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INVITED ARTICLE

Confronting the Challenge of Energy Governance

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Abstract
There is a compelling argument for developing a low carbon emissions trajectory to mitigate climate change and for doing so urgently. What is needed is a transformation of the energy sector and an 'energy revolution'. Such a revolution can only be achieved through effective energy governance nationally, regionally, and globally. But frequently such governance is constrained by the tensions between energy security, climate change mitigation and energy poverty. At national level, there is a chasm between what is needed and what governments do 'on the ground', while regionally and globally, collective action challenges have often presented insurmountable obstacles. The article examines what forms of energy law, regulation and governance are most needed to overcome these challenges and whether answers are most likely to be found in hierarchy, markets, or networks.

Keywords: Energy, Governance, Regulation, Environmental Law, Climate Change

1. INTRODUCTION

What is the most pressing challenge affecting environmental law and governance in the coming decade? Of course, there are many credible responses to this question, and it would be unwise for any writer to claim a monopoly of wisdom in this regard.

The view expressed in this article – that the greatest challenge lies within the sphere of energy law and governance – is an unconventional one. For energy has yet to become a 'mainstream' environmental issue and is often seen to reside at the periphery – a somewhat exotic and obscure area best left to its own technical experts, many of them operating within the arcane silo of energy security.

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This article will not only challenge this conception but will also suggest that when it comes to the greatest challenge of our generation, namely climate change, then energy law and governance are profoundly important and must be located front and centre. Indeed, it will be argued not only that climate change mitigation and energy policy are inextricably interlinked, but also that without effective energy law and governance the necessary transition to a low carbon economy will be all but impossible.

The remainder of the article makes a number of arguments. In Section 2.1 it is suggested that the conventional wisdom – that only through an international treaty incorporating a carbon price can 'dangerous' climate change be prevented – is mistaken. In Section 2.2 it is shown that the transformation of the energy sector (responsible for some 65% of global emissions) is essential in achieving a transition to a low carbon economy. Section 3 asks what are the main obstacles to such an energy sector-led transition, the answer being framed in terms of an 'energy trilemma' involving tensions between energy security, climate change mitigation and (in the developing world) energy poverty. Section 4 examines the central roles of law, regulation and governance in bringing about an energy revolution, distinguishing what might be done at the level of the nation state and what can only be achieved at the global level.

Some clarification of terms may be helpful. For present purposes, 'law' and 'governance' are treated as opposite poles on a continuum, with 'regulation' in its varying forms being located somewhere between them. At one end is highly specific state-based law – that which in democratic states is promulgated by parliament and interpreted by the courts. Regulation is a broader category and includes flexible and innovative forms of social control through which the state seeks to shape behaviour (for example, of business or householders), not only directly but also indirectly. For example, it may involve economic instruments, persuasion, self-regulation and co-regulation, and it may invoke surrogates for direct government regulation – mechanisms that are only partially or indirectly related to state law. In contrast, at the other end of the continuum, governance (steering the flow of events within a social system) does not privilege the state and state law is simply one node amongst many in a world of diffused power and responsibility.

2. PATHWAYS TO A LOW CARBON ECONOMY

2.1. *A Climate Change Mitigation Treaty*

Climate change is widely recognized as posing a profound threat to humankind, which, if not successfully addressed, may have catastrophic consequences. Recent science reveals that the tipping points beyond which dangerous climate change becomes irreversible are close, and that the window for effective climate change mitigation is short.[1] Accordingly, there is a compelling argument for developing a low emissions trajectory and for doing so in the shortest possible time.

[1] K. Richardson, *et al.*, 'Climate Change: Global Risks, Challenges and Decisions', Synthesis Report, Copenhagen, 10–12 March 2009, available at: http://climatecongress.ku.dk/pdf/synthesisreport; J. Rockstrom, *et al.*, 'A Safe Operating Space for Humanity' (2009) 461 *Nature*, pp. 472–5.

As to *how* such cuts might be achieved, attention has focused on the role of a global climate change agreement going substantially beyond the Kyoto Protocol.[2] However, achieving such an agreement – or even a more modest political accord – is an enormous challenge, as the limited outcomes delivered to date graphically illustrate.[3] The reasons for this are well documented. Climate change effects operate across borders and regions (and across generations), making a multinational response essential. Yet, there are formidable obstacles to cooperation between nations and powerful incentives for individual countries to 'free ride' because 'each country benefits from a national point of view if it does less of the mitigation itself, and others do more'.[4] To date, most nations have succumbed to this logic and, in substantial part for this reason, no credible international agreement has been achieved and global emissions, far from being stabilized, continue to rise rapidly.

But even if an international treaty were capable of being agreed upon, it would not, in and of itself, be sufficient to mitigate climate change to the extent necessary or in the time available.

The principal mechanism contemplated to deliver agreed emission reduction targets under such a treaty (as under a related political accord) is to place a price on carbon (whether through an emissions trading scheme or a carbon tax) and to rely on market mechanisms to achieve agreed reductions. Raising the price of high carbon goods and services is likely to result in a decrease in their use, an increasing focus on energy efficiency, a shift towards existing low carbon fuels and technologies and a stimulus to the development of new ones. Under this model there is a central role for economic incentives through imposing a carbon price, with the market arguably providing the most flexible and least cost mechanism for delivering agreed carbon reductions.

