarily the case at the moment, […] it is difficult to decouple that completely* (Aus-Policy Scientist 2).

This interviewee also questioned the legitimacy and credibility of impact and risk assessments on the basis that their derivation involves cascading uncertainties[92] that have the ability to become politicised:

> *Inevitably you'll end up with something which is based on a number of assumptions […], those assumptions and how they're put together can be influenced by both scientists and by policymakers so it's a challenging process […] to do that effectively* (Aus-Policy Scientist 2).

One Australian policy player believed that bringing politics into risk assessment in an overt way might be a useful way to stop it subverting the available evidence through unfair assessment processes and covert politicisation. As he noted, politics is already subverting the available evidence as a result of its uncertainties: "*I think they're using the uncertainty in the science to prevent decisions being made […] there's really no reliance on [the evidence base] at the moment"* (Aus-Policy Player 2).

6.6.3 Salience:

There was general agreement among interview participants from both the UK and Australia that impact and risk assessments often lack salience for policy players and decision making. There were four principal, inter-related reasons given for this which in many instances mirror the reasons given

[92] See Chapter 5, Figure 5.2

for a lack of legitimacy or credibility as described above, and which further indicate the ambiguous character of Cash et al.'s (2002) criteria for effective knowledge systems as well as the normative characteristics of policy evidence more generally:

- A linear model of evidence provision for policy cannot account for the complexity, uncertainties and contingency associated with climate adaptation issues. This means that risk and impact assessments have limited relevance for policy players, while facilitating unrealistic expectations for what expertise can provide;
- The evidence-based mandate is often trumped by political prioritisation and therefore ex-ante policy assessment has limited appeal or relevance for decision making;
- Normative choice is a necessary component of adaptation evidence for policy but is often not accounted for in the development of impact and risk assessments, or is made implicitly; and/or,
- The purpose and scope of impact and risk assessments are often poorly communicated and therefore these assessments are often misinterpreted by policy players not involved in their derivation.

Much like section 6.6.1 above, this section demonstrates a clear imbalance between the cases of Australia and the UK, reflecting the differing priorities between interview participants in relation to evidence credibility, legitimacy and salience, and I argue is an indication of the primacy that legitimacy holds in the development of effective policy evidence.

A linear model of evidence provision for policy is inadequate and facilitates unrealistic expectations about what climate adaptation evidence can provide

Most participants were in agreement that risk-based decision making can be a useful means of conceptualising and addressing climate adaptation problems[93]. However as described in section 6.6.1 above, interviewees highlighted a number of caveats relating to the difficulties of using

[93] These views also align with the IPCC's 5th assessment report which has used a risk-based framework to understand and evaluate climate change risks (IPCC, 2014)

decision making frameworks designed to follow a linear or rational model of evidence provision, such as seeking to objectively assess risk (through empirical assessment of Likelihood X Consequence) with the use of climate science. These difficulties were particularly highlighted in relation to the development of the UKCCRA (Aus-Policy Scientist 4; UK-Policy Scientists 3,4,10), as well as for the use of standardised risk metrics for public policy and planning such as Annual Exceedance Probabilities (AEP) commonly used in Australian governance (Aus-Policy Scientist 6; Aus-Policy Player 2) and relate to both the salience and credibility of these assessments for policy players. A number of participants expressed the view that existing ‘top-down’ risk-based decision frameworks have failed to provide the types of information required for adaptation policy and can foment unrealistic expectations about the types of information science can provide. Many believed that these frameworks need to be approached as an aide to decision making in a way that doesn’t expect the right answer based on the available science, but rather in a way that uses necessarily uncertain science to inform explicit objectives and priorities and addresses pre-existing issues relating to climate vulnerability and resilience.

The principal difficulty with risk-based approaches in terms of salience, therefore, appears to relate to how they are applied and interpreted for policy making (Aus-Policy Scientists 4,5,6; UK-Policy Scientists 5,10; UK-Policy Player 4). Policy players have failed to understand the incompatibilities inherent between traditional risk assessment methods and climate change risks when applying a risk-based approach:

> *What I saw […] with the UK risk assessment was the, trying to do the perfect job of a risk assessment, doing it as a linear thing where you only do it once and so you know you’ve got to get the risk assessment perfect before you can think of anything else, which is crazy because I think it distracts you from thinking about solutions […] or about response options* (Aus-Policy Scientist 4).

A number of interviewees alluded to the difficulties of attempting to use traditional risk assessment approaches for climate adaptation (described in detail in Chapter 5), which were frustrated by complexity, uncertainty and the divergence of values and priorities between those assessing risks and those using the outputs of that assessment (UK-Policy Scientists 1,3,6,7,8,9,10; Aus-Policy Scientists 4,5).

Under a linear interpretation of the evidence-based mandate, a separation has often been mandated between technical risk assessment, the development of normative priorities based on that assessment of risk, followed by the development of policy responses.

> *When the [UK]CCRA started in 2009 there was a presumption that you started with your climate projections, you go through and then it tells you what your priorities are and then you devise your adaptation planning off the back of that* (UK-Policy Scientist 1).

Public and political expectations for a clear demarcation between expert and political authority and for an adherence to the linear-technocratic model (Keller, 2009) are fundamentally problematic because the wicked characteristics of adaptation problems preclude adequate and objective technical assessment that would follow a linear approach to evidence development and use for policy (Jaeger et al., 1998). Thus, many policy players believe these assessments lack salience because the methods used cannot be adequately followed and do not live up to the promise of the linear-technocratic model.

For those with such linear-technocratic expectations, these assessments lacked salience because they failed to provide the types of answers expected (discrete, deterministic and 'correct' answers). Conversely, those who had tried to follow the oft-prescribed linear-technocratic approach and failed had, as a result, more realistic expectations of climate change evidence, yet they also considered their endeavours at this type of assessment to lack salience. This latter group believed that what is required in the face of wicked problem characteristics is a 'decision-based approach' that reformulates the problem in the context of explicit norms, objectives and priorities that allow options to be developed concurrently within an assessment of the available evidence (UK-Policy Scientists 5,10; UK-Policy Players 1,4; Aus-Policy Scientists 3,4,5).

> *You really need to flip the way you're looking at the world so climate science […] has been operating […] before and after AR4 [The IPCC's 4th Assessment Report][…] around the information-deficit view of the world which is that if I just get all this information and keep pushing it into models, eventually I'll get greater clarity and be able to resolve some of these uncertainty issues […] which is, just requires more money to be thrown at something which is*

> *just about impossible […] to resolve in a form that would be useful to decision makers […] what we really need to look at it is from a decision-centric view of the world, so for a given set of decisions how far into the future do I need to look and what type of information do I need to inform those decisions* (Aus-Policy Scientist 3).

As a result of the continued pursuit of a linear-technocratic approach to adaptation policy evidence, some believed that assessments such as the UKCCRA were ultimately abstract or academic exercises on the basis of very uncertain projections (UK-Policy Scientist 5; UK-Policy Players 2, 3), which only marginally informed subsequent policy decisions (UK-Policy Scientists 1,5,10; UK-Policy Players 2,7; Aus-Policy Scientist 4).

In Australia one interviewee working in Queensland state government believed that the suite of adaptation plans developed under the previous Labor government had not appropriately considered potential climate change impacts at sufficient levels of detail or across a broad enough range of circumstances in order to be salient. This reflected, he believed, the tendency of science-led impact assessments to be unable to account for the complexities of adaptation problems: "*This state is too diverse to have a one size fits all [approach to adaptation policy]"* (Aus-Policy Player 2). In the view of some Australian policy players (1,2) this problem is compounded by the fact that responsibility for climate adaptation is increasingly being passed to local government levels, which have the lowest capacity to handle evidence development and interpretation, and the least capacity to deal with strategic adaptation problems:

> *The political system is pushing the decision making on how to implement the evidence to the lowest level, a level that has the least capacity and ability to be able to understand and apply it. […] the planning scheme […] doesn't give them the ability to consider climate change and what its true impact is* (Aus-Policy Player 2).

Other interviewees suggested that decision makers are only interested in climate change evidence that is meaningful in terms of the timescales in which they consider policy. Because climate science lacks salience over useful timescales, as described in section 6.5.3, the principal difficulty with subsequent impact and risk assessments is that they are not providing salient information about climate change at the temporal scales relevant to policy making decisions (Aus-Policy Scientist 5; Aus-Policy Player 5). Robust climate science for decadal changes in climate at regional and local scales is non-existent and so short term climate impact and risk assessments must focus on existing vulnerabilities and resilience to climate extremes or on existing climate variability.

The evidence-based mandate is often trumped by political prioritisation

A number of interviewees spoke about a lack of salience of ex-ante policy assessment in the sense that the evidence-based mandate is poorly adhered to more generally (Climate Change Scientists 2,6; Aus-Policy Player 1). Some participants suggested that perceptions of salient evidence depend on the players involved, the level of government in question and the types of evidence available (Aus-Policy Players 2,4; Aus-Policy Scientist 6). One prominent Australian policy scientist observed that there is a wide diversity of policy makers in Australia, not all of whom consider evidence as an important component of policy making. Some don't adhere to the evidence-based mandate at all; others see 'evidence' as: "*What you can pull out of your brain in five minutes to justify [policy], which comes from your own experience and things like that"* (Aus-Policy Scientist 4).

Another policy scientist argued that at local government level evidence-based policy becomes more of a catalogue of ideas rather than a strict mandate. In any case, this participant argued, there are fewer structures at local level than at state or federal level, such as the Auditor General and Senate Committees, to ensure adherence to the evidence-based mandate: "*Evidence-based policy? I think you'd be lucky to find it in local government in Australia really"* (Aus-Policy Scientist 6). The policy scientist in question believed that the technical efficacy of policy evidence at local and state government level is one of a number of considerations of its salience alongside political appeal (or whether it adheres to a political ideal); whether it's going to look good in the newspaper, and whether or not an implicated policy is expensive. The interviewee believed that at state level evidence is often collected under the pretence of pursuing an evidence-based approach even if it is often subsequently ignored in favour of political priorities (Aus-Policy Scientist 6).

In the UK by contrast, there seems a much greater willingness to adhere to or assume support for the evidence-based mandate, particularly in relation to climate change. As one interviewee noted:

> *[we are] a nation obsessed with collecting data […] we are possibly the single most data-rich country in the world with exception perhaps of a few other European countries, so a science-led approach was feasible* (UK-Policy Scientist 1).

However, many UK interviewees echoed their Australian counterparts by stating that what constitutes salient evidence depends on the decision making needs and political persuasions of policy players. As discussed above, this concept of salience is in turn dependent on the broader political acceptability for climate change and climate science, that is, its legitimacy.

Normative choice is a necessary component of evidence for policy:

Interview participants believed that ex-ante assessment often lacked not just credibility and legitimacy (as described above) but also salience by failing to explicitly address either key strategic normative issues or local and contextual perspectives. According to UK interviewees, the UKCCRA encountered difficulties of salience when used by policy players for the purposes of informing local government or non-departmental government institutions' policy since it had not addressed key strategic issues relevant across all scales and levels of government and had failed to provide clear evidence-based statements about national risks, vulnerabilities, and priorities that could usefully inform all levels of government (UK-Policy Players 2,7; UK-Policy Scientist 10): "*Urban Heat Island Effect, right yeah, but what does it mean? [...] what are the actual effects you're talking about?"* (UK-Policy Player 1).

Many believed that the UKCCRA simply rehashed oft-repeated messages concerning high level impacts that everybody was already aware of but which were not particularly salient for policy decision making. Without clear statements about national risks and prioritisation, interviewees believed that it is difficult to develop corresponding evidence-based policy across government levels:

> *I just think… it was too vanilla! […] it didn't say anything we didn't already know, […] which wasn't particularly helpful. I think because it was at a national level, it missed the opportunity to make some clear statements about the impacts of climate change at a national scale and what the key regional issues were for each part of the country and from that, kind of pull out some major issues that they wanted to really look at, at a national scale* (UK-Policy Player 2).

This was not helped by the format and content of the UK government's subsequent National Adaptation Programme which interviewees believed also failed to prioritise meaningfully for those responsible for policy design and implementation at sub-national levels (UK-Policy Players 1,2,3; UK-Policy Scientists 1,10):

> *We don't fully understand the scale of the problem, which goes back to the risk assessment […] we need a […] [v]ery high level, very simple [National Adaptation Programme]: where are we going to have our ports, where are we going to get our food, what are we going to do with immigrants […] the big stuff, cause you can't plan everything at a local level, especially when local people want to stay where they are, and they can't necessarily* (UK-Policy Scientist 10).

Notwithstanding the absence of explicit normative decisions in the development of policy evidence, some participants believed that the information provided by risk and impact assessment, was nonetheless a useful source of evidence for certain policy making purposes. For example, a number of interview participants used it as a means of promoting climate adaptation policy and its implementation at various levels of government. They stated that it was a useful document 'to wave at people' (UK-Policy Scientists 6,7,8,9,10; UK-Policy Players 3,7) which speaks to Weiss' (1979) ideas concerning the *tactical* or *enlightenment* uses of knowledge for policy making (see section 3.7). It would seem therefore, that the perceived lack of salience of ex-ante assessments relates to directly informing policy making in a linear-technocratic way, even though they may hold a degree of tactical utility as a means of garnering policy legitimacy by dint of their very existence. The lack of perceived salience, however, highlights the difficulties of technical risk assessment for policy making, due to public and political expectations for the contrasting priorities of, on the one hand, the transparency of normative input, and on the other, the maintenance of credible expert authority in evidence-based policy.

The scope and purpose of impact and risk assessments are often poorly communicated:

In both Australian and UK cases a significant difficulty was associated with poor communication of technical information which compounded the tendency for stakeholders to misunderstand what risk assessments and metrics were for, what they were saying, and thus compounded their failure to deliver information with sufficient relevance, detail or scope to help policy players understand the implications of climate change. Some UK policy scientists suggested that DEFRA[94] and the contractors it had hired had failed to develop an effective communication plan for the UKCCRA, which meant that participants involved in its development had insufficient understanding of what the assessment was trying to achieve and what its intended scope and audience were.

Those who had been consulted in the development of the assessment believed that they were part of the intended audience for its outputs, while DEFRA may actually have intended the assessment for use principally by ministerial departments to inform central government policy (UK-Policy Player 5). While those working in central government understood the UKCCRA to be intended as a report to inform ministerial departments, interviews with those at other levels of government revealed expectations that the UKCCRA had a much broader remit, which were not met by the final assessment outputs. Those participants working in local government and non-departmental government institutions in particular appeared to believe that the UKCCRA was meant to inform a broad audience of policy players, including themselves (UK-Policy Scientists 6,7,8,9,10; UK-Policy Players 2,3), which seems understandable since, in the absence of clarity from DEFRA, the assessment had incorporated a range of policy players across all levels of government. One policy scientist suggested that this was exemplified by the types of questions and issues raised by the assessment's stakeholder forum:

> *I don't think what [DEFRA] have produced is what the stakeholders will have been expecting when they were involved in the CCRA […] I think it's a long way from what they were expecting;*
>
> *At the last CCRA Forum, there were people, stakeholders were still saying I want to know what government is going to do about this [risk][…] and they were being told, oh well the National Adaptation Program will be looking at that* (UK-Policy Scientist 1).

In Australia, although interviewees didn't have the same experience of developing such a national risk assessment, some participants agreed with UK consensus on the poor communication of ex-ante assessment as well as of climate change evidence more generally to suggest that 'policy

[94] The UK's Department of Environment, Food and Rural Affairs

science' is an important burgeoning discipline for interpreting and communicating climate change evidence to policy makers (Aus-Policy Scientists 1,2,3). One participant suggested there was a fundamental conflict in the pursuit of evidence-based policy because policy makers and scientists don't understand each other, in the sense that they have such differing frames of reference and use of language (Aus-Policy Player 2):

> *It really does need a translator from what the scientists say to what the politicians do and that has to be someone in between who can speak a little of both languages, [...] put a politician and a scientist in a room and try and come up with a policy and I guarantee you they will fail because they speak different languages* (Aus-Policy Player 2).

For example, Annual Exceedance Probabilities (AEPs), commonly in the form of so-called 'Q100' flood defence metrics provide a measure of probable extreme flood depth in any 100 year period. These metrics are used, for example, by Queensland local government planning schemes to indicate the permissible location and design of buildings in a flood plain. Participants believed such metrics were often misinterpreted by the public such that they were perceived to provide a reliable indication of the relative safety of a building location from flood risk. However, such metrics do not account for important dynamics of flood risk, as well as the non-stationarity of weather-related impacts as a result of climate change (Climate Change Scientist 1; Aus-Policy Scientists 3,6; Aus-Policy Player 5): "*The Q100 says that this is a 1 in 100 year flood, so the tendency is for people to say we're not going to have another flood for a hundred years, which is wrong of course"* (Aus-Policy Scientist 6). These metrics were prone to being misused and misinterpreted which meant that they increasingly lacked salience for decision makers for the purposes of policy making and planning. Further, as will be explained in detail in chapter 7, their derivation has also been subject to political influence in ways that also call into question their credibility and/or legitimacy (QFCI, 2011, 2012).

6.7 Conclusion

The analysis presented in sections 6.5 and 6.6 above confirms the expectations outlined in section 6.4, that pre-existing norms and values influence policy players' perceptions of climate science and policy evidence, and that these perceptions reflect the likely influence of this information on political priorities and policy objectives.

This analysis demonstrates how, although climate science is generally perceived as credible, it lacks both legitimacy and salience because of the complex, contingent, and uncertain nature of adaptation problems and the difficulties of appropriately accounting for norms and values in the development and presentation of this knowledge. Climate science is not salient because it fails to present information at spatial and temporal scales and levels of governance appropriate for decision makers, because it contains uncertainties that make its use difficult within a linear decision making model, or because it is provided in probabilistic formats that can be difficult to communicate and to understand. Climate science lacks legitimacy because its conclusions often conflict with the norms, values and interests of policy players or the normative expectations placed upon them by the evidence-based mandate, or simply because relevant policy players were not adequately consulted in the development of that evidence.

By comparison to *climate science*, the resulting *policy evidence*[95], derived (at least in part) from that climate science, can be deficient across all three criteria of credibility, legitimacy and salience, particularly for those policy players not involved in the development of that evidence, or who sit at contrasting levels of government from that at which the evidence was commissioned or developed. More troubling however, is the indication provided by interview participants that while policy evidence lacks *explicit* normative prioritisation as a result of linear-technocratic expectations for what evidence is and should do, it may nonetheless be subject to covert political influence during its development and presentation.

Although climate science may be perceived as broadly credible, by contrast, policy evidence is not credible because it fails to adequately account for the uncertain, complex, contingent and pluralistic nature of adaptation policy problems. These problems are very difficult to adequately (i.e., impartially) apprehend from any individual governance level or scale because, apart from the

[95] Again, for the purposes of understanding this analysis, please note the important distinctions described here and in Chapter 5 between these two forms of knowledge.

considerable technical complexities and uncertainties associated with understanding social-ecological and climatic systems, vulnerability to climate is a uniquely subjective condition. Under a linear-technocratic policy model, this evidence may also be misinterpreted, miscommunicated and/or misused as representing some objective assessment of reality, which ultimately compounds perceptions that it lacks credibility.

Policy evidence lacks legitimacy too because, despite coproduction processes designed to enhance this legitimacy, at its core it is a contingent interpretation of impact and risk that can never account for the perspectives of all policy players and the plurality of norms and values of these various perspectives. Finally, policy evidence lacks salience because of this inability to account for multiple perspectives relevant to adaptation problems which means that it cannot inform decision makers in the ways promoted by linear-technocratic policy models and assessment methods, particularly for those policy players at different levels and scales of government. Further, this evidence lacks salience because it does not explicitly address normative/political choices in its analysis of a kind that could be very useful for policy players' decision making across governance levels.

Rather ironically therefore, according to many of those interviewed, policy evidence may exhibit greater salience and credibility for policy players across all levels of governance when it explicitly incorporates government values and priorities into the framing and content of its analysis. Yet risk and impact assessments usually fail to explicitly do so due to rationalist expectations for what policy evidence ought to do. Under linear-technocratic policy models evidence must be seen as the impartial analysis of objective science, however redundant or incredible this expectation seems to be. And so, given the political influences on evidence development, in practice this knowledge is often perceived by policy players as the politicised presentation of science, whereby, its supposedly objective messages are considered to be covertly circumscribed by prevailing political forces. In other words, policy evidence lacks credibility and salience for failing to explicitly address these norms, values and priorities of government, and lacks legitimacy because of its tendency toward covert politicisation under linear-technocratic policy assessment methods. And yet, in a rather contradictory way (as I demonstrate in Chapter 7), it is only due to the legitimacy granted to the climate change issue, to objective expert authority in policy making and to the preceding climate science specifically, that subsequent policy evidence for adaptation becomes politicised under the linear-technocratic evidence-based mandate.

However, my research shows that, even if governments were to be wholly explicit about their norms and priorities in the derivation of policy evidence, they cannot adequately account for the values, interests and specific circumstances of all relevant policy players from the perspective of a single governance level or scale. Such is the nature of climate change, the pluralistic nature of adaptation problems and the task of understanding climate risks, impacts and policy responses that the development of evidence necessitates subjective assumptions about how we view the world and subjective, normative prioritisation about what we value, where our priorities lie and what we ought to do. It would seem therefore that, in order to be convincing and technically credible and salient, evidence for policy must be unambiguous about its contingent nature and its subjective framing and prioritisation. In order to be considered legitimate it must also attempt to be congruent with the norms and values of the broadest possible range of relevant policy players.

The difficulties of balancing these priorities cut to the core of the problematic nature of the science-policy interface and the tensions between expert and political authority therein. Although transparency of norms and political influence in policy evidence may appear to be a desirable characteristic for robust evidence-based policy, doing so draws unwanted attention to the basis upon which expertise assumes authority in policy decision making. The presence of expert authority is desirable for both experts (to ensure they have a seat at the table) and for policy makers to rationalise their political decisions. As such, there may also be advantages to keeping norms and politics hidden within the available evidence. As I venture to suggest in Chapter 8, pursuit of linear-technocratic evidence-based policy making may facilitate a pragmatic and efficient policy process by allowing a range of minor yet significant political norms and priorities to pass undetected (or at least unchallenged) within the provision of expert evidence used to rationalise policy. Yet, the advantages of adhering to such a pragmatic process appear stronger for some cases than others.

In Australia, many political decision makers and policy elites appear unconvinced by the available climate science and derivative policy evidence as justification for policy action, as an alternative to, or even to supplement more deterministic and robust information about immediate costs and benefits, or as an alternative to the explicit pursuit of political priorities irrespective of the evidence. Further, as demonstrated by interviewees here, policy making at local and state levels of government appear to have little regard for the evidence-based mandate more generally. By contrast, in the UK the evidence-based mandate appears stronger and climate science and policy evidence hold a degree of legitimacy under the *Climate Change Act (2008)* even though in the eyes of individual policy players such legitimacy is still in question. Because this evidence is legitimised under the Act, it also appears susceptible to processes of politicisation and scientisation that ensure tacit approval for the norms and priorities of policy makers under the guise of impartial expertise. It is because of this propensity for politicisation, alongside the propensity for contrasting norms and priorities across scales and levels of government, that policy players interviewed during my research questioned the legitimacy of this evidence. Further, this evidence also fails to provide information for policy decision making that is sufficiently credible and salient to prompt policy action beyond calls for more and better information.

It seems unsurprising therefore that a number of interviewees in both the UK and Australia have suggested that political preferences ultimately trump the available evidence in relation to climate change when they are in conflict, despite any avowed allegiance to an evidence-based mandate and the use of ex-ante policy assessment supposedly undertaken to inform policy in a robust and objective way. Policy makers and politicians often refuse to take on board the available science because it conflicts with their norms and values or raises a threat of litigation from business interests or the public. As one interviewee put it:

> *I've never believed that evidence per se decides policy… I believe that all decisions when you get down to it are political decisions driven by particularly economic and social aspects* (UK-Policy Scientist 9).

My research leads me to conclude that evidence legitimacy ultimately holds primacy over credibility and salience as the principal determinant of evidence use for policy making. However, my research also demonstrates that, when politics does not reject the evidence-based mandate, as will be described further in Chapter 7, failure to explicitly address the norms inherent in evidence development can also result in political/normative prioritisation occurring implicitly or covertly through processes of politicisation and scientisation. These processes seek to maintain public and political acceptability of ideological or normative positions through government's legitimate recourse to the available 'facts'. It is these issues of politicisation and scientisation that I address in Chapter 7.

Chapter 7. Evidence-based policy and the politicisation and scientisation of climate risk management

Science is organised knowledge. Wisdom is organised life – Immanuel Kant

7.1 Introduction

This chapter examines more closely the framing and assessment (i.e., construction) of climate adaptation problems through the use of risk-based decision making methods during the development of policy evidence. In particular, this chapter explores the propensity for processes of deliberate politicisation[96] and scientisation that allow for values and politics to be expressed covertly and/or deliberately through the provision and use of policy evidence. Chapter 5 of this thesis described in detail the normative, contingent nature of adaptation problems and what we know about them, suggesting that claims toward a positivist objectivity or impartiality in the development of climate science and evidence may be difficult to substantiate in practice. Chapter 6 confirmed the contingent nature of adaptation problems and associated evidence, by demonstrating how policy players may perceive the credibility, legitimacy and salience of climate science and policy evidence in varying ways. These perceptions vary, I argue, depending on the congruence of policy players' circumstances, norms and politics with those values inherent in, or attributed to, the available climate science and policy evidence.

The data collected from research interviews suggests that the importance of congruent norms and values gives primacy to legitimacy, over credibility and salience, as the principal determinant of useful, usable evidence for adaptation policy making. Yet, legitimacy for climate science and policy evidence may also be the most difficult attribute to attain in such a polarised policy arena as for climate change because of the political and economic contingencies associated adaptation problems and the climate change evidence available to understand them. These

[96] What was referred to in previous chapters as a 'politicisation-by-agency'

characteristics are indicative of the ongoing tensions that exist between expert and political authority in liberal democratic policy making that must be managed in order to produce effective knowledge for climate adaptation policy.

This chapter builds on these findings to examine the extent to which risk-based decision making methods for evidence development facilitate processes of politicisation and scientisation whereby values and priorities may be deliberately hidden within the development and use of supposedly impartial evidence. Using case-study examples from the UK and Queensland, I argue that although the contingent nature of adaptation problems and evidence does not necessarily result in the deliberate politicisation of adaptation policy evidence, under a linear-technocratic model such covert expression of values and priorities through the development of this evidence is certainly possible and strongly indicated by the cases I examine. The processes of politicisation and scientisation demonstrated by the examples in this chapter strengthen my conclusions about the primacy of legitimacy over credibility and salience for developing useful, usable evidence for adaptation policy. However, they also point to the challenges policy makers face when pursuing an evidence-based approach to wicked policy problems.

To begin, I briefly discuss the history of the phenomenon of evidence-based policy making and the increasing popularity of risk-based decision making prescriptions for climate adaptation policy. I then discuss the theoretical development of concepts of scientisation developed by scholars such as Jurgen Habermas as a result of the resurgence of expert authority for policy making in the twentieth century. Using case-study material I then demonstrate how these prescriptions are built on an assumption that expert evidence can provide impartial, strategic[97] understandings of climate hazards and therefore also rational assessments of climate risks and opportunities, in order to allow government and its agencies to make robust decisions. By attempting to shoe-horn adaptation problems into linear-technocratic decision making models, I argue that the resulting evidence not

[97] That is, an accurate over-arching summary understanding of climate hazards that would be meaningful for linear decision making

only fails to convince many policy players of the credibility, legitimacy and salience of these assessments, it also suggests that this evidence may be prone to deliberate politicisation.

Such politicisation occurs where government and its advisors use linear-technocratic prescriptions to promote tacit acceptance for certain values and political priorities under the guise of supposedly impartial technical analysis and interpretation. The resulting evidence may then be used in a scientised process of political prioritisation or policy debate, whereby the political elite align with preferred sets of evidence, or preferred interpretations of a single evidence set, that are congruent with their chosen politics. I conclude that while scientised policy debate may occur in the ways originally conceptualised by Habermas (1971), Weingart (1999) and Sarewitz (2004), scientised policy making has also been facilitated by *ex-ante* risk assessment methods and the types of expert knowledge available to inform them. That is to say, a scientisation of policy making may proceed through the deliberate and covert adjustment of expert conclusions by *non-experts* to ensure coherence between expert and political forms of authority, a process that is made feasible by increasing efforts toward the coproduction of policy evidence for wicked problems like climate change.

Constructivist scholars have long argued and demonstrated empirically that it is in the nature of science and evidence, as the outputs of social processes, to be influenced and infused by participants' values and even politics (Hoppe, 2005; Jasanoff et al., 1995; Jasanoff, 1990). Given that a degree of social construction in the production of evidence appears inevitable, the resulting evidence cannot be dismissed or invalidated simply because it fails to meet the unrealistic expectations of positivist ideals. What is important for the purposes of ensuring evidence credibility (as well as legitimacy and salience) for public policy, I argue, is how this knowledge is derived, presented and used. Politicisation and scientisation occur when significant and relevant values and ideals travel unaddressed through the knowledge utilisation process such that they 'illegitimately' influence policy and political decisions. In one sense therefore, given the arguments presented in chapter 5, it can be argued that all climate adaptation science and policy evidence is politicised[98] to some extent, however unintentional it may be by those experts who stringently adhere to the precepts of 'good' scientific and research practice.

Yet, the characteristics of policy evidence such as risk assessment suggest that both expert and non-expert policy players may have the opportunity to deliberately infuse this evidence with normative and political views as a means to legitimise their political positions, or to expedite particular policy initiatives. Not only does politicisation as a general concept highlight the increasingly constructivist character of environmental science for policy, it raises important questions about whether it will ever be possible to reconcile evidence credibility (so often concerned with ideals of objectivity and positivism) with its salience and legitimacy for decision making which necessitate observance of a plurality of norms and values.

7.2 Evidence-based policy: an evolving field of decision making

Kitcher (2011) suggests that, although the idea that good decisions should be based on expert knowledge has origins dating back (at least) to Plato's "The Republic" (ca. 380 B.C.), it has only been since the eighteenth century or so that the natural sciences have been considered by many as the epitome of human knowledge and therefore an important constituent in public policy making and implementation (Weingart, 1999). Yet, despite society's dependence on science and technology for its understanding, design and provision of the trappings of modernity, there has often been a tension about the role of such knowledge in political decision making, relating to the interactions between expert authority (which originates from a supposed ability to apprehend objective truth) and political authority (which originates from democratically elected representation or choice) (Nutley et al., 2002). In negotiating this tension, governments have often heeded the advice of experts (for instance on public health issues such as smoking, for which there is considerable determinacy in the expected morbidity) though rarely if ever have they relinquished decision making control. The reason for government accession in this regard is presumably because of both the

98 As discussed in previous chapters, this form of inevitable politicisation may be considered a 'politicisation-by-process'.

instrumental and legitimating power that evidence can have for public policy making (Weingart, 1999). However, evidence-based policy making has simultaneously highlighted the aforementioned tensions between experts and politics and which, with the advent of applied social science, appear to have become even greater, perhaps because of the ability of the latter to address normative or political questions in a more direct way than science and engineering ever could (Marston and Watts, 2003).

