1. Framing the sustainability questions

John C. Dernbach

Few energy issues in recent decades have proven as contentious as shale gas. The rapid recent development of shale gas in the United States has reduced gas prices, helped the U.S. economy recover from the recent recession, reduced U.S. dependence on foreign energy supplies, and apparently helped reduce U.S. greenhouse gas emissions. But adverse air and water quality impacts, as well as community disruption, and concerns about its effect on efforts to mitigate climate change all raise large questions about the desirability of shale gas. Supporters and opponents often speak in such strikingly divergent terms that they seem to be describing different activities. Typically, supporters point to the economic and security impacts of shale gas, and minimize the adverse environmental and social effects. Opponents often point to negative environmental and social impacts, and downplay the economic and security effects. Because each side emphasizes some effects and de-emphasizes others, it is hard to get a sense of the overall picture.

Sustainable development would force a more complete understanding of whether shale gas contributes to overall human well-being. Conventional development, which is based on both economic and social development and requires a foundation of peace and security, tends to adversely affect both the environment and people who depend on that environment.¹ To its critics, shale gas is just another version of conventional development, and even, because it is a fossil fuel, a particularly pernicious version. Sustainable development, in partial contrast, would further the economic, security, and social goals of conventional development, but would also protect the environment and the people who depend on it – at the same time.²

¹ John C. Dernbach, Patricia E. Salkin, and Donald A. Brown, *Sustainability as a Means of Improving Environmental Justice*, 19 MO. J. ENVTL. AND SUSTAINABILITY L. 1 (2012).

² John C. Dernbach, *Sustainable Development as a Framework for National Governance*, 49 CASE W. RES. L. REV. 1 (1998).

Is shale gas development sustainable? If not, can law and policy actually make shale gas development sustainable, or are there inherent sustainability issues or problems with shale gas development that cannot be solved by law or policy? These represent one set of questions that this book attempts to answer.

But it is not enough for shale gas to contribute *to some degree* to environmental protection, economic and social development, and peace and security. Extreme poverty is still widespread and environmental conditions around the world continue to deteriorate.³ Concentrations of greenhouse gases in the atmosphere are rising, and are already at levels that have not been seen for at least 800,000 years.⁴ The 2012 United Nations Conference on Sustainable Development thus emphasized the need to ‘accelerate progress’ toward sustainability.⁵ Similarly, the parties to the 2012 Conference of the Parties of the United Nations Framework Convention on Climate Change agreed on the importance of ‘accelerating the reduction of global greenhouse gases.’⁶ So the question is not simply: how do we achieve sustainable development? The question, rather, is: how do we accelerate the transition?⁷ In this book, the more specific

³ UNITED NATIONS ENVIRONMENT PROGRAMME, GLOBAL ENVIRONMENTAL OUTLOOK 5: ENVIRONMENT FOR THE FUTURE WE WANT (Nairobi: United Nations Environment Programme 2012), accessed 25 Sept. 2015 at http://www.unep.org/geo/pdfs/geo5/GEO5_report_full_en.pdf.

⁴ 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 11 (Cambridge: Cambridge University Press 2013).

⁵ United Nations Conference on Sustainable Development, *The Future We Want*, para 19, in Report of the United Nations Conference on Environment and Development, U.N. Doc. A/CONF.216/16 (24 July 2012), accessed 22 Sept. 2015 at <http://www.uncsd2012.org/content/documents/814UNCSD%20REPORT%20final%20revs.pdf>.

⁶ Conference of the Parties, U.N. Framework Convention on Climate Change, *Advancing the Durban Platform*, Decision 2/CP.18, FCCC/CP/2012/8/Add.1 (2012), accessed 25 Sept. 2015 at https://unfccc.int/files/bodies/election_and_membership/application/pdf/decision_2_cp18_adp_bureau.pdf.