But as various reports and analyses have argued, markets alone (even in conjunction with a carbon price and even assuming that that price is sufficiently high to substantially shape behaviour) will be unable to achieve the necessary adjustment in the time left to us.[5] First, carbon markets do not necessarily provide incentives to business to change its behaviour. In part this is because market mechanisms are 'fuzzy' and unable to deal effectively with such market imperfections as monitoring,

[2] Kyoto Protocol to the United Nations Framework Convention on Climate Change, Kyoto (Japan), 10 Dec. 1997, in force 16 Feb. 2005, available at: http://unfccc.int/kyoto_protocol/items/2830.php.

[3] For example, the Cancun summit was an agreement, though not a binding treaty, to limit global warming to less than 2 degrees Celsius above pre-industrial levels. However, it contained no agreement on how to extend the Kyoto Protocol nor was it determined how a previously agreed $100 billion Green Climate Fund, designated to assist poor countries, would be raised. Nor was there any statement that action must be taken to ensure that emissions 'peak' within ten years, as the science suggests is essential. See J. Vidal, 'Does Cancun Agreement Show Climate Leadership?', *The Guardian*, 13 Dec. 2010.

[4] R. Garnaut, *The Garnaut Climate Change Review 2008* (Cambridge University Press, 2008), p. *i*.

[5] See, e.g., US Government Accountability Office, 'Observations on the Potential Role of Carbon Offsets in Climate Change Legislation (Statement of John Stephenson, Director Natural Resources and Environment)', 5 Mar. 2009, available at: http://www.gao.gov/new.items/d09456t.pdf. This is not to deny the importance of energy taxes or to suggest that they do not play an important role, but rather that they are necessary but not sufficient: see Copenhagen Economics, 'Innovation of Energy Technologies: The Role of Taxes. Final Report', 26 Nov. 2010', available at: http://ec.europa.eu/taxation_customs/resources/documents/common/publications/studies/taxation_energy_innov.pdf.

enforcement and asymmetric information problems which prevent some emitters from responding to price signals.[6] Moreover, as the Organization for Economic Co-operation and Development (OECD) points out:

> carbon pricing does not address the large market failures undermining [research and development] in climate mitigation, such as incompatibility with existing infrastructure and weak intellectual property rights protection.[7]

Crucially, it will be necessary not only to encourage and facilitate the development and dissemination of low carbon technologies *but to do so more rapidly than market mechanisms will allow*.[8] For example, infrastructure changes (not least, the development of smart grids), in conjunction with policy approaches that stimulate investment in low carbon technologies, are urgently needed (including large-scale research and development projects which only government funding is likely to make viable),[9] together with fast tracking of embryonic renewable technologies and intellectual property rules that encourage the development *and* facilitate the transfer of such technologies.

In short, a climate change agreement, even one which was strong and well designed, would not, in and of itself, be sufficient to mitigate climate change to the extent the science tells us will be necessary.

2.2. *Transforming the Energy Sector*

Another window on the question of how can a transformation to a low carbon economy best be achieved is to ask what sector of the global economy contributes most to carbon emissions, and how sizeable is this contribution? Here the answer is simple and stark: energy production and consumption accounts for approximately 65% of greenhouse gas emissions.[10] The necessary implication of this harsh statistic is that, without achieving a drastic transformation in the energy sector, climate change mitigation will be close to impossible.

This is not to suggest that the focus of climate change mitigation should be exclusively on energy. On the contrary, progress must be made on multiple fronts. Deforestation, in particular, must be contained and ultimately reversed and other

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6 OECD, *The Economics of Climate Change Mitigation* (OECD, 2009), pp. 20–1.

7 Ibid.

8 R.E.H. Sims, *et al.*, 'Climate Change 2007: Working Group III: Mitigation of Climate Change', IPCC Fourth Assessment Report, Ch. 4 'Energy Supply', available at: http://www.ipcc.ch/publications_and_data/ar4/wg3/en/ch4.html. See also R. Sims, 'Can Energy Technologies Provide Energy Security and Climate Change Mitigation?', NATO Advanced Research Workshop, Energy and Environmental Challenges to Security, Budapest (Hungary), 21–23 Nov. 2007.

9 See further J. Aldy & W. Pizer, 'Issues in Developing US Climate Change Policy', Resources for the Future Discussion Paper, RFF DP 08-20, June 2008, at p. 21, available at: http://www.rff.org/documents/RFF-DP-08-20.pdf (pointing out that R&D generates benefits that the innovator cannot fully appropriate).

10 International Energy Agency (IEA), *Emissions from Fuel Combustion* (IEA, 2009); World Resources Institute, 'Power Surge: Energy Use and Emissions Continue to Rise', available at: http://www.wri.org/publication/content/8601; Global CCS Institute, 'Energy Fact Sheet', available at: http://www.globalccsinstitute.com/institute/media-centre/energy-fact-sheet.

sectors (particularly transport) will also need to be reshaped. Nevertheless, 'as the leading source of greenhouse gas emissions, energy is at the heart of the problem and so must be integral to the solutions'[11] and achieving a low emissions trajectory and the transformation of the energy sector remains the single most important means of mitigating climate change.

So what might a transformation of the energy sector involve? What are the greatest obstacles to its achievement, and what roles can law, regulation and governance play in reducing those obstacles and facilitating opportunities for a transition to a low carbon economy?

These are large questions and it is well beyond the scope of this exploratory article to provide comprehensive answers to them. Rather, the remainder of the article will proceed as follows. In terms of the first question, International Energy Agency (IEA) data and analysis suggest that a transformation of the energy sector must involve four 'pillars': (i) energy efficiency, (ii) renewable energy, (iii) nuclear power, and (iv) carbon capture and storage.[12]

The second question is complex and multidimensional and even very preliminary and partial answers will be contingent upon the energy profile and social, political and economic contexts of particular nations and regions. A fine-grained analysis would require a country by country approach (or perhaps one based on 'energy profile ideal types') linked to regional and global dimensions. Such an approach is not practicable within the constraints of this article.[13] For present purposes, the most helpful approach is to engage on a broader level of generality, making a distinction between the circumstances of developed and developing countries and to explore the tensions involved in pursuing climate change mitigation, energy security and (in the case of the developing world) reducing energy poverty.