Sanderson (2002) suggests that the take-off point for social science research for policy in the UK occurred in the mid-1960s, but that this relationship was problematic due to a political culture resistant to the influence of 'rational knowledge' from experts for political decision making[99]. More recently however, following more than two decades of 'conviction politics' under successive Conservative governments, Nutley et al. (2002) and Solesbury (2001) describe how evidence-based policy making in the UK witnessed a resurgence of interest under the 'New Labour' government of the late 1990s, who had adopted the mantra 'what matters is what works'. Davies et al. (1999) and Solesbury (2001) argue that evidence-based policy was promoted by Labour as part of a reformist, anti-ideological stance[100] in reaction to previous governments' neo-liberal convictions[101]. This new evidence-based mandate sought to demonstrate the efficacy of evidence for the resolution of policy problems, as well as policy makers' rational use of it.

In Australia, as described in chapter 4, there has often been a suspicion of expertise and its role for dictating environmental management practices, particularly in the state of Queensland. Kay (2011) and Banks (2009) suggest that recent ambitions toward evidence-based policy, at federal level at least, aligned with the reinstatement of the Labor Party in 2007, as newly elected Prime Minister Kevin Rudd observed that "evidence-based policy making is at the heart of being a reformist government" (Banks, 2009: p. 3). Yet, the clarion call from the UK concerning 'what works' was most certainly heard in Australian politics well before the arrival of the Rudd government

[99] Weingart (1999) documents a similar scepticism of the role of expertise in policy making in the US during the mid-twentieth century.
[100] Despite their concurrent embrace of 'The Third Way', a social-democratic governance ideal (Giddens, 1998).
[101] Relating to greater autonomy of the market place to manage public goods and services, and a corresponding shrinking of government intervention in matters of public policy (Harvey, 2007: p. 2).

(Holmes and Clark, 2008; Marston and Watts, 2003; Hess and Adams, 2002). Further, Banks (2009) argues that the governance ideal of evidence-based policy making has existed in Australia since the 1980s at least, albeit principally for economic rather than social and environmental policy making. However, much as Nutley et al. (2002) has argued for the case of the UK, Banks (2009) suggests that Australian federal government has been more evidence-*influenced* than evidence-based and that evidence rarely, if ever, plays a deterministic or technocratic role in political decisions.

In chapter 3, I explored the types of knowledge that constitute scientific evidence for adaptation policy and the theoretical precepts behind ideas of science, trans-science, post-normal science and coproduced policy knowledge. I also discussed the role that knowledge can have in the policy making process beyond its assumed linear problem-solving function. However, the evolution of evidence-based policy seems to have developed largely independently from the concurrent development of constructivist theories of science and expert authority. Only in recent times have policy makers begun to take on board the advice of the academy regarding the contingent nature of evidence, and an associated need for the democratisation of expertise for public policy problems (Maasen and Weingart, 2005). Despite increasing acceptance by governments of the need for broader concepts of what evidence and expertise are (Solesbury, 2001), rationalist models of evidence-based policy making still prevail in ways that seem to largely conflict with constructivist arguments concerning the contingency of policy evidence (Sanderson, 2002).

A number of key debates have arisen in the academic literature concerning the value of evidence and its use for policy making. Marston and Watts (2003) suggest these relate to two opposing conceptual models of policy making which I have discussed at length in Chapter 3. The rational policy model (or perhaps more accurately, the linear-technocratic model), on the one hand, advances the idea that policy decisions can be wholly rationalised, and even determined directly, by available research. On the other hand, the political model, argues that policy making is, at best, evidence-influenced but largely derived through political machinations and deliberation. These contrasting perspectives raise contentious debates about what rational knowledge is. Nutley et al.

(2002) suggest that although the UK government has provided a broad canvas for what constitutes evidence for policy since the resurgence of interest in this form of policy making, the prevalence of the rational model means that in practice, there is a clear hierarchy between different types of information. Quantitative scientific and social research sits at the top of this hierarchy and qualitative knowledge derived from, for instance, public consultations is situated further down. Thus:

> *If knowledge operates hierarchically, we begin to see that far from being a neutral concept, evidence-based policy is a powerful metaphor in shaping what forms of knowledge are considered closest to the 'truth' in decision-making processes and policy argument* (Marston and Watts, 2003: p. 145)

If, as argued by Head (2008b), Jasanoff (1990, 2003a, 2005), and Nutley et al. (2002) amongst others, there is validity to a political model of policy making then it seems plausible, I argue, that adherence to linear-technocratic prescriptions that favour scientific quantitative evidence over qualitative or less rigorously derived local or contextual knowledge may facilitate the deliberate politicisation of policy evidence for wicked adaptation problems. This is because, as demonstrated in Chapter 5 and in the case-study examples in this chapter, the types of evidence preferred under the linear-technocratic model still necessitate subjective and normative decisions in their derivation for climate adaptation that can, I argue, be manipulated in the course of evidence development to align with political preferences. As I discuss further in section 7.3, a political policy making model also indicates the possibility of a scientisation of policy decision making whereby political choice is disguised, or debate is suppressed, through policy players' recourse to expert authority and the supposedly impartial evidence they provide. Such processes of politicisation and scientisation suggest that, rather than replacing political influence in policy formulation, the evidence-based mandate may actually facilitate the politics of policy making by taking advantage of the authority granted to experts for informing policy decisions.

Existing *ex-ante* policy assessment tools such as risk assessment, used by governments to fulfil the commitments of evidence-based policy making, largely rely on a rationalist schema (Hertin et al., 2009; Nilsson, 2008). This is problematic I argue because, rather than simply serving as a heuristic device, the rational model has become formalised within policy assessment tools seeking to standardise robust decision making. Despite the difficulties these tools encounter in adequately accounting for complexity, uncertainty and the divergence of opinions and values in relation to concepts of risk, cost and benefit, they are used in an attempt to enhance the usefulness and usability of scientific research through formalised empirical assessment and prioritisation which, I argue, is often ill-suited to the task. In this chapter I focus upon the phenomenon of risk-based decision making and its use for climate adaptation policy under the rationalist schema, to demonstrate how ex-ante methods can facilitate processes of politicisation and scientisation. However, to begin I discuss the phenomena of politicisation and scientisation during public policy making.

7.3 The scientisation of policy making

Perhaps one of the first scholars to discuss the scientisation of politics was Jurgen Habermas (1971) who described the distinction between *decisionistic* and *technocratic* relationships between expert and political authority. Decisionism involves prescribed roles for politicians and expert advisors such that there is a clear separation between value-based (what Habermas calls 'irrational') decision making by politicians, and the legitimation and rationalisation of those decisions and their instrumentation through the use of expert advice. This model has its origins in the writings of Max Weber (see section 3.6.1) amongst others, and suggests that government's decisions inevitably have both a technical, rational component relating to the use of evidence in the design and implementation of policy and a purely 'irrational' component relating to the value positions of the political elite:

> *As much as the objective knowledge of the expert may determine the techniques of rational administration […] practical decision in concrete situations cannot be sufficiently legitimated through reason. Rationality in the choice of means accompanies avowed irrationality in orientation to values, goals and needs* (Habermas, 1971: p. 63).

Under this Weberian decisionism, Habermas envisages the scientisation of politics as a process by which expert authority is used in an instrumental or legitimising way to aid the irrational decision making of the political executive. However, decisionism is flawed, he argues, since those who are supposed to impartially implement the wishes of the executive have their own values and priorities and the process of policy implementation requires value-based decisions which defy resolution through pure rationalisation.

Yet, Habermas' (1971) critique of decisionism is somewhat underspecified and he pays considerably greater attention to an opposing model of technocracy. Since policy players have increasingly sought to rationalise decision making through the application of decision theory and systematic forms of analysis (e.g., risk assessment), Habermas (1971) suggests that the decisionistic model has often competed for space with technocratic ideals. Under a technocratic model, experts would be trusted to rationalise decision making in such a way as to make the political elite increasingly redundant:

> *The politician would then be at best something like a stopgap in a still imperfect rationalization of power, in which the initiative has in any case passed to scientific analysis and technical planning* (Habermas, 1971: p. 64).

Habermas rejects technocracy on the basis that it is impossible to fully rationalise political decisions. There will always be an 'irrational' value-based component to decision making, no matter how far technical expertise can erode the scope of political deliberation. Under technocracy then, the scientisation of politics becomes a process by which experts gain increasing control over value-preferences and political decision making, under the guise of technical impartial control. Habermas (1971) argues for a pragmatic compromise between decisionism and technocracy in order to avoid the worst excesses of both, whereby there would be an ongoing dialogue between expert and political authority, guided by an hermeneutic understanding of the public's "value beliefs", articulated by the discourse of relevant communities (Habermas, 1971: p. 68, 69).

More recently, Weingart (1999) and Sarewitz (2004) have added considerable colour to the discussion of the scientisation of politics, particularly in relation to the resolution of environmental problems such as climate change. Weingart (1999) tracks the development of governments' science policy and the use of science for policy in the USA and Germany since World War II as a means of illuminating the relationship between experts and politics and the *scientification* of policy making that has occurred during this time. He argues that despite an initial concern amongst politicians and the media that scientists were gaining increasing status and illegitimate influence over policy making in the US (i.e., technocratic control), a democratisation of expertise subsequently occurred, resulting in ready access to expert knowledge by all participants in policy making. What ensued was a process of scientification allowing policy players to pick and choose expert evidence, leading to "*a competition for expertise which intensifies controversies in policy-making rather than alleviating them*" (Weingart. 1999: p. 152) and which delegitimises expert authority as a result. Weingart (1999) argues that the scientification of policy making is tightly coupled with the politicisation of science; scientific knowledge is not value-free and experts engaging in policy making are not politically neutral, particularly as the competition between expertise resulting from this scientification means that, increasingly, scientific research is used before its veracity can be adequately determined.

For the sake of simplification, Sarewitz' (2004) begins his argument by assuming that science does what it says it does: it provides impartial objective truth about the world. Similar to Weingart (1999), he argues that because there are so many disciplinary lenses through which to view the world, there are many scientific or empirically-derived truths, not all of which are commensurable. Sarewitz (2004) draws attention to the nature of contemporary scientific knowledge in a pluralistic world, and thus the task of addressing wicked problems such as climate change (described in detail in chapters 5 and 6) whereby there appear to be many valid truths and interpretations of evidence to legitimise political decisions. Sarewitz (2004) interprets scientisation as *the suppression of normative debate by recourse to the 'facts'*, which is facilitated for wicked problems by a plurality of valid scientific arguments and disciplinary lenses that can align with alternative and potentially contrasting political positions. Thus, conflicting political positions have their own sets of legitimised 'facts', and the choice of, or debate concerning which set to use suppresses or supplants explicit normative debate. Sarewitz (2004) concludes that scientisation in this form occurs as a result of how science has traditionally been used in policy debates (i.e., decisionistically, to rationalise pre-existing norms and political positions). For the sake of simplicity he largely avoids discussion of political forces at play in evidence development itself, such as those described in section 7.4 below. However, his argument about scientisation of environmental policy clearly implicates a form of politicisation that can occur in the choice and presentation of evidence and draws further attention to the tight coupling between scientisation and politicisation (Weingart, 1999).

Politicisation, as defined for the purposes of my research, occurs as a result of normative or political influence in either the development or communication of science and policy evidence. My research follows the arguments of Fischer (2009) concerning the legitimacy of expertise to suggest that politicisation occurs as a result of scientists extending their legitimate expert authority beyond the realms of what they can legitimately claim to have privileged knowledge about. This extension occurs, deliberately or otherwise, either by the hand of experts themselves or on their behalf by non-expert parties, but in either case politicisation is the process by which values influence scientific endeavour, or influence experts' conclusions and communication of science in a way that promotes (intentionally or otherwise) a normative or political position.

I argue that although the distinction between politicisation and scientisation is an important one, whereby the former relates to that which is something that happens to science and the latter is that which happens to policy making, this distinction becomes difficult to discern at the science-policy interface for issues like climate change, where 'policy evidence' (as characterised in chapter 5) is often not wholly scientific in its make-up, but rather is coproduced through some combination of technical analysis and normative prioritisation while still seeking rationalisation through access to privileged expert knowledge. Under such circumstances, these phenomena are so tightly coupled that I argue that Weingart's (1999) and Sarewitz' (2004) characterisation of scientisation is inadequate on its own because they assume that expert evidence is produced solely by experts. Both scholars leave unanswered the question of what happens to policy making when non-expert policy players deliberately politicise the coproduction of policy evidence which, under a linear-technocratic schema, is construed as objective expertise. In such circumstances, I argue, another mechanism of scientisation prevails whereby non-expert policy players can politicise evidence within the functional bounds of expert authority (rather than through their subsequent communication of that expertise during the policy process) in order to scientise.

It is at the science-policy interface for wicked policy issues like climate adaptation that non-expert policy players have the opportunity to deliberately over-extend expert authority on experts' behalf. This over-extension occurs as a result of contradictory expectations for both an adherence to the linear-technocratic model to ensure credibility on the one hand, and for the democratisation of evidence production for policy making to ensure political acceptability (i.e., legitimacy) on the other. As the cases of the UKCCRA and Q100 assessments for the City of Brisbane described below demonstrate, normative prioritisation can quite easily become wrapped up in technical considerations of environmental management and policy players can deliberately manipulate those considerations to ensure expert evidence tells the story best aligned with existing norms and politics.

Although Weingart (1999: p. 157) eschews the idea that the boundary between expert and political authority has been blurred because "[this idea] incorrectly assumes that the functional differentiation between science and politics disappears", the case-studies described below indicate that during the coproduction of policy evidence non-experts do have the opportunity to undertake normative/political prioritisation under the guise of impartial, independent expertise. The difference between this form of scientisation and those identified by Weingart (1999) and Sarewitz (2004) is that, in the former case, expert authority is manipulated through the actual development of evidence, whereas Weingart (1999) and Sarewitz (2004) argue that expertise is manipulated through the choice and communication/presentation of evidence. Alternatively, of course, experts may over-extend their own authority by annexing trans-scientific or policy questions as technical matters when they are inevitably encountered in the development of policy evidence, as was suggested by some interview participants during the 'expert elicitation' exercises conducted as part of the UKCCRA, described in Chapter 6.

As the case-studies in section 7.4 below demonstrate, the scientisation process consists of the political executive saying: ‘Our policy is informed by and coherent with the facts that experts provided’, while those facts were actually derived not just from scientific research or expert judgement but through knowledge coproduction processes between experts and non-experts. During this coproduction process, values and priorities are negotiated through some combination of problem framing, characterisation and technical modelling and assessment, through the choice of which evidence to use and which experts to listen to. I argue that during this coproduction process science can be politicised by various policy players in the course of creating an internally consistent body of policy knowledge in line with government politics. This, in turn, results in the scientisation of policy because this politicised evidence has covertly answered and therefore suppressed substantive normative debates and is used to legitimise policy positions through recourse to these ‘facts’. I argue, therefore, that adaptation policy becomes scientised in two ways:

1) When seeking to legitimise decisions through the choice of one set of facts, or interpretations of facts, over other available and equally valid sets or interpretations (Weingart, 1999; Sarewitz, 2004); or,
2) When seeking to legitimise decisions through deliberate politicisation during the development of a single available set of evidence by either experts or non-experts, to ensure that government’s rational recourse to the ‘facts’ is absolute.

Both forms of scientisation involve an attempt by partisan players to shut down specific areas of normative/ political discussion through recourse to supposedly objective truth. And though the distinction between politicised evidence development and politicised evidence choice/communication may be slight, the coproduction processes described in the case-studies here demonstrate the extent of overlap between science and politics during adaptation policy making. Through the second mechanism described above, in particular, I argue that politicisation and scientisation are not just two sides of the same coin, but that the functional differentiation between science and politics has indeed become blurred.

The case-study analyses in section 7.4 below demonstrate that processes of politicisation and scientisation are facilitated by the linear-technocratic policy model. I argue that linear-technocratic heuristics and prescriptions such as provided by Willows and Connell (2003) are merely a façade behind which norms and politics can easily hide. Climate adaptation problems need coproduced policy evidence to ensure sufficient legitimacy for expertise to inform policy making and to adequately address the wicked nature of adaptation problems that make them immune to definitive characterisation. However, in order to ensure credibility, this evidence must also be seen to be objective by following linear-technocratic prescriptions. Policy evidence (as defined in chapter 5) must increasingly balance the competing requirements of credibility, legitimacy and salience, since the political elite needs the support of expert authority in order to be seen to be doing the right thing, yet cannot get on board with it if it doesn't provide usable, salient and politically acceptable information for government. As I describe in the next section, risk assessment has become a principal tool for government policy making to address these contradictory needs.

7.4 Risk-based decision making for climate adaptation

Under the linear-technocratic model, the concept of risk or risk-based decision making holds considerable allure. As described by Renn (2008) and Beck (1992), contemporary society has become shaped and preoccupied by considerations of risk, as the trappings of modernity have become a potential source of its own destruction[102]. The unintended negative consequences of technological advance and collective action can outweigh its intended benefits, and therefore risk has become a sort of currency in the global economy whereby it has become a principal determinant of capitalist expansion:

> *The gain in power from techno-economic 'progress' is being increasingly overshadowed by the production of risks. In an early stage, these can be legitimated as 'latent side effects'. As they become globalized, and subject to public criticism and scientific investigation, they […] achieve a central importance in social and political debates […] unlike the factory-related or occupational hazards of the nineteenth and the first half of the twentieth centuries, these can*

102 So-called 'Reflexive Modernisation' (Beck, 1992) *no longer be limited to certain localities or groups, but rather exhibit a tendency to globalization* (Beck, 1992: p. 13)

Lash and Wynne (1992) argue that, although risk is a multidisciplinary concept that provides the illusion of pluralistic research and debate, the dominant discourses of risk are instrumentalist and reductionist in their outlook, thus aligning with linear-technocratic perceptions of policy making. In this vein, Renn (2008) argues that the contemporary definitions of risk contain three elements:

1) Outcomes that can impact on what humans value;
2) The possibility of occurrence; and,
3) A formula to combine both elements (e.g., Risk = Likelihood X Consequence[103]).

Indeed, perhaps it is because of this empirical formula that Lash and Wynne (1992) argue that, just as the types of evidence for policy are often arranged by government hierarchically (Marston and Watts, 2002), so are the types of expertise available: “technical experts are given pole position to define agendas and impose bounding premises *a priori* on risk discourses” (Lash and Wynne, 1992, p. 4). Yet, risk is also clearly a social construction as it depends on personal and socio-cultural interpretations of what is important and what we value, which defies any ‘objective’ instrumental calculation by technical experts. Risk acceptability, therefore, is fundamentally a political issue (Douglas and Wildavsky, 1983). Conversely, technical risk assessors are influenced in their assessment of risk by cultural values, by available resources and economic priorities, as well as the format and availability of scientific research and other forms of evidence (Renn, 2008).

In order to demonstrate the contingent nature of risk assessment for climate adaptation, I describe here two examples, the first from the UK and the second from Queensland, that have used this empirical risk formula in ways that have combined research science and prevailing norms and politics in the development of policy evidence to rationalise policy decisions, under a façade of impartial technical analysis. These case-studies provide useful examples of the processes of politicisation and scientisation that may ensue when using instrumentalist risk-based methods to

[103] The IPCC’s 5th Assessment Report aligns with this definition of risk: “*Risk is often represented as probability of occurrence of hazardous events or trends multiplied by the impacts [or consequences] if these events or trends occur. Risk results from the interaction of vulnerability, exposure and hazard*” (IPCC, 2014: p. 1772)

understand necessarily contingent adaptation problems. These examples help to address the question of whether ex-ante policy assessment approaches may be particularly prone to normative and political influence, beyond that which is inherent and inevitable in the social construction of otherwise robust climate science and policy evidence.

7.4.1 The UK Climate Impacts Program – Risk Framework

The UK Climate Change Risk Assessment (UKCCRA) was developed using a method published by the UK Climate Impacts Program (UKCIP) in 2003 (DEFRA, 2009; Willows and Connell, 2003). However, this method draws heavily on a decision making framework that has been in development by UK government departments and agencies over the course of many years, following a format very similar to previous risk assessment methods used for evidence-based policy making for the natural environment. In particular, UKCIP's assessment framework has strong similarities to a set of environmental risk assessment guidelines known as "Greenleaves". The first edition of Greenleaves was published in 1995 by the then Department of Environment, Transport and the Regions (DETR), with a second edition in 2000 and a most updated edition published in 2011 by the current Department of Environment, Food and Rural Affairs (DEFRA, 2011a). Much like the Greenleaves guidelines, the UKCIP framework follows a rationalist schema that assumes that climate scientists and other experts can apprehend reality with sufficient accuracy to impartially assess climate risks and inform judgements about those risks for decision making. The method gives explicit priority to scientific and technical evidence for informing these decisions:

> *The assessment of climate risks is a complex undertaking* ***that must support judgements*** *and decisions concerning appropriate future courses of action. It requires a combination of* ***scientific and technical knowledge*** *[…] of society's tolerance and acceptance of risk, and the costs and benefits of different courses of action* (Willows and Connell, 2003: p. 3) [Emphasis added]

The framework assumes that climate adaptation problems are tractable, that they can be defined "correctly" (Willows and Connell, 2003, p. 7, 10) to facilitate "good practice in decision making" (Willows and Connell, 2003, p. 6), allowing "robust decisions" (Willows and Connell, 2003, p. 5) to be made using the best available information. Implicit throughout this guidance is the assumption that adaptation problems can be unambiguously defined, to the satisfaction of all (or most) relevant stakeholders, using science and other technical knowledge. Judgements and policy decisions are considered, not so much a part of the risk assessment process itself (as argued in this thesis), but something which can be usefully informed by the assessment of risk in a linear and transparent way. The framework suggests that robust decisions are essentially rational ones: they are informed by sufficient objective expert knowledge about the nature of risk to be able to rationally weigh the costs and benefits in order to identify and implement “good adaptation options” (Willows and Connell, 2003: p. 4).

As I argue here, and in chapter 5, such assumptions about the tractability of adaptation policy problems and the objective nature of the available evidence are difficult to justify in practice. The expectations and information requirements for rational policy making cannot be met when addressing most contemporary policy issues. Rittel and Webber’s (1973) use of the term ‘wicked’ to describe policy and planning problems that display a high degree of uncertainty, complexity and divergence of values and objectives amongst decision stakeholders appears particularly apt to describe climate adaptation issues (Head, 2008b). There are few, if any, definitive answers to climate adaptation problems, particularly when it comes to human interactions with the environment and the evidence that exists is open to subjective, normative influence, selection and interpretation (Oreskes, 2004; Sarewitz, 2004).

More troubling, however, is the idea that climate risk, which constructivist scholars argue is a fundamentally normative concept to begin with (Renn, 2008; Douglas and Wildavsky, 1983), can be impartially apprehended by government in a way that provides an adequate summation of any given policy problem to allow subsequent political judgement. As demonstrated by my analysis of the nature of climate-related evidence provided in Chapter 5, and the perceptions of policy players regarding climate science and adaptation evidence described in Chapter 6, this rationalist assumption, supported by ex-ante assessment frameworks such as provided by UKCIP (Willows and Connell, 2003) is, I argue, fundamentally misguided. Climate risk cannot be defined ‘correctly’, any more than it is possible to define objectively ‘good adaptation options’. The assessment of climate risks necessitates important judgements by those tasked with undertaking it and, I argue, may curtail subsequent judgements by government due to the propensity for these assessments to become politicised, and for policy players to use this information in a scientised policy making process.

As described in detail in section 6.6, the resulting difficulties of using the UKCIP risk assessment framework were keenly felt amongst those who participated in the development of the UKCCRA. Those interviewed for this study described how there are ongoing tensions between the rationalist framework prescribed by UKCIP and the realities of apprehending the risks from climate change at a strategic level. These difficulties related to:

1) The sheer complexity and uncertainty of understanding risks at a national level that would provide unambiguously correct answers;
2) The difficulties of using climate science to assess risk in a linear ‘top-down’ or deterministic way; that is, using climate science to understand future hazards with sufficient precision and accuracy to effectively understand climate change risks to chosen receptors;
3) The difficulties of avoiding the influence of prevailing norms and values or the influence of cognitive bias in the risk assessment process. For instance, confirmation bias was suggested by a number of interview participants involved in the UKCCRA whereby experts identified risks that aligned with their pre-existing academic priorities and expertise; and,
4) The pressure placed upon the assessors to deliver politically acceptable results by public servants working in a wide range of ministerial departments, who were then asked to sign-off on the assessment and its conclusions before it was presented to parliament.

As described in chapter 6, these difficulties were revealed in the course my investigation into perceptions of evidence credibility, legitimacy and salience. The first three of these difficulties align with those characteristics of coproduced policy evidence specifically discussed in chapter 5, concerning the necessarily contingent, trans-scientific or post-normal character of climate science, adaptation science and policy evidence. However, the fourth of the difficulties above is perhaps of greatest relevance to the focus of this chapter. Testimony suggesting political pressure on the risk assessment process not only correlates with participants' perceptions of failing credibility, legitimacy and salience of policy evidence, it also suggests the possibility of deliberate covert politicisation of supposedly impartial knowledge.

A number of those interviewed who had been closely involved in the UKCCRA gave testimony suggesting significant influence in the interpretation and reporting of evidence by civil servants during the assessment process (UK-Policy Scientists 1,2,3,10). Such influence speaks to notions about the coproduction of policy evidence (described in Chapter 5). However, this influence also relates to problems of deliberate politicisation that may be present during coproduction processes that claim to adhere to rationalist principals of impartiality and privileged expertise. Such politicisation appears to have been not just an inevitable characteristic of policy evidence development given the nature of the available research and the manner in which risks were assessed; the UKCCRA may have been, to some extent, deliberately influenced by prevailing politics in order to ensure tacit acceptance of particular norms and values. As one policy scientist noted of the UKCCRA's assessment process:

> *You kind of needed to be robust, otherwise you were at risk of being kicked all over the field, because it's an area that evokes quite strong views […], it meant that it was a very political environment;*
>
> *It started to get quite brutal from a contractor point of view […] we misread it, we treated it as a technical contract, [but] the technical work was probably less than 40% of the contract, and most of it was to do with stakeholder engagement with a particular emphasis on government departments rather than the original intention which was for a much wider stakeholder engagement […] and then producing a report which met departments' needs and that was completely different to producing a report that stated the technical case* (UK-Policy Scientist 2).

The policy scientist in question described how the initial technical report which had followed the method set out in the UKCIP risk framework was deemed unacceptable by those ministerial departments affected by the conclusions of this analysis:

The technical report that they initially produced essentially cranked the handle on the methodology and produced some results, […] and then you've got to interpret it, but here it was a case of interpreting it and ensuring you kind of addressed the interests of each department, and that was a mix of not saying things that would scupper existing policy as well as having some sight of where they're trying to get to and making sure that there was information there;

At the stage we were defining the problem there was very little interest [from ministerial departments]; once we'd done the analysis and produced the initial report, suddenly there was interest and suddenly they wanted something different, […] we did quite a lot of second and third phase analysis, adding in parameters and variables where we could […] we worked in additional parameters to meet these various departmental needs;

At the end of the main, the first reporting phase, there was a realisation by government that the reports, the technical reports were not what they wanted so there was a new phase negotiated which was all about producing the reports you now see on the website, which was, I mean they went through about four or five edits, and there were thousands of comments, […] And that was kind of in parallel with a change in their approach to stakeholder engagement […] It was certainly our intention to go with the initial technical result and discuss it with stakeholders but that's where there was a change of direction and a real concern by the government departments that they didn't want to go public on this until it had been laid before parliament (UK-Policy Scientist 2).

Another prominent UK policy scientist (10) agreed with this view of government intervention and believed that the UKCCRA had only presented the risks that were deemed politically acceptable for government to recognise. This scientist believed the assessors and their patrons at DEFRA had deliberately excluded the issue of extreme sea-level rise because of the political ramifications of doing so. The policy scientist in question (a national expert in sea-level rise and associated flood risk on the urban environment) believed that a credible, legitimate risk assessment would have addressed the full range of risks from sea-level rise given the considerable scientific uncertainties regarding their likelihood, and due to the potentially catastrophic consequences on particular locations and regions of the country that could arise from step-changes in sea-level due to Greenland and Antarctic ice melt:

I came across quite a few civil servants who said, well there's no appetite for this […] so we're not going to tell it […] we're not going to do anything about it, […] even if you say well this is the implication, it's very difficult, but we should do something about it, [and] if we don't X will happen; but if you don't even get to that stage how can you possibly blame the politician? (UK-Policy Scientist 10)

Such political interference however was alluded to by a number of other interviewees in relation to the derivation of the risk assessment more generally. One local government player who had been involved in the UKCCRA suggested that it had failed to address the real risks from climate change because: "*To be perfectly honest the politicians weren't interested in it"* (UK-Policy Player 2). Another prominent UK policy scientist described the UKCCRA as: "*The political presentation of science"* (UK-Policy Scientist 5), while another interviewee stated:

> *I'm less convinced [the UKCCRA] does represent a sort of [expert] consensus or even a biased consensus on the basis of who shouted loudest, I think it was between who won the contract and who was pulling the strings in DEFRA at the time* (UK-Policy Scientist 7).

By comparison, some Australian interview participants recounting their own experiences of ex-ante policy assessment such as risk and impact assessment agreed with the views of those participants in the UKCCRA to suggest that these assessments are often prone to covert political influence (Aus-Policy Player 2,3; Aus-Policy Scientist 5,6). One policy scientist believed that because of both the complexity of adaptation issues and the plurality of valid interpretations, there is an unavoidable political component to the provision of adaptation policy evidence reflecting the capricious nature of its legitimacy, depending on the political views of those using it:

> *I can't tell you how many times in my career; I've been involved in decision making for kind of complex environmental social and economic issues for a long time and I can't tell you how many, hundreds, the majority of the time that those kind of expert, multi-criteria sort of assessment systems, that they are intentionally manipulated by one or more parties to basically drive the outcome that people want. It's so easy to manipulate it* (Aus-Policy Scientist 5).

The case-study of the UKCCRA is a useful example of the limitations of risk-based approaches to adaptation policy evidence development. Not only did the method used struggle to account for the complexity and uncertainty of adaptation risks, particularly in relation to the management of social-ecological systems as described in chapter 6, but the process of risk assessment more generally highlights its contingent nature. The technical assessment undertaken for the UKCCRA was deemed largely unacceptable to those working in government. However, this assessment was also adjustable because of the many and varied complexities and uncertainties associated with the assessment of climate hazards and impacts which meant that this analysis could not provide irrefutable or definitive answers as per the expectations of the linear-technocratic model it had attempted to adhere to. Further, it seems unsurprising that interview participants believed that it had failed the tests of credibility, legitimacy and salience, in particular for those policy players at different jurisdictional and geographic scales and levels of governance (see Section 6.6).

