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Operationalizing Sustainable Development: Ecological Integrity as a *Grundnorm* of International Law

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The current process of designing the post-2015 Sustainable Development Goals (SDGs) offers the opportunity to more clearly define the underlying idea of sustainable development. At its core is ecological sustainability defined as the integrity of the Earth's life-supporting systems, or ecological integrity for short. This definition is reflective of the science and ethics of planetary boundaries, referred to in international environmental agreements and can be formulated as a priority goal in the context of SDGs. In the context of international law, the article argues for developing ecological integrity as fundamental principle or grundnorm *similar to the* grundnorm *character that human rights or the rule of law have in domestic and international law.*

1 Introduction

The neoclassical economic model assumes a free and infinite supply of natural resources, hence failing to recognize the limits to economic growth imposed by a finite environmental carrying capacity.[1] Despite the fact that the underlying assumption defies the fundamental laws of physics such as the second law of thermodynamics,[2] it has always informed the

[1] H.E. Daly, 'Allocation, Distribution, and Scale: Towards an Economics That Is Efficient, Just, and Sustainable', 6 *Ecological Economics* (1992), 185; R. Costanza *et al.*, *An Introduction to Ecological Economics* (CRC Press, 1997); H.E. Daly and J. Farley, *Ecological Economics: Principles and Applications* (Island Press, 2010).
[2] The law that entropy, a measure of disorder, of an isolated system never decreases. W.E. Rees, 'Revisiting Carrying Capacity: Area-Based Indicators of Sustainability', 17 *Population and Environment* (1996), 195; W. Norde, 'Energy and Entropy: A Thermodynamic Approach to Sustainability', 17 *The Environmentalist* (1997), 57; R.U. Ayres, 'Eco-thermodynamics: Economics

contemporary sustainable development discourse. For example, the authors of the Brundtland Report did not believe in the absolute ecological limits, but only relative limits imposed by 'the present state of technology and social organization on environmental resources'.[3] For the past several decades, human societies have denied the biophysical reality and focused on finding convenient ways to sustain economic growth from a technocentric worldview.

Against this backdrop, the international community adopted the Millennium Declaration at the Millennium Summit in 2000. A set of eight Millennium Development Goals (MDGs) and related targets and indicators were identified by the United Nations (UN) Secretariat as a blueprint for the next fifteen years. The MDGs were mostly development-oriented, specifically targeting poverty-related issues in developing countries for creating 'an environment … which is conducive to development and to the elimination of poverty'.[4] MDG 7 on ensuring environmental sustainability was the only environmental goal of the eight, but it did not set absolute limits on the amount of environmental impact that human societies may exert. Among the four targets within MDG 7, only two were genuinely about environmental conditions (Targets 7.A and 7.B) while the other two were about human basic needs (Targets 7.C and 7.D).[5]

In light of the worsening global environmental conditions,[6] however, there is a general consensus on the need for post-2015 Sustainable Development Goals (SDGs) to pay greater attention to the environment than the MDGs did.[7] In particular, there is an emerging consensus within the scientific community that environmental boundaries for planetary well-being need to be incorporated in the SDGs.[8] Human societies have already pushed a

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and the Second Law', 26 *Ecological Economics* (1998), 189; J.J. Kay *et al.*, 'An Ecosystem Approach for Sustainability: Addressing the Challenge of Complexity', 31 *Futures* (1999), 721; B. Muys, 'Sustainable Development within Planetary Boundaries: A Functional Revision of the Definition Based on the Thermodynamics of Complex Social-Ecological Systems', 1 *Challenges in Sustainability* (2013), 41.

[3] World Commission on Environment and Development, *Our Common Future* (Oxford University Press, 1987), at paragraph 27.

[4] United Nations Millennium Declaration (UNGA Resolution A/RES/55/2, 18 September 2000), at paragraph 12.

[5] See < http://www.un.org/millenniumgoals>.

[6] Millennium Ecosystem Assessment, Ecosystems and Human Well-being: Synthesis (Island Press, 2005); Intergovernmental Panel on Climate Change, Climate Change 2013: The Physical Science Basis. Working Group I Contribution to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (Cambridge University Press, 2013).

[7] L. Brito, 'Analyzing Sustainable Development Goals', 336 *Science* (2012), 1396; M. Leach *et al.*, 'Transforming Innovation for Sustainability', 17 *Ecology and Society* (2012).

[8] D. Griggs *et al.*, 'Sustainable Development Goals for People and Planet', 495 *Nature* (2013), 305; J. Rockström and J.D. Sachs, *Sustainable Development and Planetary Boundaries: Background Research Paper* (High-level Panel on the Post-2015 Development Agenda, 2013).

number of Earth-system processes beyond their critical thresholds,[9] and we are now entering a new geological epoch named the Anthropocene.[10] According to the best available scientific knowledge, the Anthropocene will be different from the Holocene, the last 11,000 year-long period when climate was unusually stable, enabling civilizations to develop and flourish. The environmental conditions of the Anthropocene are very likely to be catastrophic to the resilience of human societies and economies.[11] Our best bet for survival is to maintain the Holocene state, which is 'the only state of the Earth System that we know for sure can support contemporary society',[12] by mitigating disruptive global environmental change.

To that end, a new set of SDGs must fill the ecological gap in the MDGs and ensure human societies to operate within a safe operating space defined by planetary boundaries. But, of course, the question is *how* to introduce the idea of planetary biophysical limits to international environmental law, or more broadly, the governance of states and corporations.[13] A number of innovative and transformative institutional reform options already exist.[14] In this paper, we put forward a novel idea of organizing post-2015 SDGs as a nested system of goals, targets, and indicators with a single priority goal at the apex. We propose that this goal should be formulated in terms of planetary boundaries and ecological

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[9] T.M. Lenton *et al.*, 'Tipping Elements in the Earth's Climate System', 105 *Proceedings of the National Academy of Sciences* (2008), 1786; J. Rockström *et al.*, 'A Safe Operating Space for Humanity', 461 *Nature* (2009), 472; H.-J. Schellnhuber, 'Tipping Elements in the Earth System', 106 *Proceedings of the National Academy of Sciences* (2009), 20561.

[10] P.J. Crutzen, 'Geology of Mankind', 415 *Nature* (2002), 23; W. Steffen, P.J. Crutzen and J.R. McNeill, 'The Anthropocene: Are Humans Now Overwhelming the Great Forces of Nature?', 36 *AMBIO* (2007), 614.

[11] W. Steffen et al., Global Change and the Earth System: A Planet Under Pressure (Springer, 2004).

[12] W. Steffen *et al.*, 'The Anthropocene: From Global Change to Planetary Stewardship', 40 *AMBIO* (2011), 739, at 739.

[13] See, e.g., D. Vidas, 'The Anthropocene and the International Law of the Sea', 369 *Philosophical Transactions of the Royal Society A* (2011), 909; G. Whiteman, B. Walker and P. Perego, 'Planetary Boundaries: Ecological Foundations for Corporate Sustainability', 50 *Journal of Management Studies* (2013), 307.

[14] B. Walker *et al.*, 'Looming Global-Scale Failures and Missing Institutions', 325 *Science* (2009), 1345; W. Steffen, J. Rockström and R. Costanza, 'How Defining Planetary Boundaries Can Transform Our Approach to Growth', 2 *Solutions* (2011); F. Biermann *et al.*, 'Transforming Governance and Institutions for Global Sustainability: Key Insights from the Earth System Governance Project', 4 *Current Opinion in Environmental Sustainability* (2012), 51; K. Bosselmann, P.G. Brown and B. Mackey, 'Enabling a Flourishing Earth: Challenges for the Green Economy, Opportunities for Global Governance', 21 *Review of European Community and International Environmental Law* (2012), 23; V. Galaz *et al.*, ''Planetary Boundaries'—Exploring the Challenges for Global Environmental Governance', 4 *Current Opinion in Environmental Sustainability* (2012), 80; N. Kanie *et al.*, 'A Charter Moment: Restructuring Governance for Sustainability', 32 *Public Administration and Development* (2012), 292.

integrity, a common denominator concept that can be found widely in the existing international environmental instruments.[15]

The paper proceeds in the following format. We start by briefly describing the science and ethics of planetary boundaries, and their implications for SDGs. We argue that we need to redefine sustainable development and agree on a single priority goal in the context of SDGs. In searching for what this goal might be, we arrive at the multifaceted concept of ecological integrity. We outline how it has been expressed in international law, define what it means in terms of planetary boundaries, and discuss practical governance implications. We then explore how the priority goal, as defined in terms of planetary integrity and boundaries, might be achieved through the rule of law. We pay particular attention to a specific form of legal principle called *grundnorm*, and how it could be institutionalized and implemented within the UN system.