Against this backdrop, the final section will show how, in their various dimensions, law, regulation and governance will be fundamental in achieving an energy sector-led, low carbon transformation. To do so, it will address separately action that can be taken within the nation state and that which can only be achieved regionally and globally.

3. OBSTACLES TO A LOW CARBON TRANSFORMATION: OVERCOMING THE ENERGY TRILEMMA

This section suggests that energy policy often finds itself on the horns of an 'energy trilemma', involving the (sometimes competing) demands of energy security, climate

11 International Energy Agency, *World Energy Report* (IEA, 2009), p. 3.

12 OECD/NEA and OECD/IEA 2010, Technology Roadmap, Nuclear Energy; OECD/IEA 2010, Energy Efficiency Governance; OECD/IEA 2011, Clean Energy Progress Report, IEA Input to the Clean Energy Ministerial, Update June 2011; OECD/IEA 2010, World Energy Outlook 2010 Factsheet; World Energy Outlook (WEO) 2010, International Energy Agency.

13 It is, however, the concern of a long-term project being undertaken with my colleague, Professor Peter Drahos. See generally the Climate and Environmental Governance Network (CEGNet), at the Australian National University, and in particular its working paper series available at: http://cegnet.anu.edu.au/workingpapers/index.php.

change mitigation and (in developing countries) energy poverty. It begins by examining the relationship between energy security and climate change mitigation.

Energy security is often dealt with as a discrete issue from climate change policy but – given that the burning of fossil fuels is the principal cause of carbon emissions – is intimately related to it, although these connections are not commonly appreciated.

Energy security is conventionally defined as having a reliable and adequate supply of energy at reasonable prices, which by implication also means addressing short- and long-term energy *in*security. This might be achieved, for example, by establishing strategic oil reserves, diversification of sources of supply and their origin, switching to renewable energy, technological innovation, and so on.[14] The actual choice and energy mix is likely to depend on the circumstances and energy profile of the individual state.

For many states, energy security is becoming increasingly pressing as key energy sources diminish (for example, world oil production may peak before 2020) and some states become dependent on hostile governments (parts of Western Europe rely heavily on Russian gas).[15] The world's two largest carbon emitters, the United States (US) and China have both been prominent in addressing energy security issues. China's policies to support clean energy are directly linked to its broader energy security strategy,[16] which also involves establishing long-term bilateral agreements to secure energy supplies from a number of developing countries in Africa and elsewhere.[17] The Obama administration has similarly made clear its support for renewable energy and nuclear power, independent of any global climate deal, on the basis of its need to become less dependent on international oil markets.[18]

However, the future energy challenge involves not just energy security but also climate change mitigation. In 2008, the IEA, close affiliate of the OECD and energy policy adviser to 28 member countries, stated:

> The world's energy system is at a crossroads. Current global trends in energy supply and consumption are patently unsustainable – environmentally, economically and socially. But that can – and must – be altered; there is still time to change the road we are on. It is not an exaggeration to claim that the future of human prosperity depends on how successfully we tackle the two central energy challenges facing us today: securing the supply of reliable and affordable energy; and effecting a rapid transformation to a low-carbon, efficient and environmentally benign system of energy supply. What is needed is nothing short of an energy revolution.[19]

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14 A. Bauen, 'Future Energy Sources and Systems: Acting on Climate Change and Energy Security' (2006) 157(2) *Journal of Power Sources*, pp. 893–901, at 896.

15 As to why Russia has not been more effective in wielding power through energy supplies, see S.Closson, 'The Energy Curse: Dependency in Soviet and Russian Policy' (2010), available at: http://ssrn.com/abstract=1663402.

16 W. Chen & R. Xu, 'Clean Coal Technology Development in China' (2010) 38(5) *Energy Policy*, pp. 2123–30.

17 M.J. Bradshaw, 'The Geopolitics of Global Energy Security' (2009) 3 *Geography Compass*, pp. 1920–37; J.B. Eisen, 'The New Energy Geopolitics? China, Renewable Energy, and The "GreenTech Race"' (2011) 86(1) *Chicago-Kent Law Review*, pp. 9–58.

18 Available at: http://www.whitehouse.gov/energy/securing-american-energy#energy-menu. See also G. Bang, 'Energy Security and Climate Change Concerns: Triggers for Energy Policy Change in the United States?' (2010) 38(4) *Energy Policy*, pp. 1645–53.

19 International Energy Agency, *World Energy Outlook 2008* (IEA, 2008), at p. 37, available at: http://www.iea.org/textbase/nppdf/free/2008/weo2008.pdf.