This case-study shows that there are a range of potential sources of normative/political influence and bias associated with the interpretation of research during ex-ante policy assessment. The problem with risk assessment of this kind is not, I argue, that it contains subjective and normative influence. Rather, it is that it is *portrayed* by government as objective, impartial and largely technical evidence to legitimise political priorities, which then leaves it open to deliberate politicisation in order to garner tacit political support for important norms or policy decisions (such as the decision to largely ignore some of the risks from sea-level rise, as described above). Thus, the combination of technical analysis and political influence from the various advocacy coalitions in the development of the UKCCRA described above, was portrayed by the relevant government Minister to a parliamentary and public audience as a rational, impartial and comprehensive assessment of the available science to understand climate change risks (see DEFRA, 2012a,b):

> *The UK is at the forefront of climate science. Whilst the future is highly uncertain, we can use the* ***best scientific evidence*** *available alongside well established risk-based decision approaches* ***to assess risks and decide how to respond*** *[…] The CCRA Evidence Report is a world-class* ***independent research*** *project that analyses the key risks and opportunities that changes to the climate bring to the UK. It* ***provides a baseline*** *that sets out how climate risks may manifest themselves in the absence of current and planned actions. The baseline of the CCRA Evidence Report allows Government and others to assess the extent to which our actions and plans are climate resilient* (DEFRA, 2012a: p. 3) [Emphasis added];
>
> *It presents the* ***best information available*** *on the vulnerability of the UK to climate change,* ***identifies notable risks and opportunities and gaps in our current understanding*** *of climate risks.* (DEFRA, 2012b: p. V) [Emphasis added]

In reality, the outputs of the assessment appear to have been anything but "independent" and its description as the "best information available" seems audacious given that it was adjusted by various advocacy groups within government departments to align with their political priorities. This potential for politicisation has important implications for the use of risk-based decision making methods and their propensity for facilitating the scientisation of policy debates and policy making.

7.4.2 Floodplain management in SEQ: the use of Q100 metrics to determine urban planning policy

In this section I describe how the use of risk-based methods for urban planning in Brisbane, SEQ has effectively concealed necessary political decisions about communities' flood risk and exposure, and I argue, indicates a process of evidence politicisation at work in the development of flood risk management policy by Brisbane City Council. I argue that flood risk assessment methods that dictate the tolerable level of urban development in the floodplains of the Brisbane and Bremer rivers, are based on politically-motivated assumptions about the operation of the Wivenhoe dam. As I seek to demonstrate here, these assumptions have, thus far, proven to be technically inadequate for the purposes of flood risk management, in particular by the events surrounding the 2010-2011 floods (QFCI, 2012). They have, I argue, been instrumental in adversely affecting the level of exposure of communities in Brisbane to extreme flooding events.

While undertaken as part of governments' evidence-based approach to flood risk management, these supposedly impartial assessments were derived, at least in part, through covert political influence. What is interesting about this case-study is that, although it relates directly to the issue of climate adaptation policy making, it avoids grasping the thorny issue of climate change and the associated indeterminacy of technical risk assessments faced during the UKCCRA. Yet, this assessment of risks was nonetheless hampered by difficulties of uncertainty, complexity and divergent norms and values that allowed supposedly expert evidence to become subject to political influence. This case demonstrates how, even when ignoring the spectre of climate change, understanding bio-physical and social-ecological systems still requires a balance between evidence credibility, legitimacy and salience (or between socio-cultural and technical reasoning) for the purposes of policy making.

In December 2010 and January 2011, an unusually strong La Nina event and prolonged intense monsoonal rainfall caused extreme flooding in the Brisbane River catchment, Lockyer Valley, and surrounding areas of Southeast Queensland. The flooding resulted in the deaths of 35 people and an estimated $5 billion worth of damage (Queensland Police, 2011; QFCI, 2011: p. 20). The La Nina event in question and its associated rainfall were forecast by the Australian Bureau of Meteorology, which briefed the Queensland Government of the potential for heavy rainfall in advance of the floods (QFCI, 2011). As described in Chapter 4, the Brisbane area has a long history of extreme climate and weather events. The 2011 floods were preceded by a prolonged drought in the State of Queensland between 2001 and 2009, while the last major flooding event in Queensland on a par with 2011 had occurred in 1974.

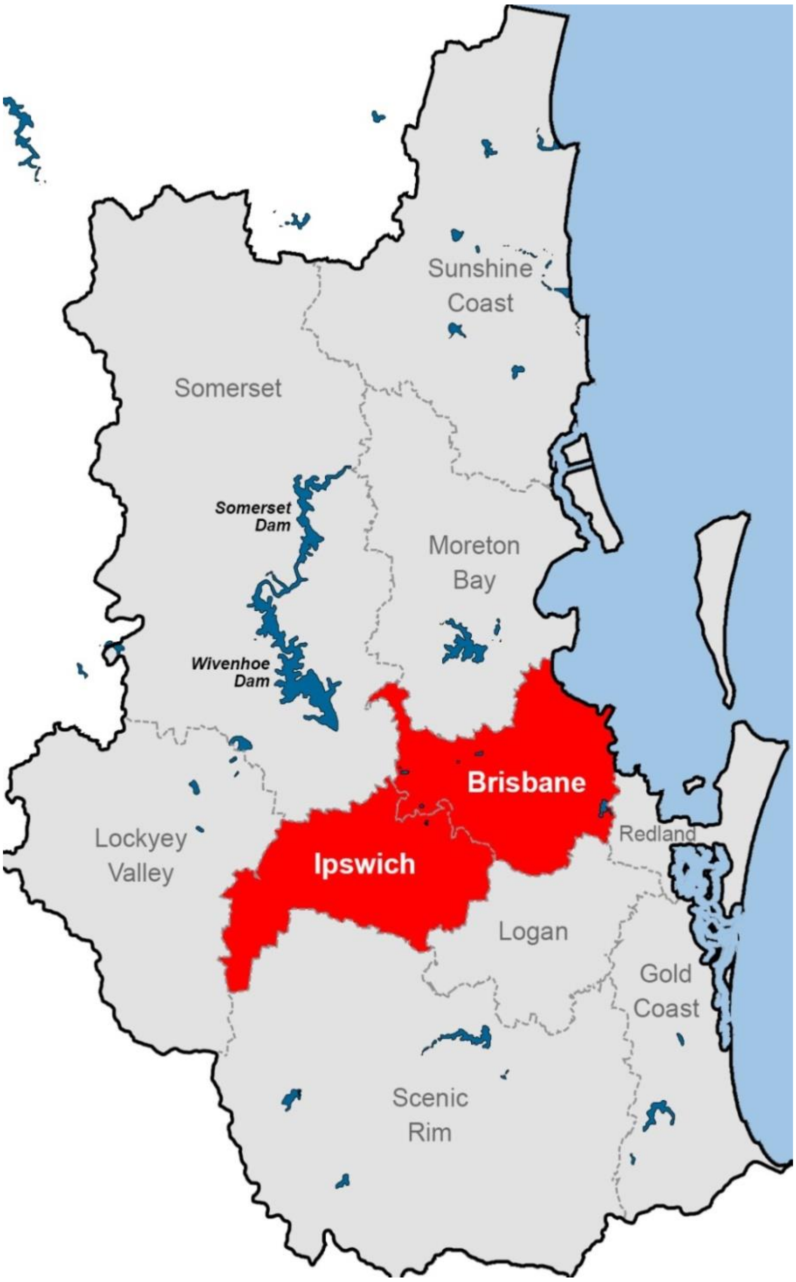


Figure 7.1. Southeast Queensland showing the local council jurisdictions of Brisbane and Ipswich alongside the Wivenhoe and Somerset lakes/dams

In the aftermath of the 2010-2011 floods, the Queensland Government established an independent Commission of Inquiry into state and local governments' DRM provisions. The Commission's interim and final reports focused much of their analysis on the operation of the Wivenhoe and Sommerset dams (QFCI, 2011, 2012). As described in Chapter 5 (see Box 3, Section 5.5) the operation of these dams necessitates normative, political decisions in a zero-sum game concerning the relative priority given to the management of the opposing risks from flooding and drought. However, while political decisions about the dual and conflicting roles played by the dams directly influenced the scale of the flooding experienced by the cities of Brisbane and Ipswich in 2010-2011 (Heazle et al., 2013), I argue that these political decisions also indirectly influenced the level of exposure of communities to flooding extremes during this period. For the purposes of this analysis, I summarise here the Commission's reporting of the development of flood-risk management strategy for the city of Brisbane in order to illustrate the political influence that can be present in governments' design and use of risk-based decision making.

Brisbane City Council's flood risk management strategy – the assessment of Q100

The Queensland Floods Commission of Inquiry's final report (QFCI, 2012) tells the official record of how flood risk management strategies used in the development of Planning Schemes for Brisbane and Ipswich City Councils were derived. As such this report will be the principal point of reference for the case-study described here.

The flood risk management strategies of Brisbane and Ipswich use a risk-based decision making approach that utilises Annual Exceedance Probabilities (AEP) as metrics of flood risk. AEPs have been used in Queensland since the 1970s to provide an indication of the probability of flooding at specific locations (QFCI, 2012). A 1% AEP, also known as 'Q100', indicates the degree of flooding that will recur on average every 100 hundred years. The derivation of the Q100 level through hydrologic/hydraulic modelling for a specific location is then extrapolated for the entire catchment. This technical assessment allows local government councils to specify through their planning schemes where, at what elevation on the floodplain and what kind of development may be permitted in flood risk-prone areas. From 1976 to the present, Brisbane City Council has relied on a Q100 level of 3.7 metres measured at the Port Office gauge in Brisbane (BCC, 2014; QFCI, 2012). During this time the Council has received multiple estimates from expert engineers of the Q100 level, ranging from 3.16 – 5.34 metres. Yet, the level of 3.7 metres adopted in 1976 and based on the peak height that would have been reached in the 1974 floods if it had been mitigated by the

Wivenhoe Dam[104], was still in use by the time of the flooding events of 2010-2011, and is still in use today (BCC, 2014; QFCI, 2012).

The first study to establish a more accurate Q100 than the original estimate was commissioned in 1996 and delivered to Brisbane City Council in 1998 with a best estimate of 5.34 metres. However, the Council had reservations about the method used and commissioned a review of this estimate by an expert hydrologist. Amongst other technical reservations, the Council had questioned the assumptions made in the derivation of the estimate that the Wivenhoe and Somerset dams would be at 100% of full supply level[105] at the beginning of any flooding event. The expert reviewer agreed with the Council's concerns and concluded that 5.34 metres was an overestimate. The Council then commissioned a second estimate to address these concerns. Produced in June 1999, this second estimate gave a Q100 of 5.0 metres. The Council were again unhappy with this figure, since its derivation had not adequately addressed the concerns of the reviewer of the original estimate. A third estimate was then commissioned and produced in December 1999 with a Q100 of 4.7 metres, and again the Council were unhappy with the assessment[106]. The Council made no adjustment to Brisbane's Q100 level or to its planning scheme during this time as it considered that further work on the Q100 estimate and the city's flood study was needed.

Given their dissatisfaction with these three previous estimates, Brisbane City Council decided to consult the state Department of Natural Resources and Mines, the Bureau of Meteorology and the Southeast Queensland Water Corporation[107] at a workshop held in October 2000. The purpose of the workshop was to decide on a most appropriate method for the estimation of Q100. Participants at the workshop were informed that new studies were being commissioned by

[104] The Wivenhoe Dam was completed in 1985 and as will be explained here, is a fundamental determinant of flood risk and exposure along the Brisbane river.

[105] That is, that the flood mitigation potential of the dams would be at its lowest (see Box 3, section 5.5)

[106] Unfortunately the Commission does not reveal in its report precisely why the latter two assessments were considered inadequate, however as described below, they intimate that – much like the first estimate – their concerns were due, at least in part, to the assumptions made about the operation of the Wivenhoe and Somerset dams and in part due to other technical inadequacies in the models used.

[107] Also known as SEQWater, is responsible for the management of the Wivenhoe and Sommerset dams

the state department that would clarify the government's preferences (concerning the relative priority given to water resources versus flooding) in relation to likely releases from the Wivenhoe dam in the event of major flooding, and which would produce a Q100 estimate closer to the original estimate of 3.7 metres. While the results of this study were expected in December 2000, the Council decided to put work on their updated flood study on hold. In the event, the department's analysis was not made available to the Council until June 2003, despite some intense media scrutiny in the intervening period due to the ongoing absence of an up-to-date Q100 estimate. Because of this public scrutiny, the Lord Mayor of Brisbane at the time, commissioned an independent review panel to investigate the results that would eventually be provided by the state department, and to oversee a final, definitive Q100 estimate for Brisbane[108]. Notably, the terms of reference for the review panel included the sentence:

> *Even if the Q100 changes from 6800 m^3/s* [i.e., 3.7 metres at the Port Office gauge]*, it is likely that the Development Control Level will remain the same as is currently used in the Brisbane City Plan* (QFCI, 2012: p. 50)

Testimony by a senior engineer in the water resources branch of the Council who wrote these terms of reference testified to the Commission of Inquiry that he intended this statement to mean that if the Q100 level was found to be lower than the existing level, planning control levels would not be correspondingly lowered (QFCI, 2012). Yet, the political and planning ramifications of a final Q100 estimate that was considerably higher than 3.7 metres must also have been considered by the council and are unlikely to have been an attractive proposition for the Council's management of a rapidly expanding city. Furthermore, there was every reason for the Council's engineer, when writing the terms of reference, to believe that any new and impartial Q100 estimate could be higher than 3.7 metres, since all three previous estimates in 1998 and 1999 had been considerably higher. It seems worthy to note, in the context of these terms of reference, that all three previous modelled estimates had been steadfastly rejected by Council as unacceptable, and that the supposed technical inadequacies of previous models and the Council's preferred assumptions regarding the operation of

[108] The review panel was chaired by the expert who had reviewed the original study in 1998, while the company commissioned to undertake the modelling work for the estimate was the same company that had been commissioned to undertake the original estimate of 5.34 metres.

Wivenhoe dam during a flooding event, aligned to avoid the obvious political and economic ramifications[109] that are likely to have resulted from a more precautionary assessment of Q100.

The Commission's report describes how the review panel were given five weeks to produce their estimate upon receiving the necessary data from the state department. The company commissioned to undertake the technical works were instructed not to undertake any new modelling, but to use the models they had originally used in 1998 which had resulted in the estimate of 5.34 metres. No consideration appears to have been given to whether these models were appropriate, despite the original expert reviewer (now the chair of the independent review panel) expressing a number of reservations in 1998 concerning their technical adequacy. Furthermore, during the contractors' technical analysis, the prospect of undertaking MonteCarlo analyses[110] was discussed as an effective means of addressing the various uncertainties in the models, yet this method was rejected, apparently due to time constraints. The final result was provided in September 2003. The review panel and its contractors determined that the best estimate of Q100 was 3.3 metres, subsequently adjusted to 3.51 metres, and adjusted yet again in February 2004 to 3.16 metres. The Council recommended to civic cabinet that the existing planning control be maintained at 3.7 metres (as per the terms of reference cited above).

Despite the review panel's report recommending that MonteCarlo analysis be undertaken at a later date to address the uncertainties in the model, no such recommendation was made by Council to cabinet. The recommendation to maintain the existing planning control was approved by elected members of Council in December 2003. The Council never did proceed with any MonteCarlo analysis since the existing planning control level was over and above the three Q100 levels provided by the review panel between September 2003 and February 2004, and at the time of these final estimates, such analysis was considered beyond best practice.

[109] For instance, given the density of urban development along the Brisbane River downstream of the Wivenhoe Dam, it seems reasonable to conclude that any new estimate of Q100 considerably higher than the current value of 3.7 metres would result in significant impacts on property values. Those buildings once designed and built to a safe standard of flood risk protection would no longer be deemed adequate under a revised Planning Scheme.

[110] MonteCarlo Analysis is a computational modelling exercise that allows an input-output model system (such as provided by the hydrologic/hydraulic analyses of a flood study) to be tested with a large range and number of variable conditions in order to test the sensitivities and limits of the modelled system.

Flood risk management – A political approach to an 'evidence-based' decision?

The story recounted above, as investigated by the Commission of Inquiry and in the context of the analysis provided by Heazle et al. (2013) is, I argue, indicative of the political forces that prevail in the assessment of environmental risk, especially under a linear-technocratic schema that can provide a façade of impartial evidence development and use. The Council's initial assessment of Q100 (3.7 metres) in 1976 was based on an assumption of the flood mitigation that would have been provided by a Wivenhoe Dam had it been in place in 1974. However, the Commission never specified what operating conditions for the dam were assumed and that had underpinned this estimate. Given the zero-sum game (between water resources and flood risk management) involved in the dam's operation, I argue that this assumption constitutes a very significant political decision on the part of Brisbane City Council. When the Council sought to reassess their Q100 estimate, they were unhappy with the operating assumptions taken by three consecutive estimates by technical contractors concerning the dam's operation. The contractors' initial precautionary assumption, that the dam would be at full supply level and thus have the least potential to mitigate flooding, was deemed unacceptable as a baseline from which to assess the Q100 level for Brisbane's Planning Scheme. Yet it was this very operating condition[111] that was in place during the 2010-2011 floods.

[111] In fact, the Wivenhoe Dam did release 5% of its full supply capacity in advance of the floods, but the Commission's expert hydrologist considered this release to have been too little, too late and made a negligible enhancement to the dam's flood mitigation capacity (QFCI, 2011)

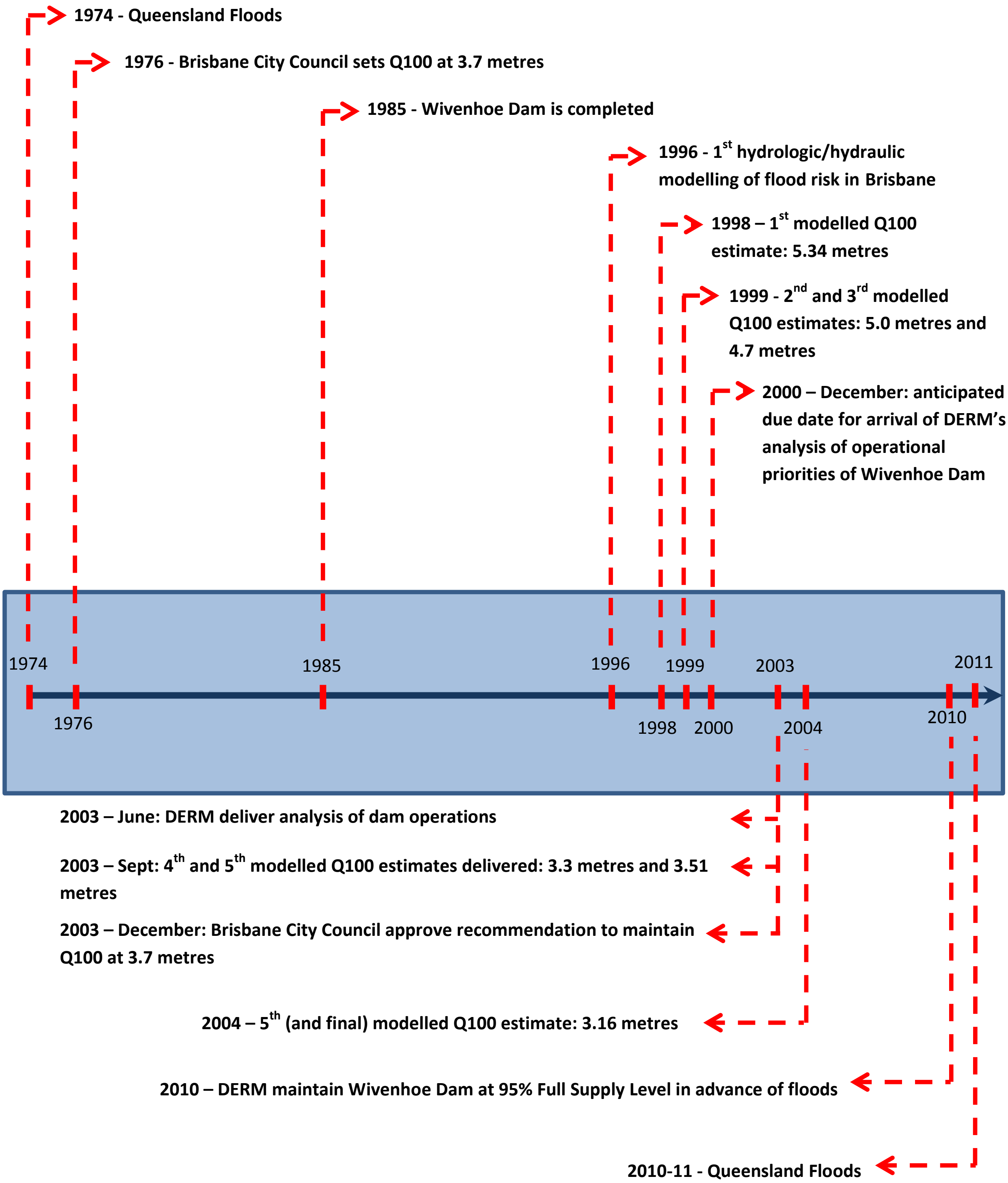


Figure 7.2. Timeline of flood risk management by Brisbane City Council

Clearly then, questions remain about the technical credibility and legitimacy of the final Q100 estimate given:

a) The underlying assumption by Council about the flood risk management strategy underpinning the operation of Wivenhoe dam, that was used to assess Q100, was ultimately incorrect – it conflicted with the actual operation of the dam during the 2010-2011 floods;

b) That the Council used a model which had previously been assessed as technically deficient after its first three uses (1996 – 1999), though was then considered legitimate and credible according to the dubious assumptions underpinning its re-use in 2003; and,

c) The apparent motives of Brisbane City Council in maintaining a development control level of 6800 m^3/s (3.7metres at the Port Office Gauge), and the circumstantial evidence revealed by the Commission of Inquiry suggesting that the Council has continually avoided its adjustment (in the period 1996 – 2011) to a more precautionary level.

I argue that the political decisions made by state government (concerning Wivenhoe dam) and by Brisbane City Council (concerning the city's flood risk tolerance) combined in ways that ensured that Brisbane's floodplain communities were more exposed to flooding than they expected to be. As recounted by Heazle et al. (2013), an essentially political decision had been made by state government, through the auspices of technical experts in Seqwater and the state Department of Environment and Resource Management (DERM) in 2010 to prioritise water supply over flood risk management in advance of the 2011 floods. This political decision was couched in technical terms – to maintain 95% full supply level of the Wivenhoe dam – and was left in the hands of technical experts. Notwithstanding the fact that this decision was portrayed by many in the aftermath of the floods as technical incompetence, yet was essentially a political decision (Heazle et al., 2013), it nonetheless seems a reasonable policy prioritisation given the Brisbane region's prolonged drought conditions between 2001 and 2009. Yet, I argue, this political decision had unexpected ramifications for the degree of exposure to flooding incurred by communities in the flood plain during the 2010-2011 floods, because it was in direct conflict with the assumptions and political priorities of Brisbane City Council and their prior assessment of Q100 flood risk.

Assuming that Brisbane City Council's priority for spatial planning (in the period 1976 – 2011) was to optimise development in the floodplain within safe limits (BCC, 2000), then this normative prioritisation found expression in the derivation of a Q100 level in the decades prior to 2011 and more specifically through the Council's assumptions about the operation of the Wivenhoe dam therein. Brisbane City Council appears to have assumed in both their initial and final Q100 assessments that either:

a) Dam operators would have sufficient flexibility to reduce water levels in advance of flooding events to allow for the realisation of the assumptions made by Council when estimating Q100; or,

b) State government would give greater weighting to flood-risk management in the operation of Wivenhoe dam than was actually the case in practice.

The Commission of Inquiry never specified in its reports what operating assumptions were made concerning the Wivenhoe dam for the Council's first Q100 estimate in 1976, nor in its final estimate in 2003-04. However, the Commission does reveal that neither estimation took a precautionary approach as per the calculations made by technical experts contracted to advise Council between 1996 and 2000, which had assumed that the dam would be at Full Supply Level. In fact this precautionary approach appears to have been systematically rejected by Council. Assuming the data provided by the DERM in 2003 gave an accurate assessment of the dam's ability to release water in the event of significant flooding, then it seems reasonable to surmise that the final Q100 assessment was based on the second of the aforementioned assumptions about state government's priority for flood risk management over water supply, an assumption that aligned with Council's own normative and political priorities. These priorities and the assumptions made in pursuit of them were ultimately confounded by state government's prioritisation for water supply made immediately in advance of the 2010-2011 floods.

Unfortunately, no members of Brisbane City Council's Natural Environment, Water and Sustainability Branch were permitted by ruling council members to be interviewed about the operation of the Wivenhoe dam or their assessment of Q100, which means that conclusions regarding the norms and motives of the Council can only be surmised from the testimony and investigation described by the Queensland Floods Commission of Inquiry's reports (QFCI, 2012, 2011).

The Commission's investigation, however, clearly reveals that Brisbane City Council's normative priorities about the advantages (to the local economy and to urban spatial planning) of having a Q100 level as low as possible were in direct conflict with competing priorities of state government to ensure adequate water supply for the southeast Queensland region. As a result of this normative conflict, communities on the floodplain in Brisbane have been living and working under an incorrect assumption of flood risk exposure, as expressed through the Council's planning scheme and its Defined Flood Level of 3.7 metres at the Port Office Gauge, an estimate that has remained unchanged despite the flooding events of 2010-2011 and the operating decisions for Wivenhoe dam that prevailed at that time (BCC, 2014). That this normative conflict was masked by technical issues relating to dam operations and the assessment of Q100, when in fact they required important normative and political decisions about risk prioritisation, tolerability and the relative exposure of communities to climate extremes, I argue, speaks to the notion of a scientised policy making process for climate adaptation and natural resource management in Southeast Queensland.

7.5 Conclusion

In the analysis presented in chapters 5 and 6 I demonstrated that adaptation problems contain inevitable normative components which influence how useful and usable climate science and policy evidence can be for informing policy making. In the case-studies in this chapter, I have considered politicisation of policy evidence, not just as an inevitable result of accounting for this contingency as technical experts seek to understand these problems through climate research, modelling and presentation of model outputs (what might be referred to as politicisation-by-process), but politicisation as a deliberate adjustment in technical assessment, framing or conclusions of evidence in accordance with policy players' norms and values (a politicisation-by-agency). This latter form of politicisation occurs, I argue, in order to garner evidence legitimacy (i.e. political acceptability) and to suppress explicit debate. This politicisation in turn can ensure tacit acceptance for particular normative views or political priorities, that is, to scientise policy making in order to garner policy legitimacy.

As described in chapter 6, most interview participants believed that, notwithstanding the shortcomings of previous attempts by government, risk assessment was nonetheless a valuable tool for understanding climate adaptation problems. Risk is an intuitively appealing concept for scientists and policy makers addressing environmental problems since, as discussed in section 7.4, it speaks to the reflexive nature of contemporary notions of modernity in a globalised society; utilises a simple empirical formula that aligns with linear-technocratic norms concerning experts' ability to accurately assess policy problems, and therefore is seen to allow transparently rational policy making. The concept of risk is facilitated in these presumed characteristics through the simple calculation: Risk = Likelihood X Consequence. However, as described in detail in chapter 5 and as demonstrated further by the two case-study examples above, risk is problematic when used under a linear-technocratic model for climate adaptation because the aforementioned formula is unable to be followed convincingly in practice.

Likelihood, consequence, and indeed risk itself resists impartial derivation for climate adaptation problems that are deeply complex, uncertain and subject to strong divergence of values and priorities. Risk assessment encounters difficulties when used in a way that assumes that it is a technical exercise; that risk can be objectively apprehended, or that any given assessment can encapsulate all (or even most) normative priorities and viewpoints. As demonstrated by Brisbane City Council's Q100 calculation and the UKCCRA, technical impact and risk assessment allows norms and values to pass undetected through the assessment process, the results of which will ultimately be used by the political executive as impartial expert evidence.

In summary, therefore, there are several factors at play in the processes of politicisation and scientisation:

1) The contingent nature of adaptation problems and the trans-scientific, post-normal character of the scientific research available to understand them, which means that experts,

despite their best and most honest efforts, can never provide definitive or wholly objective assessments of climate hazards or their probability of occurrence;

2) The desire (if not also the need) for *ex-ante* policy assessment as a result of adaptation problem complexity, uncertainty and contingency, which suggests that evidence for policy must be coproduced between various expert and non-expert policy players in order to ensure that it is sufficiently legitimate and salient to be useful and usable for policy decisions; and,
3) The prevalence of the linear-technocratic model of policy making which derives from expectations that experts can apprehend objective reality, that they must do so in order for their evidence to be credible, and that policy can be linearly informed by this impartial scientific and social science research.

These contributing factors raise two important challenges for policy makers when deriving evidence to effectively inform policy decisions.

First, policy makers face a pressing need to balance the legitimacy and salience of policy evidence on the one hand through, for instance, coproduction processes such as risk assessment, and the credibility of evidence on the other which, under a linear technocratic schema, is dependent on the expectation that scientific research and policy evidence should be technical, wholly impartial and can provide some degree of objective truth about the world. This need to balance legitimacy, salience and credibility involves important interactions across the science-policy boundary (Cash et al., 2002) and directly addresses the tensions between expert and political forms of authority. As demonstrated by the examples in this chapter, this boundary must be bridged in order to ensure legitimacy and salience, yet sufficiently preserved in order to ensure scientific credibility.

Second, as a result of this need to balance the competing demands for credibility, legitimacy and salience, policy evidence is in danger of succumbing to processes of politicisation and scientisation. Evidence coproduction such as that which ensued in the development of the UKCCRA allows both expert and non-expert policy players to adjust the outputs and conclusions of scientific research in accordance with their preferred norms, values and politics. However, such politicisation may also occur during the commissioning and design of policy evidence, as in the case of the Q100 assessment for the city of Brisbane. Both examples of politicisation were facilitated by the linear-technocratic model which ensured that policy evidence was construed as objective, impartial expertise that provides some measure of universal truth about the world. Because of this ability to politicise, I argue, both expert and non-expert policy players are in a position to adjust the content of evidence in such a way as to suppress further explicit debate or to garner tacit acceptance for their preferred norms and politics under the guise of expert authority, that is, to scientise.

The degree of overlap and tension between expertise and politics for adaptation policy making is exemplified by these cases, whereby, non-experts can politicise not just through how they select and communicate evidence to rationalise policy, but also through their input in the actual development of supposedly expert, impartial knowledge. In my examination of these issues, questions therefore arise about whether the ex-ante policy assessment methods currently used by policy players might be designed in ways that can overcome such difficulties or otherwise sooth the ongoing tensions between expertise and politics. For instance, if not using concepts of risk, then how else might we conceptualise the hazards presented by climate and climate change to ensure effective adaptation policy? The answers to these questions are largely beyond the scope of this research. However, in the final chapter I will discuss some possibilities for how policy players may effectively address the trade-offs that must be made between credibility, legitimacy and salience, and whether these trade-offs can ever find a sensible or logical resolution.