2 Planetary Boundaries: The Preconditions for Sustainable Development

This section reviews the scientific and ethical underpinnings of the planetary boundaries framework.

2.1 Science

Building on decades of scientific research on the limits to growth,[16] safe minimum standards,[17] and tolerable windows,[18] a group of environmental scientists have identified nine planetary biophysical subsystems or processes that determine the self-regulating capacity of the Earth system.[19] The identified Earth system processes are climate change,

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[15] R.E. Kim and K. Bosselmann, 'International Environmental Law in the Anthropocene: Towards a Purposive System of Multilateral Environmental Agreements', 2 *Transnational Environmental Law* (2013), 285.
[16] D.H. Meadows et al., The Limits to Growth: A Report for the Club of Rome's Project on the Predicament of Mankind (Universe Books, 1972).
[17] S.V. Ciriacy-Wantrup, *Resource Conservation: Economics and Policies* (University of California Press, 1952); R.C. Bishop, 'Endangered Species and Uncertainty: The Economics of a Safe Minimum Standard', 60 *American Journal of Agricultural Economics* (1978), 10; T.M. Crowards, 'Safe Minimum Standards: Costs and Opportunities', 25 *Ecological Economics* (1998), 303.
[18] G. Petschel-Held *et al.*, 'The Tolerable Windows Approach: Theoretical and Methodological Foundations', 41 *Climatic Change* (1999), 303.
[19] See J. Rockström *et al.*, n. 9 above.

biodiversity loss, interference with the nitrogen and phosphorus cycles, stratospheric ozone depletion, ocean acidification, global freshwater use, changes in land use, chemical pollution, and atmospheric aerosol loading. The scientists argue that each process has a certain threshold which, if crossed, may trigger non-linear changes in the functioning of the Earth system. As these processes are tightly coupled with each other, one issue alone cannot be managed in isolation. Collectively, therefore, the planetary boundaries define the safe operating space for humanity with respect to the Earth system.

The planetary boundaries framework is grounded on resilience theory,[20] in which the Earth system *in toto* is considered as a complex adaptive, social-ecological system.[21] A social-ecological system is a system in which 'people depend on resources and services provided by ecosystems, and ecosystem dynamics are influenced, to varying degrees, by human activities'.[22] The characterization as a complex adaptive system implies that the Earth system self-organizes within certain limits.[23] Within the limits, the system is resilient, that is, it has the capacity to absorb shocks while maintaining function.[24] When these limits are exceeded the system no longer tends to recover towards its original 'identity', but instead tends towards a different configuration.

A number of Earth subsystems or processes are going through such a regime shift since the Industrial Revolution.[25] Human activities have put too much stress on the Earth system, hence reducing its resilience to perturbations. There is compelling scientific evidence to suggest three of the nine planetary boundaries identified so far have already been crossed (climate change, biodiversity loss, and the nitrogen cycle), and others are under threat.[26] The Earth system is no longer in the relatively stable Holocene period, but rapidly moving into the unpredictable Anthropocene.

The planetary boundaries framework is intended to be used in defining the boundary between the Holocene and the Anthropocene, thereby conditioning the type and

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[20] C. Folke *et al.*, 'Resilience and Sustainable Development: Building Adaptive Capacity in a World of Transformations', 5 *AMBIO* (2002), 437; B. Walker *et al.*, 'Resilience, Adaptability and Transformability in Social–ecological Systems', 9 *Ecology and Society* (2004); B. Walker and D. Salt, *Resilience Thinking: Sustaining Ecosystems and People in a Changing World* (Island Press, 2006); C. Folke, 'Resilience: The Emergence of a Perspective for Social-Ecological Systems Analyses', 16 *Global Environmental Change* (2006), 253.

[21] O.R. Young and W. Steffen, 'The Earth System: Sustaining Planetary Life-Support Systems', in: F.S. Chapin III, G.P. Kofinas and C. Folke. (eds.), *Principles of Ecosystem Stewardship: Resilience-Based Natural Resource Management in a Changing World* (Springer, 2009), 295.

[22] F.S. Chapin III, C. Folke and G.P. Kofinas, 'A Framework for Understanding Change', in: F.S. Chapin III, G.P. Kofinas and C. Folke, ibid, 3, at 6.

[23] J.H. Holland, Hidden Order: How Adaptation Builds Complexity (Basic Books, 1995); S.A. Levin, Fragile Dominion: Complexity and the Commons (Perseus Books, 1999).

[24] See C. Folke *et al.*, n. 20 above.

[25] See W. Steffen, P.J. Crutzen and J.R. McNeill, n. 10 above.

[26] See J. Rockström *et al.*, n. 9 above.

level of human activities upon respecting the thresholds in the Earth subsystems or processes. The positions of most thresholds can be defined and measured through one or more control variables such as the atmospheric carbon dioxide (CO_2) concentration and the species extinction rate.[27] The threshold levels in these variables are, in essence, a set of Earth's 'safe minimum standards' for safeguarding the planetary sustainability must-haves, which are absolutely essential for human survival, and for that matter, sustainable development of any kind.

2.2 Ethics

At the fundamental level, our ecological crisis is an ethical crisis. The roots of almost all environmental problems can be traced to the misconceived human-nature relationship.[28] That is, thinking humans are above or outside nature, and that we have the right and ability to dominate over and even control nature. Such a worldview is probably nicely captured in the current proposals for and tacit acceptance of geoengineering the climate by both the science and policy communities.[29] On that premise, we have built our exploitative economic systems, which is degrading the environment to the point where human security is highly threatened. For the past several decades, therefore, the international community has repeatedly called for 'a new ethic, embracing plants and animals as well as people, which will enable human societies to live in harmony with the natural world on which they depend for survival and well-being'.[30]

The planetary boundaries framework provides a scientific groundwork for this new ethic. By focusing on the biophysical dimensions of the Earth system dynamics, planetary boundaries place a greater importance on staying within the 'environmental ceiling' over the

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[27] Ibid.
[28] K. Bosselmann, 'Losing the Forest for the Trees: Environmental Reductionism in the Law', 2 *Sustainability* (2010), 2424.
[29] Geoengineering is 'planetary-scale environmental engineering, particularly engineering aimed at counteracting the undesired side effects of other human activities'. D.W. Keith, 'Geoengineering', 409 *Nature* (2001), 420. Examples include ocean iron fertilization and stratospheric sulphate aerosols. See generally, D.G. Victor, 'On the Regulation of Geoengineering', 24 *Oxford Review of Economic Policy* (2008), 322; D. Victor *et al.*, 'The Geoengineering Option: A Last Resort Against Global Warming?', 88 *Foreign Affairs* (2009), 64; R. Bellamy *et al.*, 'A Review of Climate Geoengineering Appraisals', 3 *Wiley Interdisciplinary Reviews: Climate Change* (2012), 597; A. Ridgwell, C. Freeman and R. Lampitt, 'Geoengineering: Taking Control of Our Planet's Climate?', 370 *Philosophical Transactions of the Royal Society A* (2012), 4163.
[30] International Union for Conservation of Nature, *World Conservation Strategy: Living Resource Conservation for Sustainable Development* (International Union for Conservation of Nature, United Nations Environment Programme, World Wildlife Fund, 1980), at 46.

so-called 'social floor'.[31] In this sense, this framework is ecocentric, although it is principally concerned about human development, rather than the intrinsic value of nature as such. Nonetheless, implicit in the concept of planetary boundaries is ecosystems thinking, that humans are fellow citizens of the wider community of life, who need to take the role of planetary stewardship.

However, this does not mean that we undervalue the importance of social equity. We reject the widespread criticism that the planetary boundaries approach involves conflict between global equity and environmental sustainability goals. The concept of planetary boundaries should not be mistaken for a denial of the rights of developing countries to develop and improve their welfare. These countries often have few options for poverty reduction but to engage in activities that contribute to the transgression of planetary boundaries. In other words, the rich is leaving no choice for the poor but to exploit the nature to satisfy basic human needs. A just international economic order is, therefore, a prerequisite for global sustainability. Similarly, Steffen and Stafford Smith argue that it is necessary and possible to address the biophysical aspects of these boundaries in ways that are compatible with enhancing many aspects of social equity.[32]

3 Implications for Post-2015 Sustainable Development Goals

The science and ethics of the planetary boundaries framework has important implications for the post-2015 development agenda. In this section, we discuss the need to revisit the concept of sustainable development, and agree on a single priority goal in the context of SDGs.