⁷ JOHN C. DERNBACH, ROBERT ADLER, RACHEL ARMSTRONG, JENNIFER BAKA, ATHENA BALLESTEROS, GARY D. BASS, DONALD A. BROWN, CARL BRUCH, WYNN CALDER, FEDERICO CHEEVER, MARIAN R. CHERTOW, JAIMIE P. CLOUD, ILONA COYLE, ROBIN KUNDIS CRAIG, JULIAN DAUTREMONT-SMITH, MICHAEL DiRAMIO, CATHERINE EASTON, ANNE H. EHRLICH, JOEL B. EISEN, JONATHAN BARRY FORMAN, LYNN R. GOLDMAN, KIRK HERBERTSON, DIETER T. HESSEL, KEITH H. HIROKAWA, LEO HERRIGAN, FRANCES IRWIN, KEVIN KENNEDY, JOHN

questions are: (1) can shale gas can help accelerate the transition to sustainability, and (2) if so, how? This is the second set of questions this book attempts to answer.

The answers to both sets of questions depend on an understanding of what sustainable development actually requires.

SUSTAINABLE DEVELOPMENT – AN OVERVIEW

Sustainable development and sustainability are used synonymously so often that it is easy to overlook or ignore the term ‘development,’ treating it as unnecessary or, alternatively, part of the problem. Yet understanding development is essential to understanding what sustainable development means.⁸ For many in the United States and other developed countries, development is the name given to a specific project or activity that replaces a field, woodlot, or forest with housing, a parking lot, or a shopping mall. This understanding captures some core truths about development, but it does not tell the whole story. At the international level, where the term sustainable development first came to prominence, development includes but is not limited to economic development. It also includes social well-being – for example, education, housing, employment, health care, and healthy communities – all of which contribute to economic development but which have the broader effect of improving human quality of life. Development requires a foundation of peace and security; without that, little else is possible. The basic objectives of development are to protect and foster human freedom, opportunity, quality of life, and well-being.

A. (‘SKIP’) LAITNER, JEANNINE M. LA PRAD, AMY E. LANDIS, ROBERT LAWRENCE, MARK D. LEVINE, REID LIFSET, ROBERTA MANN, BRIAN MCNAMARA, JOEL A. MINTZ, CRAIG OREN, BRADLEY C. PARKS, TRIP POLLARD, DAVID REJESKI, ED RICHARDS, J. TIMMONS ROBERTS, K.W. JAMES ROCHOW, PATRICIA E. SALKIN, JIM SALZMAN, BRENT STEEL, KURT A. STRASSER, SUSANNA SUTHERLAND, DAN TARLOCK, MICHAEL J. TIERNEY, JONATHAN WEISS, AND CHRISTOPHER WILLIAMS, ACTING AS IF TOMORROW MATTERS: ACCELERATING THE TRANSITION TO SUSTAINABILITY (Washington, D.C.: Environmental Law Institute Press 2012).

⁸ The iconic definition of sustainable development is ‘development that meets the needs of the present without compromising the ability of future generations to meet their own needs.’ WORLD COMMISSION ON ENVIRONMENT AND DEVELOPMENT, *OUR COMMON FUTURE* 43 (Oxford and New York: Oxford University Press 1987).

Whether we know it or not, this understanding of development is central to our lives. Since at least the end of World War II, we have measured progress (or the lack of progress) in terms of economic growth, improvements in human education and health, and the relative absence of major disruptive wars. But this progress has come at a price.

Two enormous challenges – growing environmental degradation and huge unmet human needs – define much of the basic context for human civilization for the foreseeable future. These challenges have prompted governments, at least officially, to modify the basic framework for achieving human well-being. Instead of conventional development or, more simply, development – they are now seeking *sustainable* development.

As shown in numerous studies and reports from around the world, conventional development has caused or contributed to widespread environmental degradation. As the World Commission on Environment and Development explained in its landmark 1987 report, *Our Common Future*, a foundational idea for sustainability is that the environment itself imposes limits on the manner in which economic and social development can be effectively conducted.