Chapter 8. Conclusion

> *Science is a first rate piece of furniture for a man's upper chamber, if he has common sense on the ground floor. But if a man hasn't got plenty of good common sense, the more science he has, the worse for his patient* – Oliver Wendell Holmes Sr.

This thesis has synthesised theory from the social studies of science and politics alongside original research and analysis relating to the epistemologies of climate adaptation policy problems to suggest that the use of evidence for climate adaptation policy making is determined not just (or even mostly) by its technical adequacy. I argue that evidence use is principally determined by the congruence of values and political priorities attributed to or inscribed within this evidence, with those norms and priorities of the policy making community. I conclude that evidence legitimacy holds primacy over credibility and salience as necessary determinants of useful and usable evidence for adaptation policy making.

My research demonstrates that climate science often lacks both salience and legitimacy for those involved in climate adaptation policy making irrespective of what government level they sit at or scale of governance they are concerned with. As a result of the difficulties of attaining legitimacy and salience for climate science, in practice policy players see this information as a secondary concern in the development of robust evidence for climate adaptation. Of principal concern for policy players is the collection and interpretation of information relating to the vulnerability and resilience of a given jurisdiction, community or socio-economic or ecological system. This pragmatic approach, advocated by many policy players interviewed in the course of my research, sits in contrast to the expectations of many in the climate science community, as well as politicians and the public that adaptation policy should be principally informed by the best available projections of future climate change.

As climate science research and modelling relating to climate change, vulnerability and resilience approach the science-policy interface, however, they require increasing levels of normative/political interpretation and development to ensure this information is politically acceptable and salient at a chosen governance level. This politicisation-by-process occurs through the development of post-normal climate science projections and scenarios and further through the coproduction of subsequent policy evidence[112]. The interpretive input required for the development of policy evidence (e.g., during impact and risk assessments) for a given jurisdiction means that, although the credibility, legitimacy and salience of policy evidence may be sufficient for those who produced it, this information may be perceived as deficient across all three criteria amongst other policy players. In particular, policy players situated at different levels of government or who are concerned with differing governance scales may reject policy evidence due to its necessarily contingent nature.

As a result of these findings, my research has also demonstrated the limitations of the knowledge systems framework proposed by Cash et al. (2002) since their criteria of credibility, legitimacy and salience, I argue, fail to adequately account for the influence of prevailing political values and priorities in the production of effective knowledge for climate adaptation policy. Therefore, I propose an alternative reading of these criteria, and in particular a revised definition of the concept of legitimacy, in order to account for the importance of political acceptability as a measure of effective knowledge systems. When conceptualised as a measure of both the fair and representative nature of the knowledge production process, and the political acceptability of resulting evidence, legitimacy appears to hold primacy over credibility and salience in determining the usefulness and usability of effective knowledge for adaptation policy.

These findings are significant for a number of reasons discussed below in relation to the questions posed in the course of this research.

[112] Again, note the distinction between climate science and policy evidence for the purposes of this discussion.

8.1 How do tensions between expert advice and political authority influence the generation of knowledge about climate change risks for adaptation policy?

This thesis has used, and sought to develop further, the conceptual framework of Cash et al. (2002) to help understand the tensions that exist between expert advice and political authority during the development and use of evidence for climate adaptation. These tensions exist as a result of the inability of expertise to be wholly rational and objective on the one hand, and the inability of politics to legitimise policy decisions on the basis of purely ideological reasons on the other. Expertise and political representation are interdependent forms of decision making authority in a liberal democracy (Ezrahi, 1990).

As explained in Chapter 3 and again in Chapter 6, Cash et al.'s (2002) 'knowledge systems' framework appears to at least partially address the competing problems of legitimacy and extension (Collins and Evans, 2002) that are at the heart of tensions between expert and political authority when resolving public policy issues. The need to account for a broader range of expert perspectives and local and contextual knowledge to understand wicked policy issues creates a problem of legitimacy whereby scientific experts alone cannot provide definitive answers. This need for legitimacy[113] results in coproduction processes to ensure a more acceptable range of expertise and other knowledge is accounted for during evidence development. However, this need for legitimacy then presents a further difficulty described as the problem of extension, whereby, as the remit of expert authority is broadened and democratised to account for local and contextual knowledge, it becomes difficult to know where expertise ends and political influence begins. My research demonstrates that understanding the locus of the interface between expert and political authority is important for avoiding processes of deliberate politicisation that can allow policy players to use evidence to disguise significant political decisions under the guise of impartial expertise. In this

[113] It is important to note here that Collins and Evans' (2002) definition of legitimacy is somewhat different to that of Cash et al. (2002) since the former is referring to a political acceptability for policy knowledge and the latter relates more to the credibility of the knowledge production process. However as I describe in detail in section 6.3 my proposed definition reconciles these two former definitions in order to enhance the knowledge systems framework as a descriptive model.

research I show how Cash et al.'s (2002) conceptualisation of knowledge systems can address the same tensions described by Collins and Evans (2002) that arise as a result of the need for expert authority to take account of a range of perspectives and viewpoints (and the norms and values associated with them) in evidence development. This tension may be addressed by attempting to effectively balance criteria of credibility, legitimacy and salience during the development of policy knowledge.

Through an analysis of policy players' perceptions of climate science and resulting policy evidence, I have shown how the need for evidence credibility competes with legitimacy and salience in determining climate change hazards and risk for adaptation policy. Evidence credibility, which aligns with the linear-technocratic norm for impartial experts' access to objective truth, is often achieved at the expense of evidence legitimacy and salience. Therefore, as I demonstrate in section 6.5, although climate science may be perceived as credible it is often insufficiently legitimate or salient. These latter attributes require science to account for user needs and the norms and values of various policy players which may compromise its credibility when formulating useful, usable evidence. Where experts have given greater consideration to the salience of climate science, policy players have increasingly questioned the technical credibility of climate science outputs. Further, where questions of evidence legitimacy need to be addressed due to the pressure from prevailing politics and values, such as in Queensland, policy players largely ignore concurrent issues of credibility and salience, since they are more concerned with whether this evidence should be used in the first place than whether it is technically adequate and relevant for informing policy.

Given the need for a broad range of knowledge concerning climate adaptation and risk and the inevitable normative/political constituents of policy evidence, my research demonstrates how, in practice, legitimacy holds primacy over credibility and salience when balancing the tensions between expert and political authority for climate adaptation policy making. Where evidence legitimacy is established, credibility is easily attained (irrespective of the technical adequacy of the available science) and salience takes over as the principal remaining concern for policy players seeking to understand climate risks. However, where evidence legitimacy does not exist, neither credibility nor salience is sufficient to convince policy players of the suitability of this evidence for policy making purposes.

8.2 How do contextual and political forces influence the role of experts in climate adaptation?

Contextual and political forces influence the role of experts as it becomes increasingly necessary to look to unconventional sources of knowledge for understanding adaptation problems. As described in Chapters 3 and 5, the complex, uncertain and contentious nature of contemporary policy problems has prompted scholars to broaden their consideration of what constitutes expertise for policy making. Calls for the democratisation of expertise relate to expectations of access for a greater number of participants and the public to expert evidence, and a revised definition of expertise itself, whereby local and contextual knowledge are valued alongside science and economics. In chapter 5 I explained the challenges of evidence provision for climate adaptation and climate change in particular which mean that processes of knowledge co-design and coproduction between experts and non-experts are necessary and inevitable in order to make climate science legitimate and salient, and to allow the subsequent development of useful policy evidence. As climate science approaches the science-policy interface it must allow itself to be manipulated and adjusted to account for the decision making needs and prevailing norms of policy makers.

Although 'post-normal' co-design and coproduction processes speak to the democratisation of expertise and therefore an enhanced legitimacy for policy evidence, they also appear to conflict with the linear-technocratic expectations and guidelines of liberal-democratic government for robust, credible and impartial evidence for policy decision making. As I argue in Chapter 5, climate adaptation is a policy problem which evades definitive characterisation except perhaps in the context of understanding specific communities, jurisdictions, habitats or other social-ecological receptors. This difficulty makes strategic understanding under a linear-technocratic schema at national or regional levels of governance particularly problematic. Understandings of climate hazards, impacts, risks and responses will vary depending on the perspectives of policy players involved and are subject to a wide variety of valid expert interpretations. Technical experts, therefore, cannot fulfil their traditional roles as the purveyors of objective truth for adaptation policy making. The concept of expertise itself requires a broader conceptualisation in order to account for local and contextual knowledge and the need to undertake a socio-cultural reasoning during the development of technical evidence in relation to how best to address adaptation problems.

Where the linear-technocratic model prevails, experts therefore have the opportunity to extend their authority beyond that which they can legitimately claim privileged knowledge over. Alternatively, the façade of objective expertise provided by linear-technocratic heuristics may facilitate the politicisation of policy evidence by non-experts participating in coproduction processes. The comparative political analysis of this research, alongside the collected views of adaptation policy players, demonstrates that contextual and political forces have an important and inevitable influence on experts, climate and other adaptation science, and on policy evidence due to the 'wicked' characteristics of adaptation policy problems. Addressing these problems effectively requires a balance to be struck between objective technical and scientific analysis by experts on the one hand, alongside relevant local and contextual knowledge and the necessary incorporation of values and decision making priorities into the design and development of useful and usable evidence outputs on the other.

Thus, in order for experts to maintain their legitimate input to policy making processes and their traditional authority as the purveyors of the 'truth', it appears that they must increasingly balance society's desire for impartial expertise with a need to share that privileged status with a range of unconventional experts in the form of local and contextual players in order to account for contextual and political factors. Further, experts appear to need to redefine the precise limits of their expertise, since the development of policy evidence requires them to provide commentary and guidance on a range of issues related but not confined to their particular area of privileged knowledge; engaging in the policy evidence development process therefore requires both technical and socio-cultural reasoning.

8.3 How does the need for political legitimacy of adaptation policy influence the provision of evidence and the interpretation of climate risks?

My research demonstrates an important correlation between the presence (or absence) of *political* legitimacy for climate change policy (as described in Chapter 4), and a concurrent legitimacy (or political acceptability) for the available climate science for informing that policy. Where political legitimacy exists for addressing climate change, such as established by the *Climate Change Act (2008)* in the UK case, the associated climate science is also considered legitimate and necessary and is provided for policy makers with considerable attention to its usability[114]. Political legitimacy and the subsequent provision of politically acceptable science therefore result in an enhanced focus being placed on salience as a predominant concern of policy players using science and policy evidence for climate adaptation.

Somewhat ironically however, legitimacy for climate science, in tandem with an evidence-based approach more generally, may also mean a greater propensity for processes of politicisation and scientisation to occur. Under a linear-technocratic schema, evidence for climate adaptation policy making can be inscribed with significant normative positions and/or political decisions made during coproduction processes, behind a façade of impartial expertise during the development of ex-ante policy evidence. This may, in turn, reduce the legitimacy of particular sets of policy evidence for individual policy players, even though the underlying climate science may be legitimate.

Where political legitimacy does not exist however, as in the case of Queensland and at local government level in the UK, I have shown here how legitimacy for climate science and associated policy evidence is also lacking and as a result, evidence salience is a minor or irrelevant concern.

[114] Although climate science and policy evidence may be used in a variety of ways that do not necessarily correlate with rationalism. For example, this evidence may be used tactically or for enlightenment purposes, amongst others – see section 2.7.

Indeed climate change evidence may be entirely ignored in favour of political priorities and/or concurrent evidence sets that align more effectively with existing decision making norms and prescriptions, even if that evidence is outwardly accepted as technically credible.

Finally, even where political and evidence legitimacy exists at a given governance level or scale, my interview research (outlined in Chapter 6) confirms the pluralistic nature of climate adaptation problems described in Chapter 5 whereby policy players at differing government levels (or who are concerned with differing governance scales) may not perceive policy evidence as legitimate for policy making irrespective of the level of legitimacy present for adaptation policy making or for the available climate science.

8.4 How do *ex-ante* policy analyses account for political influences in the development and presentation of evidence?

As described in Chapters 5, 6 and 7, in order to make climate science more legitimate and salient, both expert and non-expert policy players engage in knowledge coproduction processes that seek to decipher the conclusions of scientific research and present conclusions in the form of policy evidence, which is expected to subsequently inform adaptation policy making in a rational way. However, such ex-ante processes of evidence development sit at the interface between expert and political authority and contain impartial, expert knowledge (such that it exists), local and contextual perspectives and the political norms and priorities of policy players involved in this process.

Although upon examination much of the analysis that occurs during ex-ante appraisal (as, for instance, in the case of the UKCCRA) appears to be a process of deliberation between groups of experts and non-experts, the outputs of this process are nonetheless portrayed by policy makers as impartial independent expertise. As I conclude in Chapter 4 and demonstrate in Chapter 6, policy evidence is therefore politicised to the extent that the framing and characterisation of climate risks and adaptation responses requires subjective, political/normative input when addressing policy problems that require both technical and socio-cultural reasoning.

However, as I describe in Chapters 6 and 7, such ex-ante evidence development is also prone to processes of deliberate and covert politicisation and scientisation as a result of this coproduction during the development of policy evidence. The case-study investigations in Chapter 7 describe how the assessment of climate risk can result in important political decisions being made during the development of policy evidence. Under a linear-technocratic policy making schema, these decisions are made covertly under the guise of objective expertise, thus garnering tacit acceptance for policy decisions that might otherwise be open to political debate or controversy within democratic forums of government. As such, adaptation policy making, I argue, may become scientised through the deliberate politicisation of policy evidence, either during the development of that evidence or subsequently during policy players' interpretation, communication and use of it. In fact, as the cases examined in this thesis demonstrate, the distinction between evidence and its presentation to policy makers has become difficult to identify since ex-ante assessments of climate impact and risk are considered to constitute one or the other depending on the perspective of individual policy players or advocacy coalitions.

Although it may be argued that linear-technocratic heuristics facilitate evidence politicisation and therefore the scientisation of adaptation policy making that are contrary to the ideals of liberal democracy, the phenomenon of ex-ante policy evidence may nonetheless provide a means to address the tensions between expert and political authority. Because ex-ante policy evidence is prone to being overcome by processes of politicisation, it seems useful to question here whether this evidence may also facilitate the efficient functioning of a scientised policy process. Where evidence legitimacy exists and the evidence-based mandate is adhered to (through legislative dictate or otherwise), is it not possible that ex-ante assessment may actually facilitate the timely and expedient delivery of adaptation policy by suppressing explicit normative/political debate under the guise of expert authority? Though beyond the remit of this thesis, my research suggests that these heuristics may actually provide a useful means by which policy making may avoid time-consuming and potentially intractable debates concerning society's priorities for climate resilience and adaptation.

8.5 How do political attitudes toward climate science influence the development of climate adaptation policy?

My research suggests that the role of experts, scientific research and policy evidence in the development of climate adaptation policy is ambiguous, uncertain and ultimately dependent on prevailing political attitudes toward climate science and the phenomenon of climate change. On the one hand, although experts can confirm the greenhouse effect and anthropogenic influence on the global climate, they cannot definitively say how the climate may change in the future or what the effect of anthropogenic influence upon it will ultimately be. Attempts to provide answers to these questions are undertaken within the virtual laboratory of climate change models, can only be proven in a post-hoc way, and to date have proven difficult to interpret and to use for policy making purposes on their own. The complexity and uncertainty associated with understanding the implications of climate change projections for policy mean that coproduction processes of evidence development have been used in an attempt to draw meaningful conclusions from the available science. However, as experts and their research have been pulled closer to the policy making process, their evidence is inevitably politicised by attempts to make it more legitimate and salient for policy makers. As such, prevailing political attitudes of players in the policy process appear to be the principal determining factor for the effectiveness of knowledge systems for climate adaptation policy making.

I argue that where there is political legitimacy for climate change, the associated climate science is granted a corresponding level of legitimacy that allows experts to then attempt to inform policy making through the development of risk and impact assessments. These ex-ante assessments are, under a linear-technocratic schema, interpreted as impartial expert evidence, even though they are developed through coproduction between expert and non-expert policy players. In this circumstance, experts are granted authority beyond that which they can claim privileged knowledge about, and as a result, this evidence can become deliberately politicised to the extent that important values and political decisions are granted legitimacy under the guise of impartial expertise. Such politicisation can ultimately contribute to a scientised policy making process that suppresses important normative or political debates through the use of expert evidence.

8.6 Some final reflections

The conclusions described above concerning the politicisation of climate science and policy evidence are reflected in a curious irony which reveals itself in the comparative cases of Queensland and the UK. In Queensland, although prevailing political priorities of government have, in recent times, suppressed political legitimacy for climate change as a policy issue, and as a result removed the legitimacy for the use of climate change science in policy making, this region has a significant and largely effective portfolio of climate adaptation-related policy (see section 4.5.1). In part this reflects the extreme nature of Queenland's climates which have necessitated ongoing disaster risk management measures such as the effective coordination of emergency services, the development of community resilience initiatives as well as urban planning schemes that pay considerable attention to managing the risks from extreme climate events.

My research shows that climate adaptation policies in Queensland have developed without the use of climate *change* science. Instead, this policy has largely focused upon the political and socio-economic priorities of government alongside more tangible or deterministic forms of evidence relating to the vulnerability, exposure and resilience of communities to existing extremes and weather variability, and the elimination of extant climate risks. By prioritising political values and priorities rather than depending on the development of objective facts about the future (which don't, for the most part, actually exist) Queensland's adaptation policy appears to have largely avoided the difficulties presented by climate change science and its use by a scientised bureaucracy.

In the UK, by contrast, strict adherence to the evidence-based mandate and governments' ongoing allegiance to the resolution of the climate change problem has resulted in continuing attempts to understand how climate may change in the future and a commitment by successive governments to design policy on the basis of the conclusions of climate change science. This has ultimately meant that the available climate science and derivative policy evidence have become politicised in order for it to be congruent with UK government's existing and developing political priorities, which in some instances (e.g., the risks from sea-level rise), conflict with the conclusions of experts. This situation raises important questions about the practical utility of complex, contentious and uncertain evidence sets such as provided by climate scientists which are easily politicised through the coproduction of policy evidence.

While it may be intuitively appealing to seek to account for future climate in the development of public policy, the intractable uncertainties associated with understanding what may happen in the future, and the complex and contentious nature of the available science suggest that, in practice, attempts to inform policy making in this rationalist way are doomed to failure. Further, the tendency toward politicisation appears to validate the explicit pursuit of political priorities over the available evidence, as in Queensland in recent years, however unpalatable those priorities may seem to those concerned by climate change. I argue, therefore, that risk-based approaches to adaptation policy in particular, pursued under a linear-technocratic policy making schema, are problematic for addressing climate change problems, due to their tendency to facilitate processes of politicisation and scientisation that appear to significantly undermine attempts at rational evidence-based policy making.

Instead, I suggest that adaptation policy making needs a conceptual framework that can encapsulate the most certain aspects of climate science (relating to existing social-ecological climate vulnerability and resilience – see Appendix A), recognition of anthropogenic climate change and the wide variety of potential hazards it may pose in the future (without getting bogged down in designing policies in line with problematic climate projections), alongside explicit normative prioritisation concerning governments' political values and priorities for maintaining and enhancing the climate resilience of what and for whom. Such explicit normative prioritisation can, I argue, minimise the extent of evidence politicisation to which climate change projections and risk assessments have thus far been prone to.

My research suggests that bureaucratic policy making currently uses linear-technocratic heuristics to legitimise political decisions necessary in the development of both adaptation evidence and policy. In doing so, I argue, this schema foments unrealistic expectations about the role of experts and the value of evidence for policy, suggesting that experts can have access to sufficient objective truth about environmental hazards, impacts and even risk. As advocated by the science and technology studies (STS) community, it would seem sensible, therefore, to seek to adjust these rationalist expectations of government and the public to once and for all burst the positivist myth of expertise, to account for the presence of normative decisions by experts, and to understand a broader concept of what expertise is. Such an adjustment could allow the credibility of expert authority for policy making to be maintained on a more realistic footing and allow evidence to avoid becoming over-whelmed by covert political influence.

However, despite these conclusions about how expertise *should* ideally interact with politics, it seems useful to conjecture here about the reasons why the linear-technocratic schema has endured. I propose that, rather than being a persistent impediment to good governance, this schema has endured due to its ability to ensure a degree of expediency in the policy making process under an evidence-based mandate. Without the processes of politicisation and scientisation facilitated by this schema, I suggest that policy making would become bogged down in endless debates concerning normative minutiae about how and what we know. Alternatively, bureaucratic policy making would be accused of being undemocratic in its decision making concerning a myriad of minor political/normative judgements made by unelected officials and expert advisors. Therefore, it could be argued that bureaucracy uses rationalist assumptions to ensure the smooth and efficient running of government. Explicit normative prioritisation may actually come at a high price and at the expense of efficient and timely policy making. The danger, however, is that this system of politicisation/scientisation allows major political decisions to slip undetected through the policy making of bureaucratic government.

In conclusion, my research suggests that evidence for policy is used only to the extent that it can provide unequivocal facts, or, be adjusted in line with prevailing norms and politics. Attempting to pursue a truly impartial evidence-based (or evidence-informed) approach using complex, uncertain and contentious science has proven a bridge too far for experts and their privileged policy making authority when it comes to climate change adaptation. And yet, explicit normative prioritisation during the development of policy evidence presents significant risks to both expert and political authority. Such explicit prioritisation can threaten governments' political authority where it conflicts with the expert community's strong support for addressing climate change, or as a result of the contentious and divisive nature of many adaptation problems that may cause public anger due to a perceived irrationality on the part of government decision makers. Meanwhile, such explicit prioritisation may draw undue attention to the political machinations of policy evidence development and may, therefore, call into question the credibility of experts as the purveyors of objective truth. It would appear therefore, that easing the tensions between expert and political authority involve risks and opportunities for both forms of authority in the policy making process.

Appendix A – Glossary

Adaptation: The process of adjustment to actual or expected climate and its effects. In human systems, adaptation seeks to moderate or avoid harm or exploit beneficial opportunities. In some natural systems, human intervention may facilitate adjustment to expected climate and its effects. (IPCC, 2014: p. 5).

Bayesian Probability: After the 18th Century mathematician Thomas Bayes. Bayesian probability is different from other types of probability in that it is subjectively (rather than objectively) derived based on a prior assumed probability of occurrence, which is then updated as new observations are made (Bertsch McGrayne, 2011). In the case of climate change, prior probabilities are provided by the degree of congruence of a particular climatic outcome to the average outputs of an ensemble of Global Circulation Models (GCMs) (Frigg et al, 2013b). These probabilities are not objectively assessed in terms of their propensity based on past occurrence of climatic states, or their empirical derivation based on knowledge of all possible outcomes (Crawford, 2005), both of which are impossible given the complexity of the systems in question and the relative non-stationarity of climate due to anthropogenic forcing. Rather they are based on the projections of a series of models of possible future climates that incorporate anthropogenic forcing using a range of subjective assumptions and assertions concerning the dynamics of the Earth's climate system (Frigg et al, 2013b; Edwards, 2010).

Climate Science / Climate Change Science: The range of data collection, parameterisation, modelling and analysis activities that are undertaken by climate scientists for the purposes of understanding global and regional climate systems. This scientific research and evidence is usually compiled and input into Global Circulation Models and Earth Systems Models for the purposes of understanding climate systems in the past, present and future (Edwards, 2010; Miller and Edwards, 2001).

Constructivism: The ways in which social groups collectively construct knowledge and meaning about the world they perceive around them (McNamee, 2004; Ackermann, 2001).

Credibility: Whether an actor perceives information as meeting standards of scientific plausibility and technical adequacy (Cash et al., 2002).

Critical Realism: Broadly defined, the view that an objective reality, independent of any individual's perception, exists but that our perceptions cannot necessarily account for it. Thus a critical realist epistemology contains both intransitive (that which knowledge is about, i.e., some objective reality) and transitive (constructed knowledge) components (Archer et al., 1998: p. xii).

Exposure: The presence of people, livelihoods, species or ecosystems, environmental functions, services, and resources, infrastructure, or economic, social, or cultural assets in places and settings that could be adversely affected (IPCC, 2014: p. 5).

Frequentist Probability: An interpretation of probability as the limit of the relative frequency of an event or occurrence in a large number of events. In terms of climate probabilities it used as a measure of the frequency of occurrence of particular extreme events.

Glocal: "…the meeting, intersection, overlap and coexistence of the particular and the universal." (Rhodes, 2006: p. 81).

Hazard: The potential occurrence of a natural or human-induced physical event or trend or physical impact that may cause loss of life, injury, or other health impacts, as well as damage and loss to property, infrastructure, livelihoods, service provision, ecosystems, and environmental resources. In this report, the term *hazard* usually refers to climate-related physical events or trends or their physical impacts (IPCC, 2014: p. 5).

Impact: Effects on natural and human systems. The term *impact* is used primarily to refer to the effects on natural and human systems of extreme weather and climate events and of climate change. Impacts generally refer to effects on lives, livelihoods, health, ecosystems, economies, societies, cultures, services, and infrastructure due to the interaction of climate changes or hazardous climate events occurring within a specific time period and the vulnerability of an exposed society or system. Impacts are also referred to as *consequences* and *outcomes*. The impacts of climate change on geophysical systems, including floods, droughts, and sea level rise, are a subset of impacts called physical impacts (IPCC, 2014: p. 5).

Legitimacy (Evidence): Cash et al. (2002) defines evidence legitimacy as: *whether an actor perceives the process of knowledge production by the system as unbiased and meeting the standards of political and procedural fairness; that the knowledge production system considers appropriate values, interests, concerns and specific circumstances from multiple perspectives*.

For the purposes of my research, I propose an alternative definition (see section 6.3) as: *The degree to which information for policy making is considered politically acceptable and the process of knowledge production considered to be unbiased and inclusive of appropriate values, interests, concerns, and specific circumstances from multiple perspectives.*

Legitimacy (Policy): A measure of the political acceptance granted to a given policy issue or policy action by democratic representatives in a liberal democracy. Legitimacy derives from popular explicit and implicit consent of the governed (Ashcraft, 1991).

Level: For the purposes of this research, *scale* refers to the spatial, temporal, or otherwise quantitative or analytical dimensions used to measure governance. *Level* is the unit of analysis located at different positions on any given governance scale. Therefore, for instance, ‘local’, ‘national’ and ‘international’ describe levels of governance on a jurisdictional and/or geographical scale. In the course of this research I also refer to a temporal scale of governance and associated levels relating to political electoral cycles (i.e., 3 or 4 years), decadal climate influences (i.e., 10 years), as well as longer term climate change (30+ years).

Linear-technocratic model: a ‘rationalist’ decision making model prescribing an approach which assumes that the decision-maker(s) is motivated to maximise social gain; that he or she has adequate objective knowledge of the problem and the value preferences of those involved, knows all the options available, understands all the costs and benefits of these options, and can rationally choose and evaluate the best one in a linear fashion (Dye, 2005: p. 15).

Neo-liberalism: “[A] theory of political economic practices that proposes that human well-being can best be advanced by liberating individual entrepreneurial freedoms and skills within an institutional framework characterized by strong private property rights, free markets, and free trade” (Harvey, 2007: p. 2).

Normative: Relating to an ideal, standard or model, or relating to what should be, what is correct, a shared expectation of behaviour or what one ought to do (Merriam Webster, 2015; Scott and Marshall, 2005).

Norm: A standard, pattern or practice of decision making that is typical or expected (Merriam Webster, 2015; Scott and Marshall, 2005).

Policy Evidence: For the purposes of this research, I define policy evidence as the form in which science and other expert knowledge is presented to government decision makers to allow them to understand a problem like climate change in terms that they can relate to and understand. What distinguishes policy evidence from other forms of knowledge for decision making is that it is overseen and/or commissioned by government for the purposes of informing policy and is usually coproduced between experts and non-experts. Policy evidence includes assessment and appraisal techniques such as climate impact and risk assessments.

Politicisation: For the purposes of this research I distinguish between a necessary and inevitable *Politicisation-by-process* during the development of climate science and policy evidence due to the need to engage in socio-cultural reasoning, and a deliberate *Politicisation-by-agency*. The latter politicisation, as defined for the purposes of my research, occurs as a result of deliberate normative or political influence in either the development or communication of science and policy evidence.

My research follows the arguments of Fischer (2009) concerning the legitimacy of expertise to suggest that both types of politicisation occur as a result of scientists extending their legitimate expert authority beyond the realms of what they can legitimately claim to have privileged knowledge about. This extension occurs either by the hand of experts themselves or on their behalf by non-expert parties, but in either case politicisation allows values to influence scientific endeavour, or to influence experts' conclusions and communication of science in a way that may promote a normative or political position.

Politics: The practice and theory of influencing other people, distributing power and resources within a given community, or, achieving and exercising positions of governance (Merriam Webster, 2015).

Receptor: An entity that may be harmed by a particular set of hazardous events (Willows and Connell, 2003).

Resilience: The capacity of social, economic, and environmental systems to cope with a hazardous event or trend or disturbance, responding or reorganizing in ways that maintain their essential function, identity, and structure, while also maintaining the capacity for adaptation, learning, and transformation (IPCC, 2014: p. 5) (See also Appendix B for a discussion of this concept).

Risk: The potential for consequences where something of value is at stake and where the outcome is uncertain, recognizing the diversity of values. Risk is often represented as probability of occurrence of hazardous events or trends multiplied by the impacts if these events or trends occur. Risk results from the interaction of vulnerability, exposure, and hazard (IPCC, 2014: p. 5).

Salience: The perceived relevance of information for an actor's decisions, or for the decisions that affect that actor.

Scale: The spatial, temporal, or otherwise quantitative or analytical dimensions used to measure governance.

Scientisation: The suppression of normative debate in the policy making process by recourse to the 'facts' (Sarewitz, 2004). See section 7.3 for a detailed discussion of this concept.

Sensitivity: The degree to which a system is affected, either adversely or beneficially, by climate variability or change. The effect may be direct (e.g., a change in crop yield in response to a change in the mean, range or variability of temperature) or indirect (e.g., damages caused by an increase in the frequency of coastal flooding due to sea-level rise) (IPCC, 2007a,b).

Social-ecological system: *"A social-ecological system consists of a bio-geophysical unit and its associated social actors and institutions. Social-ecological systems are complex and adaptive and delimited by spatial or functional boundaries surrounding particular ecosystems and their problem context"* (Glaser et al, 2008).

Vulnerability: The propensity or predisposition to be adversely affected. Vulnerability encompasses a variety of concepts and elements including sensitivity or susceptibility to harm and lack of capacity to cope and adapt (IPCC, 2014: p. 5).

Appendix B – Conceptions of resilience for climate adaptation policy making

Resilience, I argue, holds considerable potential as a conceptual frame for the derivation of policy evidence. It is a concept that is relevant to all governance activities concerned with the viability of human settlements and the communities they sustain. It informs policy players' normative prioritisation of adaptation objectives, risks and management options. When defined appropriately it can, I argue, be a concept that encompasses a broader range of norms and values than the comparable concept of risk. Resilience speaks to the combined strengths of communities or jurisdictions, rather than being dependent on understanding individual vulnerabilities or the intractable uncertainties of future unknowable events. It can simultaneously address issues of climate risk, vulnerability and exposure in ways that, I argue, may circumvent the technical inadequacies (i.e., a lack of salience and legitimacy) of existing climate science outputs while directly addressing political and economic norms.