Policies to address these two challenges are sometimes complementary. For example, the future security of conventional oil, gas and electricity supplies might be enhanced by energy efficiency measures and the expansion of renewable energy and nuclear power, all of which will also reduce greenhouse gas emissions. However, more often there are trade-offs between climate change mitigation and energy security. For example coal-to-liquids technology would increase energy security, but would have negative impacts on the climate, as would an increased reliance on coal and lignite in countries with abundant national supplies but energy security concerns. The complex connections between energy security and mitigation focused energy policy are too rarely recognized, with the result that the two challenges are only infrequently dealt with in tandem.[20]

But while the tensions between climate change mitigation and energy security present considerable obstacles to a low carbon transformation in developed countries, the developing world confronts an additional obstacle: energy poverty. Worldwide, an estimated 1.4 billion people (20% of the global population) lack access to electricity and some 2.7 billion people rely on the traditional use of biomass for cooking.[21] Any energy policy that ignores the plight of this group is not only extremely inequitable but often also politically impractical. In terms of the latter, the problem is not just with those (primarily rural) communities that lack electricity entirely, but with much more politically influential urban communities and the business sector, which suffer the consequences of frequent brown-outs and black-outs. Add to this the fact that, in many developing countries, basic sources of fuel such as kerosene are heavily subsidized, and the route to energy reform becomes even more problematic.

Of course, the energy trilemma is hardly the only obstacle to an energy revolution. It is also the case, for example, that 'a carbon economy embeds fossil fuels into the fabric of its infrastructure'[22] and creates powerful vested interests, capable of capturing governments and shaping energy decision-making in their own interests.[23] Accordingly, as Sims points out:

> A rapid transition toward new energy supply systems with reduced carbon intensity needs to be managed to minimize economic, social and technological risks *and to co-opt those stakeholders who retain strong interests in maintaining the status quo*.[24]

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20 S.P.A. Brown & H.G. Huntington, 'Energy Security and Climate Change Protection: Complementarity or Tradeoff?' (2008) 36(9) *Energy Policy*, pp. 3510–3.

21 See, further, International Energy Agency, *World Energy Outlook 2010* (IEA, 2010), at p. 14, available at: http://www.iea.org/Textbase/npsum/weo2010sum.pdf. See also International Energy Agency, 'Energy Poverty – How to Make Modern Energy Access Universal?', Sept. 2010, available at: http://www.iea.org/weo/docs/weo2010/weo2010_poverty.pdf.

22 D. Helm, 'Climate Change Policy: Why Has So Little Been Achieved?' (2008) 24(2) *Oxford Review of Economic Policy*, pp. 211–28, at 215.

23 G. Pearse, *High and Dry* (Penguin Books, 2007).

24 R.E.H. Sims, 'Bioenergy to Mitigate for Climate Change and Meet the Needs of Society, the Economy and the Environment' (2003) 8(4) *Mitigation and Adaptation Strategies for Global Change*, pp. 349–70 (emphasis added).

These are challenges that require concerted and strategic government policy intervention, in the absence of which fossil fuels will continue to dominate the global energy market – with catastrophic consequences for climate change.

That intervention, moreover, must take place not only in the developed world but also in rapidly developing economies whose approaches will be fundamental to any attempt to decarbonize the world economy. Here the challenges are even greater, not only because such countries lack the resources and sometimes the governance capacity to achieve major change unaided, but also because only strategies that are consistent with the political imperative of continued economic growth have any chance of success.

4. TOWARDS AN ENERGY REVOLUTION: THE ROLES OF LAW, REGULATION AND GOVERNANCE

In 2009, the IEA called for an 'energy revolution', involving radical action by governments – at national and local levels – and through participation in coordinated international mechanisms. Fundamental to achieving such a revolution is the role of government. As the IEA has pointed out:

> Governments hold the key to changing the mix of energy investment. The policy and regulatory frameworks established at national and international levels will determine whether investment and consumption decisions are steered towards low carbon options.[25]

But as we will see below, while some things can be achieved solely at the national or provincial level, there are others that can only be achieved regionally or globally.

4.1. *Energy Policy within the Nation State*

At present, energy sector reform is addressed (to the extent that it is addressed at all) primarily at national level. An increasing number of countries are beginning to explore strategies and tools that might be invoked to achieve a different energy mix. For example, there is increasing interest in harnessing renewable energy, increasing energy efficiency and removing fossil fuel subsidies. A few countries have also expressed interest in carbon capture and storage but this has not, to date, been supported by the substantial financial investment (for example, in pilot plants) that might make this technology commercially viable at some future time.[26]

But, overall, energy sector reform within the nation state is currently modest in the extreme. Indeed, a 2009 report that reviewed energy policy in a sample of eight countries

[25] International Energy Agency, *World Energy Outlook 2009* (IEA, 2009), available at: http://www.iea.org/textbase/npsum/weo2009sum.pdf.

[26] See, e.g., '£1bn Carbon Capture Project Axed', *The Guardian*, 20 Oct. 2011.

found 'the absence of a long-term low-carbon policy framework or coherent set of policies'.[27] The underdeveloped nature of energy sector reform within the nation state is perhaps understandable. State energy policy must be addressed at a time when, in many countries in the developed world, key state assets have been privatized as a result of previous waves of market liberalization (and are therefore more difficult to influence)[28] while, in the developing world, population growth is increasing pressure on existing resources and infrastructure (exacerbating energy security concerns). The fact that some fossil fuels (in particular, coal) are still relatively cheap also results in energy reform initiatives failing to gain political traction.

However, the situation is gradually changing. Governments must increasingly compete for dwindling fossil fuel supplies, mindful that future energy demand is also likely to grow substantially and that a profligate use of energy will in the future generate considerable energy *in*security. These pressures are prompting an increasing concern to harness renewable energy and energy efficiency (and sometimes nuclear power). And in a minority of countries (principally, but not exclusively, in Western Europe),[29] climate change mitigation has also risen up the political agenda, prompting decision makers to take a more proactive approach, irrespective of energy security considerations.

When governments do act (whether driven by energy security considerations, climate change mitigation or some combination of the two) then economic incentives, regulation and support for R&D are the central tools in the policy arsenal.