Growth has no set limits in terms of population or resource use beyond which lies ecological disaster. Different limits hold for the use of energy, materials, water, and land. ... But ultimate limits there are, and sustainability requires that long before these are reached, the world must ensure equitable access to the constrained resource and reorient technological efforts to relieve the pressure.⁹

A great deal of scientific research has been conducted on particular issues, in particular ecosystems, by individual scientists or teams of scientists. Much of this research is summarized and synthesized in periodic reports. According to the United Nations Environment Program, ‘all components of the environment – land, water, biodiversity, oceans and atmosphere – continue to degrade.’¹⁰ The population of wild vertebrate species declined 31 percent between 1970 and 2006; nearly a

⁹ Id. at 45.

¹⁰ UNITED NATIONS ENVIRONMENT PROGRAM, KEEPING TRACK OF OUR CHANGING ENVIRONMENT: FROM RIO TO RIO+20 (1992–2012) (Nairobi: United Nations Environment Programme 2012), accessed 25 Sept. 2015 at http://www.unep.org/geo/pdfs/keeping_track.pdf.

quarter of all plant species are threatened with extinction.¹¹ In addition, there is growing evidence that ‘extinctions are altering key processes important to the productivity and sustainability of Earth’s ecosystems.’¹²

The concept of ‘planetary boundaries’ provides a way of understanding the space within which humans can operate safely, and scientific evidence indicates that several of these boundaries have already been crossed. ‘Planetary boundaries define, as it were, the boundaries of the “planetary playing field” for humanity if we want to be sure of avoiding major human-induced environmental change on a global scale.’¹³ The consequences of crossing those boundaries are likely to be severe: ‘Transgressing one or more planetary boundaries may be deleterious or even catastrophic due to the risk of crossing thresholds that will trigger non-linear, abrupt environmental change within continental-to-planetary-scale systems.’¹⁴ At least nine such boundaries exist, and three have already been transgressed: ‘climate change, rate of biodiversity loss, and changes to the global nitrogen cycle.’¹⁵

Across all countries and environmental issues, one of the basic underlying causes is the growing consumption of energy, materials, water, and land, with resulting increases in environmental pollution and degradation. According to one calculation, it would take nearly five Earths to produce the resources necessary to supply everyone in the world at the level now consumed by the average American.¹⁶ The other is

¹¹ SECRETARIAT OF THE CONVENTION ON BIOLOGICAL DIVERSITY, GLOBAL BIODIVERSITY OUTLOOK 3 (2010). accessed 25 Sept. 2015 at <http://www.cbd.int/doc/publications/gbo/gbo3-final-en.pdf>.

¹² David U. Hooper, E. Carol Adair, Bradley J. Cardinale, Jarrett E.K. Byrnes, Bruce A. Hungate, Kristin L. Matulich, Andrew Gonzalez, J. Emmett Duffy, Lars Gamfeldt, and Mary I. O’Connor, *A Global Synthesis Reveals Biodiversity Loss as a Major Driver of Ecosystem Change*. 485 NATURE 105 (2012).

¹³ Johan Rockström, Will Steffen, Kevin Noone, Åsa Persson, F. Stuart Chapin III, Eric Lambin, Timothy M. Lenton, Marten Scheffer, Carl Folke, Hans Joachim Schellnhuber, Björn Nykvist, Cynthia A. de Wit, Terry Hughes, Sander van der Leeuw, Henning Rodhe, Sverker Sörlin, Peter K. Snyder, Robert Costanza, Uno Svedin, Malin Falkenmark, Louise Karlberg, Robert W. Corell, Victoria J. Fabry, James Hansen, Brian Walker, Diana Liverman, Katherine Richardson, Paul Crutzen, and Jonathan Foley, *Planetary Boundaries: Exploring the Safe Operating Space for Humanity*, 14 ECOLOGY AND SOC’Y 32, 32 (2009).

¹⁴ Id.

¹⁵ Id.