3.1 Revisiting Sustainable Development

The oft-quoted definition of sustainable development can be found in the Brundtland Report as 'development that meets the needs of the present without compromising the ability of

[31] K. Raworth, A Safe and Just Space for Humanity: Can We Live within the Doughnut? (Oxfam International, 2012).
[32] W. Steffen and M. Stafford Smith, 'Planetary Boundaries, Equity and Global Sustainability: Why Wealthy Countries Could Benefit from More Equity', 5 *Current Opinion in Environmental Sustainability* (2013), 1.

future generations to meet their own needs'.[33] The central idea was about achieving a balance or integration of competing interests of the environment, society, and economy. However, the transgression of the thresholds for several planetary equilibria serves as an empirical evidence for the failure of the existing model of sustainable development for acting within planetary boundaries.[34]

Sustainable development as defined by the World Commission on Environment and Development is a paradoxical concept because 'it aimed at reconciling the right of development of every world citizen with the global environmental burdens associated with the current development model'.[35] From a purist point of view, it is a contradiction in terms because genuine sustainability and genuine development would be irreconcilable.[36] Given the general bias towards tangible economic benefits over the intangible environmental concerns in today's neoliberal economies, striking a tenuous balance between the three pillars of sustainable development was not successful in most cases. Rather, sustainable development has been driven by general imperatives of growth or progress. Therefore, as Leach *et al.* argue, 'broad calls for integration need to be underpinned by finer-grained attention to what sort of sustainability and development are being pursued, for whom and how, and what this implies for improved stewardship of our planet'.[37] It should be remembered that, in the concept of sustainable development, 'sustainability' is what conditions 'development', not vice versa.[38]

This implies the need to delve deeper into the authentic meaning of sustainability. The idea of sustainability has deep roots in all cultures of the world.[39] The term itself, however, was shaped in the 17th century European discourse on timber shortage. Initiated

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[33] World Commission on Environment and Development, 1987. *Our Common Future* (Oxford University Press, 1987).
[34] See B. Muys, n. 2 above.
[35] Ibid., at 42.
[36] J.A. Du Pisani, 'Sustainable Development – Historical Roots of the Concept', 3 *Environmental Sciences* (2006), 83. However, it should be noted that there are more progressive understandings of economic development, which are defined on the basis of qualitative rather than purely quantitative criteria, or on the basis of indicators that encompass more than pure economic growth, including environmental quality. See, e.g., Y. Matsui, 'The Road to Sustainable Development: Evolution of the Concept of Development in the UN', in: K. Ginther, E. Denters and P.J.I.M. de Waart (eds.), *Sustainable Development and Good Governance* (Martinus Nijhoff Publishers, 1995).
[37] M. Leach *et al.*, n. 7 above, at 4-5. See also A. Dobson, 'Environment Sustainabilities: An Analysis and a Typology', 5 *Environmental Politics* (1996), 401.
[38] K. Bosselmann, The Principle of Sustainability: Transforming Law and Governance (Ashgate, 2008), at 53.
[39] D. Mebratu, 'Sustainability and Sustainable Development: Historical and Conceptual Review', 18 *Environmental Impact Assessment Review* (1998), 493; C.G. Weeramantry, *Universalising International Law* (Martinus Nijhoff Publishers, 2004); U. Grober, *Deep Roots – A Conceptual History of 'Sustainable Development' (Nachhaltigkeit)* (Social Science Research Center Berlin, 2007).

by the Royal Society and its founding member John Evelyn, this discourse soon spread to Europe, and paved the way to a new approach to the management of forests. In Germany, for example, it led to the coining of the new term *Nachhaltigkeit* (sustainability). Its first legislative use dates back to 1713 by Hans Carl von Carlowitz, the head of the Royal Mining Office in the Kingdom of Saxony, in the context of meeting the challenge of a predicted shortage of timber.[40] The principle of sustainability was fundamental in forest legislation of the nineteenth century. For example, Article 2 of the Bavarian Forest Law of 1852 read: 'The management of state-owned forests has to follow sustainability as its highest principle'.

The historical sources shed a new light on the essence of the modern composite term 'sustainable development', which is often diluted and distorted. The fact that sustainability was a legal term with a defined content and used in legislation is important for the interpretation of sustainable development. It would be wrong to assume that this construct only emerged following the Brundtland Report and could only be interpreted accordingly. We need to revise the concept of sustainable development in light of historical usage and refocus on its core meaning as 'not risking the substance'.

At the global level, the international community as a whole would have to acknowledge that planetary boundaries define the environmental target corridor within the larger context of sustainable development.[41] They are the biophysical preconditions for sustainable development. In this context, Muys, for example, proposed a new definition of sustainable development as 'the increase of human prosperity (exergy content) and human well-being (exergy buffering) without the loss of ecosystem structure (exergy content) and ecosystem functioning (exergy buffering)', which in short can be expressed as 'development that does not degrade the biosphere'.[42]

3.2 Organizing Sustainable Development Goals in a Normative Hierarchy

How can we design post-2015 SDGs so that they collectively work towards such a revised definition of sustainable development? In this section, we argue that it is necessary to organize SDGs in a normative hierarchy, with a single priority sustainability goal at the apex.

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[40] See K. Bosselmann, n. 38 above, at 17-22; J.A. Du Pisani, n. 36 above.
[41] F. Biermann, 'Planetary Boundaries and Earth System Governance: Exploring the Links', 81 *Ecological Economics* (2012), 4.
[42] See B. Muys, n. 2, at 45.

3.2.1 Why a Single Priority for Sustainable Development Goals?

The MDGs have formed a nested system of 8 goals, 21 targets, and 60 indicators. The goals, targets, and indicators are interrelated and should be seen as a whole. However, in practice, the MDGs and their subsidiary targets and indicators may point in different directions. For example, poverty eradication (MDG 1) and environmental conservation (MDG 7) may require different actions to be taken in order to achieve one's own objective most efficiently. They may even contradict one another depending on how the goals and targets are implemented, and which indicators are used to measure progress. For example, two indicators used for MDG 1 and MDG 7, 'proportion of population below $1 (PPP) per day' (Indicator 1.1) and 'CO_2 emissions, total, per capita and per $1 GDP (PPP)' (Indicator 7.2), may come into conflict. Between 1990 and 2010, the proportion of population in extreme poverty in China was reduced from 60 to 12 per cent.[43] It is questionable, however, whether the source of this progress is climatically benign. Indeed, during the same period, China increased its total and per capita CO_2 emissions by about three fold.[44] Here, causality can be suggested that the recent economic growth and associated progress in poverty eradication were largely driven by burning more fossil fuels and degrading the local and global environment.

Therefore, improving the performance of one goal or target in isolation may come to constrain the actions of another goal or target to the point of serious injury. In systems terminology this is called the problem of suboptimization, where optimizing the result for each of the subsystems independently (i.e., goals, targets, or indicators) may actually suboptimize the performance of the overall system.[45] The principle of suboptimization provides at least a partial explanation as to why some targets are met,[46] but the spirit of the MDGs is not.

Such a systems perspective to goal-setting and implementation needs to be adopted when formulating post-2015 SDGs. What we can do to make sure the spirit of post-2015 SDGs, that is, human development within the ecological limits, is met is to formulate SDGs with the whole system, including its self-organizing evasive possibilities, in mind. The collective goal of a system, in this case a 'goal system', is a powerful and necessary leverage point for steering the direction of self-organization.[47]

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[43] United Nations, The Millennium Development Goals Report 2014 (United Nations, 2014).
[44] See <http://data.worldbank.org>.
[45] F. Heylighen, 'Evolution, Selfishness and Cooperation', 2 *Journal of Ideas* (1992), 70.
[46] See United Nations, n. 43 above.
[47] D.H. Meadows, *Thinking in Systems: A Primer* (Chelsea Green, 2008).

Here is an example from economics. Because of non-linear dynamics between micromotives and macrobehaviour, [48] macroeconomics cannot be derived from microeconomics. In order to direct economic systems towards desired macroscopic outcomes which might be keeping the market competitive, the self-organizing aspects of the market must be complemented by the top-down feedbacks. These feedbacks would come from goal-oriented central agencies, which modify local rules of interaction to prevent each individual corporation from eliminating its competitors.[49] Similarly, in ecosystems, the goal of keeping populations in balance and evolving trumps the goal of each population to reproduce without limit.[50]

In this context, we argue that the international community has to be clear about what post-2015 SDGs will collectively aim to achieve, and bind individual SDGs and targets to contribute to the ultimate purpose. In other words, a single priority goal needs to be agreed to and it should be given the power to trump other auxiliary SDGs and targets lower in the goal-system hierarchy.

Our proposal for a single priority goal does not cancel out the importance of diversity of goals, targets, and indicators. It should be emphasized that our single-goal approach is not a top-down, monolithic approach to global governance. The goal-oriented approach is rather directed towards achieving coherence under change while maintaining some degree of institutional diversity.[51] Our approach needs to be differentiated from the centralization argument, which is often associated with the idea of establishing an authoritative organization.[52] Here, we do not assume the presence of a central authority. In fact, a goal-oriented approach to orchestration would prove to be particularly relevant in a decentralized system without central control, such as the international system.