In terms of the first, a few countries – and, at regional level, the European Union (EU) – have sought to put a price on carbon via either an emissions trading scheme or a carbon tax. The EU has led in terms of its Emissions Trading System (ETS), but is not alone in this regard. New Zealand has also developed such a scheme, California's will operate from 2012 and South Korea is also contemplating going down this path.[30] Others, most notably Australia, prefer a carbon tax, at least in the short term.[31] However, as emphasized earlier, putting a price on carbon, while necessary, will nevertheless be insufficient to achieve a transformation of the energy sector in the time available.

Other economic incentives to lower carbon emissions (for example, pricing of consumer products, incentives to change householders' behaviour) have also been

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27 Global Climate Network, 'Breaking Through on Technology: Overcoming the Barriers to the Development and Wide Deployment of Low-Carbon Technology', Global Climate Network Discussion Paper No. 2, July 2009, at p. 2, available at: http://www.globalclimatenetwork.info/ecomm/files/breaking_through.pdf.

28 A number of Western countries which privatized their energy sector in the interests of efficiency and competition now find that this led to the deferment of investments and infrastructure: Sims, n. 8 above. This has had adverse implications for greenhouse gas emissions and which they are now seeking belatedly to address.

29 See, in particular, South Korea's *Framework Act for Low Carbon Green Growth*, 2010, available at: http://www.greengrowth.org/download/Framework%20Act%20on%20Low%20Carbon%20Green%20Growth%202010.pdf.

30 N. Anger, 'Emissions Trading Beyond Europe: Linking Schemes in a Post-Kyoto World' (2008) 30(4) *Energy Economics*, pp. 2028–49; E. Tyler, M.D. Toit & Z. Dunn, 'Emissions Trading as a Policy Option for Greenhouse Gas Mitigation in South Africa: The Economics of Climate Change Mitigation' (Energy Research Centre, University of Cape Town, 2009).

31 G. James & R. Stuart, 'Climate Policy: From Carbon Tax to Direct Action?' (2010) 110 *Chain Reaction*, pp. 23–4.

introduced in some developed countries and within the EU in particular, but these also suffer from significant limitations, not least imperfect information, principal–agent problems and behavioural failures.[32] The bottom line, in the IEA's view, is that 'while carbon pricing is a prerequisite for least-cost carbon mitigation strategies, carbon pricing is not enough to overcome all the barriers to cost-effective energy efficiency actions'.[33]

Accordingly, economic incentives are best seen as just *one* component of a broader mix of energy policy initiatives.[34] For example, the same IEA report argues, with regard to energy efficiency, that a number of other policies (primarily regulatory) will be necessary in both residential appliance electricity use and buildings heating use, these being much better able to overcome the barriers described above. These include energy performance standards, energy performance labelling, consumer feedback tools, awareness-raising efforts, and contractual support for the construction of low energy buildings.[35]

In the case of renewable energy, rapid growth again depends substantially on government policies, primarily in the form of regulatory policies, fiscal incentives, public finance mechanisms and climate-led policies. To illustrate:

> Regulatory policies include feed-in-tariffs, quotas or portfolio standards, priority grid access, building mandates, and bio-fuel blending requirements. Fiscal incentives refer to tax policies and direct government payments such as rebates and grants. Public finance includes mechanisms such as loans and guarantees. Climate-led efforts include carbon pricing mechanisms, cap and trade, emission targets, and others.[36]

Increasing investment in nuclear energy has also been viewed by the IEA as one of the core pillars of energy reform, but in the wake of the Fukushima nuclear power plant disaster in Japan this has slid well down the agenda in a number of developed countries, most notably in Germany. Whether countries such as South Korea, which imports close to 95% of its energy, will continue with their ambitious plans to rapidly expand the number of nuclear plants remains to be seen. France, which generates almost 80% of its electricity from nuclear plants, has indicated no shift in its own position.

The fourth pillar that the IEA believes is necessary to transform the energy sector, carbon capture and storage (CCS), appears to have lost much of its impetus, at least for the moment. The most recent estimate by the IEA reveals that the broad deployment of

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32 International Energy Agency, *Energy Efficiency Policy and Carbon Pricing* (IEA, 2011); and see also IEA, *Combining Policy Instruments for Least-Cost Climate Mitigation Strategies* (IEA, 2010).

33 IEA, 2011, ibid., p. 8.

34 See, e.g., P. Soderholm, 'Technological Change and Carbon Markets' (2010) 1(2) *Low Carbon Economy*, pp. 80–5 (arguing that while technological progress depends critically on maintaining efficient carbon markets, other policy instruments, including public R&D and technology support, will also be necessary).

35 L. Ryan, S. Moarif, E. Levina & R. Baron, 'Energy Efficiency Policy and Carbon Pricing', International Energy Agency, Information Paper, Aug. 2011, available at: http://www.iea.org/papers/2011/EE_Carbon_Pricing.pdf.