¹⁶ Global Footprint Network, *Earth Overshoot Day Media Backgrounder* (2009), accessed 1 Oct. 2015 at http://www.footprintnetwork.org/images/uploads/EO_Day_Media_Backgrounder.pdf.

the growing global human population, which was about 3 billion in 1960, is about 7.2 billion at present, and is projected to reach 9 billion by 2040.¹⁷ It is probable that the global human population will not stabilize this century as had previously been projected, and will increase to between 9.6 billion and 12.3 billion by 2100.¹⁸ In general, developed countries tend to have a greater per-capita environmental impact than developing countries – in spite of their relative success in reducing air and water pollution.

Environmental pollution and degradation also harms the people who depend on the affected ecological systems and resources, compromising their health and safety and reducing the availability of quality resources on which they depend. Environmental degradation thus puts many people in a worse situation than they would otherwise have been, and contributes to widespread poverty. If development is progress, this is the price of progress.

The large and growing price of progress threatens development in two distinct ways. First, it undermines the physical foundation for development by damaging human health, undermining the resource base on which economic development depends, and raising the potential for conflict by contributing to resource shortages and scarcity. Second, it undermines the moral or ethical legitimacy of development; it is simply not right that some people benefit while others are made worse off in absolute terms, whether those others are now living or are in future generations.

This model of conventional development tracks with substantial accuracy much of what has happened with shale gas development to date. Shale gas development has some enormously positive attributes; it has fostered direct economic development in the gas industry and indirect economic development by lowering gas prices and through the multiplier effects of shale gas extraction. It has created a contested but nonetheless significant number of new jobs. By displacing coal, it has also reduced air pollution and, perhaps, the emission of greenhouse gases. It has also reduced U.S. dependence on foreign energy supplies. On the other hand,

¹⁷ U.S. Census Bureau, *World Population: 1950–2050* (2015), accessed 24 May 2015 at <https://www.census.gov/population/international/data/idb/worldpopgraph.php>.

¹⁸ Patrick Gerland, Adrian E. Raftery, Hana Ševčíková, Nan Li, Danan Gu, Thomas Spoorenberg, Leontine Alkema, Bailey K. Fosdick, Jennifer Chunn, Nevena Lalic, Guiomar Bay, Thomas Buettner, Gerhard K. Heilig, and John Wilmoth, *World Population Stabilization Unlikely This Century*, 346 *SCIENCE* 234 (10 Oct. 2014).

shale gas development has profoundly changed the character of many areas that previously lacked any oil and gas development, has imposed costs on local government for increased police and other services as well as wear and tear on roads and other infrastructure. It has also caused surface water pollution, adversely affected water supplies, caused air pollution, and may be leading to methane emissions at a level that offsets the greenhouse gas reduction achieved by displacing coal.

While environmental degradation was one of the driving forces behind the decision to sustainable development, it was not the only driving force. The other was poverty. While the number of people living in poverty has declined over the past several decades, more than two billion people lived on less than two dollars per day in 2011.¹⁹ Environmental degradation is both a cause of poverty (making it harder for people to live healthy and productive lives) and an effect of poverty (leading humans to damage the environment in order to survive). But while poverty is related to environmental degradation, it also means that development is not fully effective on its own terms.

In response to these challenges, the world's nations decided at the 1992 United Nations Conference on Environment and Development in Rio de Janeiro (also known as the Earth Summit) to modify the way that they sought development. Instead of achieving economic development, peace and security, and social development or human rights at the environment's expense, they would achieve those goals and protect and restore the environment at the same time. They did not abandon the idea of development; they agreed to modify it. *Sustainable* development, they reasoned, would both protect the environment and reduce large-scale poverty. The non-legally binding agreements reached in Rio, including a comprehensive plan of action for sustainable development called Agenda 21²⁰ and a statement of 27 sustainable development principles called the

¹⁹ World Bank, *Poverty Overview* (2015), accessed 24 May 2015 at <http://www.worldbank.org/en/topic/poverty/overview>.