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[48] T.C. Schelling, *Micromotives and Macrobehavior* (Norton, 1978).
[49] See D.H. Meadows, n. 47 above. See also S.A. Levin, 'Complex Adaptive Systems: Exploring the Known, the Unknown and the Unknowable', 40 *Bulletin of the American Mathematical Society* (2002), 3.
[50] Ibid.
[51] E. Ostrom, 'Coping with Tragedies of the Commons', 2 *Annual Review of Political Science* (1999), 493; T. Dietz, E. Ostrom and P.C. Stern, 'The Struggle to Govern the Commons', 302 *Science* (2003), 1907; B. Low *et al.*, 'Redundancy and Diversity: Do they Influence Optimal Management?' in: F. Berkes, J. Colding and C. Folke (eds.), *Navigating Social-Ecological Systems: Building Resilience for Complexity and Change* (Cambridge University Press, 2003), 83; E. Ostrom, *Understanding Institutional Diversity* (Princeton University Press, 2005).
[52] F. Biermann, 'The Case for a World Environment Organization', 42 *Environment* (2000), 22. But see A. Najam, 'The Case Against a New International Environmental Organization', 9 *Global Governance* (2003), 367; S. Oberthür and T. Gehring, 'Reforming International Environmental Governance: An Institutionalist Critique of the Proposal for a World Environment Organisation', 4 *International Environmental Agreements: Politics, Law and Economics* (2004), 359.

3.2.2 Sustainable Development *per se* is Unfit as a Priority Goal

In response to our case for a single priority goal, one may claim that sustainable development itself is already the *de facto* priority goal of the international community as a whole. However, we consider the concept of sustainable development as lacking the necessary qualities of an overarching goal for the purpose of guiding SDGs.

Commonly agreed definitions of sustainable development contain two different goals, namely environment conservation (sustainability) and socio-economic growth and equity (development). However, none of them provide a clear guidance on how to integrate the two competing interests in a principled manner. This includes the revised definition of sustainable development in the context of SDGs in Griggs *et al.*: 'development that meets the needs of the present while safeguarding Earth's life-support systems, on which the welfare of current and future generations depends'.[53] Here, the two objectives of sustainable development, namely their 'updated MDGs' (i.e., end poverty and hunger, universal education, gender equality, health, environmental sustainability, and global partnership) and 'planetary must-haves' (i.e., materials use, clean air, nutrient (N and P) cycles, hydrological cycles, ecosystem services, biodiversity, and climate stability), are linked in an unclear manner by the connecting word 'while'.[54] Does the latter, some level of environmental integrity that could not be traded away, condition the former, development? From a grammatical point of view, probably yes, but different interpretations can be derived. In fact, Griggs *et al.* stated that 'the protection of Earth's life-support systems and poverty reduction

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[53] See D. Griggs *et al.*, n. 8 above, at 306.

[54] The word 'while' in section 5 (purpose) of New Zealand's Resource Management Act 1991 has allowed a wide range of statutory interpretations of the purpose of the Act. D.E. Fisher, 'The Resource Management Legislation of 1991: A Judicial Analysis of Its Objectives', in: *Resource Management* (Brooker and Friend, 1991), 11; J. McLean, 'New Zealand's Resource Management Act 1991: Process with Purpose?', 7 *Otago Law Review* (1992), 538; B.V. Harris, 'Sustainable Management as an Express Purpose of Environmental Legislation: The New Zealand Attempt', 8 *Otago Law Review* (1993), 51; G. Smith, 'The Resource Management Act 1991: "A Biophysical Bottom Line" vs "A More Liberal Regime"; A Dichotomy?', 6 *Canterbury Law Review* (1997), 499; I.H. William, 'The Resource Management Act 1991: Well Meant But Hardly Done', 9 *Otago Law Review* (2000), 673; P. Skelton and A. Memon, 'Adopting Sustainability as an Overarching Environmental Policy: A Review of Section 5 of the RMA', 10 *Resource Management Journal* (2002), 1; S. Upton, H. Atkins and G. Willis, 'Section 5 Re-visited: A Critique of Skelton and Memon's Analysis', 10 *Resource Management Journal* (2002), 10; P. Fuller, 'The Resource Management Act 1991: "An Overall Broad Judgment"', 7 *New Zealand Journal of Environmental Law* (2003), 243; I. Carlman, 'The Resource Management Act 1991 Through External Eyes', 11 *New Zealand Journal of Environmental Law* (2007), 181. See also *New Zealand Rail Limited v. Marlborough District Council* [1994] NZRMA 70; *Foxley Engineering Limited v. Wellington City Council*, W12/94; *L.A. Campbell and Others v. Southland Regional Council*, W114/94; *Trio Holdings Limited v. Marlborough District Council* [1997] NZRMA 97; *North Shore City Council v. Auckland Regional Council* [1997] NZRMA 59.

must be the *twin priorities* for SDGs',[55] without discussing how potential conflicts between the two priorities might be addressed, which has always been the crux of the problem with sustainable development.

3.2.3 Environmental Problem Shifting between Planetary Boundaries

Another reason for a hierarchical goal-system structure is that individual actions taken to *protect* a part of the environment, when collectively considered, may not necessarily lead to an improved environment overall.[56] This problem of 'the whole being smaller than the sum of its parts' often results from environmental problem shifting across multiple planet's biophysical subsystems or processes. Notable examples of environmental problem shifting may actually be observed among the current environmental indicators for MDG 7. For example, expanding biofuel crop plantations, while potentially contributing to reductions in 'CO_2 emissions, total, per capita and per $1 GDP (PPP)' (Indicator 7.2), will likely decrease the 'proportion of land area covered by forest' (Indicator 7.1).[57] Replacing hydrochlorofluorocarbons (HCFCs) with hydrofluorocarbons (HFCs) which has zero ozone depletion potential, while contributing to reducing the level of 'consumption of ozone-depleting substances' (Indicator 7.3), exacerbate climate change because HFCs have a high global warming potential.[58] Our understanding of environmental problem shifting could be extended to include more passive forms of problem shifting such as the transformation of climate change to ocean acidification, as inadvertently facilitated by the UN Framework

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[55] See D. Griggs *et al.*, n. 8 above, at 305 (emphasis added).
[56] L.A. Teclaff and E. Teclaff, 'Transfers of Pollution and the Marine Environment Conventions', 31 *Natural Resources Journal* (1991), 187.
[57] F. Danielsen *et al.*, 'Biofuel Plantations on Forested Lands: Double Jeopardy for Biodiversity and Climate', 23 *Conservation Biology* (2008), 348; J. Fargione *et al.*, 'Land Clearing and the Biofuel Carbon Debt', 319 *Science* (2008), 1235; T. Searchinger *et al.*, 'Use of U.S. Croplands for Biofuels Increases Greenhouse Gases Through Emissions from Land-Use Change', 319 *Science* (2008), 1238; H. Kim, S. Kim and B.E. Dale, 'Biofuels, Land Use Change, and Greenhouse Gas Emissions: Some Unexplored Variables', 43 *Environmental Science and Technology* (2009), 961; D. Tilman *et al.*, 'Beneficial Biofuels-The Food, Energy, and Environment Trilemma', 325 *Science* (2009), 270; Y. Yang *et al.*, 'Replacing Gasoline with Corn Ethanol Results in Significant Environmental Problem-Shifting', 46 *Environmental Science and Technology* (2012), 3671. See also B. Mackey *et al.*, 'Untangling the Confusion around Land Carbon Science and Climate Change Mitigation Policy', 3 *Nature Climate Change* (2013), 552.
[58] G.J.M. Velders *et al.*, 'The Importance of the Montreal Protocol in Protecting Climate', 104 *Proceedings of the National Academy of Sciences* (2007), 4814. See also S. Oberthür, 'Linkages between the Montreal and Kyoto Protocols: Enhancing Synergies between Protecting the Ozone Layer and the Global Climate', 1 *International Environmental Agreements: Politics, Law and Economics* (2001), 357.

Convention on Climate Change (UNFCCC),[59] thereby decreasing the 'proportion of fish stocks within safe biological limits' (Indicator 7.4).

Cross-system, cross-scale interactions among planetary boundaries reveal a governance challenge that goes well beyond the conventional debate on sustainable development, that is, the relationship between environmental and developmental policies.[60] They call for much stronger attention to the *internal* coherence of international environmental law and governance with respect to strategies to stay within individual planetary boundaries.[61] The climate, ozone, and biodiversity regimes, for example, would need to be designed and implemented in a mutually supportive manner, without compromising one over the other. The threats addressed and the solutions outlined by individual environmental institutions have to be evaluated in relation to an *overall* environmental goal.[62] Individual institutions with more specific objectives are then bound by the priority goal, but given a degree of flexibility to self-organize and make mutual adjustments. This could possibly translate into less efficient sectoral measures in the short term, but its aim is to ensure long-term global ecological integrity and sustainability.