36 UN General Assembly, 'Promotion of New and Renewable Sources of Energy: Report to the Secretary General', 15 Aug. 2011, at p. 15, available at: http://www.un.org/esa/dsd/resources/res_pdfs/ga-66/SG%20report_Promotion_new_renewable_energy.pdf. See also IPCC, 'Special Report on Renewable Energy Sources and Climate Change Mitigation', New York, 2011; Renewable Energy Policy Network for the 21st Century (REN21), *Renewables 2010: Global Status Report* (REN21 Secretariat, 2010).

low carbon energy technologies could reduce projected 2050 emissions to half the levels of 2005 – and that CCS could contribute about one-fifth of those reductions in a least-cost emissions reduction portfolio. Reaching that goal, however, would require around 100 CCS projects to be implemented by 2020 and over 3,000 by 2050.[37] Such rapid deployment and expansion of integrated CCS projects is not only challenging but also raises many regulatory issues, which is considered to be one of the possible reasons for CCS losing momentum,[38] while other reasons include the relatively high cost of CCS technology to capture, transport and safely store CO_2, compared with the same facilities without CCS.[39]

In terms of the developed world, most crucial of all will be the development and commercialization of new technologies (particularly 'break-though technologies'). While some might argue this can be left to the private sector, in reality technological innovation is typically a public good, with not all of the benefits of new knowledge capable of being 'captured' by the innovator. Accordingly, technological innovation, particularly with regard to the development of renewable energy and CCS (but also arguably to develop 'next generation' nuclear power), will require substantial public expenditure and the development of public–private partnerships. The need for such expenditure becomes even more compelling given the extent to which such technologies will need to be 'fast tracked'. Accordingly, supportive government policies, including direct financial support in conjunction with complementary policies removing the structural advantages of fossil fuels, will be necessary.

Within the developing world, in many cases, one of the most important policy initiatives (as the G20 continues to emphasize) would be the removal (or more realistically, the reduction) of inefficient fossil fuel subsidies that cause wasteful consumption (and which totalled an estimated $312 billion in 2009).[40] Eradicating such subsidies would enhance energy security, reduce emissions of greenhouse gases and air pollution *and* bring economic benefits.[41]

The particular challenge here is in terms of energy poverty. In the developing world, energy subsidies are often used explicitly to mitigate energy poverty (and to promote economic development. Although such subsidies are often regressive (the rich benefit far more than the poor) their removal is likely to be tenaciously resisted by the latter, who fear that their source of cheap fuel will be removed without compensation.[42] Clearly, only policies that use the money saved by the removal of these subsidies, to substantially reduce energy poverty by other means, are likely to be

37 OECD/IEA, 'Carbon Capture and Storage: Legal and Regulatory Review', May 2011, available at: http://www.iea.org/Papers/2011/ccs_legal.pdf.

38 Ibid.

39 Global CCS Institute, 'Economic Assessment of Carbon Capture and Storage Technologies', 2011, available at: http://cdn.globalccsinstitute.com/sites/default/files/publications/12786/economic-assessment-carbon-capture-and-storage-technologies-2011-update.pdf.

40 International Energy Organisation, 'World Energy Outlook 2010 and Renewables', available at: http://www.iea.org/work/2011/rewp/Session_1_Birol.pdf.

41 IEA, *World Energy Outlook 2010*, n. 21 above, at p. 13.

42 'Analysis of the Scope of Energy Subsidies and Suggestions for the G20 Initiative', IEA, OPEC, OECD, World Bank Joint Report, prepared for submission to the G20 Summit Meeting Toronto (Canada), 26–27 June 2010, available at: http://www.oecd.org/dataoecd/55/5/45575666.pdf.

acceptable politically. In practice, if the developed world wants developing countries to remove these subsidies, then it must support such initiatives by providing increased climate finance (and technology), an issue which will be revisited in Section 4.2.

Beyond this, which other policies might sensibly form part of the policy mix will depend substantially upon each country's individual energy profile (energy importer/exporter, opportunities for harnessing particular energy sources, technological capabilities, economic circumstances, etc.) as well as upon the political, economic and social constraints within which its government must make decisions.[43]

4.2. *Global and Regional Energy Governance*

Energy governance, like climate policy, is a global challenge which cannot be effectively addressed without effective international collaboration and coordination. Put differently, only with global energy governance will it be possible to achieve the sort of comprehensive and rapid transformation in the production, transportation and use of energy that is necessary to achieve the transition to a low carbon economy.[44]

For example, how can resources be pooled to create a global technology development fund? How can intellectual property constraints on the use of new technology be minimized? And how can developing countries be effectively integrated into a global energy strategy? Such questions about the appropriate allocation of scarce resources and the coordination of collective action are all fundamentally questions of regulation and governance which can only be effectively addressed at the global (and to a much lesser extent, regional) level.

At present, however, energy governance at the global level is seriously underdeveloped. Indeed, even the precise nature of global energy governance is unclear. Traditionally, international relations (whether in its realist, liberal or constructivist forms) has tended to think of international governance as involving treaty negotiations and dispute resolution mechanisms, with collective processes orchestrated by key international organizations – and often by a single organization which has been given primary responsibility within a particular sphere.[45]

Yet, the architecture of global energy governance does not remotely approximate this traditional characterization. As the former head of the International Atomic Energy Agency (IAEA), Mohamed ElBaradei, has put it:

> We have a World Health Organisation, two global food agencies, the Bretton Woods financial institutions and organisations to deal with everything from trade to civil aviation and maritime affairs. Energy, the motor of development and economic growth,

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43 See also R. Baron, 'Combining Policy Instruments for Least-Cost Climate Mitigation Strategies', International Energy Agency, 6 Dec. 2010, available at: http://www.iea.org/work/2010/cop16/Baron_IEA_Side_event.pdf, which provides guidance on how to assess the need for supplementary policies for energy efficiency and renewable energy with existing carbon pricing.