²⁰ United Nations Conference on Environment and Development, *Agenda 21*, U.N. Doc. A/CONF.151/26 (1992), accessed 25 Sept. 2015 at <https://sustainabledevelopment.un.org/content/documents/Agenda21.pdf>. As this book went to press, the United Nations General Assembly adopted a new sustainable development agenda. Transforming Our World: The 2030 Agenda for Sustainable Development, G.A. Res. 70/1, U.N. Doc. A/RES/70/1 (25 Sept. 2015), accessed 2 Nov. 2015 at http://www.un.org/ga/search/view_doc.asp?symbol=A/RES/70/1&Lang=E.

Rio Declaration on Environment and Development,²¹ would be carried out in each country, based on the circumstances and conditions each country faced.²²

Sustainable development would integrate two seemingly separate and incompatible spheres – development and environment. Both would be treated as equal in importance; neither would dominate or trump the other, and both would be achieved at the same time. The word ‘would’ is used here because sustainable development is a normative term. Sustainable development is also the opposite of what we mostly experience now – unsustainable development.

The key action principle for sustainable development is integrated decision making.²³ The root problem with conventional development, as agreed by the countries at the Earth Summit, is that development decisions are made with insufficient regard for the environment and the people who depend on it. Thus, the Rio Declaration says: ‘In order to achieve sustainable development, environmental protection shall constitute an integral part of the development process and cannot be considered in isolation from it.’ While there are a variety of ways to understand and apply integrated decision making, a useful starting point is to recognize that development and environment need to be given the same weight in the decision-making process.²⁴

Sustainable development is thus not anti-development; rather, it is an ambitious effort to redirect development. Sustainable development requires not only economic development and social well-being based on a foundation of peace and security; it also requires protection and restoration of the environment. When development does that, the adverse effects of conventional development on the environment and other humans do not occur. Sustainable development maximizes the positive effects of development by limiting or preventing the negative effects.

²¹ United Nations Conference on Environment and Development, *Rio Declaration on Environment and Development*, U.N. Doc. A/CONF.151/5/Rev.1, 31 I.L.M. 874 (3–14 June 1992), accessed 25 Sept. 2015 at <http://www.unep.org/Documents.Multilingual/Default.asp?documentid=78&articleid=1163>. For a detailed explanation of each of the principles contained in the Rio Declaration, see THE RIO DECLARATION ON ENVIRONMENT AND DEVELOPMENT: A COMMENTARY (Jorge E. Viñuales ed., Oxford: Oxford University Press 2015).

²² For a more detailed explanation, see *Sustainable Development as a Framework for National Governance*, *supra* note 2, at 17–33.

²³ John C. Dernbach, *Achieving Sustainable Development: The Centrality and Multiple Facets of Integrated Decisionmaking*, 10 IND. J. GLOBAL LEG. STUD. 247 (2003).

²⁴ *Id.* at 262–5.

Sustainable development is also deeply anthropocentric or human centered. It shares with conventional development the goals of protecting and fostering human freedom, opportunity, quality of life, and well-being. Some find that objective inappropriate, arguing that the only appropriate approach is to protect the environment for its own sake, and not for the sake of humans. Yet sustainable development's human-centered orientation is also pragmatic. Far from compromising environmental protection, the identification of human self-interest with environmental protection is essential to protecting the environment in both the short run and the long run. In fact, the term sustainable development was first employed in 1980 by the International Union for the Conservation of Nature and Natural Resources (IUCN) – a non-governmental environmental organization – in a report arguing that the only effective way to achieve conservation of living resources is to integrate their conservation with development.²⁵

Finally, sustainable development has a deep ethical dimension, anchored as it is in a criticism of conventional development as unfair to both current and future generations.²⁶ Sustainable development is also just development. In the long run, it could be argued, sustainable development is more likely to last because it is more consistent with basic human values concerning justice.