In this sense, the provisional SDGs in Griggs *et al.*,[63] for they lack a single point of reference, would likely to struggle in managing trade-offs and maximising synergies among the *environmental* goals and targets. They did identify goals that would not end up with a false opposition between improving human lives and planetary protection, but no guidance was given as to how their proposed SDGs could be coordinated for effective governance of interacting planetary boundaries.[64] In other words, Griggs *et al.* acknowledged that 'there can be conflict between individual goals, such as energy provision and climate-change prevention',[65] but their proposed goal-system falls short of addressing such conflicts. What is missing is a clearly agreed priority goal, which would provide the system of international

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[59] R.E. Kim, 'Is a New Multilateral Environmental Agreement on Ocean Acidification Necessary?', 21 *Review of European Community and International Environmental Law* (2012), 243.
[60] See generally, D.W. Cash *et al.*, 'Scale and Cross-Scale Dynamics: Governance and Information in a Multilevel World', 11 *Ecology and Society* (2006).
[61] See R.E. Kim and K. Bosselmann, n. 15 above.
[62] See, e.g., A. Steiner, L.A. Kimball and J. Scanlon, 'Global Governance for the Environment and the Role of Multilateral Environmental Agreements in Conservation', 37 *Oryx* (2003), 227; A. Jóhannsdóttir, I. Cresswell and P. Bridgewater, 'The Current Framework for International Governance of Biodiversity: Is It Doing More Harm Than Good?', 19 *Review of European Community and International Environmental Law* (2010), 139.
[63] See D. Griggs *et al.*, n. 8 above.
[64] On governing Earth system interactions, see V. Galaz *et al.*, 'Polycentric Systems and Interacting Planetary Boundaries — Emerging Governance of Climate Change–Ocean Acidification–Marine Biodiversity', 81 *Ecological Economics* (2012), 21; M. Nilsson and Å. Persson, 'Can Earth System Interactions Be Governed? Governance Functions for Linking Climate Change Mitigation with Land Use, Freshwater and Biodiversity Protection', 81 *Ecological Economics* (2012), 10.
[65] See D. Griggs *et al.*, n. 8 above, at 305.

environmental law with a point of reference for legal reasoning and interpretation, thereby enhancing institutional coherence across Earth's subsystems.[66]

4 In Search of a Priority Goal

We have explained the case for a single goal for prioritizing sustainability in post-2015 SDGs. The question, however, remains as to how this hypothetical goal could be expressed and defined both scientifically and legally. The outstanding task is about identifying a key concept or property of Earth's life-support systems that might be acceptable to the international community *in toto* as the highest global common good.

4.1 Expressions of Ecological Integrity in International Law

In our view, the point of departure in the search for this key property should be the existing international legal documents which have been widely agreed to by the international community. We refer to earlier research, which suggested that the notion of 'ecological integrity' is emerging as a common conceptual denominator.[67]

The notion of ecological integrity first appeared in the international arena in 1978 with the Great Lakes Water Quality Agreement signed bilaterally between Canada and the United States.[68] The purpose of the agreement is 'to restore and maintain the chemical, physical, and biological integrity of the Waters of the Great Lakes'.[69] The notion of ecological integrity has then been used as a key concept in a wide range of multilateral environmental agreements. The first multilateral agreement to include the notion was the Convention on the Conservation of Antarctic Marine Living Resources adopted in 1980, which recognized in its preamble, 'the importance of safeguarding the environment and protecting the integrity of the ecosystem of the seas surrounding Antarctica'. Today, more

[66] See R.E. Kim and K. Bosselmann, n. 15 above.
[67] Ibid.; K. Bosselmann, n. 38 above, at 5, 9-41; K. Bosselmann, 'The Rule of Law Grounded in the Earth: Ecological Integrity as a *Grundnorm*, in: L. Westra and M. Vilela (eds.), *The Earth Charter, Ecological Integrity and Social Movements* (Routledge, 2014), 3-11.
[68] D. Manuel-Navarrete, J.J. Kay and D. Dolderman, 'Evolution of the Ecological Integrity Debate', in: C.L. Soskolne *et al.* (eds.), *Sustaining Life on Earth: Environmental and Human Health through Global Governance* (Lexington Books, 2007), 127.
[69] Agreement Between Canada and the United States of America on Great Lakes Quality, 1978 (Ottawa, 22 November 1978), Article 2.1.

than a dozen multilateral environmental agreements contain some reference to the integrity of ecosystems in their preamble or the operative part.[70]

In other major multilateral environmental agreements where the term did not appear in their texts, we may still observe that the underlying ideas are very similar. For example, the ultimate objective of the UNFCCC, which is to 'prevent dangerous anthropogenic interference with the climate system',[71] can be interpreted to mean safeguarding the integrity of the climate system. The Vienna Convention for the Protection of the Ozone Layer aims to protect human health and the environment against 'adverse effects', which it defines as 'changes in the physical environment or biota, including changes in climate, which have significant deleterious effects on human health or on the composition, resilience and productivity of natural and managed ecosystems, or on materials useful to mankind'.[72] Here the objective is also to safeguard the integrity of the ozone layer. In the case of the UN Convention on the Law of the Sea, 'pollution of the marine environment' which its parties are obliged to prevent, reduce, and control means 'the introduction by man, directly or indirectly, of substances or energy into the marine environment, including estuaries, which results or is likely to result in such deleterious effects as harm to living resources and marine life, hazards to human health, hindrance to marine activities, including fishing and other legitimate uses of the sea, impairment of quality for use of sea water and reduction of amenities'.[73] Again, the objective is to protect the integrity of the marine environment. The Ramsar Convention on Wetlands defines the wise use of wetlands as 'the maintenance of their ecological character, achieved through the implementation of ecosystem approaches,

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[70] See R.E. Kim and K. Bosselmann, n. 16 above. Examples include the 1990 Protocol Concerning Specially Protected Areas and Wildlife to the Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region, the 1995 Protocol Concerning Specially Protected Areas and Biological Diversity in the Mediterranean, the 1995 United Nations Fish Stocks Agreement, the 2000 Convention for the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific Ocean, the 2000 Framework Agreement for the Conservation of the Living Marine Resources of the High Seas of the South Pacific, the 2001 International Treaty on Plant Genetic Resources for Food, the 2001 Protocol on Fisheries to the Treaty of the Southern African Development Community, the 2002 Black Sea Biodiversity and Landscape Conservation Protocol to the Convention on the Protection of the Black Sea Against Pollution, the 2002 Convention for Cooperation in the Protection and Sustainable Development of Marine and Coastal Environment of the Northeast Pacific, the 2003 African Convention on the Conservation of Nature and Natural Resources, the 2008 Protocol on Integrated Coastal Zone Management in the Mediterranean, and the 2009 Convention on the Conservation and Management of High Seas Fishery Resources in the South Pacific Ocean.

[71] United Nations Framework Convention on Climate Change (New York, 9 May 1992; in force 21 March 1994), Article 2.

[72] Vienna Convention for the Protection of the Ozone Layer (Vienna, 22 March 1985, in force 22 September 1988), Article 1.2.

[73] United Nations Convention on the Law of the Sea (Montego Bay, 10 December 1982; in force 16 November 1994), Article 1.1.(4).

within the context of sustainable development',[74] thereby incorporating the elements of ecological integrity.