As both Davoudi (2012) and Pike et al. (2010) reveal, interpretations of resilience tell us much about how we view the dynamics of the social-ecological systems (SES) of which human communities are a part, as well as our normative judgements relating to existing and future community structure and function. Whether intended or not, interpretations of the notion of resilience are often implicit in expert's formulations of adaptation problems, and in policy making strategies and practices, and therefore, the concept holds considerable importance as a foundation for our understanding and governance of climate adaptation. As Prosser and Peters (2010) point out, although differences in the theoretical interpretation of resilience may appear trivial, they can result in significant differences to policy objectives, capabilities and costs, and by implication, policy outcomes and their efficacy. Contemporary concepts of resilience have been investigated or utilised across the academic disciplines of ecology, human ecology, human geography, economics and disaster risk management, amongst others (Adger et al., 2011; Carpenter et al., 2005; Funfgeld and McEvoy, 2012; Kuhlicke et al., 2011; Maguire and Hagan, 2007; Walker et al., 2004; Yohe and Tol, 2002). Despite various interpretations of the concept, all literatures are similarly concerned with an ability to cope with stresses and respond effectively to change, whether that is for individuals, species, communities, institutions or eco-systems. Recent literature has brought significant conceptual advancement to the term, attempting to reconcile varying disciplinary interpretations to allow some practical utility for environmental and social policy, planning and governance (Davoudi, 2012; Duit et al., 2010; Pike et al., 2010; Simmie and Martin, 2010). This literature focuses on resilience as a heterogeneous concept relevant to all efforts to understand how communities – and the SESs of which they are a part – can and should respond to stresses and adapt to and prepare for change.

The varying conceptualisations of resilience have been summarised and their origins explained elsewhere and so will not be repeated at length here (see for example, Davoudi, 2012; Folke et al., 2010; Pike et al., 2010). For the purposes of my research however, these interpretations can be broadly summarised into three types which relate to the various definitions of the term used by those involved in adaptation policy making (Manyena, 2006).

Engineering resilience is a measure of the speed of a system to return to its equilibrium state. The faster the system bounces back, the more resilient it is (Holling, 1973). The assumption associated with this interpretation appears in practice to be that human society and its individual communities are discrete entities whose stability and structure we must endeavour to protect and maintain in the face of external pressures.

Ecological resilience on the other hand, relates to both the magnitude of disturbance that can be absorbed and the speed of recovery or adjustment to *one of a number of alternative equilibrium states*. Ecological resilience is measured by the ability to both persist and adapt. This characterisation, developed by Holling (1996), is in line with the theory of ecological systems as prone to shifting between varying equilibrium states depending on both the endogenous and exogenous pressures placed upon them.

Evolutionary (social-ecological) resilience eschews the idea of equilibrium states and is premised on the idea that change is a fundamental component of SESs irrespective of any given external disturbance. Evolutionary resilience is therefore the ability of communities to respond, adapt and transform in response to stresses and strains and the inevitable changeability of SESs. As Davoudi (2012, p. 302) explains, evolutionary resilience is based on a view of the world as chaotic, complex, uncertain and unpredictable:

> *Faced with adversities, we hardly ever return to where we were […] regime shifts are not necessarily the outcome of an external disturbance and its linear and proportional cause and effects […] change can happen because of internal stresses with no proportional or linear relationship between cause and effect.*

For the purposes of adaptation policy, this *evolutionary* view of resilience appears most amenable to the development of diverse and context-specific solutions while simultaneously providing strategic coherence for policy makers in ways that have, as yet, eluded climate adaptation plans derived from risk assessment. Davoudi et al. (2013), Davoudi (2012), and Funfgeld and McEvoy (2012) argue that the emphasis of disaster risk management and climate adaptation policy on 'bouncing back' (engineering resilience) or 'bouncing forth' (ecological resilience) may be problematic in practice. For instance, Davoudi et al. (2013) describe how climate change adaptation plans in England have demonstrated an interpretation of resilience as, at best, ecological and at worst engineering. These equilibrium-based interpretations of resilience frame the approach of many advanced economies to climate adaptation that focus on reducing climate risk by eliminating exposure and vulnerability to future sudden, large and turbulent events. Funfgeld and McEvoy (2012) argue that this equilibrium-based view relates to the dominant formulation of climate adaptation as a practice of risk minimisation, such that a well-adapted community is deemed to be one that can perpetuate indefinitely its existing socio-economic structures and institutions. Such an idealised conceptualisation appears to deny the fundamentally changeable nature of SESs described by ecology and human ecology scholars such as Scheffer (2009), Folke (2010) and Gunderson and Holling (2002). In practice, I argue, it is not possible to adequately predict the extent and dynamics of future climate events or to eliminate climate risk for all communities. Attempts to do so often entail large public expenditures under considerable uncertainty. Examples where such costs are deemed justified (such as, for example, flood defences for the city of London and the Thames estuary (EA, 2012b) or the Wivenhoe dam in Southeast Queensland (QFCI, 2011)) will inevitably and necessarily be the exception rather than the rule, and may be found wanting in any case. Furthermore, as argued by Pike et al (2010), equilibrium-based approaches to resilience building do not adequately account for the geographical diversity and unevenness of communities' resilience, nor adequately address questions concerning the resilience of what and for whom.

The main problem with equilibrium-based views of resilience, I argue, is that because they perceive SESs as essentially static, and adaptation principally as the practice of preservation and/or conservation, they fail to recognise that flexibility is as important an attribute of community and institutional resilience as the stability of SESs. Pike et al. (2010) suggest that evolutionary resilience is maintained and enhanced by two alternating and potentially conflicting approaches that align well with the contrasting goals of societal stability and flexibility. The first approach, *adaptation*, aligns with efforts to conserve, to maintain existing infrastructure and institutions and the (political and practical) need for short term responses to extant and expected hazards. However, adaptation may limit adaptability and the possibility of transformative change as a result of the path dependency of particular engineering and infrastructure approaches, of incremental policy making and the political desire to build upon existing policies (Levin et al., 2007; EC 2009; COAG 2007). The second approach, *adaptability*, or adaptive capacity, recognises the potential dangers associated with path dependent incrementalism, and the need for mechanisms to allow policy makers to break free from policy constraints in order to evolve with the chaotic and ever-changing nature of SESs. Adaptability is concerned with the development of community and institutional flexibility to adjust, and where necessary transform[115], in response to inevitable and unpredictable change while maintaining some fundamental structure and function of those communities.

[115] Walker et al 2004 argue there is a significant distinction between the tasks of adaptability and transformability, but simultaneously note that the social capital required for both are very similar

As can be seen from the aforementioned discussion, resilience cuts to the heart of the issue of climate adaptation. Varying conceptions of resilience, I argue, directly address the underlying norms and values of policy players relating to what is valued and by whom when formulating and managing adaptation problems. While engineering and ecological resilience approaches assume a need to conserve a necessary equilibrium and the structure and function of existing political, economic and social structure, evolutionary resilience, as defined above, assumes a need for both flexibility and stability that calls into question the sanctity of existing societal infrastructure as long as a community's essential structure and function are maintained. Resilience embraces the intractability of uncertainties associated with bio-geophysical and social-ecological uncertainties. This sits in contrast to risk-based approaches that have, to date, assumed the ultimate tractability of existing uncertainties, the validity of the linear-technocratic heuristic and the ability of experts to apprehend objective reality. Worse still, risk-based approaches have disguised important norms and values behind a façade of supposedly impartial evidence, as described in the case-study examples in this thesis.

In comparison to a framing of climate adaptation policy in terms of risk, resilience can be interpreted in terms that appears to avoid linear-technocratic notions of being able to objectively apprehend adaptation problems through risk assessment, yet does not make the use of climate change projections and scenarios redundant in the way that vulnerability assessment may be seen to. Like the concept of vulnerability, resilience speaks to a fundamental characteristic of the adaptation problem described in this research: its contingent nature. As such, a resilience-based framing of adaptation problems may provide an optimal combination of risk and vulnerability (or 'top-down' versus 'bottom-up') approaches, by embracing the contingent nature of policy evidence and thus avoiding processes of politicisation, while ensuring that the best available climate science can still be used to understand how best to balance the competing demands for stability and flexibility of social-ecological systems.

Appendix C – Interview Questions

The nature of climate change evidence for policy:

1. Ideally, how should climate science inform climate adaptation policy making? Can this ideal be achieved? What kind of evidence is required to guide climate adaptation? **[Salience/ Legitimacy]**

2. In reality, does climate science provide the types of answers required for effective policy making? **[Salience]**

3. What constitutes 'evidence' for climate change adaptation? Are some types more valuable than others? What other types of evidence are appropriate for informing climate adaptation policy? **[Credibility/Salience]**

4. What gives climate science its expert authority in areas of modelling requiring subjective or normative input or given the nature of the uncertainties? How do contextual and political factors influence experts and evidence? **[Credibility]**

5. What should the role of experts be in understanding climate change impacts, risks and developing adaptation policy? **[Legitimacy]**

6. What role do policy makers and government officials play in the **<u>provision</u>** of evidence for adaptation? What role should they have? **[Legitimacy]**

The use of evidence-based policy making:

7. Are risk-based methods useful for addressing climate change adaptation?

8. Have risk-based methods provided appropriate evidence for climate adaptation? If not, can they? Is there a political element to them?

9. What might an alternative evidence-based policy analysis method look like?

Political and cultural differences between case-studies:

10. How would you characterise the climate of SEE/SEQ?

11. Do you think there is sufficient public and political legitimacy for the task of climate change adaptation in SEE/SEQ? How would you describe its legitimacy relative to, say, DRM or Urban Planning? **[Legitimacy]**

12. Do you think there is sufficient credibility in climate change science in local and state/national government, and among the public? **[Credibility]**

The characteristics of climate adaptation policy:

13. How would you characterise the existing suite of adaptation plans and policies?

14. Are these plans/policies worthwhile, effective, realistic?

15. How do those provisions relate to existing DRM, NRM and urban planning provisions?

16. Can concurrent policy priorities do the same job?

UK Only:

In relation to the UK Climate Change Risk Assessment (CCRA):

17. Can you explain the process of deliberation prescribed by Willows and Connell (2003) as it occurred in the formulation of the UKCCRA?

18. Were there both expert and lay perspectives represented at the risk assessment workshops?

19. What was the role of climate science and climate experts in the risk assessment process?

20. Did public officials and other policy players have a voice in the development of the UKCCRA?

Appendix D – Ethics Clearance and Consent Materials

The following section presents the ethical clearance attained, and consent materials used, for the purposes of conducting the research presented in this thesis:

HUMAN RESEARCH ETHICS COMMITTEE

ETHICAL CLEARANCE CERTIFICATE

This certificate generated on 18-03-2015.

This certificate comfirms that protocol 'NR: Climate Change Adaptation – uncertainty and the role of bureaucratic problem formulation in policy design across governance scales' (GU Protocol Number ENV/57/12/HREC) has ethical clearance from the Griffith University Human Research Ethics Commitee (HREC) and has been issued with authorisation to be commenced.

The ethical clearance for this protocol runs from 12-10-2012 to 29-09-2014.

The named members of the research team for this protocol are:

Dr Michael Heazle

APro Michael Howes

Mr Pete Tangney

The research team has been sent correspondence that lists the standard conditions of ethical clearance that apply to Griffith University protocols.

The HREC is established in accordance with the *National Statement on Ethical Conduct on Research Involving Humans.* The operation of this Committee is outlined in the HREC Standard Operating Procedure, which is available fromwww.gu.edu.au/or/ethics.

Please do not hesitate to contact me if you have any further queries about this matter.

Rick Williams
Manager, Research Ethics
Office for Research
Bray Centre, N54 Room 0.15 Nathan Campus
Griffith University
Phone: 07 3735 4375
Facsimile: 07 373 57994
Email: rick.williams@griffith.edu.au

Title of project

Uncertainty and the role of expertise in climate change risk assessment and adaptation policy

CONSENT FORM

Research Team

Mr Peter Tangney, Griffith Urban Research Program
Dr Michael Howes, Griffith School of Environment, (07) 555 27264, m.howes@griffith.edu.au
Associate Professor Michael Heazle, Griffith Business School.

By signing below, I confirm that I have read and understood the information package and in particular have noted that:

- I understand that my involvement in this research will include participation in a focus group, a stakeholder forum and/or an interview;
- I have had any questions answered to my satisfaction;
- I understand the risks involved;
- I understand that there will be no direct benefit to me from my participation in this research;
- I understand that my participation in this research is voluntary;
- I understand that if I have any additional questions I can contact the research team;
- I understand that I am free to withdraw at any time, without comment or penalty;
- I understand that I can contact the Manager, Research Ethics, at Griffith University Human Research Ethics Committee on 3735 5585 (or research-ethics@griffith.edu.au) if I have any concerns about the ethical conduct of the project; and
- I agree to participate in the project.

Name	
Signature	
Date	

TITLE OF PROJECT

Uncertainty and the role of expertise in climate change risk assessment and adaptation policy

INFORMATION SHEET

Chief Investigator:	Research Team:
Peter Tangney Griffith School of Environment, Climate Change Response Program, Griffith University, Nathan Campus, Mount Gravatt QLD 4111 0435 453 891 p.tangney@griffithuni.edu.au	**Dr Michael Howes,** Griffith School of Environment **Associate Professor Michael Heazle**, Griffith Business School.

Why is the research being conducted?

This research is being carried out as part of PhD research into the role of expert authority in the development of evidence-based policy for climate change adaptation. The project is designed to provide a greater understanding of the role of climate science in policy design; the processes of knowledge co-production for adaptation policy and specifically the interplay between expert and political authority.

What you will be asked to do

Involvement in this project will require your participation in a semi-structured interview either face-to-face at a time and location convenient to you, or over the phone. **With your consent, this interview will be recorded.**

The basis by which participants will be selected or screened

Participants have been selected from the public service sector related to climate change adaptation policy, elected members of government, the academic research community, scientific advisory groups and community and business advocacy groups. They have been chosen on the basis of their involvement and/or interest in climate change adaptation policy and activities, or in the development of evidence for adaptation.

The expected benefits of the research

The study has been designed to improve our understanding of how climate change adaptation policy is made; how expert and political authorities interact during the process and how evidence-based policy can be improved. We expect a variety of policymakers and planners will find this research useful.

Your confidentiality

Data collected, including notes of interviews, will be accessible only to members of the research team. You will not be identified in any reports or publications arising from this research unless you have consented to this in writing. All published material referencing the content of your interview will use non-identifiable labels such as "Government Official 1"; such labels will also be designed to preclude any possible inference toward your identity. No third parties will be informed of your participation in this research project.

Data collected during this research, including recordings of interviews and discussions and transcriptions of them, will be held securely by the research team for the duration of the research. Interview recordings will be confidentially deleted at the end of the research project. Transcriptions of recorded interviews will be retained after the completion of the research and may be accessed by other researchers with an interest in this field. All retained data will be anonymous (i.e. it will not identify you or be capable of being attributed to you in any way).

Your participation is voluntary

There is absolutely no obligation for you to participate in this research and if you do agree to do so you are free to withdraw from the research at any time.

Questions / further information

If you have any questions about the research or your participation you may contact the Chief Investigator, Mr Peter Tangney, whose contact details are listed above.

The ethical conduct of this research

Griffith University conducts research in accordance with the *National Statement on Ethical Conduct in Human Research.* If potential participants have any concerns or complaints about the ethical conduct of the research project they should contact the Manager, Research Ethics on 3735 5585 or **research-ethics@griffith.edu.au**.

Feedback to you

Bibliography

Abbott, T 2013, ‘1st Leaders Debate for the 2013 Federal Election’, Opening speech broadcast on 11 August , viewed 13 August 2013, http://www.abc.net.au/iview/#/series/12771

ABC 2007, ‘Global Warming Swindle Debate’, Australian Broadcasting Corporation, uploaded to www.youtube.com 12 July 2007, viewed 16 August 2013, https://www.youtube.com/watch?v=lIjGynF4qkE&list=PLC538324BC4FA66A6

ABC 2014a. ‘Direct Action: Government Releases Policy White Paper on Climate Change Plan’, Australian Broadcasting Corporation, 25 April, viewed 17 June 2014, http://www.abc.net.au/news/2014-04-24/government-releases-climate-change-policy-white-paper/5409262

ABC 2014b. ‘As it happened: Senate passes legislation to repeal carbon tax’, Australian Broadcasting Corporation, 17 July, viewed 17 June 2014, http://www.abc.net.au/news/2014-07-17/live-blog-coalition-in-bid-to-push-through-carbon-tax-repeal/5603830

ABC 2014c, ‘Jeff Seeney orders Moreton Bay Regional Council to remove references to climate change-derived sea level rises from regional plan’. Australian Broadcasting Corporation, 9 December, viewed 4 February 2015, http://www.abc.net.au/news/2014-12-09/seeney-removes-climate-change-references-from-council-plan/5954914

ABC 2015, ‘Jeff Seeney said climate change 'semi-religious belief': Queensland mayor signs statutory declaration stating Deputy Premier made comment’, Australian Broadcasting Corporation, 23 January, viewed 4 February 2015, http://www.abc.net.au/news/2015-01-23/jeff-seeney-denies-he-said-climate-change-was-a-semi-religious-/6041710

Ackermann, E 2001, ‘Piaget’s constructivism, Papert’s constructionism: What’s the difference?’, in *Constructivism: uses and perspectives in education*, vol. 1, no.2, pp. 85–94, Geneva, Research Center in Education

Adger, WN 2000, ‘Social and ecological resilience: are they related?’, *Progress in Human Geography*, vol. 24, no. 3, pp.347 - 364

Adger, WN, Arnell, NW, & Tompkins, EL 2005a, ‘Successful adaptation to climate change across scales’, *Global Environmental Change*, vol. 15, pp. 77 - 86

Adger, WN, Arnell, NW, & Tompkins, EL 2005b, ‘Editorial: Adapting to climate change: perspectives across scales’, *Global Environmental Change*, vol. 15, pp. 75 - 76

Adger, WN, Brown, K, & Tompkins, EL 2005c, ‘The Political Economy of Cross-scale Networks in Resource Co-Management’, *Ecology and Society*, vol. 10, no. 2, viewed 16 March 2015, http://www.ecologyandsociety.org/vol10/iss2/art9/

Adger, WN, Brown, K, Nelson, DR, Berkes, F, Eakin, H, Folke, C, Galvin, K, Gunderson, L, Goulden, M, O' Brien, K, Ruitenbeek, J, & Tompkins, EL 2011, ‘Resilience implications of policy responses to climate change’, *WIRES Climate Change*, vol. 2, pp. 757 - 766

Allison, GT 1971, *Essence of Decision: Explaining the Cuban Missile Crisis*, Little, Brown & Co., Canada

Althaus, C, Bridgman, P, & Davis G. 2007, *The Australian Policy Handbook*, 4th edn, Allen & Unwin, NSW, Australia

Anderson, K & Bows, A 2009, 'Global Emissions Pathways - A fair deal for Non-Annex 1 nations: What's left for Annex 1?', in *4 Degrees and Beyond: International Climate Conference*, University of Oxford, UK, 28-30 Sept 2009, viewed 4 March 2015, http://www.eci.ox.ac.uk/4degrees/programme.php

Anderson, K, Bows, A. & Mander, S 2008, 'From long-term targets to cumulative emissions pathways: reframing UK climate policy', *Energy Policy,* vol. 36, pp. 3714 – 3722

Archer, M, Bhaskar, R, Collier, A, Lawson, T, & Norrie, A (eds) 1998, *Critical Realism - Essential Readings*, Routledge, London and New York.

Ashcraft, R 1991, *John Locke: Critical Assessments*, Routledge, London, p. 524

Asrar, GR, Ryabinin, V, Detemmerman, V 2012, 'Climate science and services: Providing climate information for adaptation, sustainable development and risk management', *Current Opinion in Environmental Sustainability*, vol. 4, pp. 88 - 100

Assinder, N, 2000, 'Blair Seeks to Woo Green Vote', BBC News Online, 24 Oct, viewed 15 December 2014, http://news.bbc.co.uk/2/hi/uk_news/politics/988323.stm

Australian Bureau of Statistics [ABS] 2012, *Population Estimates by Local Government Area, 2001 – 2011*, ABS, Canberra, viewed 13 August 2013, http://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/3218.02011

Australian Government, 1992. *Intergovernmental Agreement on the Environment*. Department of Environment, Commonwealth of Australia, Canberra, viewed 1 February 2015, http://www.environment.gov.au/about-us/esd/publications/intergovernmental-agreement

Australian Government 1994, *National Environment Protection Council Act 1994,* Australian Government ComLaw website, viewed 1 February 2015, http://www.comlaw.gov.au/Series/C2004A04799

Australian Government 2006, *Climate Change Impacts and Risk Management: A guide for business and government,* Australian Greenhouse Office, Department of Environment and Heritage. Canberra, ACT, Australia

Australian Government 2007. *Climate Change Adaptation Actions for Local Government*. Australian Greenhouse Office, Department of the Environment and Water Resources, Canberra. Viewed 25 August 2013, http://www.climatechange.gov.au/en/what-you-can-do/community/~/media/publications/local-govt/localadaption_localgovernment.pdf

Australian Government 2012, *Natural Disaster Relief and Recovery Arrangements - determination version 1*. Commonwealth of Australia - Attorney-General's Department, Canberra, viewed 27 May 2014, http://www.disasterassist.gov.au/NDRRADetermination/Pages/default.aspx

Australian Government 2014a, *Climate Change Adaptation Program*, Department of Environment, Commonwealth of Australia, Canberra, viewed 19 July 2014, http://www.environment.gov.au/climate-change/adaptation/climate-change-adaptation-program

Australian Government 2014b, *Understanding Climate Change*, Department of Environment Commonwealth of Australia, Canberra, viewed 29 July 2014, http://www.climatechange.gov.au/climate-change/climate-science/understanding-climate-change

Australian Public Service Commission [APSC] 2007, *Tackling Wicked Problems: A public policy perspective,* APSC, Australian Government, Canberra.

Bajracharya, B, Childs, I, & Hastings, P 2011, ‘Climate change adaptation through land use planning and disaster management: Local government perspectives from Queensland’, in The 17th Pacific Rim Real Estate Society Conference, 16 - 19 January, viewed 4 March 2015, http://www.prres.net/papers/Bajracharya_Childs_Hastings_Climate_change_disaster_management_and_land_use_planning.pdf

Ballard, D, & Alexander, S 2008, *Adaptive Capacity Benchmarking: A Handbook and Toolkit*, European Spatial Planning: Adapting to Climate Events, Hampshire County Council, UK, viewed 31 June 2013, http://www.espace-project.org/publications/Extension%20Outputs/HCCPartner/ACB%20Handbook%20v2003%20final.doc

Banks, G 2009, ‘Evidence-based policy-making: What is it? How do we get it?’, Chairman's Speech, Australian Government Productivity Commission and Australia & New Zealand School of Government ANZSOG/ANU Public Lecture Series, Canberra, Australia, 4 February, viewed 7 November 2014, http://www.pc.gov.au/speeches/gary-banks/cs20090204

Barnett, J 2010, ‘Adapting to climate change: three key challenges for research and policy - an editorial essay’, *Wiley Interdisciplinary Reviews - Climate Change*, vol. 1, pp. 314 - 317

Bayley, CA 2004, *The Birth of the Modern World, 1740 - 1914: Global Connections and Comparisons,* Blackwell, London.

BBC 2004, ‘The Coal Strike 1984 – 1985’, British Broadcasting Corporation, March 2004, viewed 17 September 2013, http://www.bbc.co.uk/bradford/sense_of_place/miners/miners_strike.shtml

BBC 2006a, ‘Hypocrisy claim over Cameron bike’, British Broadcasting Corporation, 28 April, viewed 24 October 2013, http://news.bbc.co.uk/2/hi/uk_news/politics/4953922.stm

BBC 2006b, ‘Cameron visits Norwegian glacier’, British Broadcasting Corporation, 20 April, viewed 24 October 2013, http://news.bbc.co.uk/2/hi/uk_news/politics/4925444.stm

BBC 2010, ‘How 'green' is the coalition government?’, British Broadcasting Corporation, 14 September, viewed 24 October 2013, http://www.bbc.co.uk/news/uk-politics-11298334

BBC 2012a, ‘Living with coastal erosion in Happisburgh, East Anglia’, British Broadcasting Corporation, viewed 20 September 2012: http://www.bbc.co.uk/learningzone/clips/living-with-coastal-erosion-in-happisburgh-east-anglia-pt-1-2/7361.html

BBC 2012b, ‘Cameron: Man, mouse or politician?’ British Broadcasting Corporation, 28 August, viewed 24 October 2013, http://www.bbc.co.uk/news/uk-politics-19395774

BBC 2014a, ‘Britain from Above: Happisburgh’, British Broadcasting Corporation, viewed 24 August 2014, http://www.bbc.co.uk/learningzone/clips/living-with-coastal-erosion-in-happisburgh-east-anglia-pt-1-2/7361.html

BBC 2014b, ‘Met Office: Evidence 'suggests climate change link to storms'’, British Broadcasting Corporation, 9 February, viewed 10 February 2015, http://www.bbc.com/news/uk-politics-26084625

Beck, S 2010, ‘Moving beyond the linear model of expertise? IPCC and the test of adaptation’, *Regional Environmental Change*, vol. 11, pp. 297 - 236

Beck, U 1992, *Risk Society: Towards a New Modernity*, Sage, London

Beeson, M, & McDonald, M 2013, ‘The Politics of Climate Change in Australia’, *Australian Journal of Politics and History,* vol. 79, no. 3, pp. 331 - 348

Bell S. 2004, 'Appropriate' policy knowledge, and institutional and governance implications, *Australian Journal of Public Administration*, 63(1), 22 - 28

Bell, S 2006, ‘Concerned scientists, pragmatic politics and Australi'a green drought’, *Science and Public Policy,* vol. 33, no. 8, pp. 561 - 570

Benedick, RE 2001, ‘Striking a New Deal on Climate Change’, *Issues in Science and Technology,* vol. 18, no. 1, pp. 71 - 77

Berkes, F 2007, ‘Understanding uncertainty and reducing vulnerability: lessons from resilience thinking’, *Natural Hazards*, vol. 41, pp. 283 - 295

Bertsch McGrayne, S 2011, *The Theory That Would Not Die: How Bayes' rule cracked the enigma code, hunted down russian submarines, & emerged triumphant from two centuries of controversy,* Yale University Press, London.

Betsill, MM, & Bulkeley, H 2004, ‘Transnational Networks and Global Environmental Governance: the cities for climate protection programme’, *International Studies Quarterly*, vol. 48, pp. 471 - 493

Bevir, M, Rhodes, RAW, & Weller, P 2003, ‘Traditions of Governance: Interpreting the changing role of the public sector’, *Public Administration*, vol. 81, no. 1, pp. 1-17

Biesbroek, GR, Swart, RJ, Carter, TR, Cowan, C, Henrichs, T, Mela, H, Morecroft, MD, & Rey, D 2010, ‘Europe adapts to climate change: comparing national adaptation strategies’, *Global Environmental Change*, vol. 20, pp. 440 - 450

Bita, N 2012, ‘Cambell Newman orders Anna Bligh's husband Greg Withers to kill green schemes’, *The Australian*, 28 March, viewed 9 September 2012, http://www.theaustralian.com.au/national-affairs/elections/campbell-newman-orders-anna-blighs-husband-greg-withers-to-kill-green-schemes/story-fnbsqt8f-1226311864712

Bohringer, C, & Finus, M 2005, ‘The Kyoto Protocol: Success or Failure?’, in Helm, D (ed), 2005. *Climate Change Policy*. Oxford University Press, Oxford.

Bourke, L, 2014a, ‘Climate change measures like 'primitive civilisations offering up sacrifices to appease the gods', says Maurice Newman’. *The Sydney Morning Herald*, August 14, viewed 15 August 2014, http://www.smh.com.au/federal-politics/political-news/climate-change-measures-like-primitive-civilisations-offering-up-sacrifices-to-appease-the-gods-says-maurice-newman-20140814-3do0v.html

Bourke, L 2014b, ‘G20 Summit: Barrack Obama puts climate change at fore in speech at University of Queensland’. *The Sydney Morning Herald*, 15 November, viewed 30 January 2015, http://www.smh.com.au/federal-politics/political-news/g20-summit-barack-obama-puts-climate-change-at-fore-in-speech-at-university-of-queensland-20141115-11ndmg.html

Braun, D, & Guston, DH 2003, ‘Principal-agent theory and research policy: an introduction’, *Science and Public Policy,* vol. 30, no. 5, pp. 302 - 308

Brewer, GD & deLeon, P 1983, *The Foundations of Policy Analysis*, The Dorsey Press, Chicago, USA

Brisbane City Council [BCC] 2000, *Superseded Brisbane City Plan 2000*, BCC, Brisbane, viewed 5 November 2014, http://www.brisbane.qld.gov.au/planning-building/planning-guidelines-and-tools/superseded-brisbane-city-plan-2000

Brisbane City Council [BCC] 2007, *Brisbane's Plan for Action on Climate Change and Energy 2007*. BCC, Brisbane, viewed 22 July 2014, http://www.brisbane.qld.gov.au/sites/default/files/20140414%20-%20Brisbanes%20Plan%20for%20Action%20on%20Climate%20Change.pdf

Brisbane City Council [BCC] 2014, *Brisbane City Plan 2014 - Schedule 1 Definitions*, BCC, Brisbane, viewed 5 November 2014, http://eplan.brisbane.qld.gov.au/CP/Definitions#DefFloodEvent

Bruner, RD & Steelman, TA 2005, ‘Beyond Scientific Management’, in Bruner, RD, Steelman, TA, Coe-Juell, L, Cromley, CM, Edwards, CM, & Tecker, DW (eds) 2005, *Adaptive Governance: Integrating Science, Policy, and Decision Making*, Columbia University Press, NY

Bulkeley, H 2001, ‘No regrets? Economy and environment in Australia's domestic climate change policy process’, *Global Environmental Change*, vol. 11, pp. 155 - 169

Bulkeley, H 2005, ‘Reconfiguring environmental governance: Towards a politics of scales and networks’, *Political Geography*, vol. 24, pp. 875 - 902

Bureau of Meteorology [BoM] 2013. *The Centre for Australian Weather and Climate Research*. BOM, Commonwealth of Australia, Canberra, viewed 16 March 2013, http://www.cawcr.gov.au/

Carpenter, SR, Westley, F, & Turner, MG 2005, 'Surrogates for Resilience of Social-Ecological Systems', *Ecosystems*, vol. 8, pp. 941 - 944

Carrington, D 2014, 'Climate change will make UK weather too wet and too dry, says Met Office'. *The Guardian*, 26 March, viewed 12 September 2014, http://www.theguardian.com/environment/2014/mar/25/climate-change-uk-weather-wet-dry-met-office

Carrington, D 2015, 'Cameron, Clegg and Miliband sign joint climate change pledge', *The Guardian*, 14 February, viewed 19 March 2015, http://www.theguardian.com/environment/2015/feb/14/cameron-clegg-and-miliband-sign-joint-climate-pledge

Carter, N 2009, 'Vote Blue, Go Green? Cameron's Conservatives and the Environment', *The Political Quarterly,* vol. 80, no.2, pp. 233 - 242

Cash, DW, & Moser, SC 2000, 'Linking global and local scales: designing dynamic assessment and management processes', *Global Environmental Change*, vol. 10, pp. 109 - 120

Cash, DW, Adger, WN, Berkes, F, Garden, P, Lebel, L, Olsson, P, Pritchard, L, & Young, O 2006, 'Scale and Cross-Scale Dynamics: Governance and Information in a Multi-level World', *Ecology and Society*, vol. 11, no. 2, viewed 16 March 2015, http://www.ecologyandsociety.org/vol10/iss2/art9/

Cash, D, Clark, W, Alcock, F, Dickson, N, Eckley, N, & Jager, J, 2002, *Salience, Credibility, Legitimacy and Boundaries: Linking Research, Assessment and Decision Making*, John F. Kennedy School of Government, Harvard University, Faculty Research Working Papers Series, November 2002.