44 IEA, n. 25 above.

45 See A. Florini, 'Rising Asian Powers and Changing Global Governance' (2011) 13 *International Studies Review*, pp. 24–33; and D. Lake, 'The State and International Relations', available at: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1004423.

is a glaring exception. Although it cries out for a holistic, global approach, it is actually dealt with in a fragmented, piecemeal way.[46]

The fragments to which ElBaradei refers include:

- the IEA (energy consumers, but only those who are members of a 'rich man's club' paralleling OECD membership);
- the Organization of the Petroleum Exporting Countries (OPEC) (representing less than 50% by volume of oil producers);
- various weak and relatively obscure UN agencies,[47] none of which plays a major role (UN-Energy, for example);
- the International Atomic Energy Agency (IAEA) (which is mainly concerned with nuclear non-proliferation and the safety of installations rather than broader energy policy); and
- the International Renewable Energy Agency (IRENA), which was only established in 2009 and has yet to clearly demarcate its role.

There are also a number of other actors that focus on individual energy initiatives. The United Nations Environment Program (UNEP), for example, has been involved in terms of the Global Subsidies Initiative (GSI), and the G20 and the Asia-Pacific Economic Cooperation (APEC) have also committed to phase out inefficient fossil fuel subsidies. International aid organizations – such as the World Bank and its subsidiaries and the Asia Development Bank – also fund particular energy initiatives (not all of which their critics would see as 'reforms'). But as ElBaradei correctly points out, none of these organizations has a mandate that is global and comprehensive.

This picture of weak agencies and, at best, piecemeal coordination and fragmented governance on individual issues appears unlikely to change. Even obtaining agreement amongst nation states on basic elements of a global energy future seems, at least for the moment, untenable.[48] In large part, the explanation for the weakness, and sometimes complete absence, of global energy governance, lies in the energy security concerns of individual states, and their perception that energy security is often a zero-sum game in which there is only limited room for cooperation and coordination internationally, and that each state must scramble as best it can to secure scarce energy resources. Accordingly, states have guarded their autonomy over energy issues with the result that global and regional institutions, norms and organizations are weak or absent.

In the case of the many developing countries that lack the economic and the technological capacity to bring about an internal energy transition, there is (or should be)

46 M. ElBaradei, 'A Global Agency is Needed for the Energy Crisis', *Financial Times*, 23 July 2008. This is an approach that Abbott and Snidal characterize as 'international old governance': K. Abbott & D. Snidal, 'Strengthening International Regulation through Transnational New Governance: Overcoming the Orchestration Deficit' (2009) 42(2) *Vanderbilt Journal of Transnational Law*, pp. 501–78.

47 Most recently, note the establishment of the UN Secretary General's Advisory Group on Energy and Climate Change (AGECC), created in 2009, which has called on the UN system and its Member States to support the goals of ensuring universal access to modern energy services and reducing energy intensity by 40% by 2030.

48 D. Hodas, 'International Law and Sustainable Energy: A Portrait of Failure', Widener Law School Legal Studies Research Paper No. 10, 2010, available at: http://ssrn.com/abstract=1648906.

a further dimension to global energy governance. It is only with considerable assistance and support that an energy transformation in such countries might be achieved (China being a striking exception). But the level of support currently provided by organizations such as the World Bank, Asia Development Bank and national aid agencies does not remotely approach this level. Whether the Copenhagen Green Climate Fund, or the contemplated Technology Mechanism, will adequately address not only the funding issue, but also the fraught question of intellectual property rights and their role in technology development and transfer, remains to be seen.

However, the striking lack of conventional treaties relating to energy and the fragmented and often minimal role of international organizations in energy governance may not be the end of the story. That is, rather than concluding that therefore there is little or no global energy governance, it may be that traditionalists are simply looking in the wrong place.

Two other possibilities present themselves, both of which assume that global energy governance does not need formal institutions and agreements to make it work. The first possibility is that the market mechanism alone provides a more than adequate mode of energy governance.[49] Goldthau and Witte, in particular, argue that many of the most important issues of energy governance can be resolved through markets and market-based interactions structured through the development of appropriate institutions.[50] However, Goldthau and Witte's conception of global energy governance is largely confined to energy security and to the markets and related institutions that, if suitably designed, can facilitate it. While it does a great service in mapping the patchwork of market related governance mechanisms that – to varying degrees and with varying success – contribute to energy security, it does not extend to the project of global energy governance conceived in broader terms that embrace issues of climate change mitigation or (except in passing) energy poverty.

The second place where one might seek out global energy governance – again looking beyond the state-centric focus of earlier generations of international relations[51] – is in the rapidly growing, parallel conceptual universe of global governance.[52]

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49 A. Goldthau & J.M. Witte, 'Back to the Future or Forward to the Past? Strengthening Markets and Rules for Effective Global Energy Governance' (2009) 85(2) *International Affairs*, pp. 373–90. See also J.M. Witte & A. Goldthau, *Global Energy Governance: The New Rules of the Game* (Brookings Institution Press, 2010).

50 Ibid.

51 Not all international relations theory is state-centric. The 'transnational' perspective, in particular, emphasizes the role of non-state actors (individuals, multinational corporations or NGOs) across borders: see R. Keohane & J. Nye, (eds.), *Transnational Relations and World Politics* (Harvard University Press, 1972); D. Lake, 'The State and International Relations', Social Science Research Network (2007) pp. 1–16, available at: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1004423, which suggests a shift from the study of 'international relations' *per se* and toward the study of 'global society'; see D. Lake, 'Rightful Rules: Authority, Order, and the Foundations of Global Governance' (2010) 54 *International Studies Quarterly*, pp. 587–613; M. Barnett & K. Sikkink, 'From International Relations to Global Society', in C. Reus-Smit & D. Snidal (eds.), *The Oxford Handbook of International Relations* (Oxford University Press, 2008), pp. 62–81.

52 See A. Florini, 'Rising Asian Powers and Changing Global Governance', (2011) 13 *International Studies Review*, pp. 24–33.