Perhaps more significantly, most of the key international environmental soft law instruments, including the World Charter for Nature,[75] the Rio Declaration on Environment and Development,[76] the Agenda 21,[77] the Draft International Covenant on Environment and Development,[78] the Earth Charter,[79] the Plan of Implementation of the World Summit on Sustainable Development,[80] and The Future We Want[81] contain the notion of ecological integrity in their cores. The Rio Declaration, which is arguably the most authoritative text in international environmental law, states in the preamble that the UN Conference on Environment and Development worked towards 'international agreements which respect the interests of all and protect the integrity of the global environmental and developmental system'. Furthermore, one of its core principles obligates states to 'cooperate in a spirit of global partnership to conserve, protect and restore the health and integrity of the Earth's ecosystem'.[82] This was in the spirit of the World Charter for Nature, which firmly established the integrity of ecosystems or species as a non-negotiable bottom line when achieving 'optimum sustainable productivity' of natural resources.[83]

The Earth Charter put the concept of ecological integrity at its very core as a central category. It urges 'all individuals, organizations, businesses, governments, and transnational institutions' to '[p]rotect and restore the integrity of Earth's ecological systems, with special concern for biological diversity and the natural processes that sustain life'.[84] Despite the uncertain legal status of the Earth Charter,[85] this document is significant as it was adopted as the civil society alternative to the Rio Declaration and was drafted through a global participatory process. The Charter has been formally endorsed by over 2,000 organizations,

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[74] Convention on Wetlands of International Importance, especially as Waterfowl Habitat (Ramsar, 2 February 1971; in force 21 December 1975), Resolution IX.1, Annex A.
[75] World Charter for Nature (UNGA Resolution A/RES/37/7, 28 October 1982).
[76] Rio Declaration on Environment and Development (UN Doc. A/CONF.151/26/Rev.1 (Vol. I), 14 June 1992).
[77] Agenda 21: Programme of Action for Sustainable Development (UN Doc. A/CONF.151/26, 14 June 1992)
[78] IUCN Environmental Law Programme, *Draft International Covenant on Environment and Development. Fourth Edition: Updated Text* (International Union for Conservation of Nature, 2010).
[79] Earth Charter Initiative, *The Earth Charter* (The Earth Charter Initiative, 2000)
[80] Plan of Implementation of the World Summit on Sustainable Development, Report of the World Summit on Sustainable Development (UN Doc. A/CONF.199/20, 4 September 2002)
[81] The Future We Want (UNGA Resolution A/RES/66/288, Annex, 11 September 2012).
[82] Rio Declaration on Environment and Development, n. 76 above, Principle 7.
[83] Ibid., Principle 4.
[84] Ibid., Principle 5.
[85] K. Bosselmann, 'Earth Charter (2000)', in: R. Wolfrum (ed.), *Max Planck Encyclopedia of Public International Law* (Oxford University Press, 2009).

including numerous national and international associations, and international organizations such as the United Nations Educational, Scientific and Cultural Organization, the United Nations University, and the International Union for Conservation of Nature.

And there is the Draft International Covenant on Environment and Development, which aims to achieve 'environmental conservation [as] an indispensable foundation for sustainable development'.[86] The first fundamental principle is to respect and safeguard '[n]ature as a whole and all life forms' as well as maintain and where necessary restore the 'integrity of the Earth's ecological systems'.[87] It includes an article on 'resilience', where it recognizes the limited capacity of natural systems and human communities to withstand and recover from environmental disturbances and stresses.[88] Notably, among the twelve fundamental principles, social equity concerns such as 'right to development' and 'eradication of poverty' are listed below the ecological principles.[89] Although still a draft, the inclusion here is significant because the Draft Covenant is a product of decades of work of leading scholars and practitioners, and has been regularly revised to reflect new developments in the field of international environmental law and development through a deliberative process with inputs from all around the world. It is intended as a codification of existing environmental law, and a blueprint for an international framework agreement on the environment.

4.2 An Interpretation of Ecological Integrity in Terms of Planetary Boundaries

What does ecological integrity mean, and how can it me measured? Despite the widespread usage in the international environmental instruments, the concept has not been clearly defined. Here we attempt to present a scientific definition of integrity at the planetary scale in light of the science of planetary boundaries and how the concept has been used in international law.

We propose to define integrity as a system property vis-à-vis the scientific concept of robustness or resilience. Robustness is a property that allows a system to maintain its

[86] IUCN Environmental Law Programme, n. 78 above, Article 1.
[87] Ibid., Article 2.
[88] Ibid., Article 9.
[89] Ibid., Articles 10 and 11.

functions in the face of disturbance.[90] It is often misunderstood to mean staying unchanged regardless of stimuli, so that the structure and components of the system is unaffected.[91] However, robustness is the maintenance of specific *functionalities* of the system against perturbations,[92] and it often requires the system to change its mode of operation in a flexible way. In other words, robustness maintains specific functions, while allowing changes in the structure and components of the system. The integrity, then, could be defined as a system property which is maintained through the robustness. If we apply this to ecosystems, ecological integrity would refer to 'the continued healthy or proper functioning of … global- and local-scaled ecosystems and their ongoing provision of renewable resources and environmental services'.[93]

The climate system would be useful as an example for illustrating how the notion of integrity can be applicable at the planetary scale. The climate is a complex adaptive system, which self-organizes within limits.[94] Strong evidence of planetary self-regulation comes from the 420,000-year isotope record contained in the Vostok ice core,[95] which shows the regular pattern of inferred atmospheric CO_2, methane concentrations and temperature through multiple glacial-interglacial cycles. The tightly constrained upper and lower bounds of all these variables are a typical feature of a complex adaptive system. If the atmospheric concentrations are pushed beyond the upper or lower bounds, we risk that the climate system might move into an unstable state, which could have disastrous consequences for humanity. Such behaviour reflects the non-linear system nature of the climate system. The natural sciences, therefore, focus less on the somewhat vague term 'sustainability' and more on the idea of 'resilience' at a systemic level, and attempt to measure this via indicators.[96] From a sustainable development perspective, the integrity of the climate system means the

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[90] C.S. Holling, 'Resilience and Stability of Ecological Systems', 4 *Annual Review of Ecology and Systematics* (1973), 1; S.A. Levin and J. Lubchenco, 'Resilience, Robustness, and Marine Ecosystem-based Management', 58 *BioScience* (2008), 27.
[91] H. Kitano, 'Biological Robustness', 5 *Nature Reviews - Genetics* (2004), 826.
[92] See S.A. Levin and J. Lubchenco, n. 90 above.
[93] B. Mackey, 'Ecological Integrity - A Commitment to Life on Earth', in: P.B. Corcoran, M. Vilela and A. Roerink (eds.), *The Earth Charter in Action* (KIT Publishers, 2005), 65, at 66. See also B.G. Mackey, 'The Earth Charter and Ecological Integrity – Some Policy Implications', 8 *Worldviews* (2004), 76.
[94] R.N. Jones, 'Analysing the Risk of Climate Change Using an Irrigation Demand Model', 14 *Climate Research* (2000), 89.
[95] J.R. Petit *et al.*, 'Climate and Atmospheric History of the Past 420,000 Years from the Vostok Ice Core, Antarctica', 399 *Nature* (1999), 429.
[96] See G. Whiteman, B. Walker and P. Perego, n. 13 above.

continued functioning of the global atmosphere within 'natural climate variability observed over comparable time periods'.[97]

The integrity of the Earth system as a whole can be interpreted, and therefore, defined in terms of planetary boundaries. There are so far nine identified planetary boundaries. Most thresholds that define these boundaries can be determined by a critical value for one or more control variables, such as carbon dioxide concentration.[98] When these thresholds remain uncrossed, the Earth system remains in the Holocene state, and the integrity of the Earth's life-support systems is maintained. We understand that the suggested threshold levels are preliminary estimates which need to be questioned and evaluated in the face of inherent scientific uncertainties. However, because thresholds do exist and we can choose values for control variables that are at a 'safe' distance from thresholds in a precautionary manner, the integrity of Earth's life-support systems is no longer an ambiguous or impractical concept. It can be measured and monitored,[99] hence even used as a direct measure of the legality of state behaviour.

4.3 Implications for International Sustainable Development Governance

How might the concept of integrity, if recognized as a single priority goal in post-2015 SDGs, be practically useful for sustainable development? A major practical usefulness comes from the normative hierarchy between sustainability and development which the concept establishes. For example, the UNFCCC aims to stabilize greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system, and within a time-frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economies to expand in a sustainable manner.[100] Implicit here is a tension between the climate stability and the general imperative of economic growth. The SDG formulated in terms of ecological integrity would strictly prioritize the protection of the climate system as a precondition for food security and economic growth.

Furthermore, the goal would prioritize maintaining the planetary integrity over myriad environmental objectives of treaties and institutions, thereby addressing trade-offs in a way that would ensure an improved environment overall. For example, in implementing

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[97] United Nations Framework Convention on Climate Change (New York, 9 May 1992; in force 21 March 1994), Article 1.2.
[98] See J. Rockström *et al.*, n. 9 above.
[99] S.W. Running, 'A Measurable Planetary Boundary for the Biosphere', 337 *Science* (2012), 1458.
[100] United Nations Framework Convention on Climate Change, n. 97 above, Article 2.

the UNFCCC and its Kyoto Protocol, their provisions would need to be interpreted and applied in a way that would consider and address unacceptable unintended consequences for biodiversity, hence creating a mutually supportive relationship between the climate treaty and biodiversity-related treaties in light of the priority goal. Consider, for example, climate mitigation externalities in the form of ocean acidification.[101] In accordance with the priority to safeguard the integrity of Earth's life-support systems as a whole, the UNFCCC would need to internalize the externalities. In a similar context, no large-scale geoengineering projects would be allowed because they involve risk of unacceptable unintended consequences.[102] This could possibly translate into less efficient climate change mitigation measures in the short term, but its aim is to ensure long-term global ecological integrity and sustainability.