Sustainable development opens up a space for innovation in law, policy, technology, behavior, and other fields that historically did not exist, at least not in any broad or significant way. The predominant cultural frame for understanding the human relationship to the environment is development *or* environment, but not both. In effect, people and organizations are forced to choose sides. Proponents of each tend to make arguments that, if taken seriously, would advance their position at the expense of the other. This does not usually occur in pure form; proponents of each are willing to tolerate some recognition of the other as long as it does not compromise their primary objective. Because they see things from the standpoint of their primary objective, however, people and organizations develop and advance proposals with that primary objective in mind.

²⁵ INTERNATIONAL UNION FOR THE CONSERVATION OF NATURE AND NATURAL RESOURCES, *WORLD CONSERVATION STRATEGY: LIVING RESOURCE CONSERVATION FOR SUSTAINABLE DEVELOPMENT* (Gland, Switzerland: International Union for Conservation of Nature and Natural Resources 1980), accessed 25 Sept. 2015 at <http://data.iucn.org/dbtw-wpd/edocs/WCS-004.pdf>.

²⁶ EDITH BROWN WEISS, *INTERNATIONAL LAW, COMMON PATRIMONY, AND INTERGENERATIONAL EQUITY* (Ardsley, N.Y.: Transnational Publishers 1989).

Sustainable development, by contrast, advances a third position that has not ordinarily even been recognized: development *and* environment. In so doing, sustainable development provides a way for humans to live in harmony with nature, rather than at nature's expense, as we have for centuries. For that reason, it may be one of the most important ideas to come out of the twentieth century.

The challenge we face – with a growing global population; a growing global economy; a warming climate and deteriorating environment; and vast unmet human needs, particularly in developing countries – is to populate that space with new and innovative ideas, technologies, policies, institutions, behaviors, and laws that foster both genuine development and genuine environmental protection at the same time. These new approaches must not only work and occur at a large enough scale to be effective; they must also be consistent with the values, history, and culture of the places where they are applied. These challenges are enormous, but sustainable development at least provides a framework for addressing them.

In many sectors, there are dedicated practitioners, organizations, and businesses that have thought deeply about what sustainable development means and why it is attractive, and whose day-to-day job is to make it happen, fix what does not work, and improve results. They are engaged in a wide variety of fields, including agriculture, manufacturing, technology, community planning and development, business and industry, government, education, building construction, engineering, and law. Some of the most prominent examples are in green building, sustainable forestry, higher education, community sustainability, and business sustainability. For shale gas, the sustainability effort is much less well developed. In the United States, a Center for Sustainable Shale Development has developed standards for sustainable shale development and created a third-party certification program for compliance with those standards.²⁷ As of this writing, however, certification is limited to less than a handful of companies.²⁸

That said, the meaning and applicability of sustainable development are deeply contested. To some degree, this is due to the way in which sustainable development challenges conventional ways of thinking, particularly the binary 'development *or* environment' approach in which

²⁷ Center for Sustainable Shale Development, Home, accessed 25 May 2015 at <https://www.sustainables shale.org/>.

²⁸ Center for Sustainable Shale Development, News, accessed 25 Sept. 2015 at <https://www.sustainables shale.org/news/> (showing press releases for certification of each of three companies).

environment-related issues are traditionally framed. If people are not looking for a third approach, they tend not to even see it. To some degree, too, this is also due to the predominance of unsustainable development at present; the many examples of unsustainable development make it hard to picture a more sustainable world or even believe that it is possible. Because a human generation has passed since the 1992 Earth Summit, moreover, many people do not understand the historical and functional meanings that accompanied the formulation of sustainable development, opting instead for various dictionary or common-usage meanings, and simply seeing sustainability as the new term for something vaguely green.

In addition to these sources of confusion, moreover, is the stark reality that sustainable development, if taken seriously, would profoundly challenge existing ways of doing many things, including energy production and consumption. Those with a stake in the outcome – and there are many – thus have an enormous incentive to shape and control the public understanding of sustainable development in ways that advantage them or at least blunt the basic messages of sustainability. Much corporate ‘green-washing’ – false or misleading claims about the supposed environmental benefits of a particular product or service – reflects that basic point.