More specifically, within the closely related spheres of what are variously termed 'Earth System Governance', 'global environmental governance' and 'climate change governance',[53] one finds a rapidly proliferating literature which offers a very different perspective on climate and energy governance.

What is distinctive about this literature is the extent to which it takes seriously the potential roles of a range of non-state actors which include civil society organizations, business entities, international standard-setting bodies, public–private partnerships and networks within and between state and non-state entities. Much of the focus is normative, concerned with reshaping governance, particularly in relation to challenges involving global public goods and major free-rider problems, and with designing and implementing new systems of global governance.[54]

However, when it comes to issues of global energy governance, is there is any more 'there there' than when the world is viewed through the lens of international relations?

The answer is unclear, because insufficient empirical work has been done to map the sorts of informal networks and other non-state mechanisms that might form the 'glue' for this form of governance. To what extent are global energy norms in the process of development and, if they are, how does the development of such norms create a 'logic of appropriateness'[55] under which actors are induced to 'do the right thing'? Are international standards playing a role, particularly in enhancing energy efficiency, and how rapidly are these being disseminated? Are corporations being harnessed as energy innovators, and in what circumstances are they capable of playing this role? Is there evidence that networks of actors, through ongoing dialogue and persuasion, are capable of shifting their preferences and developing common interests?[56] And beyond all else, what webs, networks, public–private collaborations, or 'coalitions of the willing' in terms of inter-governmental cooperation are being established that might plausibly facilitate the development of energy alternatives that, over the long term, can compete on price with fossil fuels?

In answering these and related questions, while insights are likely to be derived primarily from the work of Earth Systems and global governance theorists, those of international relations theory should not be forgotten. Regime theory, in particular,

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53 See, e.g., F. Biermann, 'Earth System Governance as a Crosscutting Theme of Global Change Research' (2007) 17(3–4) *Global Environmental Change*, pp. 326–37; J.G. Speth & P.M. Haas, *Global Environmental Governance* (Pearson Longman: 2006).

54 J. Stiglitz, *Globalization and Its Discontents* (Norton, 2002); C. Okereke, H. Bulkeley & H. Schroeder, 'Conceptualizing Climate Governance Beyond the International Regime' (2009) 9(1) *Global Environmental Politics*, pp. 58–78; M. Castells, 'The New Public Sphere: Global Civil Society, Communication Networks and Global Governance' (2008) 616 *Annals of the American Academy of Political and Social Science*, pp. 78–93.

55 J.G. March & J.P. Olsen, 'The Institutional Dynamics of International Political Orders' (1998) 52 *International Organisation*, pp. 943–69; J.G. March & J.P. Olsen, *Rediscovering Institutions: The Organisational Basics of Politics* (The Free Press, 1989).

56 T. Risse, '"Let's Argue!" Communicative Action in International Relations' (2000) 54 *International Organisation*, pp. 1–39.

does recognise the role of implicit, informal regimes – the first oil regime, for example, was not only very robust but also exactly of the kind that Keohane and other regime theorists would have envisaged.[57] But we should not be drawn into the traditional international relations search for governance primarily in multilateral organizations – a global regime could quite plausibly develop on the basis of bilateral agreements and in the absence of global or regional multilateral organizations.

Finally, in terms of what form(s) of energy governance is/are most needed, perhaps the most insightful answer to date is provided by Cherp, Jewell and Goldthau,[58] who suggest that global energy governance arrangements are best seen as:

> evolving complex systems with their own histories, fluid boundaries, dynamic connections, intricate networks and feedback loops, uncertainties and nonlinearities and that effective governance structures must 'incorporate diverse institutions and mechanisms arranged in 'nested', 'multilevel' and 'polycentric' systems of governance.[59]

In their view, it is in the literature on governing for complexity, that we are likely to find the richest answers.

But even theirs is a work in progress and the descriptive and analytical project of mapping existing global governance mechanisms, and the normative project of working out what forms of global energy governance we should aspire to, and how best to develop them, remain in their infancy.

5. CONCLUSION

There is a compelling argument for developing a low carbon emissions trajectory to mitigate climate change, and for doing so urgently. What is needed is a transformation of the energy sector and an 'energy revolution'. Such a revolution can only be achieved through effective energy governance nationally, regionally, and globally. But frequently such governance is constrained by the tensions between energy security, climate change mitigation and energy poverty. At the national level, there is a chasm between what is needed and what governments do 'on the ground', while regionally and globally, collective action challenges have often presented insurmountable obstacles.

Which form or forms of governance are likely to be most effective in addressing these challenges is a contentious issue. While at the *national* level, governments will play a key role because they hold most of the effective policy levers, it is far less clear that this is the case at regional and global levels. On the contrary, there is growing evidence to suggest that non-state actors as diverse as non-governmental organizations (NGOs), multinational corporations and international financial institutions are becoming important 'governors', and that, in some circumstances at least, 'network

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57 R. Keohane & D. Victor, 'The Regime Complex for Climate Change' (2011) 9(1) *Perspectives on Politics*, pp. 7–23.

58 A. Cherp, J. Jewell & A. Goldthau, 'Governing Global Energy: Systems, Transitions, Complexity' (2011) 2(1) *Global Policy*, pp. 75–88.

59 Ibid., at p. 80.

governance' is becoming more important in shaping energy policy internationally than states and state-dominated international organizations.

Crucially, however, neither traditional governance through nation states and international treaties and organizations, nor the coordination provided by markets or network governance in its various manifestations, has so far proved remotely capable of facilitating the energy revolution that will be necessary to avert dangerous climate change.