5 Towards the Rule of Law for Sustainable Development

We have made a case for the integrity of Earth's life-support systems to be agreed to as a single priority for post-2015 SDGs. This section expands the argument further, and explores how the goal could be made legally binding. The rule of law is necessary because goal-setting is effective to the extent agents are willing and able to adhere to goals. We cannot rely totally on market incentives as they themselves cannot set environmental limits.[103]

5.1 Safeguarding the Integrity of Earth's Life-support Systems as a *Grundnorm* of International Law

It has been already pointed out by international environmental governance scholars that the concept of 'planetary boundaries' invites further exploration of the concepts of *jus cogens* (peremptory norms) of international law that no state may derogate from.[104] However, the case for *jus cogens* tolerates multiple environmental rules or principles to guide state actors,

[101] See R.E. Kim, n. 59 above.
[102] B. Allenby, 'A Critique of Geoengineering', 31 *IEEE Potentials* (2012), 22; V. Galaz, 'Geo-engineering, Governance, and Social-Ecological Systems: Critical Issues and Joint Research Needs', 17 *Ecology and Society* (2012); S. Barrett *et al.*, 'Climate Engineering Reconsidered', 4 *Nature Climate Change* (2014), 527.
[103] See K. Bosselmann, P.G. Brown and B. Mackey, n. 14 above; N. Kosoy *et al.*, 'Pillars for a Flourishing Earth: Planetary Boundaries, Economic Growth Delusion and Green Economy', 4 *Current Opinion in Environmental Sustainability* (2012), 74. See also P.G. Brown and G. Garver, *Right Relationship: Building a Whole Earth Economy* (Berrett-Koehler Publishers, 2009).
[104] See V. Galaz *et al.*, n. 14 above; B. Walker *et al.*, n. 14 above; F. Biermann, n. 41 above.

hence failing to address the issues which we have discussed in this paper. Furthermore, *jus cogens* of international law must be grounded on *opinio juris* (i.e., state practice), hence only a few, specific, sectoral commitments such as limiting the emissions of ozone depleting substances could be considered as potential *jus cogens*. Yet, no one has successfully identified any specifically environmental rules or principles with a *jus cogens* status.[105]

We suggest that this new commitment to safeguarding the integrity of Earth's life-support systems should be promoted as a basic norm or *grundnorm* of international law. The concept of a *grundnorm* is commonly understood as a fundamental legal principle or norm against which all other legal norms can be assessed and validated.[106] More specifically it should be seen as a basic norm to bind and guide governmental power.[107] Examples include the rule of law, the idea of justice or human rights. This understanding differs from Kelsen and is closer to Kant's argument that any positive law must be grounded in a 'natural' norm of general acceptance and reasonableness (*Vernunft*) to prevent pure arbitrariness (*blosse Willkür*). The existence of an environmental *grundnorm*, therefore, rests on the assumption that respecting planetary boundaries is a dictate of reason (*Gebot der Vernunft*) and general acceptance (*allgemeine Gültigkeit*).

Kant formulated the idea of a 'basic norm' (though he did not use this specific term) as a source of the validity of positive law in his 1797 work, *The Metaphysics of Morals* (commencing with a treatise on the philosophy of law).[108] In contrast to Kelsen, to whom the basic norm is simply an epistemological premise, Kant thinks the basic norm is a natural law (recognized by means of reason). For Kant, a legal system can consist entirely of positive law, but must be 'preceded by a natural law that establishe[s] the legislator's authority…to bind others simply by his arbitrary action'.[109] Alexy argues for a legal *grundnorm* to include 'content'.[110] He reinterprets Kelsen's basic norm as making a claim to substantive justice with respect to the content of the laws it purports to authorize. The basic

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[105] A. Boyle, 'Relationship Between International Environmental Law and Other Branches of International Law', in: D. Bodansky, J. Brunnée and E. Hey (eds.), *The Oxford Handbook of International Environmental Law* (Oxford University Press, 2007), 125.
[106] H. Kelsen, *Pure Theory of Law* (Reine Rechtslehre, 1967). See also U. Bindreiter, *Why Grundnorm? A Treatise on the Implications of Kelsen's Doctrine* (Kluwer Law International, 2002).
[107] See K. Bosselmann, n. 67 above; K. Bosselmann, 'Grounding the Rule of Law', in: H.C. Bugge and C. Voigt (eds.), *Rule of Law for Nature: Basic Issues and New Developments in Environmental Law* (Cambridge University Press, 2013).
[108] U. Bindreiter, n. 106 above, at 15.
[109] R. Alexy, *The Argument from Injustice* (Clarendon Press, 2002; translated by S.L. Paulson and B.L. Paulson), at 116, citing Kant, *Metaphysical Elements of Justice* (part 1 of *Metaphysics of Morals*).
[110] L. Vinx, *Hans Kelsen's Pure Theory of Law: Legacy and Legitimacy* (Oxford University Press, 2007), at 58, citing R. Alexy, *Begriff und Geltung des Rechts* (Freiburg, 1994), at 154-197 (English translation: *The Argument from Injustice*).

norm 'may include moral elements that take the argument of injustice into consideration. … [the basic norm] needs grounding'.[111]

Conceptually, a *grundnorm* exists independently of a legal system, but underpins legal reasoning in the form of an inference rule. In this way, the legal decision-making process, for example in courts, will always be informed by some fundamental concerns along the lines of the Kelsian idea of a *grundnorm*. By contrast, Kantian perspectives suggest the prevalence of common interest based on reasonableness and general acceptance. Only what can be assumed as reflecting the reasonably defined common interest could be considered as a *grundnorm*. Apart from the mentioned rule of law, the idea of justice or the concept of human rights[112], the preservation of natural conditions of life or integrity of Earth's life-supporting systems reflects common interest in this sense. No reasonable person would deny this. Effectively, *grundnorms* set benchmarks or default positions for processes of legal decision-making.

With respect to international environmental law, Adalheidur Jóhannsdóttir has examined this further.[113] Analysing the processes of legal decision-making on the protection of biological diversity, she asked: What is the law if there is no law? If a treaty contains - expressively or implicitly - no fundamental duty around ecological sustainability, then the default position is state sovereignty[114] with its traditional right to exploit and use natural resources. This is the crux. There is little incentive for states to be serious about ecological sustainability if they can rely on their default position. Consequently, the lack of serving the common interest goes in their favour of national sovereignty. According to Jóhannsdóttir to reverse this, the default position needs to be ecological sustainability.

As default law, an environmental *grundnorm* would underpin and guide the interpretation of existing and the creation of new laws.[115] As a 'core adjudicatory norm', it will help build systemic relationships between international rules by envisaging them as part

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[111] See R. Alexy, n. 109 above, at 147.

[112] On the rule of law as a *grundnorm* of international law, see K. Bosselmann, 'Grounding the Rule of Law', in: Voigt, C. (ed.), *Rule of Law for Nature: New Dimensions and Ideas in Environmental Law*, (Cambridge University Press, 2014), 75-93. On human rights as a *grundnorm* of international law, see E. Mendes, *Global Governance, Human Rights and International Law: Combating the Tragic Flaw* (Routledge, 2014), at 14.

[113] A. Jóhannsdóttir , The Significance of the Default: A Study in Environmental Law Methodology with Emphasis on Ecological Sustainability and International Biodiversity Law (Uppsala University Faculty of Law, 2009).

[114] Often referred to as a *grundnorm* in international law; see Mendes, n. 112 above, at 1.

[115] On the grundnorm character of the environment see also A. Philippopoulos-Mihalopoulos, Absent Environments: Theorising Environmental Law and the City (Routldege, 2007), 16; D. Fisher, Legal Reasoning in Environmental Law: A Study of Structure, Form and Language (Edward Elgar, 2013); G. Wickham and J.-A. Goodie, Legal and Political Challenges of Governing the Environment and Climate Change (Routledge, 2013), at 104.

of the shared purpose.[116] In the international law context, the principle of systemic integration of Article 31(3)(c) of the Vienna Convention on the Law of Treaties of 1969 could be further developed to help *grundnorms* to carry out this critical role.[117] Pursuant to this principle, international environmental agreements would, in theory, be interpreted and applied by reference to their normative environment, or 'any relevant rules of international law', especially *grundnorms* that are universally applicable.