None of these challenges to understanding sustainable development undermine the legitimacy of its underlying approach to maintaining and improving the human condition in the face of enormous obstacles. In fact, this book is premised on the view that sustainable development creates a normative conceptual framework that is sufficiently precise to provide a basis for evaluating shale gas development. These challenges do, however, underscore the importance of an understanding of the term that is grounded in its history and purpose.

As will be seen in the remainder of this book, the Rio Declaration provides a remarkably useful set of tools for analysing and evaluating laws and policies for sustainable development. These include not only integrated decision making but a variety of supporting principles (for example, public participation, public information, and access to justice; sustainable production and consumption; the polluter-pays principle). Agenda 21, the plan of action for sustainable development adopted at the Earth Summit, has become somewhat dated with the passage of time; the best thinking about sustainable development has evolved considerably since 1992. The Rio Declaration, by contrast, has proven more enduring because it states principles of sustainable development.²⁹

²⁹ Cf. Jorge E. Viñuales, *The Rio Declaration on Environment and Development: Preliminary Study*, in THE RIO DECLARATION ON ENVIRONMENT AND

URGENCY OF SUSTAINABLE DEVELOPMENT: ACCELERATING THE TRANSITION

These principles need to be employed, not just on behalf of some abstract effort toward sustainable development at some point in time, but rather to make the transition as rapidly as possible. Although the environmental, population, and poverty issues described above lead to that conclusion, the challenge of addressing climate change underscores this point with particular urgency and clarity.

The objective of the United Nations Framework Convention on Climate Change is the ‘stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system.’³⁰ While the Convention itself does not specify what that concentration is, the conference of the parties to the convention has translated that objective as ‘a likely chance of holding the increase in global average temperature below 2°C or 1.5°C above pre-industrial levels.’³¹ Scientists have begun calculating how much additional carbon dioxide and other greenhouse gas emissions can be emitted before that temperature increase will be exceeded. Their calculations can be explained in terms of a carbon budget.

According to the Intergovernmental Panel on Climate Change, the world cannot emit more than 1,010 additional gigatons³² of carbon dioxide equivalent if we are to have a two-in-three chance of not

DEVELOPMENT: A COMMENTARY, *supra* note 21, at 1, 60 (‘[T]he Rio Declaration is the only international instrument adopted by consensus that brings together, around a common backbone, most foundational principles of international environmental law ... placing them in a developmental perspective ... in an attempt to conciliate them with socio-economic development’).

³⁰ United Nations Framework Convention on Climate Change, art. 2, 29 May 1992, S. TREATY DOC. NO. 102-38, 1771 U.N.T.S. 107, U.N. Doc. A/AC.237/18 (Part II)/Add.1; 31 I.L.M. 849.

³¹ See, for example, Conference of the Parties, United Nations Framework Convention on Climate Change, *Decision 1/CP.17 (Establishment of an Ad Hoc Working Group on the Durban Platform for Enhanced Action)*, in REPORT OF THE CONFERENCE OF THE PARTIES ON ITS SEVENTEENTH SESSION, HELD IN DURBAN FROM 28 NOVEMBER TO 11 DECEMBER 2011, ADDENDUM, PART TWO: ACTION TAKEN BY THE CONFERENCE OF THE PARTIES AT ITS SEVENTEENTH SESSION, FCCC/CP/2011/9/Add.1 (2012), accessed 25 Sept. 2015 at <http://unfccc.int/resource/docs/2011/cop17/eng/09a01.pdf>.