Cash, DW, Clark, WC, Alcock, F, Dickson, NM, Eckley, N, Guston, DH, Jager, J, Mitchell, RB, 2003, 'Knowledge systems for sustainable development', *Proceedings of the National Academy of Sciences,* vol. 100, no. 14, pp. 8086 - 8091

Christensen, T 2014, 'New Public Management and Beyond - The Hybridisation of Public Sector Reforms', in Drori, GS, Hollerer, MA, & Walgenback, P, (eds) 2014. *Global Themes and Local Variations in Organisation and Management - Perspectives on Globalisation*, Routledge, New York

Christoff, P 1998, 'From Global Citizen to Renegade State: Australia at Kyoto', *Arena,* vol. 10, pp. 113 - 127

Christoff, P 2005, 'We're all greenies now? Recent patterns in environment policy in Australia and New Zealand', *Around the Globe*, winter 2005, pp. 6 - 9

Christoff, P 2008, 'Aiming High: On Australia's Emissions Reductions Targets', *UNSW Law Journal,* vol 31, no. 3, pp. 861 - 879

Clark, WC & Majone, G 1985, 'The Critical Appraisal of Scientific Inquiries with Policy Implications', *Science, Technology & Human Values,* vol. 10, no. 3, pp. 6 - 19

Clifton, R 1979, 'Theory and Methodology in Comparative Politics', *Unit 15 - The methodology of comparison*, The Open University Press, Milton Keynes, UK

Coastal Protection and Management Act 1995, Queensland Government, viewed 19 March 2015, https://www.legislation.qld.gov.au/LEGISLTN/CURRENT/C/CoastalProtA95.pdf

Collingridge, D, & Reeve, C 1986, *Science Speaks to Power: The role of experts in policy making*, Frances Pinter Publishers, London, UK

Collins, HM, & Evans, R 2002, 'The Third Wave of Science Studies: Studies of Expertise and Experience', *Social Studies of Science,* vol. 32, no. 2, pp. 235 - 296

Commonwealth Scientific and Industrial Research Organisation [CSIRO] & the Bureau of Meteorology 2010, *State of the Climate,* CSIRO, Melbourne, Australia.

Commonwealth Scientific and Industrial Research Organisation [CSIRO] 2011, *South East Queensland Climate Adaptation Research Initiative*, CSIRO, viewed 16 August 2013, http://www.csiro.au/partnerships/seqcari

Commonwealth Scientific and Industrial Research Organisation [CSIRO] 2013, *OzClim*, CSIRO, viewed 15 September 2014, http://www.csiro.au/ozclim/home.do

Cook, J, Nuccitelli, D, Green, SA, Richardson, M, Winkler, B, Painting, R, Way, R, Jacobs, P, & Skuce, A 2013, Quantifying the consensus on anthropogenic global warming in the scientific literature, *Environmental Research Letters*, vol. 8, no. 2, pp. 1 - 7

Corfee-Morlot, J, Cochran, I, Hallegatte, S, & Teasdale, P 2011, 'Multilevel risk governance and urban adaptation policy', *Climatic Change*, vol. 104, pp. 169 - 197

Council of Australian Governments [COAG] 2007, *National Climate Change Adaptation Framework, Council of Australian Governments*, Commonwealth of Australia, viewed 9 September 2012, http://www.climatechange.gov.au/government/initiatives/national-climate-change-adaptation-framework.aspx

Council of Australian Governments [COAG], 2011. *National strategy for disaster resilience: building our nation's resilience to disasters*, National Emergency Management Committee (NEMC) Working Group tasked by the COAG, Commonwealth of Australia, viewed 11 April 2013, www.coag.gov.au

Council of Australian Governments [COAG] 2015. *About COAG*. COAG, Commonwealth of Australia, viewed 4 February 2015, https://www.coag.gov.au/about_coag

Craig, RK 2010, '"Stationarity is Dead" - Long live Transformation: Five principles for climate change adaptation law', *Harvard Environmental Law Review*, vol. 34, pp. 9 - 73

Crawford, M 2005, 'Three types of probability', in *Art of Problem Solving Introductory Topics*, Presented at NASA Educators Workshop September 13, AoPS Incorporated. Alpine, CA

Cronstedt, M 2002, 'Prevention, Preparedness, Response, Recovery - an outdated concept?', *Australian Journal of Emergency Management,* vol. 17, no. 7, pp. 10 - 13

Crowley, K 2007, 'Is Australia faking it? The Kyoto Protocol and the greenhouse policy challenge', *Global Environmental Politics,* vol. 7, no. 4, pp. 118 - 139

Crowley, K & Walker, KJ (eds) 2012, *Environmental Policy Failure: The Australian Story,* Tilde University Press, Vic, Australia

Curran, G 2009, 'Ecological modernisation and climate change in Australia', *Environmental Politics* vol. 18, no. 2, pp. 201 - 217

Curran, G 2011, 'Modernising climate policy in Australia: climate narratives and the undoing of a Prime Minister', *Environment and Planning C: Government and Policy,* vol. 29, pp. 1004 - 1017

Curry, J 2013, 'Consensus Distorts the Climate Picture', *The Australian,* 21 September, Library.PressDisplay.com

Damro, C, & Mendes, PL 2005, 'Emissions Trading at Kyoto: From EU resistance to Union Innovation', in Jordan, A (ed) 2005, *Environmental Policy in the European Union: Actors, Institutions and Processes,* 2nd edn, Earthscan, London

Davies, HTO, Nutley, SM, & Smith, PC 1999, 'What Works? The role of evidence in public sector policy and practice', *Public Money & Management,* vol. 1, pp. 3 - 5

Davoudi, S 2012, 'Resilience: A Bridging Concept or a Dead End?', *Planning Theory & Practice*, vol. 13, no. 2, pp. 299 - 333

Davoudi, S, Brooks, E, Mehmood, A 2013, 'Evolutionary Resilience and Strategies for Climate Adaptation', *Planning, Practice & Research,* vol. 28, no. 3, pp. 307 - 322

de Boer, J, Wardekker, JA, & van der Sluijs, JP 2010, 'Frame-based guide to situated decision-making on climate change', *Global Environmental Change*, vol. 20, pp. 502 - 510

Dedekorkut, A, Mustelin, J, Howes, M, Byrne, J 2010, 'Tempering growth: planning for the challenges of climate change and growth management in SEQ', *Australian Planner,* vol. 47, no. 3, pp. 203 - 215

Dedekorkut-Howes, A, & Howes, M 2014, 'Climate Adaptation Policy and Planning in South East Queensland', in Burton, P (ed), *Responding to Climate Change: Lessons from a hotspot*, CSIRO Publishing, Melbourne

Department of Environment, Food and Rural Affairs [DEFRA] 2006, *Climate Change - The UK Programme 2006*, DEFRA, London, viewed 9 January 2014, http://www.official-documents.gov.uk/document/cm67/6764/6764.pdf

Department of Environment, Food and Rural Affairs [DEFRA] 2007, *Overall Impact Assessment of the Water Framework Directive (2000/60/EC)*. DEFRA, London, viewed 1 February 2015, http://archive.defra.gov.uk/environment/quality/water/wfd/documents/RIA-river-basin-v2.pdf

Department of Environment, Food and Rural Affairs [DEFRA] 2009, *Adapting to climate change: Helping key sectors to adapt to climate change*, DEFRA, London, viewed 11 March 2013, http://archive.defra.gov.uk/environment/climate/documents/interim2/report-guidance.pdf

Department of Environment, Food and Rural Affairs [DEFRA] 2010, *National Indicator 188: Adapting to climate change*. DEFRA, London, viewed 28 October 2013, http://archive.defra.gov.uk/corporate/about/with/localgov/indicators/ni188.htm

Department of Environment, Food and Rural Affairs [DEFRA] 2011a, *Greenleaves 3: Guidelines for Environmental Risk Assessment and Management*, DEFRA, London, viewed 17 March 2015, http://www.defra.gov.uk/publications/files/pb13670-green-leaves-iii-1111071.pdf

Department of Environment, Food and Rural Affairs [DEFRA] 2011b, *Advice for Local Authorities*, DEFRA, viewed 9 September 2012, http://www.defra.gov.uk/environment/climate/sectors/local-authorities/

Department of Environment, Food and Rural Affairs [DEFRA] 2012a, *UK Climate Change Risk Assessment: Government Report*, HMSO, Norwich, UK, viewed 6 May 2013, http://www.defra.gov.uk/publications/files/pb13698-climate-risk-assessment.pdf

Department of Environment, Food and Rural Affairs [DEFRA] 2012b, *UK Climate Change Risk Assessment: Evidence Report*, DEFRA, viewed 6 May 2013, http://randd.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&Completed=0&ProjectID=15747#RelatedDocuments

Department of Environment, Food and Rural Affairs [DEFRA] 2012c, *Climate Change Risk Assessment Methodology Report*, DEFRA, London, viewed 17 March 2015, http://randd.defra.gov.uk/Default.aspx?Module=More&Location=None&ProjectID=15747

Department of Environment, Food and Rural Affairs [DEFRA] 2012d, *Adaptation Reporting Power - Received Reports*, DEFRA, viewed 8 August 2014, http://webarchive.nationalarchives.gov.uk/20130123162956/http:/www.defra.gov.uk/environment/climate/sectors/reporting-authorities/reporting-authorities-reports/

Department of Environment, Food and Rural Affairs [DEFRA] 2012e, *Climate Change Risk Assessment for the Biodiversity and Ecosystem Services Sector,* DEFRA, London, viewed 6 May 2013, http://randd.defra.gov.uk/Default.aspx?Module=More&Location=None&ProjectID=15747

Department of Environment, Food and Rural Affairs [DEFRA] 2013a, *The National Adaptation Programme - Making the country resilient to changing climate*, HMSO, Norwich, UK, viewed 17 March 2015, http://randd.defra.gov.uk/Default.aspx?Module=More&Location=None&ProjectID=15747

Department of Environment, Food and Rural Affairs [DEFRA] 2013b, *The National Adaptation Programme Report: Analytical Annex - Economics of the National Adaptation Programme*, DEFRA, London, viewed 28 October 2013, https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/209867/pb13942a-nap-annex-economics.pdf

Department of Environment, Food and Rural Affairs [DEFRA] 2014, *Adapting to Climate Change,* DEFRA, viewed 21 July 2014, https://www.gov.uk/government/policies/adapting-to-climate-change

Department of Business Innovation and Skills [DBIS] 2011, *Impact Assessment Template for Government Policies*, UK Government website, viewed 29 July 2014, https://www.gov.uk/government/publications/impact-assessment-template-for-government-policies

Department of Climate Change [DCC] 2010, *Adapting to Climate Change in Australia: An Australian Government Position Paper,* DCC, Canberra, viewed 7 February 2015, http://www.environment.gov.au/climate-change/adaptation/publications/adapting-climate-change-australia

Department of Communities and Local Government [DCLG] 2012, *National Planning Policy Framework*. DCLG, London, viewed 30 October 2013, https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/6077/2116950.pdf

Department of Local Government and Planning [DLGP] 2009, *The South East Queensland Regional Plan 2009-31*. Queensland Government, Brisbane, viewed 4 June 2013, http://www.google.com.au/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&cad=rja&uact=8&ved=0CB4QFjAA&url=http%3A%2F%2Frti.cabinet.qld.gov.au%2Fdocuments%2F2009%2Fjul%2Fseq%2520regional%2520plan%25202009-31%2Fsouth%2520east%2520queensland%2520regional%2520plan%25202009-31.doc&ei=6oEHVeSOI-PSmAWs5YGwBQ&usg=AFQjCNHgLRPh3sd_4P1wH6h1FQGr5fKTgg&sig2=SxgNiszq1JT47hAgW_d56w&bvm=bv.88198703,d.dGY

Dessai, S, & Hulme, M 2003, *Does climate policy need probabilities? Working paper 34*, Tyndall Centre for Climate Change Research, viewed 10 March 2013, http://www.tyndall.ac.uk/sites/default/files/wp34.pdf

Dessai, S, & Hulme, M 2004, 'Does climate adaptation policy need probabilities?', *Climate Policy*, vol. 4, no. 2, pp. 107 - 128

Dessai, S, Hulme, M, Lempert, R, & Pielke Jr., R 2009, 'Climate prediction: a limit to adaptation?', in Adger, WN, Lorenzoni, I, & O' Brien, KL (eds) 2009, *Adapting to Climate Change: Thresholds, Values, Governance*, Cambridge University Press, Cambridge, UK

Department of Environment, Transport and the Regions [DETR] 2000, *Climate Change - The UK Programme,* HMSO, Norwich, UK, viewed 17 March 2015, http://www.cne-siar.gov.uk/emergencyplanning/documents/Climate%20Change%20-%20UK%20Programme.pdf

Devine, M 2002, ‘Drought relief sceptics must be hung out to dry’, *The Sun-Herald*, 13 October, viewed 2 August 2013, http://www.smh.com.au/articles/2002/10/12/1034222635512.html

Dilling, L 2007, ‘Towards science in support of decision making: characterizing the supply of carbon cycle science’, *Environmental Science & Policy*, vol. 10, pp. 48 - 61

Dilling, L, Lemos, MC, 2011, ‘Creating usable science: Opportunities and constraints for climate knowledge use and their implications for science policy’, *Global Environmental Change,* vol. 21, pp. 680 - 689

Disaster Risk Management Act 2003, Queensland Government, viewed 19 March 2015, https://www.legislation.qld.gov.au/LEGISLTN/CURRENT/D/DisastManA03.pdf

Douglas, M, & Wildavsky, A 1983, *Risk and Culture*, University of California Press, London, UK.

Dovers, S 1998, ‘Community involvement in environmental management: thoughts for emergency management’, *The Australian Journal of Emergency Management*, vol. 4, pp. 6 - 11

Dovers, S (ed) 2000, *Environmental History and Policy: Still Settling Australia*, Oxford University Press, Melbourne, Vic, Australia

Doyle, T 2000, *Green Power: The environment movement in Australia*, UNSW Press, Sydney

Dryzek, JS 1993, ‘Policy Analysis and Planning: From Science to Argument’, in Fischer, F & Forester, J (eds) *The Argumentative Turn in Policy Analysis and Planning*, Duke University Press, Durham, NC

du Gay, P 2005, *The Values of Bureaucracy*, Oxford University Press, Oxford, UK

Duit, A, Galaz, V, Eckerberg, K, & Ebbeson, J 2010, ‘Governance, Complexity, and Resilience’*, Global Environmental Change*, vol. 20, pp. 363 - 368

Dunn, B 2014, ‘Making sense of austerity: The rationality in an irrational system’, *The Economic and Labour Relations Review*, vol. 25, no. 3, pp. 417 - 434

Dye, TR 2005, *Understanding Public Policy*, 11th edn, Pearson Prentice Hall, New Jersey, USA

Edwards, PN 2004, ‘“A Vast Machine" Standards as Social Technology’, *Science,* vol. 304, pp. 827 - 828

Edwards, PN 2010, *A Vast Machine - Computer Models, Climate Data and the Politics of Global Warming*, The MIT Press, London

Emergency Management Australia [EMA] 2004, *Emergency Management in Australia – Concepts and Principles*. Attorney General’s Department, Commonwealth of Australia, Canberra, viewed online 17 March 2015, http://www.em.gov.au/Documents/Manual01-EmergencyManagementinAustralia-ConceptsandPrinciples.pdf (accessed online 25.11.12).

Environment Agency of England & Wales [EA] 2008, *Climate Change Adaptation Strategy 2008 - 11*. EA, Bristol, UK, viewed 30 October 2013, http://www.environment-agency.gov.uk/static/documents/Leisure/adaptation_strategy_2083410.pdf

Environment Agency of England & Wales [EA] 2010a, *Managing the Environment in a Changing Climate*. EA, Bristol, UK, viewed 17 March 2015, http://www.environment-agency.gov.uk/research/library/publications/130528.aspx

Environment Agency of England & Wales [EA] 2010b, *State of the Environment - South East England*, EA, Bristol, UK, viewed 20 August 2013, http://www.environment-agency.gov.uk/research/library/publications/34103.aspx

Environment Agency of England & Wales [EA] 2012a, *Climate Ready: Practical Resources*, EA, viewed 9 September 2012, http://www.environment-agency.gov.uk/research/137639.aspx

Environment Agency of England & Wales [EA] 2012b, *Thames Estuary 2100 - Managing flood risk through London and the Thames estuary: TE2100 Plan*, EA, viewed 30 July 2014, https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/322061/LIT7540_43858f.pdf

Environment Agency of England & Wales [EA] 2013, *Adaptation Planning*, EA, viewed 30 October 2013, http://www.environment-agency.gov.uk/research/planning/132423.aspx

Etzioni, A 1967, 'Mixed-Scanning: A "Third" Approach to Decision-Making', *Public Administration Review, vol.* 27, no. 5, pp. 385 - 392

European Commission 2009, *White Paper - Adapting to climate change: towards a European framework for action,* EC, Brussels, COM(2009) 147 final, viewed 17 March 2015, http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2009:0147:FIN:EN:PDF

European Commission 2001, *Governance in the EU: a White Paper*, EC, Brussels, COM(2001) 428 final, viewed 17 March 2015, http://ec.europa.eu/governance/docs/archives_en.htm

Evans, D 2003, *A History of Nature Conservation in Britain,* 2nd edn, Routledge, London

Evans, R, 2007, *A History of Queensland*, Cambridge University Press, Cambridge, UK

Ezrahi, Y 1990, *The Descent of Icarus: Science and the Transformation of Contemporary Democracy*, Harvard University Press, Cambridge, Massachusetts

Fagan, B 2000, *Floods, Famines and Emperors*, Pimlico, London, UK

Finnemore, M, & Sikkink, K 2001, 'Taking Stock: The Constructivist Research Program in International Relations and Comparative Politics', *Annual Review of Political Science*, vol. 4, pp. 391 - 416

Fischer, F, & Forester, J (eds) 1993, *The Argumentative Turn in Policy Analysis and Planning*, Duke University Press, Durham, NC

Fischer, F 2009, 'Technical Knowledge in Public Deliberation: Towards a Constructivist Theory of Contributory Expertise', in Fischer, F 2009, *Democracy and Expertise: Reorienting Policy Inquiry*, Oxford University Press, Oxford, UK

Fitzgerald, R 1984, *A History of Queensland from 1915 to the 1980s,* University of Queensland Press, St Lucia, Queensland, Australia

Flannery, T 1994, *The Future Eaters: An Ecological History of the Australasian Lands and People*, New Holland Publishers, NSW, Australia

Folke, C 2006, 'Resilience: The emergence of a perspective for social-ecological systems analyses', *Global Environmental Change*, vol. 16, pp. 253 – 267

Folke, C, Carpenter, SR, Walker, B, Scheffer, M, Chapin, T, & Rockstrom, J 2010, 'Resilience Thinking: Integrating resilience, adaptability and transformability', *Ecology and Society*, vol. 15, no. 4, pp. 20

Frigg, R, Bradley, S, Du, H, & Smith, LA 2013a, *Laplace's Demon and Climate Change, Centre for Climate Change Economics and Policy Working Paper No. 121*, Grantham Research Institute on Climate and the Environment, viewed 14 May 2013, http://seamusbradley.nfshost.com/Papers/demon-grantham.pdf

Frigg, R, Smith, LA, & Stainforth, DA 2013b, 'The Myopia of Imperfect Climate Models: The Case of UKCP09', *Philosophy of Science,* vol. 80, pp. 886 - 897

Funfgeld, H, & McEvoy, D 2012, 'Resilience as a useful concept for climate change adaptation?', *Planning Theory & Practice*, vol. 13, no. 2, pp. 324 - 333

Funtowicz, SO & Ravetz, JR 1992, 'Risk Management as a Post-Normal Science', *Risk Analysis*, vol. 12, no. 1, pp. 95 - 97

Funtowicz, SO & Ravetz, JR 1993, 'Science for the Post-Normal Age', *Futures*, September, pp. 739 - 755

Garnaut, R 2008, *Garnaut Climate Change Review: Final Report*, Cambridge University Press, Cambridge

Garnaut, R 2011, *The Science of Climate Change. Garnaut Climate Review Update Report 5*, Commonwealth of Australia, Canberra, ACT, Australia

Garner, R 2000, *Environmental Politics - Britain, Europe and the Global Environment,* 2nd edn, Macmillan Press, London

Gerth, HH, & Wright Mills, C (eds) 1970, *From Max Weber: Essays in Sociology*, Routledge & Kegan Paul, London

Gibbons, M, Limoges, C, Nowotny, H, Schwartzman, S, Scott, P, & Trow, M 1994, *The New Production of Knowledge: The Dynamics of Science and Research in Contemporary Societies*, Sage, London

Giddens, A 1990, *The Consequences of Modernity*, Polity Press. Cambridge, UK

Giddens, A 2009, *The Politics of Climate Change*, Polity Press, Cambridge, UK

Giddens, A 1998, *The Third Way: The Renwal of Social Democracy*, Polity Press, Cambridge, UK

Gieryn, TF 1995, 'Boundaries of Science', in Jasanoff, S, Markle, GE, Peterson, JC & Pinch, T (eds) 1995, *Handbook of Science and Technology Studies*, Sage Publications, Thousand Oaks, USA

Gieryn, TF 1983, 'Boundary-work and the demarcation of science from non-science: strains and interests in professional ideologies of scientists', *American Sociological Review,* vol. 48, pp. 781 - 795

Glacken, TJ 1990, *Traces on the Rhodian Shore: Nature and Culture in Western Thought from Ancient Times to the End of the Eighteenth Century*, 5th edn, University of California Press, Berkeley, Los Angeles, London

Glaser, M, Krause, G, Ratter, B, & Welp, M 2008, 'Human Nature Interaction in the Anthropocene. Potential of Social-Ecological Systems Analysis', Paper for the *DGH-Symposium: Human-Nature-Interactions in the Anthropocene: Potentials of Social-Ecological Systems Analysis*, Sommerhausen, 29 – 31 May, viewed 15 January 2009, www.dgh2008.org

Gold Coast City Council [GCCC] 2009, *Climate Change Strategy 2009 – 2014*, GCCC, viewed 22 January 2014, http://www.goldcoast.qld.gov.au/documents/bf/climate_strategy.pdf

Granger, K, & Haynes, M 2001, *Natural hazards and the risks they pose to South-East Queensland. Australian Geological Survey Organisation - Geoscience Australia*, Commonwealth of Australia, viewed 19 September 2014, http://www.ga.gov.au/image_cache/GA4218.pdf

Gray, TS 1997, 'Politics and the environment in the UK and beyond', in Redclift, M, & Woodgate, G (eds) 1997, *The International Handbook of Environmental Sociology,* Edward Elgar Publishing, Cheltenham, UK

Grice, A 2009, 'Cameron hit by Tory backlash on environment', *The Independent,* 2 December, viewed 24 October 2013, http://www.independent.co.uk/news/uk/politics/cameron-hit-by-tory-backlash-on-environment-1832208.html

Griffiths, A, Haigh, N, & Rassias, J 2007, 'A Framework for understanding institutional governance systems and climate change: The case of Australia', *European Management Journal,* vol. 25, no. 6, pp. 415 - 427

Grubb, M 2002, 'Britannia waives the rules: The UK, the EU and climate change', *New Economy*, vol. 9, no. 3, pp. 139 - 142

Grubler, A, & Nakicenovic, N 2001, 'Identifying dangers in an uncertain climate', - letter submitted to *Nature*, vol. 412, pp. 15

Grundmann, R 2006, 'Ozone and Climate: Scientific Consensus and Leadership', *Science, Technology & Human Values,* vol. 31, no. 1, pp. 73 - 101

Grundmann, R 2007, 'Climate Change and Knowledge Politics'. *Environmental Politics,* vol. 16, no. 3, pp. 414 - 432

Gunderson, LH, & Holling, CS 2002, *Panarchy: Understanding Transitions in Human and Natural Systems*, Island Press, Washington DC

Guston, DH 2001, 'Boundary organizations in environmental policy and science: An introduction', *Science, Technology, & Human Values,* vol. 26, pp. 299–408

Habermas, J 1971, *Toward a Rational Society,* Heinemann, London

Hajer, M 1995, *The Politics of Environmental Discourse: Ecological Modernisation and the Policy Process*, Oxford University Press, Oxford

Hall, PA 1993, 'Policy paradigms, social learning and the state - The case of economic policymaking in Britain', *Comparative Politics*, vol. 25, no. 3, pp. 275 - 296

Hall, J, 2007, 'Probabilistic climate scenarios may misrepresent uncertainty and lead to bad adaptation decisions', *Hydrological Processes,* vol. 21, pp. 1127 - 1129

Hallegatte, S 2009, 'Strategies to adapt to an uncertain climate change', *Global Environmental Change*, vol. 19, pp. 240 - 247

Hamlin, C 2008, 'Third Wave Science Studies: Toward a History and Philosophy of Expertise', in Kourany, J, Carrier, M, & Howard, D (eds) 2008, *The challenge of the social and the pressure of practice: Science and values revisited*, University of Pittsburgh Press, Pittsburgh, PA.

Hampson, N 1968, *The Enlightenment – An evaluation of its assumptions, attitudes and values*, Penguin, London

Harling, P, 2001, *The Modern British State - An Historical Introduction*, Polity Press, Cambridge.

Harvey, D 2007, *A Brief History of Neoliberalism*, Oxford University Press, Oxford, UK

Haskins, R, & Baron, J 2011, 'The Obama Administration's evidence-based social policy initiatives: an overview', in NESTA 2011, *Evidence for Social Policy and Practice: Perspectives on how research and evidence can influence decision making in public services*, NESTA, London, pp. 28 - 32

Head, B 2008a, 'Wicked Problems in Public Policy', *Public Policy*, vol. 3, no. 2, pp. 101 - 118

Head, B 2008b, 'Three Lenses of Evidence-Based Policy', *Australian Journal of Public Administration*, vol. 67, no. 1, pp. 1 – 11

Head, BW 2013, 'Evidence-Based Policymaking - Speaking Truth to Power?', *Australian Journal of Public Administration*, vol. 72, no. 4, pp. 397 - 403

Head, L, Adams, M, McGregor, HV, & Toole, S 2014, 'Climate Change and Australia'. *WIRES Climate Change,* vol. 5, pp. 175 - 197

Heazle, M, Tangney, P, Burton, P, Howes, M, Grant-Smith, D, Reis, K, & Bosomworth, K 2013, 'Mainstreaming climate change adaptation: An incremental approach to disaster risk management in Australia', *Environmental Science & Policy*, vol. 33, pp. 162 - 170

Heazle, M 2010, *Uncertainty in Policy Making: Values and evidence in complex decisions*, Earthscan, London

Hennessy, K, Fitzharris, B, Bates, BC, Harvey, N, Howden, SM, Hughes, L, Salinger, J, & Warrick, R 2007, 'Australia and New Zealand', in Parry, ML, Canziani, OF, Palutikof, JP, van der Linden, PJ, & Hanson, CE (eds), *Climate Change 2007: Impacts, Adaptation and Vulnerability.*

Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, Cambridge University Press, Cambridge, UK, pp. 507-540

Herbohn, K, Dargusch, P, & Herbohn, J 2012, 'Climate change policy in Australia: Organisational Responses and Influences', *Australian Accounting Review,* vol. 22, no. 2, pp. 208 - 222

Hertin, J, Jordan A, Turnpenny, J, Nilsson, M, Russel, D, & Bjorn, N 2009, 'Rationalising the policy mess? Ex ante policy assessment and the utilisation of knowledge in the policy process', *Environment and Planning A*, vol. 41, pp. 1185 – 1200

Hess, M, & Adams, D 2002, 'Knowing and Skilling in Contemporary Public Administration', *Australian Journal of Public Administration,* vol. 61, no. 4, pp. 68 - 79

Higgins, V, & Lockie, S 2002, 'Rediscovering the Social: Neo-liberalism and hybrid practices of governing in rural natural resource management', *Journal of Rural Studies*, vol. 18, no. 4, pp. 419 - 428

Hirschi, T 1973, 'On the Methodology of Comparative Urban Politics', *Journal of Comparative Administration*, February, pp. 499 - 513

HM Treasury 2004, *The Orange Book: Management of Risk - Principles and Concepts*, HMSO, Norwich, UK, viewed 9 September 2012, http://www.hm-treasury.gov.uk/d/orange_book.pdf

HM Treasury 2011, *The Majenta Book: Guidance for evaluation*, HMSO, Norwich, UK, viewed 9 September 2012, http://www.hm-treasury.gov.uk/d/magenta_book_combined.pdf

Holling, CS 1973, 'Resilience and stability of ecological systems', *Annual Review of Ecology and Systematics*, vol. 4, pp. 1 - 23

Holling, CS 1996, 'Engineering resilience versus ecological resilience', in Schulze, P (ed) 1996, *Engineering within ecological constraints*, National Academy Press, Washington DC, US

Holmes, J & Clark, R 2008, 'Enhancing the use of science in environmental policy-making and regulation', *Environmental Science & Policy*, vol. 11, pp. 702 - 711

Hooghe, L, & Marks, G 2003, 'Unravelling the Central State, but How? Types of Multi-level Governance', *American Political Science Review*, vol. 97, no. 2, pp. 233 - 243

Hoppe, R 2005, 'Rethinking the science-policy nexus: from knowledge utilization and science technology studies to types of boundary arrangements', *Poiesis Prax*, vol. 3, pp. 199-215

Howes, M 2008, 'Rethinking Governance: Lessons in collaboration from environmental policy', *Australasian Political Studies Association Annual Conference 2008*, 6 - 8 July, viewed 13 August 2013, http://www98.griffith.edu.au/dspace/handle/10072/22581

Howes, M, & Dedekorkut-Howes, A 2010, 'From White Shoes To Waders: Climate change adaptation and government on the Gold Coast'. *Australian Political Science Association Conference 2010*, viewed 5 August 2013, http://apsa2010.com.au/full-papers/pdf/APSA2010_0056.pdf

Howes, M, McKenzie, M, Gleeson, B, Gray, R, Byrne, J, & Daniels, P 2010, 'Adapting the idea of ecological modernisation to the Australian context', *Journal of Integrative Environmental Sciences*, vol. 7, no. 1, pp. 5 - 22

Howes, M, Grant-Smith, D, Bosomworth, K, Reis, K, Tangney, P, Heazle, M, McEvoy, D, & Burton, P 2012, 'Rethinking emergency management and climate adaptation policies', *Australian Political Studies Association conference 2012*, 24-26 September, viewed 17 March 2015, http://www.auspsa.org.au/sites/default/files/rethinking_emergency_management_michael_howes_deanna_grant_smith_karyn_bosomworth_et_al.pdf

Howes, M, Grant-Smith, D, Bosomworth, K, Reis, K, Tangney, P, Heazle, M, McEvoy, D, & Burton, P 2012, *The challenge of integrating climate change adaptation and disaster risk management: Lessons from bushfire and flood inquiries in an Australian context*, Urban Research Program, Issues Paper 17, Griffith University, Brisbane, Australia

Howes, M, Grant-Smith, D, Reis, K, Bosomworth, K, Tangney, P, Heazle, M, McEvoy, D, & Burton, P 2013, *Rethinking disaster risk management and climate change adaptation*, National Climate Change Adaptation Research Facility, Gold Coast, pp. 63. viewed 5 August 2013, http://apo.org.au/sites/default/files/docs/Howes-2013-rethinking-disaster-risk-mngt-WEB.pdf

Howes, M, Tangney, P, Reis, K, Grant-Smith, D, Heazle, M, Bosomworth, K, & Burton, P 2014, 'Towards Networked Governance: improving interagency communication and collaboration for disaster risk management and climate change adaptation in Australia', *Journal of Environmental Planning and Management,* vol. 58, no. 5, pp. 757 - 776

Hulme, M 2007, 'Understanding climate change - the power and the limit of science', *Weather*, vol. 62, no. 9, pp. 243-244

Hulme, M 2009, *Why we disagree about climate change - understanding controversy, inaction and opportunity*, Cambridge University Press, Cambridge, UK

Hulme, M, & Dessai, S 2008, 'Negotiating future climates for public policy: a critical assessment of the development of climate scenarios for the UK', *Environmental Science & Policy*, vol. 11, pp. 54 - 70

Hulme, M, Dessai, S, Lorenzoni, I, & Nelson, DR 2009, 'Unstable climates: Exploring the statistical and social constructions of 'normal' climate', *Geoforum*, vol. 40, pp. 197 - 206

Hurst, D 2012a, 'Workplace rights office, justice body axed', *Brisbane Times*, 19 May, viewed 9 September 2012, http://www.brisbanetimes.com.au/queensland/workplace-rights-office-justice-body-axed-20120518-1yvvw.html

Hurst, D 2012b, 'Environment minister's climate science doubts 'refreshing'', *Brisbane Times*, 5 June, viewed 30 July 2014, http://www.brisbanetimes.com.au/queensland/environment-ministers-climate-science-doubts-refreshing-20120605-1zthu.html

Hutton, D, & Connors, L 1999, *A History of the Australian Environment Movement,* Cambridge University Press, Cambridge, UK

Field, CB, Barros, V, Stocker, TF, Qin, D, Dokken, DJ, Ebi, KL, Mastrandrea, MD, Mach, KJ, Plattner, GK, Allen, SK, Tignor, M, & Midgley, PM (eds) 2012, *Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation: A special report of Working Groups I and II of the Intergovernmental Panel on Climate Change*, IPCC, Cambridge University Press, Cambridge, UK and New York, USA.