5.2 A Post-2015 Institutional Framework for a Flourishing Earth

We anticipate that recognizing and implementing an environmental *grundnorm* may require a major reform in international environmental governance. The international community is in need of a new constitution-type agreement that will redefine the relationship between humans and the rest of the community of life. In the run up to Rio+20 Summit, the academic community called for a constitutional or charter moment,[118] or 'greening' the UN Charter.[119] Such a call for a defining moment in global governance can be traced at least to 1987, when the World Commission on Environment and Development called for creation of a 'universal declaration' in the form of a 'new charter to guide state behavior in the transition to sustainable development' and also recommended that the charter 'should prescribe new norms for state and inter-state behavior needed to maintain livelihoods and life on our shared planet'. In 1990, the former UN Secretary-General, Javier Perez de Cuellar, stated:

> The Charter of the United Nations governs relations between States. The Universal Declaration of Human Rights pertains to relations between the State and the individual. The time has come to devise a covenant regulating relations between humankind and nature.[120]

In this statement, the UN Secretary-General was referring to an overarching eco-constitutional framework that would identify living within ecological limits as a

[116] K. Bosselmann, n. 38 above, at 67.
[117] For a discussion on Article 31(3)(c) of the Vienna Convention on the Law of Treaties as the principle of systemic integration, see, e.g., C. McLachlan, 'The Principle of Systemic Integration and Article 31(3)(c) of the Vienna Convention', 54 *International and Comparative Law Quarterly* (2005), 279.
[118] See N. Kanie *et al.*, n. 14 above; F. Biermann *et al.*, 'Navigating the Anthropocene: Improving Earth System Governance', 335 *Science* (2012), 1306.
[119] F. Biermann, 'Greening the United Nations Charter: World Politics in the Anthropocene', 54 *Environment: Science and Policy for Sustainable Development* (2012), 6.
[120] Report of the Secretary-General on the Work of the Organization (UN Doc. A/45/1, 16 September 1990).

fundamental concern and commitment of all humanity. According to Bodansky, what we currently have is state-driven, 'thin' constitutionalism with vague general principles of international environmental law.[121] The Stockholm Declaration on the Human Environment,[122] the World Charter for Nature, and the Rio Declaration on Environment and Development contain important widely accepted principles in this regard, but most of these principles cannot be directly implemented. Although they proclaim objectives and, in some cases, provide directives to achieve them, but none of them state a general international obligation on all states to protect the whole of the environment, comparable to Article 192 of the Law of the Sea Convention.

Potential candidates for an international environmental constitution or covenant include the Draft International Covenant on Environment and Development and the Earth Charter which we discussed. In implementing this hypothetical agreement, it will be useful to have an international organization which has similar functions and capacity of the World Health Organization and International Labour Organization, mandated to protect the global environment. A practical option would be to make use of the UNEP, which has recently been strengthened by the UN General Assembly as 'the leading global environmental authority that sets the global environmental agenda'.[123] A key component of this upgrade was the UN Environment Assembly in place of the Governing Council of the UNEP. The Assembly will have universal membership of all UN member states, which would strengthen governance, and responsiveness and accountability of the UNEP to the member states.

From a planetary boundaries perspective, the upgraded UNEP must aim to promote 'the coherent implementation of the environmental dimension of sustainable development',[124] not 'sustainable development' as such. The environmental conservation goal must not be compromised within international environmental law.[125] However, it is yet uncertain what the upgraded UNEP will look like. Although the new UN Environment Assembly will certainly have more authority than its predecessor, the Governing Council of the UNEP, it will still be far from instituting 'a better way to make international law for the

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[121] D. Bodansky, 'Is There an International Environmental Constitution?', 16 *Indiana Journal of Global Legal Studies* (2009), 565.
[122] Declaration of the United Nations Conference on the Human Environment (UN Doc. A/Conf.48/14/Rev. 1, 16 June 1972).
[123] The Future We Want, n. 81 above, at paragraph 88.
[124] Ibid.
[125] D.K. Anton, 'The 2012 United Nations Conference on Sustainable Development and the Future of International Environmental Protection', 7 *Consilience: The Journal of Sustainable Development* (2012), 55.

environment' as proposed by Palmer.[126] In order to be an effective 'authoritative advocate for the global environment',[127] one option would be to consider giving the UN Environment Assembly a global trusteeship function over common concerns of humankind under international law, such as biodiversity conservation,[128] climate change,[129] and possibly the availability and use of fresh water.[130] The trusteeship duties will include global obligations for the integrity of planetary boundaries and the wellbeing of the greater community of life; overseeing markets to ensure that they are protective of non-market common goods; and ensuring impartiality between all interests along with respect for human rights and concern for ecological wellbeing.[131]

The trusteeship mandate will require that it has the means to stop individuals or states from degrading the global commons or transgressing planetary boundaries.[132] A major issue which has hampered the advancement of an international response to ecological issues is the lack of accountability for states in breach of their legal obligations. Traditionally, it has been up to states to call upon the International Court of Justice when another state acts outside of the bounds of their legal jurisdictions. However, problematically, both states have to agree upon the Court's jurisdiction, and in the past state have been able to avoid the legal ramifications of decisions by political manoeuvring. The upgraded UNEP should, therefore, be mandated with the power to act with dispute resolution mechanisms similar to those of the World Trade Organization.

Furthermore, a new institutional mechanism should allow states to unilaterally be able to take another to court.[133] The judgements entered into by the panel would need to be legally binding, and backed by sanctions. In the case of the global commons, where there is the issue of the lack of a plaintiff clearly qualified to demonstrate both standing and injury, the legal guardians could be drawn from existing international agencies such as the UNEP, and possibly from other non-governmental organizations such as WWF. This is similar in concept to guardians for infants, the insane, and the senile, or the UN Trusteeship Council that acted on behalf of yet-to-be state entities that are not legally recognized.

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[126] G. Palmer, 'New Ways to Make International Environmental Law', 86 *American Journal of International Law* (1992), 259.
[127] The Future We Want, n. 81 above, at paragraph 88.
[128] Convention on Biological Diversity (Rio de Janeiro, 5 June 1992; in force 29 December 1993), at Preamble.
[129] United Nations Framework Convention on Climate Change, n. 100 above, at Preamble.
[130] E. Brown Weiss, 'The Coming Water Crisis: A Common Concern of Humankind', 1 *Transnational Environmental Law* (2012), 153.
[131] See K. Bosselmann, P.G. Brown and B. Mackey, n. 14 above.
[132] K. Bosselmann, Earth Governance: Trusteeship for the Global Commons (Edward Elgar, forthcoming 2015).
[133] See K. Bosselmann, P.G. Brown and B. Mackey, n. 14 above.

6 Conclusion

The scientific community has a consensus on where the Earth system is likely to be heading, the largely unknown Anthropocene. If the business-as-usual trend continues, humanity is very likely to face disastrous consequences in the next few decades. Due to the complex nature of the Earth's social-ecological system, the changes will not be incremental but likely be abrupt, involving a societal collapse.[134] To avoid the collapse, human societies must find ways to protect Earth's life-support systems as an absolute precondition for human existence and development.

This paper drew on the latest scientific findings and their implications for effective legal governance of planetary boundaries. The key argument we put forward is that post-2015 SDGs must be organized around a single priority at the apex of the goal-system hierarchy. We define the priority goal as the protection of the biophysical preconditions that are essential for long-term sustainable development. Our case stands in contrast to other more common claims for twin priorities of environmental protection and poverty eradication.[135] We insist that all other interests such as socio-economic development, albeit important, must be subordinated under this ultimate biophysical priority goal.

In search of the core concept around which this priority goal could be defined, we identified the notion of ecological integrity as an emerging common denominator among international legal documents. Integrity is a system property maintained by resilience of robustness of the system. At the Earth system level, the integrity can be measured and monitored through multiple control variables associated with interlined planetary boundaries. In general terms, the integrity is maintained if the Earth system stays in the Holocene, but it is lost if human-induced stress reduces the robustness and Earth undergoes a regime shift into the Anthropocene.

We propose to adopt safeguarding the integrity of Earth's life-support systems as the priority goal for post-2015 SDGs. For an effective implementation of post-2015 SDGs, the priority goal needs to be legally binding. To that end, the goal should be recognized as a *grundnorm*, and instituted through global eco-constitutionalism. Where there is a regulatory gap, this *grundnorm* fills in the void. Where there is already a treaty obligation, it reinforces and clarifies treaty obligations in light of the planetary boundaries framework. The

[134] J. Diamond, Collapse: How Societies Choose to Fail or Succeed (Viking Press, 2005).
[135] D. Griggs *et al.*, n. 8 above.

grundnorm could be implemented through the upgraded UNEP as a trustee and a legal guardian for the global commons and common concerns of humankind. These institutional building blocks would constitute the core of the next generation of international environmental law, which could be called 'Earth system law'.[136]

[136] R.E. Kim and B. Mackey, 'International Environmental Law as a Complex Adaptive System', 14 *International Environmental Agreements: Politics, Law and Economics* (2014), 5.