³² A gigaton is one billion tons.

exceeding a temperature increase of 2°C.³³ At current emissions trajectories, how long will it take before we blow these budgets? By its assessment, global greenhouse gas emissions need to be 40 to 70 percent lower by 2050 and ‘near zero’ gigatons of carbon dioxide equivalent or ‘below’ by 2100.³⁴

Other calculations of a carbon budget provide less time to get emissions that low. The writers of a frequently cited 2009 paper in *Nature* focus on the time period between 2000 and 2050, not 2000 and 2100, and calculate carbon budgets to avoid exceeding 2°C based on cumulative emissions in the first half of this century.³⁵ Given past and projected emissions, they conclude, ‘we would exhaust the CO₂ emission budget by 2024, 2027 or 2039, depending on the probability accepted for exceeding 2°C (respectively 20%, 25% or 50%).’³⁶

Others are less certain that the world can increase global temperatures by 2°C without severe adverse consequences. They would argue that 1.5°C, or an even lower temperature limit, would be even better.³⁷ Thus, based on many of the principles described above, including the precautionary approach and intergenerational equity, we should reduce greenhouse gas emissions to an ultimate goal of zero, and then below zero, as rapidly as possible. We must, in other words, accelerate the transition to sustainability.

³³ CLIMATE CHANGE 2013: THE PHYSICAL SCIENCE BASIS, *supra* note 4, at 27.

³⁴ INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, CLIMATE CHANGE 2014: MITIGATION OF CLIMATE CHANGE: CONTRIBUTION OF WORKING GROUP III TO THE FIFTH ASSESSMENT REPORT OF THE INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE 13 (Cambridge: Cambridge University Press 2014) (footnote and emphasis in first sentence omitted). The term ‘likely’ means a ‘66–100%’ chance of a particular outcome. *Id.* at 4, no. 2.

³⁵ Malte Meinshausen, Nicolai Meinshausen, William Hare, Sarah C.B. Raper, Katja Frieler, Reto Knutti, David J. Frame, and Myles R. Allen, *Greenhouse-gas Emission Targets for Limiting Global Warming to 2°C*, 458 NATURE 1158 (30 April 2009).

³⁶ *Id.* at 1159.

³⁷ James Hansen, Pushker Kharecha, Makiko Sato, Valerie Masson-Delmotte, Frank Ackerman, David J. Beerling, Paul J. Hearty, Ove Hoegh-Guldberg, Shi-Ling Hsu, Camille Parmesan, Johan Rockstrom, Eelco J. Rohling, Jeffrey Sachs, Pete Smith, Konrad Steffen, Lise Van Susteren, Karina von Schuckmann, and James C. Zachos, *Assessing ‘Dangerous Climate Change’: Required Reduction of Carbon Emissions to Protect Young People, Future Generations and Nature*, 8 PLOS ONE e81648 (2013). See also Jeff Tollefson, *Global-warming Limit of 2°C Hangs in the Balance*, 520 NATURE 14 (2 April 2015).

In practice, the distinction between making development sustainable and accelerating the transition can be blurred. Each action taken by government, business, or nongovernmental organizations results in movement toward or away from sustainability, and a commitment to that action for some shorter or longer period of time afterwards. Still, it is possible to take actions that move in a genuinely sustainable direction, but then take too few of them, or without enough ambition, or at an insufficient scale, to make a meaningful difference.

SUMMING UP: A NORMATIVE FRAMEWORK FOR EVALUATING SHALE GAS

Sustainable development, then, provides a normative and reasonably precise framework for evaluating laws and policies on nearly any subject. For sustainable shale gas development, this framework can be summarized in terms of three overall criteria. To be sustainable, shale gas development:

1. requires a sophisticated and comprehensive regulatory system to protect the environment and public health as well as a legal and policy framework capable of ensuring both significant social and economic benefits and ensuring that no one is made socially or economically worse off in absolute terms;
2. must be nested in ambitious national and international energy and climate change laws to ensure that it is a bridge fuel to a sustainable future, and does not delay or divert from that objective; and
3. must occur within a political and legal system that is committed to accelerating the transition to sustainability.

In the chapters that follow, the contributing authors assess the sustainability of shale gas based on the framework described in this chapter. As will be seen, a great deal can be learned about how shale gas development should occur by employing this framework.