Integrated Planning Act 1997, Queensland Government, viewed 19 March 2015, http://www.oma.org.au/__data/assets/pdf_file/0015/4560/Integrated_planning_Act_1997.pdf

Intergovernmental Panel on Climate Change [IPCC] 2007a, *Climate Change 2007: the physical science basis: contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, Cambridge University Press, , Cambridge, UK and New York, USA

Intergovernmental Panel on Climate Change [IPCC] 2007b, *Climate change 2007: impacts, adaptation and vulnerability: contribution of Working Group II to the fourth assessment report of the Intergovernmental Panel on Climate Change*, Cambridge University Press, Cambridge, UK and New York, USA

Intergovernmental Panel on Climate Change [IPCC] 2014, 'Summary for policymakers', in Field, CB, Barros, VR, Dokken, DJ, Mach, KJ, Mastrandea, MD, Bilir, TE, Chatterjee, M, Ebi, KL, Estrada, YO, Genova, RC, Girma, B, Kissel, ES, Levy, AN, MacCracken, S, Mastrandea, PR, White, LL (eds) 2014, *Climate Change 2014: Impacts, adaptation and vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the fifth assessment report of the Intergovernmental Panel on Climate Change*. Cambridge University Press, Cambridge, UK and New York, USA, pp. 1 - 32

Irwin, A 2006, 'The Politics of Talk: Coming to terms with the 'New' scientific governance', *Social Studies of Science*, vol. 36, no. 2, pp. 299 - 320

Jaeger, CC, Renn, O, Rosa, EA, & Webler, T 1998, 'Decision analysis and rational action', in Rayner, S, & Malone, EL (eds) 1998, *Human Choice and Climate Change Volume 3: Tools for Policy Analysis*, Batelle Press, Columbus, Ohio

Janis, IL 1982, *Groupthink: Psychological studies of policy decisions and fiascos*, Houghton Mifflin, Boston.

Jasanoff, S 1990, *The Fifth Branch: Science Advisers as Policymakers*, Harvard University Press, Cambridge Mass., USA

Jasanoff, S, & Wynne, B 1998, 'Science and decision-making', in Rayner, S, & Malone, EL (eds) 1998, *Human Choice and Climate Change Volume 1: The Societal Framework*, Batelle Press, Columbus, Ohio

Jasanoff, S 2003a, '(No?) Accounting for expertise'. *Science and Public Policy,* vol. 30, no. 3, pp. 157 - 162

Jasanoff, S 2003b, ‘Technologies of humility: Citizen participation in governing science’, *Minerva*, vol. 41, pp. 223 - 244

Jasanoff, S (ed) 2004, *States of Knowledge: The co-production of science and social order*, Routledge, London.

Jasanoff, S 2005, ‘Judgement under siege: The three-body problem of expert legitimacy’, in Maasen, S, & Weingart, P (eds) 2005, *Democratization of Expertise? Exploring novel forms of scientific advice in political decision-making*, Springer, Dordrecht, The Netherlands

Johnston, WR 1988, *A Documentary History of Queensland*, University of Queensland Press. St Lucia, Brisbane, Australia

Jones, R 2010, ‘A risk management approach to climate change adaptation’, in Nottage, RAC, Wratt, DS, Bornman, JF, & Jones, K (eds) 2010, *Climate change adaptation in New Zealand: Future scenarios and some sectoral perspectives*, New Zealand Climate Change Centre, Wellington, NZ, pp. 10 – 25

Jordan, A 2001, ‘National environmental ministries: managers or ciphers of European Union environmental policy?’, *Public Administration,* vol. 79, no. 3, pp. 643 - 664

Jordan, A 2002a, ‘European Union Environmental Policy and Britain’, in Jordan, A 2002, *The Europeanization of British Environmental Policy - A Departmental Perspective*, Palgrave Macmillan, UK

Jordan, A 2002b, ‘Efficient Hardware and Light Green Software: Environmental Policy Integration in the UK’, in Lenschow, A (ed) 2002, *Environmental Policy Integration: Greening Sectoral Policies in Europe*, Earthscan, London

Jordan, A (ed) 2005, *Environmental Policy in the European Union: Actors, Institutions and Processes*, 2nd edn, Earthscan, London

Jowitt, J 2012, ‘Flooding rated as worst climate change threat facing UK’, *The Guardian*, 26 January, viewed 27 August 2013, http://www.theguardian.com/environment/2012/jan/26/floods-worst-climate-change-uk

Juntti, M, Russel, D, Turnpenny, J 2009, ‘Evidence, politics and power in public policy for the environment’, *Environmental Science and Policy*, vol. 12, pp. 207 – 215

Kahan, DM, Peters, E, Witlin, M, Slovic, P, Larrimore Ouelette, L, Braman, D, & Mandel, G 2012, ‘The polarizing impact of science literacy and numeracy on perceived climate change risks’, *Nature Climate Change,* vol. 2, pp. 732 - 735

Kahneman, D 2011, *Thinking, Fast and Slow*, Farrar, Straus and Giroux, New York

Kay, A 2011, ‘Evidence-Based Policy Making: The Elusive Search for Rational Public Administration’, *The Australian Journal of Public Administration*, vol. 70, no. 3, pp. 236 - 245

Keller, AC 2009, *Science in Environmental Policy: The Politics of Objective Advice,* The MIT Press, London

Kellow, A 2005, *The greenhouse and the garbage can: Uncertainty and problem construction in climate policy - Policy paper 3,* Academy of the social sciences in Australia, Canberra

Kellow, A 2009, *Science and Public Policy - The Virtuous Corruption of Virtual Environmental Science*, Edward Elgar Publishing, UK.

Kern, K, & Bulkeley, H 2009, 'Cities, Europeanization and Multi-level Governance: Governing Climate Change through transnational Municipal Networks', *Journal of Common Market Studies*, vol. 47, no. 2, pp. 309 - 332

Keskitalo, E, & Carina, H 2010, 'Climate change adaptation in the United Kingdom: England and Southeast England', in Brannlund, L (ed) 2010, *Developing Adaptation Policy and Practice in Europe: Multi-level governance of Climate Change*, Springer Science and Business Media

King, D 2004, cited in The Carbon Brief n.d., *Profiles – David King*, viewed 18 March 2015, http://www.carbonbrief.org/profiles/david-king/

Killoran, M 2012, 'Climate team may face axe', *The Gold Coast Bulletin*, 18 October, p. 4

Kirchoff, CJ, Lemos, MC, Dessai, S 2013, 'Actionable Knowledge for Environmental Decision Making: Broadening the Usability of Climate Science', *Annu. Rev. Environ. Resour.,* vol. 38, pp. 393 - 414

Kitcher, P 2011, *Science in a Democratic Society*, Prometheus Books, New York

Kuhlicke, C, Steinfuhrer, A, Begg, C, Bianchizza, C, Brundl, M, Buchecker, M, De Marchi, B, Di Masso Tarditti, M, Hoppner, C, Komac, B, Lemkow, L, Luther, J, McCarthy, S, Pellizoni, L, Renn, O, Scolobig, A, Supramaniam, M, Tapsell, S, Wachinger, G, Walker, G, Whittle, R, Zorn, M, & Faulkner, H 2011, 'Perspectives on social capacity building for natural hazards: outlining an emerging field of research and preactice in Europe', *Environmental Science & Policy*, vol. 14, pp. 804 - 814

Kuhn, T 1962, *The Structure of Scientific Revolutions*, The University of Chicago Press, Chicago, US

Lane, JE 2000, *New Public Management,* Routledge, London

Lane, MB, McDonald, GT, & Morrison, TH 2004, 'Decentralisation and Environmental Management in Australia: a Comment on the Prescriptions of the Wentworth Group', *Australian Geographical Studies*, vol. 42, no. 1, pp. 103-115

Lash, S, & Wynne, B 1992, 'Introduction', in Beck, U 1992, *Risk Society: Towards a New Modernity*, Sage Publications, London, UK

Lean, G 1998, 'How Britain came clean', *The Independent*, 5th July, London, UK

Leiss, W 2000, 'Between Expertise and Bureaucracy: Risk management trapped at the science-policy interface', in Doern, GB, & Reed, T (eds) 2000, *Risky Business: Canada's changing science-based policy and regulatory regime*, University of Toronto Press, Toronto

Lemos, MC, & Morehouse, BJ 2005, 'The co-production of science and policy in integrated climate assessments', *Global Environmental Change,* vol. 15, pp. 57 - 68

Lemos, MC, & Boyd, E 2010, 'The Politics of Adaptation Across Scales: The Implications of Additionality to Policy Choice and Development', in Boykoff, MT (ed) 2010, *The Politics of Climate Change: A Survey*, Routledge, Kentucky, USA

Lemos, MC, & Rood, RB 2010, 'Climate projections and their impact on policy and practice', *WIREs Climate Change*, vol. 1, pp. 670 - 682

Lengwiler, M 2008, 'Participatory approaches in science and technology: historical origins and current practices in critical perspective', *Science Technology Human Values*, vol. 33, pp. 186 – 200

Levin, K, Cashore, B, Bernstein, S, & Auld, G 2007, 'Playing it Forward: Path dependency, progressive incrementalism, and the 'super wicked' problem of global climate change', *International Studies Association Convention*, 28 February – 3 March 2010, Chicago, Illinois, USA, viewed 17 March 2015, http://citation.allacademic.com/meta/p_mla_apa_research_citation/1/7/9/7/0/pages179707/p179707-1.php

Leviston, Z, Leitch, A, Greenhill, M, Leonard, R, & Walker, I 2011, *Australians' views on climate change*, CSIRO, Canberra, viewed 9 September 2012, http://www.garnautreview.org.au/update-2011/commissioned-work/australians-view-of-climate-change.pdf

Lijphart, A 1971, 'Comparative Politics and the Comparative Method', *The American Political Science Review,* vol. 65m no. 3, pp. 682 - 693

Lindblom, CE 1959, 'The Science of "Muddling Through"', *Public Administration Review*, vol. 19, no. 2, pp. 79 - 88

Lipschutz, RD 1996, *Global Civil Society & Global Environmental Governance: The Politics of Nature from Place to Planet*, State University of New York Press, Albany N.Y.

Lipset, SM 1994, 'The Social Requisites of Democracy Revisited - 1993 Presidential Address', *American Sociological Review*, vol. 59, no. 1, pp. 1 - 22

Lipsky, M 2010, *Street-Level Bureaucracy: Dilemmas of the individual in public services*, 30th aniversary edn, Russell Sage Foundation, New York, US

Local Government Association of Queensland [LGAQ] 2007, *Adapting to Climate Change: A Queensland local government guide,* LGAQ, Brisbane, viewed 13 August 2013, http://www.lgaq.asn.au/web/guest/public-home?p_p_id=20&p_p_lifecycle=1&p_p_state=exclusive&p_p_mode=view&_20_struts_action=%2Fdocument_library%2Fget_file&_20_folderId=82043&_20_name=DLFE-5573.pdf

Lockie, S, & Higgins, V 2007, 'Roll-out neoliberalism and hybrid practices of regulation in Australian agri-environmental governance', *Journal of Rural Studies,* vol. 23, pp. 1 - 11

Lockie, S 1997, ‘Beyond a 'Good Thing': Political Interests and the Meaning of Landcare’, in Lockie, S, & Vanclay, F (eds) 1997, *Critical Landcare,* Centre for Rural Social Research, Charles Sturt University, NSW, Australia

Lorenzoni, I, Pidgeon, NF, & O' Connor, RE 2005, ‘Dangerous Climate Change: The Role for Risk Research’, *Risk Analysis*, vol. 25, no. 6, pp. 1387-1398

Louca, J 2009, *State Budget 2009 - 10: Performance and outlook for the Queensland economy*, Presentation from the Macroeconomics Team of the Queensland Treasury, Queensland Government. Viewed 12 August 2013, http://www.treasury.qld.gov.au/office/knowledge/docs/state-gov/Seminars/2009-06-24/performance-outlook-queensland-economy.pdf

Lowe, P, & Ward, S (eds) 1998, *British Environmental Policy and Europe: Politics and policy in transition*, Routledge, London

Ludwig, Donald 2001, The Era of Management is Over, Ecosystems, 4, 758 - 764

Lupton, D 1999, *Risk*, Routledge, London

Lyles, MA & Mitroff, II 1980, ‘Organisational Problem Formulation: An Empirical Study’, *Administrative Science Quarterly*, vol. 25, no. 1, pp. 102 - 119

Lyles, MA & Thomas, H 1988, ‘Strategic Problem Formulation: Biases and Assumptions embedded in alternative Decision-making models’, *Journal of Management Studies*, vol. 25, no. 2, pp. 131 - 145

Maasen, S, & Weingart, P 2005, ‘What's new in scientific advice to Politics?’, in Maasen, S & Weingart, P (eds) 2005, *Democratization of Expertise? Exploring novel forms of scientific advice in political decision-making*, Springer, Dordrecht, The Netherlands

Macgregor, N, Michell, H, Webb, J 2010, *Assessing and responding to climate risks to Natural England's objectives: Report to the Secretary of State for Environment, Food and Rural Affairs*, Natural England, viewed 15 October 2014, file:///C:/temp/Chrome/Downloads/Climate_change[1]%20(1).pdf

Maguire, B, & Hagan, P 2007, ‘Disasters and communities: understanding social resilience’, *The Australian Journal of Emergency Management*, vol. 22, no. 2, pp. 16 - 20

Maguire, B, & Cartwright, S 2008, *Assessing a community's capacity to manage change: A resilience approach to social assessment*, Australian Government Bureau of Rural Sciences, Commonwealth of Australia, Canberra

Maher, S 2011 ‘Climate change department for chop: Hockey’, *The Australian*, 4 August, viewed 5 August 2013, http://www.theaustralian.com.au/national-affairs/climate/climate-change-department-for-chop-hockey/story-e6frg6xf-1226108027421

Mahoney, J 2007, ‘Qualitative Methodology and Comparative Politics’, *Comparative Political Studies,* vol. 40, no. 2, pp. 122 - 144

Manyena, SB 2006, ‘The concept of resilience revisited’, *Disasters*, vol. 30, no. 4, pp. 433 - 450

Manzo, K 2009, ‘Imagining vulnerability: the iconography of climate change’, *Area*, vol. 42, no. 1, pp. 96 - 107

Marris, E 2007, ‘Australia warms to climate change’, *Nature Reports - Climate Change*, November, vol. 6, pp. 90

Marston, G, & Watts, R 2003, ‘Tampering with the evidence: A critical appraisal of evidence-based policy making’, *The Drawing Board: An Australian Review of Public Affairs*, vol. 3, no. 3, pp. 143 – 163

Masten, AS, & Obradovic, J 2008, ‘Disaster preparation and recovery: lessons from research on resilience in human development’, *Ecology and Society*, vol. 13, no. 1, pp. 9

Matland, RE 1995, ‘Synthesizing the Implementation Literature: The Ambiguity-Conflict Model of Policy Implementation’, *Journal of Public Administration Research and Theory,* vol. 5, no. 2, pp. 145 - 174

McCormick, J 2002, ‘Environmental Policy in Britain’, in Desai, U (ed) 2002, *Environmental Politics and Policy in Industrialized Countries*, MIT Press, Cambridge, Mass

McDonald, J, Baum, S, Crick, F, Czarnecki, J, Field, G, Low Choy, D, Mustelin, J, Sano, M, Serrao-Neumann, S 2010, *Climate change adaptation in South East Queensland human settlements: Issues and context*. Unpublished report for the South East Queensland Climate Adaptation Research Initiative, Griffith University, Queensland

McKenzie Hedger, M, Brown, I, Connell, R, & Gawith, M 2000, *Climate change: Assessing the impacts - identifying responses. Highlights of the first three years of the UK Climate Impacts Programme*. Department of Environment, Transport and the Regions, London

McLean, I 2008, ‘Climate change and UK Politics: from Brynle Williams to Sir Nicholas Stern’. *The Political Quarterly,* vol. 79, no. 2, pp. 184 - 193

McNamee, S 2004, ‘Relational Bridges Between Constructionism and Constructivism’, in Raskin, JD, & Bridges, SK 2004, *Studies in Meaning 2: Bridging the personal and social in constructivist psychology*, Pace University Press, New York.

McNie, EC 2007, ‘Reconciling the supply of scientific information with user demands: an analysis of the problem and review of the literature’, *Environmental Science & Policy,* vol. 10, pp. 17 - 38

Meadowcroft, J 2002, ‘Politics and scale: some implications for environmental governance’, *Landscape and Urban Planning*, vol. 61, pp. 169 - 179

Mearns, LO 2010, ‘The drama of uncertainty’. *Climatic Change,* vol. 100, pp. 77 - 85

Meinhausen, M 2012, ‘Science for Adaptation: Emissions Pathways’, *Climate Adaptation in Action 2012: Sharing Knowledge to Adapt, 26 - 28 June*, National Climate Change Adaptation Research Facility, Melbourne, Australia

Mercer, D, Christesen, L, & Buston, M 2007, ‘Squandering the future - Climate change, policy failure and the water crisis in Australia’, *Futures*, vol. 39, pp. 272 - 287

Merriam Webster 2015, Online dictionary, viewed 27 January 2015, http://www.merriam-webster.com/dictionary/superindividual

Merton, RK 1945, ‘The Role of the Intellectual in Public Bureaucracy’, *Social Forces,* vol. 23, no. 4, pp. 405 - 415

Meyer, R 2011, ‘The Public Values Failures of Climate Science in the US’, *Minerva,* vol. 49, pp. 47 - 70

Miller, CA & Edwards, PN 2001, *Changing the Atmosphere: Expert Knowledge and Environmental Governance,* The MIT Press, London

Miller, TR & Neff, MW 2013, ‘Defacto science policy in the making: how scientists shape science policy and why it matters (or, why STS and STP scholars should socialise)’, *Minerva*, vol. 51, pp. 295 - 315

Milly, PCD, Betancourt, J, Falkenmark, M, Hirsch, RM, Kundzewicz, ZW, Lettenmaier, DP, Stouffer, RJ 2008, ‘Stationarity is dead: Whither water management?’, *Science*, vol. 319, pp. 573 - 574

Milman, O 2014, ‘Scientists give Tony Abbott's record a lukewarm reception’, *The Guardian*, 30 October, viewed 1 December 2014, http://www.theguardian.com/australia-news/2014/oct/30/scientists-tony-abbott-record-lukewarm-reception

Moore, C 2013a, ‘To win the battle for the consumer, Cameron must cut taxes soon’, *The Daily Telegraph*, 2 September, viewed 21 July 2014, http://www.telegraph.co.uk/news/politics/conservative/10339560/To-win-the-battle-for-the-consumer-Cameron-must-cut-taxes-soon.html

Moore, T 2013b, ‘Queensland's 'practical' climate approach’, *Brisbane Times*, 4 April, viewed 30 July 2014, http://www.brisbanetimes.com.au/environment/climate-change/queenslands-practical-climate-approach-20130403-2h791.html

Morgan, MG 2003, ‘Characterising and Dealing with Uncertainty: Insights from the Integrated Assessment of Climate Change’, *Integrated Assessment*, vol. 4, no. 1, pp. 46 - 55

Morgan, MG, Kandlikar, M, Risbey, J, & Dowlatabadi, H 1999, ‘Why Conventional Tools for Policy Analysis are often Inadequate for Problems of Global Change - An Editorial Essay’, *Climatic Change*, vol. 41, pp. 271 - 281

Mori, M, Watanabe, M, Shiogama, H, Inoue, J, & Kimoto, M 2014, ‘Robust Arctic Sea-Ice Influence on the frequent Eurasian cold winters in past decades’, *Nature Geoscience,* vol. 7, pp. 869 - 873

Moser, SC 2009, ‘Whether our levers are long enough and the fulcrum strong? Exploring the soft underbelly of adaptation decisions and actions’, in Adger, WN, Lorenzoni, I & O' Brien, KL (eds) 2009, *Adapting to climate change: Thresholds, values, governance*, Cambridge University Press, Cambridge, UK

Moser, SC 2010, 'Costly Knowledge - Unaffordable Denial: The Politics of Public Understanding and Engagement on Climate Change', in Boykoff, MT (ed) 2010, *The Politics of Climate Change: A Survey*, Routledge, Kentucky, USA

Moss, RH, & Schneider, SH 2000, 'Uncertainties in the IPCC TAR: Recommendations to lead authors for more consistent assessment and reporting', in Pachauri, R, Taniguchi, T, & Tanaka, K (eds) 2000, *Guidance Papers on the cross-cutting issues of the third assessment report of the IPCC*, World Meteorological Organisation, Geneva, pp. 33 - 51

Moss, RH, Meehl, GA, Lemos, MC, Smith, JB, Arnold, JR, Arnott, JC, Behar, D, Brasseur, GP, Broomell, SB, Busalacchi, AJ, Dessai, S, Ebi, KL, Edmonds, JA, Furlow, J, Goddard, L, Hartmann, HC, Hurrell, JW, Katzenberger, JW, Liverman, DM, Mote, PW, Moser, SC, Kumar, A, Pulwarty, RS, Seyller, EA, Turner II, BL, Washington, WM, & Wilbanks, TJ 2013, 'Hell and High Water: Practice-Relevant Adaptation Science', *Science,* vol. 342, pp. 696 - 698

Mullan, M, Kingsmill, N, Kramer, AM, Agrawala, S 2013, *National Adaptation Planning: Lessons from OECD Countries*, OECD Environment Working Papers No. 54, OECD Publishing, viewed 14 May 2013, http://dx.doi.org/10.1787/5k483jpfpsq1-en

Murphy, BL 2007, 'Locating social capital in resilience community-level emergency management', *Natural Hazards*, vol. 41, pp. 297 - 315

Murphy, JM, Sexton, DMH, Jenkins, GJ, Booth, BBB, Brown, CC, Clark, RT, Collins, M, Harris, GR, Kendon, EJ, Betts, RA, Brown, SJ, Humphrey, KA, McCarthy, MP, McDonald, RE, Stephens, A, Wallace, C, Warren, R, Wilby, R, Wood, RA 2009, *UK Climate Projections Science Report: Climate change projections,* Met Office Hadley Centre, Exeter, UK

Myers, TA, Maibach, EW, Roser-Renouf, C, Akerlof, K, Leiserowitz, AA 2012, 'The relationship between personal experience and belief in the reality of global warming', *Nature*, vol. 3, pp. 343 – 347

National Climate Change Adaptation Research Facility [NCCARF] 2015. NCCARF, Queensland, viewed 4 February 2015, http://www.nccarf.edu.au/

National Emergency Management Committee [NEMC] 2010, *National Emergency Risk Assessment Guidelines*, Attorney-General's Department, Commonwealth of Australia, Canberra

National Gas Museum 2013, *The history of gas*, National Gas Museum, UK, viewed 17 September 2013, http://www.nationalgasmuseum.org.uk/index.asp?page=history

National Trust 2013, *Our History - fascinating facts and figures*, viewed 27 August 2013, http://www.nationaltrust.org.uk/what-we-do/who-we-are/our-history/

Nelson, DR, Adger, WN, & Brown, K 2007, 'Adaptation to environmental change: contributions of a resilience framework', *Annual Review of Environment and Resources,* vol. 32, pp. 395–419

New, M, Lopez, A, Dessai, S, & Wilby, R 2007, 'Challenges in using probabilistic climate change information for impact assessments: an example from the water sector', *Phil. Trans. R. Soc. A.*, vol. 365, pp. 2117 - 2131

Newman, L, & Dale, A 2005, 'Network Structure, Diversity and Proactive Resilience Building: a Response to Tompkins and Adger', *Ecology and Society*, vol. 10, no. 1, pp. 2

Ney, SM 2009, *Solving Messy Policy Problems: Handling conflicts in environmental, transport, health and ageing policy*, Earthscan, London, UK

Nilsson, M, Jordan, A, Turnpenny, J, Hertin, J, Nykvist, B, & Russel, D 2008, 'The use and non-use of policy appraisal tools in public policy making: an analysis of three European countries and the European Union', *Policy Science*, vol. 41, pp. 335-355

Norman, B 2012, 'World Bank calls for greater climate preparedness – in Australia, planning unravels', *The Conversation*, 20 November, viewed 5 August 2013, http://theconversation.edu.au/world-bank-calls-for-greater-climate-preparedness-inaustralia-planning-unravels-10807

North Norfolk District Council 2012, *Shoreline Management Plan 6 - Kelling Hard to Lowestoft Ness*, NNDC, viewed 24 August 2014, http://www.northnorfolk.org/smp6/SMP6_documents.html

Nowotny, H 2003, 'Democratising Expertise and Socially Robust Knowledge'*, Science and Public Policy,* vol. 30, no. 3, pp. 151 - 156

Nowotny, H, Scott, P, & Gibbons, M 2003, ''Mode 2' Revisited: The New Production of Knowledge', *Minerva,* vol. 41, pp. 179 - 194

Nutley, S, Davies, H, & Walter, I 2002, *Evidence Based Policy and Practice: Cross Sector Lessons from the UK – Working Paper 9*, ESRC UK Centre for Evidence Based Policy and Practice, Research Unit for Research Utilisation, Department of Management, University of St Andrews, Edinburgh, UK

O' Brien, K, Sygna, L, & Haugen, JE 2004, 'Vulnerable or Resilient? A multi-scale assessment of climate impacts and vulnerability in Norway', *Climatic Change*, vol. 64, pp. 193 - 225

O' Flynn, J, Buick, F, Blackman, D, & Halligan, J 2011, 'You win some, you lose some: Experiments with joined-up government', *International Journal of Public Administration,* vol. 34, no. 4, pp. 244 - 254

O' Flynn, J, Halligan, J, & Blackman, D 2010, 'Working Across Boundaries: Barriers, Enablers, Tensions, Puzzles', *Paper presented at the International Research Society for Public Management conference*, University of Berne, Berne, Switzerland

Oberthur, S, & Ott, HE 1999, *The Kyoto Protocol: International Climate Policy for the 21st Century,* Springer, Germany

Organisation for Economic Co-operation and Development [OECD] 1999, *National Climate Policies and the Kyoto Protocol. Organisation for Economic Co-Operation and Development*, OECD, viewed 16 October 2013, http://www.oecd-ilibrary.org.libraryproxy.griffith.edu.au/docserver/download/9799101e.pdf?expires=1381820226&id=id&accname=ocid53013929&checksum=C507522A6EF41AD6929E7EFD74957222

Office for National Statistics [ONS] 2014, *Regional Gross Value Added highest in London in 2012*, UK Government, viewed 21 July 2014, http://www.ons.gov.uk/ons/rel/regional-accounts/regional-gross-value-added--income-approach-/december-2013/sty-regional-gva-2012.html

Office of Climate Change [OCC] 2011, *Climate Change: Adaptation for Queensland - Issues Paper*, State of Queensland Department of Environment and Resource Management, Brisbane, viewed 9 September 2012, http://www.ehp.qld.gov.au/climatechange/pdf/adaptation-issues-paper.pdf

OFWAT 2010, *Adaptation to climate change - Statutory reporting information note*, The Water Services Regulation Authority, viewed 30 October 2013, http://www.ofwat.gov.uk/sustainability/climatechange/prs_inf_20100820climate

OFWAT 2014a, *Strategic Direction Statements*. The Water Services Regulation Authority, viewed 13 October 2014, http://www.ofwat.gov.uk/pricereview/sds/

OFWAT 2014b, *History of the water and sewerage sectors*. The Water Services Regulation Authority, viewed 8 December 2014, http://www.ofwat.gov.uk/industryoverview/history/

Oreskes, N 2004, ‘Science and public policy: what's proof got to do with it?’, *Environmental Science and Policy*, vol. 7, pp. 369 - 383

Oreskes, N, Shrader-Frechette, K, Belitz, K 1994, ‘Verification, Validation and Confirmation of Numerical Models in the Earth Sciences’, *Science*, vol. 263, pp. 641 - 646

Owens, S 2010, ‘Learning across levels of governance: Expert advice and the adoption of carbon dioxide emissions reduction targets in the UK’, *Global Environmental Change*, vol. 20, pp. 394 - 401

Owens, S, Rayner, T, Bina, O 2004, ‘New Agendas for Appraisal: Reflections on theory, practice, and research’, *Environment and Planning A,* vol. 36, pp. 1943 - 1959

Page, E 1985, *Political Authority and Bureaucratic Power: A Comparative Analysis*, Harvester Press, Brighton, UK

Parsons, DW 1995, *Public Policy: An Introduction to the Theory and Practice of Policy Analysis*, Edward Elgar Publishing, Gloucestershire, UK

Parsons, W 2004, ‘Not just steering but weeving: Relevant knowledge and the craft of buliding policy capacity and coherence’, *Australian Journal of Public Administration,* vol. 63, no. 1, pp. 43-57

Peiser, B 2009, *Quotes on Climate Change, Environment and Energy*, Climatism website, viewed 30 December 2014, http://www.climatism.net/quotes-on-climate-change-environment-and-energy/

Peters, BG 1998, *Comparative Politics: Theory and Methods,* New York University Press, New York.

Peters, G 2003, ‘Dismantling and Rebuilding the Weberian State’, in Hayward, J, & Menon, A (eds) 2003, *Governing Europe*, Oxford University Press, Oxford, UK

Pielke Jr., RA 2007, *The Honest Broker: Making Sense of Science in Policy and Politics,* Cambridge University Press, Cambridge, UK

Pielke Jr., RA, Prins, G, Rayner, S, & Sarewitz, D 2007, 'Climate Change 2007: Lifting the taboo on adaptation', *Nature,* vol. 445, pp. 597 - 598

Pielke Jr., RA 2009, 'The British Climate Change Act: A critical evaluation and proposed alternative approach', *Environmental Research Letters, vol.* 4, pp. 1 - 7

Pike, A, Dawley, S, & Tomaney, J 2010, 'Resilience, adaptation and adaptability', *Cambridge Journal of Regions, Economy and Society*, vol. 3, pp. 59 - 70

Plein, CL 1994, 'Agenda setting, problem definition and policy studies', *Policy Studies Journal*, vol. 22, no. 4, pp. 701 - 704

Pollitt, C 2003, 'Joined-up Government: a Survey', *Political Studies Review*, vol. 1, pp. 34-49.

Popper, K 1957, 'Philosophy of Science: a Personal Report', in Mace, CA (ed) 1957, *British Philosophy in Mid-Century*, viewed 17 March 2015, http://goodliffe.byu.edu/310/protect/popper.pdf

Porritt, J 1989, 'The United Kingdom: The Dirty Man of Europe?', *RSA Journal*, vol. 137, no. 5396, pp. 488 - 500

Preston, BL, Rickards L, Dessai S, & Meyer, R 2013, 'Water, seas, and wine - Science for successful climate adaptation', in Moser, SC, & Boykoff, MT (eds) 2013, *Successful adaptation to climate change: linking science and policy in a rapidly changing world,* Routledge, Oxon, UK.

Preston, BL, Westaway, RM, & Yuen, EJ 2011, 'Climate adaptation planning in practice: an evaluation of adaptation plans from three developed nations', *Mitigation and Adaptation Strategies for Global Change,* vol. 16, no. 4, pp. 407 - 438

Price, DK 1965, *The Scientific Estate,* The Belknap Press of Harvard University Press, Cambridge Mass., USA

Prins, G 2011, *The Wicked Problem of Climate Change*, viewed 10 September 2012, http://www.youtube.com/watch?v=Tiqrv5wMxuA

Productivity Commission 2010, *Strengthening Evidence Based Policy in the Australian Federation, Volume 1*: *Proceedings*, Productivity Commission, Canberra, viewed 17 March 2015, http://www.pc.gov.au/research/completed/strengthening-evidence

Productivity Commission 2012, *Barriers to Effective Climate Change Adaptation: Productivity Commission Draft Report,* Productivity Commission, Melbourne, Vic, viewed 17 March 2015, http://www.pc.gov.au/inquiries/completed/climate-change-adaptation/report

Prosser, B, & Peters, C 2010, 'Directions in disaster resilience policy', *The Australian Journal of Emergency Management*, vol. 25, no. 3, pp. 8 - 11

Pusey, M 1991, *Economic Rationalism in Canberra - A Nation-Building State Changes Its Mind*, Cambridge University Press, Cambridge, UK.

Queensland Farmers' Federation 2011, *Natural Disaster Events,* viewed 7 August 2013, http://www.qff.org.au/policy-projects/our-work/natural-disaster-events/

Queensland Floods Commission of Inquiry [QFCI] 2011.*Queensland Floods Commission of Inquiry: Interim Report*, QFCI, Brisbane, viewed 3 April 2013, http://www.floodcommission.qld.gov.au/publications/interimreport(accessed online 20.11.12)

Queensland Floods Commission of Inquiry [QFCI] 2012, *Queensland Floods Commission of Inquiry: Final Report*, QFCI, Brisbane, viewed 3 April 2012, www.floodcommission.qld.gov.au/__data/assets/pdf_file/0007/11698/QFCI-Final-Report-March-2012.pdf (accessed online 20.11.12)

Queensland Government 2003, *State Planning Policy 1/03 Mitigating the adverse impacts of flood, bushfire and landslide,* DLGP/DES, Brisbane, viewed 19 March 2015, http://www.dsdip.qld.gov.au/resources/policy/spp-ifbl.pdf

Queensland Government 2009a, *South East Queensland Climate Change Management Plan - Draft for Public Consultation*, Department of Infrastructure and Planning, Queensland Governement, City East, Brisbane, viewed 13 August 2013, http://www.eianz.org/sitebuilder/aboutus/knowledge/asset/files/223/draft-climate-change-management-plan.pdf

Queensland Government 2009b, *ClimateQ: toward a greener Queensland*, Department of Environment and Resource Management, Brisbane, viewed 13 August 2013, http://rti.cabinet.qld.gov.au/documents/2009/may/climateq%20toward%20a%20greener%20qld/Attachments/ClimateQ_Report_web_FINAL_20090715.pdf

Queensland Government 2009c, *South East Queensland Regional Plan 2009 – 2031*, Department of Infrastructure and Planning, Brisbane, viewed 13 August 2013, http://www.dsdip.qld.gov.au/resources/plan/seq/regional-plan-2009/seq-regional-plan-2009.pdf

Queensland Government 2009d, *South East Queensland Natural Resource Management Plan 2009 – 2031,* Department of Environment and Resource Management, Brisbane, viewed 13 August 2013, http://www.nrm.qld.gov.au/be-involved/pdf/seq_nrm_plan.pdf

Queensland Government 2011a, *2010 - 11 Annual Economic Report on the Queensland economy year ended 30 June 2011*, Queensland Treasury, Brisbane, viewed 12 August 2013, http://www.oesr.qld.gov.au/products/publications/annual-econ-report/annual-econ-report-2010-11.pdf

Queensland Government 2011b, *Climate Change in the Southeast Queensland Region*, Department of Environment and Resource Management, Brisbane, viewed 13 August 2013, http://www.ehp.qld.gov.au/climatechange/regional-summaries.html

Queensland Government 2012a, *Queensland Coastal Plan*, Department of Environment and Heritage Protection, Brisbane, viewed 13 August 2013, http://www.ehp.qld.gov.au/coastalplan/pdf/qcp-web.pdf

Queensland Government 2012b, *Queensland Local Disaster Management Guidelines*, Emergency Management Queensland, viewed 25 August 2014, http://www.disaster.qld.gov.au/Disaster-Resources/Documents/Queensland%20Local%20Disaster%20Management%20Guidelines.pdf

Queensland Government 2013, *Coastal Management Plan*, Department of Environment and Heritage Protection, viewed 19 July 2014, http://www.ehp.qld.gov.au/coastalplan/pdf/coastal-management-plan.pdf

Queensland Government 2014a, *Local Government Act 2009,* viewed 17 December 2014, https://www.legislation.qld.gov.au/LEGISLTN/CURRENT/L/LocalGovA09.pdf

Queensland Government 2014b, *Queensland Water Commission*, Department of Energy and Water Supply, viewed 15 December 2014, https://www.dews.qld.gov.au/policies-initiatives/water-sector-reform/queensland-water-commission

Queensland Government 2014c, *Review of the South East Queensland Regional Plan,* Department of State Development, Infrastructure and Planning, viewed 19 July 2014, http://www.dsdip.qld.gov.au/regional-planning/seq-regional-plan.html

Queensland Police 2011, *Media Release: Death Toll from Queensland Floods*, 24 January, viewed 12 December 2012, http://www.police.qld.gov.au/News+and+Alerts/Media+Releases/2011/01/death_toll_jan24.htm

Queensland Reconstruction Authority [QRA] 2014, *Strategic Plan 2014-15*, QRA, Brisbane, viewed 11 February 2015, http://qldreconstruction.org.au/publications-guides/reconstruction-plans

Queensland Reconstruction Authority [QRA] 2011*, Rebuilding a stronger, more resilient Queensland*, Queensland Government, viewed 19 December 2014, http://qldreconstruction.org.au/u/lib/cms2/rebuilding-resilient-qld-full.pdf

Queensland Water Commission 2010, *South East Queensland Water Strategy,* Queensland Water Commission, City East, Brisbane, viewed 13 August 2013, http://www.dews.qld.gov.au/__data/assets/pdf_file/0019/32734/seqws.pdf

Quiggin, J 2008, 'Uncertainty and Climate Change Policy', *Economic Analysis & Policy*, vol. 38, no. 2, pp. 203-210

Randalls, S 2011, 'Commentary: Climate change pathology', *Environment and Planning A*, vol. 43, pp. 1242 - 1247

Readfearn, G 2014, 'What does Australian Prime Minister Tony Abbott really think about climate change?' *The Guardian*, 16 June, viewed 15 August 2014, http://www.theguardian.com/environment/planet-oz/2014/jun/16/what-does-australian-prime-minister-tony-abbott-really-think-about-climate-change

Reilly, J, & Schimmelpfennig, D 2000, 'Irreversibility, uncertainty, and learning: Portraits of Adaptation to Long-term Climate Change', *Climatic Change*, vol. 45, pp. 253 - 278

Rein, M, & Schon, DA 1993, 'Reframing Policy Discourse', in Fischer, F & Forester, J (eds) 1993, *The Argumentative Turn in Policy Analysis and Planning*, Duke University Press, Durham, NC, USA

Renn, O 2008, *Risk Governance: Coping with Uncertainty in a Complex World*, Earthscan, London, UK

Reser, JP, Bradley, GL, Glendon, AI, Ellul, MC, Callaghan, R 2012, *Public risk perceptions, understandings, and responses to climate change and natural disasters in Australia, 2010 and 2011,* National Climate Change Adaptation Research Facility, Gold Coast, Queensland, viewed 17 March 2015, http://www.nccarf.edu.au/publications/public-risk-perceptions-second-survey

Restivo, S 1995, 'The Theory Landscape in Science Studies: Sociological Traditions', in Jasanoff, S, Markle, GE, Peterson, JC, Pinch, T (eds) 1995, *Handbook of Science and Technology Studies,* Sage Publications, Thousand Oaks, CA, USA

Rhodes, R 2006, 'Glocal - A few words on a theme', *Canadian Art,* vol. 23, no. 3, pp. 80 - 81

Richards, D, & Diamond, P 2013, 'Real reform would necessitate a willingness to reappraise core tenets of the Westminster model', *British Politics and Policy blog*, London School of Economics, web log post, viewed 29 July 2013, http://blogs.lse.ac.uk/politicsandpolicy/archives/29771

Richards, D, & Smith, MJ 2002, *Governance and Public Policy in the UK,* Oxford University Press, Oxford, UK

Rickards, L, Wiseman, J, Edwards, T 2014, 'The Problem of Fit: scenario planning and climate change adaptation in the public sector', *Environment and Planning C: Government and Policy,* vol. 32, pp. 641 - 662

Rintoul, S 2009, 'Town of Beaufort changed Tony Abbott's view on climate change', *The Australian*, 12 December, viewed 18 March 2015, http://www.theaustralian.com.au/archive/politics/the-town-that-turned-up-the-temperature/story-e6frgczf-1225809567009

Rip, A 2003, 'Constructing Expertise: In a Third Wave of Science Studies?', *Social Studies of Science* vol. 33, no. 3, pp. 419 - 434

Risk Frontiers 2012, *Historical analysis of natural hazard building losses and fatalities for Queensland 1900 – 2011,* Queensland Department of Community Safety, viewed 21 August 2014, http://disaster.qld.gov.au/Disaster-Resources/Documents/Historical%20analysis%20of%20natural%20hazard%20building%20losses%20and%20fatalities%20for%20Queensland%201900-2011.pdf

Rittel, HW & Webber, MM 1973, 'Dilemmas in a General Theory of Planning', *Policy Sciences*, vol. 4, pp. 155 - 169

Rochefort, DA, & Cobb, RW 1993, ‘Problem Definition, Agenda Access, and Policy Choice’, *Policy Studies Journal*, vol. 21, no. 1, pp. 56 - 71

Roome, N 2001, ‘Conceptualising and Studying the Contribution of Networks in Environmental Management and Sustainable Development’, *Business Strategy and the Environment*, vol. 10, pp. 69-76

Rootes, C 2008, ‘The first climate change election? The Australian general election of 24 November 2007’, *Environmental Politics,* vol. 17, no. 3, pp. 473 - 480

Ross, A, & Dovers, S 2008, ‘Making the Harder Yards: Environmental Policy Integration in Australia’, *The Australian Journal of Public Administration,* vol. 67, no. 3, pp. 245 – 260

Royal Society 2010, *Climate Change: A Summary of the Science,* London, UK

Rudd, K 2009, ‘Earth Hour 2009’, Speech 26 March, viewed 3 February 2015, http://pmtranscripts.dpmc.gov.au/browse.php?did=16474

Rudd, K 2013, ‘1st Leaders Debate for the 2013 Federal Election - opening speech’, Speech broadcast on ABC, 11 August, viewed 13 August 2013, http://www.abc.net.au/iview/#/series/12771

Rydin, Y 2003, *Urban and Environmental Planning in the UK,* 2nd edn, Palgrave Macmillan, London, UK

Sabatier, PA (ed) 1999, *Theories of the policy process*, Westview Press, Colorado, USA

Sabatier, PA 1988, ‘An Advocacy Coalition Framework of Policy Change and the Role of Policy-Oriented Learning Therein’, *Policy Sciences,* vol. 21, nos. 2/3, pp. 129 - 168

Sanderson, I 2002, ‘Evaluation, Policy Learning and Evidence-based Policy Making’, *Public Administration, vol.* 80, no. 1, pp. 1 - 22

Sano, M, Golshani, A, Splinter, KD, Strauss, D, Thurston, W, & Tomlinson, R 2011, ‘A detailed assessment of vulnerability to climate change in the Gold Coast, Australia’, *Journal of Coastal Research*, Special Issue 64, pp. 245 - 249

Sarewitz, D 2004, ‘How science makes environmental controversies worse’*, Environmental Science & Policy*, vol. 7, pp. 385 - 403

Scheffer, M 2009, *Critical Transitions in Nature and Society*, Princeton University Press, US

Schneider, A, & Ingram, H 1990, ‘Behavioural Assumptions of Policy Tools’*, Journal of Politics*, vol. 52, no. 2, pp. 510 - 529

Schneider, SH 2004, ‘Abrupt Nonlinear climate change, irreversibility and surprise’, *Global Environmental Change*, vol. 14, pp. 245 - 258

Schon, DA, & Rein, M 1994, *Frame Reflection: Toward the Resolution of Intractable Policy Controversies*, Basic Books, New York

Scott, J, & Marshall, G 2005, *Oxford Dictionary of Sociology*, Oxford University Press, Oxford, UK

Shackley, S, & Wynne, B 1996, 'Representing Uncertainty in Global Climate Change Science and Policy: Boundary-Ordering Devices and Authority', *Science, Technology & Human Values*, vol. 21, no. 3, pp. 275 - 302

Sharp, R 1998, 'Responding to Europeanisation: A governmental perspective', in Lowe, P, & Ward, S (eds) 1998, *British Environmental Policy and Europe: Politics and policy in transition,* Routledge, London

Sheail, J 2002, *An Environmental History of Twentieth-Century Britain,* Palgrave, New York

Shore, C, & Wright, S (eds) 1997, *Anthropology of Policy: Critical perspectives on governance and power*, Routledge, London

Silver, K 2012, 'Global warming will lead to fresher blueberries, plentiful fish and fewer winter deaths, finds official study (oh yes, and a lot of flooding)', *The Daily Mail*, 26 January, viewed 20 February 2014, http://www.dailymail.co.uk/sciencetech/article-2092085/Imagine-grazing-blueberries-fresh-plaice-warm-winters-Global-warming-doesnt-sounds-bad.html

Simmie, J, & Martin, R 2010, 'The economic resilience of regions: towards an evolutionary approach, Cambridge Journal of Regions', *Economy and Society*, vol. 3, pp. 27 - 43

Simon, HA 1957, *Models of Man: Social and Rational - Mathematical Essays on Rational Human Behaviour in a Social Setting*, Wiley & Sons, New York

Simon, HA 1972, 'Theories of Bounded Rationality', in McGuire, CB & Radner, R (ed) 1972, *Decision and Organisation,* North-Holland Publishing Company, pp. 161 - 176

Skeptical Science 2015, *Media coverage of The Consensus Project*, Skeptical Science, viewed 19 March 2015, http://www.skepticalscience.com/republishers.php?a=tcpmedia

Solesbury, W 2001, Evidence Based Policy: Whence it came and where it's going – Working Paper 1, ESCRC UK Centre for Evidence Based Policy and Practice, Queen Mary, University of London

Spearritt P., 2009, 'The 200km City: Brisbane, The Gold Coast and The Sunshine Coast', *Australian Economic History Review*, vol. 49, no. 1, pp. 87 - 106

Spruijt, P, Knol, AB, Vasileiadou, E, Devilee, J, Lebret, E, Petersen, AC 2014, 'Roles of scientists as policy advisors on complex issues: A literature review', *Environmental Science & Policy,* vol. 40, pp. 16 - 25

Stead, D, & Meijers, E 2009, 'Spatial Planning and Policy Integration: Concepts, Facilitators and Inhibitors', *Planning Theory & Practice*, vol. 10, no. 3, pp. 317 - 332

Steele, W, Sporne, I, Shearer, S, Singh-Peterson, L, Serrao-Neumann, S, Crick, F, Dale, P, Low Choy, D, Eslami-Endargoli, L, Iotti, A, & Tangney, P 2012, *Learning from cross-border arrangements to support climate change adaptation in Australia - Stage 1*, Urban Research Program - Research Monograph 14, Griffith University, Brisbane, Australia

Stern, N 2006, *Stern Review on the Economics of Climate Change*, HM Treasury, London, UK

Stocker, TF, Qin, D, Plattner, GK, Alexander, LV, Allen, SK, Bindoff, NL, Bréon, FM, Church, JA, Cubasch, U, Emori, S, Forster, P, Friedlingstein, P, Gillett, N, Gregory, JM, Hartmann, DL, Jansen, E, Kirtman, B, Knutti, R, Krishna Kumar, K, Lemke, P, Marotzke, J, Masson-Delmotte, V, Meehl, GA, Mokhov, II, Piao, S, Ramaswamy, V, Randall, D, Rhein, M, Rojas, M, Sabine, C, Shindell, D, Talley, LD, Vaughan, DG, & Xie, S-P 2013, 'Technical Summary', in *Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*, Cambridge University Press, Cambridge, United Kingdom and New York, USA

Stone, D 2002, *Policy Paradox: The Art of Political Decision Making,* Revised Edition, W.W. Norton & Company, New York

Strauss, S, & Orlove, B (eds) 2000, *Weather, Climate, Culture,* Berg, Oxford, UK.

Sustainable Planning Act 2009, Queensland Government, viewed 19 March 2015, https://www.legislation.qld.gov.au/LEGISLTN/CURRENT/S/SustPlanA09.pdf

Sutton, R 1999, *The Policy Process: An Overview. Overseas Development Institute*, Chameleon Press, London

Swart, R, Biesbrook, R, Capela Lourenco, T 2014, 'Science of adaptation to climate change and science for adaptation', *Frontiers in Environmental Science,* vol. 2, no. 29, pp. 1 - 7

Talberg, A, Hui, S, Loynes, K 2013, *Australian climate change policy: a chronology. Australian Department of Parliamentary Services*, 2 December 2013, viewed 3 February 2015, http://parlinfo.aph.gov.au/parlInfo/download/library/prspub/2875065/upload_binary/2875065.pdf;fileType=application/pdf

Tang, S, & Dessai, S 2012, 'Usable Science? The UK Climate Projections 2009 and Decision Support for Adaptation Planning', *Weather, Climate and Society*, vol. 4, pp. 300 - 313

Tayler-Gooby, P 2012, 'Root and Branch Restructuring to Achieve Major Cuts: The Social Policy Programme of the 2010 UK Coalition Government', *Social Policy and Administration,* vol. 46, no. 1, pp. 61 - 82

The Climate Change Act 2008, HM Government 2008, viewed 9 September 2012, http://www.legislation.gov.uk/ukpga/2008/27/pdfs/ukpga_20080027_en.pdf

The Met Office 2009, *Helping you meet climate change head on*, The Met Office Website, viewed 12 September 2014, http://www.metoffice.gov.uk/news/releases/archive/2009/warmer-future

The Met Office 2014, *Past Weather Events,* The Met Office Website, viewed 31 January 2015, http://www.metoffice.gov.uk/climate/uk/interesting

Thompson, M & Rayner, S 1998, 'Risk and Governance Part 1: The Discourses of Climate Change', *Government and Opposition*, vol. 33, no. 2, pp. 139 - 166

Thompson, M, Rayner, S, & Ney, S 1998, 'Risk and Governance Part 2: Policy in a Complex and Plurally Perceived World', *Government and Opposition*, vol. 33, no. 2, pp. 330 - 354

Thompson, E 1980, 'The 'Washminster' Mutation', in Weller, P & Jaensch, D (eds) 1980, *Responsible Government in Australia*, Drummond & the Australasian Political Studies Association, Victoria, pp. 32-40

Tidball, KG, Krasny, ME, Svenden, E, Campbell, L, Helphand, K 2010, 'Stewardship, learning, and memory in disaster resilience', *Environmental Education Research*, vol. 16, nos. 5-6, pp. 591 - 609

Tiffen, R, & Gittins, R 2009, *How Australia Compares,* 2nd edn, Cambridge University Press, Melbourne, Vic, Australia

Tompkins, EL, Adger, WN, Boyd, E, Nicholson-Cole, S, Weatherhead, K, & Arnell, N 2010, 'Observed adaptation to climate change: UK evidence of transition to a well-adapting society', *Global Environmental Change*, vol. 20, pp. 627 - 635

Tompkins, EL, & Adger, WN 2004, 'Does Adaptive Management of Natural Resources Enhance Resilience to Climate Change?', *Ecology and Society*, vol. 19, no. 2, pp. 10

Torgerson D, 1986. Between knowledge and politics: Three faces of policy analysis. Policy Sciences 19, 33 - 59

Towell, N, Kenny, M, & Smith, B 2013, 'Razor taken to CSIRO', *The Sydney Morning Herald*, 8 November, viewed 1 December 2014, http://www.smh.com.au/federal-politics/political-news/razor-taken-to-csiro-20131107-2x4fu.html

Toynbee, P 2007, 'Nimbys can't be allowed to put a block on wind farms', *The Guardian,* January 5, viewed 24 October 2013, http://www.theguardian.com/commentisfree/2007/jan/05/comment.politics

Toyne, P 1994, *The Reluctant Nation: Environment, law and politics in Australia*, ABC Books, Sydney

UK Cabinet Office 2011, *Government Response to the Science and Technology Select Committee Report on Behavioural Change*, HM Government, London, viewed 17 March 2015, https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/60538/Government-Response-House-of-Lords-Inquiry-Behaviour-Change.pdf

UK Climate Change Adaptation Sub-committee [UK-ASC] 2012, *Climate change - is the UK preparing for flooding and water scarcity? Adaptation Sub-committee Progress Report 2012*, The UK Committee on Climate Change, viewed 17 March 2015, http://hmccc.s3.amazonaws.com/ASC/2012%20report/1586%20ASC_ES_Summary.pdf

UK Climate Impacts Program [UKCIP] 2009, *UKCP09: UK Climate Projections*, Environmental Change Institute - University of Oxford, Oxford, viewed 9 September 2012, http://ukclimateprojections.defra.gov.uk/22676

Urwin, K, & Jordan, A 2008, 'Does public policy support or undermine climate change adaptation? Exploring policy interplay across different scales of governance', *Global Environmental Change*, vol. 18, pp. 180-191

US Environmental Protection Agency [USEPA] 1998, *Guidelines for Ecological Risk Assessment*, US Environmental Protection Agency, Washington DC, viewed 10 April 2013, http://www.epa.gov/raf/publications/guidelines-ecological-risk-assessment.htm

Victorian Bushfires Royal Commission [VBRC] 2009, *Final Report: Summary*, Parliament of Victoria, Melbourne, viewed 19 March 2015, http://www.royalcommission.vic.gov.au/finaldocuments/summary/PF/VBRC_Summary_PF.pdf

Walker, B, Holling, CS, Carpenter, SR, Kinzig, A 2004, 'Resilience, Adaptability and Transformability in Social-ecological Systems', *Ecology and Society*, vol. 9, no. 2, pp. 5

Walker, KJ 2002, 'Environmental Policy in Australia', in Desai, U (ed) 2002, *Environmental Politics and Policy in Industrialized Countries*, MIT Press, Cambridge, Mass

Walker, KJ 2012, 'Australia's construction of environmental policy', in Crowley, K, & Walker, KJ (eds) 2012, *Environmental Policy Failure: The Australian Story,* Tilde University Press, Vic, Australia

Walker, WE, Harremoes, P, Rotmans, J, Van Der Sluijs, JP, Van Asselt, MBA, Janssen, P, & Krayer Von Krauss, MP 2003, 'Defining Uncertainty: A Conceptual Basis for Uncertainty Management in Model-Based Decision Support', *Integrated Assessment*, vol. 4, no. 1, pp. 5 - 17

Wanna, J, & Weller, P 2003, 'Traditions of Australian Governance', *Public Administration*, vol. 81, no. 1, pp. 63 - 94

Water Framework Directive 2000 (60/EC), viewed 19 March 2015, http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32000L0060

Weale, A 2001, 'Deliberative Democracy: Science advice, democratic responsiveness and public policy', *Science and Public Policy*, vol. 28, no. 6, pp. 413-421

Weichselgartner, J, & Kasperson, R 2010, 'Barriers in the science-policy-practice interface: Toward a knowledge-action-system in global environmental change research', *Global Environmental Change* vol. 20, pp. 266 - 277

Weinberg, AM 1972, 'Science and Trans-Science', *Minerva*, vol. 10, no. 2, pp. 209 - 222

Weingart, P 1999, 'Scientific expertise and political accountability: paradoxes of science in politics', *Science and Public Policy,* vol. 26, no. 3, pp. 151 - 161

Weiss, CH 1979, 'The Many Meanings of Research Utilization', *Public Administration Review,* vol. 39, no. 5, pp. 426-431

Weiss, CH 1998, 'Have We Learned Anything New About the Use of Evaluation?', *American Journal of Evaluation*, vol. 19, no. 1, pp. 21 - 33

Wesselink, A, & Hoppe, R 2011, 'If post-normal science is the solution, what is the problem?: The politics of activist environmental science', *Science, Technology & Human Values*, vol. 36, no. 3, pp. 389 – 412

Westerhoff, L, & Juhola, S 2010, 'Science-policy linkages in climate change adaptation in Europe', *International Journal of Climate Change Strategies and Management*, vol. 2, no. 3, pp. 222 - 241

Weston, P 2014, 'New Gold Coast council flood maps criticised for downplaying storm surge risk and leaving homes vulnerable', *The Gold Coast Bulletin*, 11 August, viewed 19 August 2014, http://www.goldcoastbulletin.com.au/news/gold-coast/new-gold-coast-council-flood-maps-criticised-for-downplaying-storm-surge-risk-and-leaving-homes-vulnerable/story-fnj94idh-1227020099137?from=gold+coast+bulletin_rss

White, A 2014, 'Climate change "off the G20 agenda" as Australia prepares to abolish carbon price', *The Guardian*, 5 June, viewed 30 January 2015, http://www.theguardian.com/environment/southern-crossroads/2014/jun/05/g20-climate-change-agenda-obama-abbott

Whiteside, J 2014, *Happisburgh Village Website: Coastal Erosion at Happisburgh,* viewed 24 August, 2014, http://www.happisburgh.org/ccag

Wilbanks, TJ, & Kates, RW 1999, 'Global Change in Local Places: How Scale Matters', *Climatic Change*, vol. 43, pp. 601 - 628

Wilby, R, Dessai, S 2010, 'Robust adaptation to climate change', *Weather,* vol. 65, no. 7, pp. 180–185

Willows, R, & Connell, R (eds) 2003, *Climate Adaptation: Risk, Uncertainty and Decision-making*, UK Climate Impacts Programme, Oxford

Winner, L 1993, 'Upon Opening the Black Box and Finding it Empty: Social Constructivism and the Philosophy of Technology', *Science, Technology & Human Values,* vol. 18, no. 3, pp. 362 - 378

Woodhouse, D 2013, 'Civil Servants and Politicians: A Very British Relationship', in Neuhold C, Vanhoonacker S, & Verhey, L (eds) 2013, *Civil Servants and Politics: A Delicate Balance*, Palgrave Macmillan, UK

Wynne, B 2003, 'Seasick on the Third Wave? Subverting the Hegemony of Propositionalism: Response to Collins & Evans (2002)', *Social Studies of Science,* vol. 33, no. 3, pp. 401 - 417

Yohe, G, & Tol, RSJ 2002, 'Indicators for social and economic coping capacity: moving toward a working definition of adaptive capacity', *Global Environmental Change*, vol. 12, pp. 25 - 40

Young, OR 2002, *The Institutional Dimensions of Environmental Change: Fit, Interplay, and Scale*, The MIT Press, Cambridge, Massachusetts

Young, OR 2010, 'Institutional dynamics: Resilience, vulnerability and adaptation in environmental and resource regimes', *Global Environmental Change*, vol. 20, pp. 378 - 385

Yusoff, K, & Gabrys, J 2011, 'Climate Change and the Imagination', *WIRES Climate Change*, vol. 2, pp. 516 - 534