Governing the transition to a new energy economy

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Over the next two or three decades a new energy economy should begin to take shape in the developed industrial countries. This will not be a post-fossil fuel economy. But it could be an economy in which non-fossil sources play a more important role, where efficiency in the production, distribution and use of energy is significantly enhanced, where new storage and carrier technologies are being adopted, and where the fossil sector is being transformed by the imperative of carbon sequestration. Such an energy economy would represent a critical staging post in a much longer movement towards a carbon neutral, low-environmental impact, energy system. The extent to which a new energy economy actually materialises will depend on many factors including the pace and orientation of international economic development, the rate and direction of technological innovation and diffusion, as well as patterns of geo-strategic co-operation and conflict. But there is no doubt the trajectory will be significantly influenced by political decisions and government action on the energy file. This is the issue with which this chapter is concerned.

At the moment there are two main political drivers for the move to look beyond oil. First, there are supply concerns. Increasing global demand, production bottlenecks, and political instability have pushed oil prices towards historic highs. Although the oil intensity of the OECD economies is less than during the oil crises of the 1970s, there is no doubt that the long term economic impact of high oil prices would be considerable. There are also critical issues associated with the geographic distribution of reserves. Production from areas opened up following the
turbulence of the early 1970s (such as the North Sea) is peaking. In coming years the United States will be more heavily dependent on imported oil, with an increasing percentage of these imports destined to come from politically volatile areas in the Middle East and Asia. And this presents a serious risk of supply disruption. Meanwhile, the debate about the extent of conventional oil reserves simmers in the background, with recognised experts differing over whether the global ‘Hubbart Peak’ is already upon us, or lies several decades in the future. Second there are environmental concerns. The oil economy (and fossil fuel usage more generally) is associated with a host of environmental problems including urban smog (ozone, particulates), acid deposition (NOx and SOx), and toxic emissions (mercury) (Ristinen and Kraushaar 1999; EEA 2002). While developed countries have made some progress in managing these stresses, on a global scale they continue to rise. Above all, climate change looms on the horizon as the most complex and potentially damaging environmental problem with which human kind has had to deal.

Both these drivers are operating, but in an uneven and partly contradictory fashion. The intensity of the supply driver fluctuates with the price of oil, although the seriousness of the strategic problem has now begun to register with political elites in many countries. But this driver does not only point ‘beyond oil’: in the short term it can lead to intensified efforts to expand oil production, secure new supplies, develop unconventional oil resources, and so on. Even when the focus is not oil itself, it can motivate an additional commitment to fossil fuels as a way to diversify energy portfolios or reduce foreign dependence -- for example, by returning to coal for electricity or developing coal-to-oil and coal-to-gas conversions. Over time the environmental driver has strengthened, but it is vulnerable to the business cycle and political contingencies. It is early days for climate change politics and it is probably only when adjustment costs soar, and impacts become undeniable, that it will become a decisive factor in energy decisions. Of course, this driver points
away not just from oil, but from fossil supplies more generally – particularly from coal, the most carbon intensive of modern fuels. Here climate change and other environmental considerations pull in the same direction. But much depends on the technologies associated with particular energy sources and the assessment of the significance of diverse environmental impacts. For example, the nuclear industry has long been a target of environmental campaigners -- but if the relative risks of climate change are ranked high, the environmental costs of a new generation of fission reactors might be seen as acceptable in the race to drive down carbon emissions during the decades before other technological options become available.

Evidently we are headed for a world ‘beyond oil’. But the timing and the nature of the path into such a world is clouded with uncertainty. Two of the largest uncertainties relate to the true extent of remaining oil resources (and the technological requirements for their eventual extraction), and the ‘sensitivity’ of the climate system (how serious the problem turns out to be, and how quickly significant impacts become manifest). What is clear is that on a scale of several decades what lies ‘beyond oil’ is actually a great deal more oil (and other fossil fuels as well). Today about 35% of global primary energy supply comes from oil, with another 45% derived from other fossil sources (IEA 2004). Modern transport is almost entirely dependent on oil. More than half the oil used since commercial exploitation began in 1860 has been consumed since 1985 (Boyle, Everett and Ramage 2003). And the International Energy Agency assumes that world demand will grow by more than 50% over the next twenty years (IEA 2004). Through exploitation of more remote deposits, enhanced recovery, development of unconventional sources (tar sands and oil shale), deep ocean drilling, and so on – the industry will chase down every potential supply, although at increasing cost. Our technological infrastructure has been designed and built for oil and other fossil fuels. And they will not be abandoned lightly.
Energy politics

For most of the twentieth century the energy sector in developed states was subject to high levels of state control. Energy companies (especially in the electricity sector, but also in coal, oil, and gas) have often been under public ownership. But even where this was not the case governments have attempted to control fuel choices, investment, pricing levels, corporate mergers, and operating practices. National security, economic and industrial policy, equity, and public health and the environment provided ample justification for the establishment of complex systems of vertical and horizontal governance that influence national energy development trajectories. In most contexts the basic belief has been that the stakes in the energy game are just too high to leave things entirely to markets and private operators.

Since the mid 1980s there has been some tendency for government to pull back from direct intervention in economic affairs. This has led to de-nationalization and de-regulation in the energy sphere. There has been a rise in cross-national energy flows, and particularly in the electricity sector there have been experiments with privatization and deregulation (Harris 2002; Plourde 2005). The impact of these reforms on supplies, prices, and fuel mixes, as well as their political fall-out, has varied from jurisdiction to jurisdiction. Certainly they have altered the context for making energy policy in the developed world (Doern and Gattinger 2004). And yet, overall, energy remains among the most densely regulated economic sectors.

The everyday business of energy politics is typically conducted out of the public eye, in endless encounters between regulators, politicians and energy executives. Producer groups – whether based in the public or the private sector -- have traditionally dominated these processes.
The political pull of the oil and gas industry is legendary, but the history of nuclear power provides another illustration of producer driven development. It is only when things begin to go badly wrong that energy politics becomes the stuff of headlines. This was the case across the developed world following the oil shocks of the 1970s. But most countries have had episodic crises, accidents, scandals, protests, and political infighting that have temporarily brought energy issues to the foreground. The Enron scandal and the brownouts in California that accompanied partial electricity deregulation provide a perfect case in point. In many countries the debate about nuclear power has never really gone away. And arguments about other environmental pressures have been ongoing -- acid rain, and more recently climate change. But after oil supplies and prices settled down in the early 1980s, energy remained of comparatively low political salience for nearly two decades.

Now this looks set to change. Rising prices and pictures of motorists queuing at the gas pumps mean that the spotlight is back on oil. Political leaders are being pressed for action, and international gatherings such as the G8 are once again preoccupied with energy. Yet any quick solution to current difficulties is doubtful. With demand strong, and refining capacity stretched, supplies remain vulnerable to political or meteorological convulsions. Nevertheless, over time new supplies will be brought forward. Prices can fall as well as rise. And a serious global recession (perhaps partly sparked by high energy costs) could see demand plummet. But even if supply worries abate, pressures from the climate change side of the equation will continue to grow. So it may be that we are at a political turning point – where energy policy can no longer recede into the background. And the recent call by the Swedish Prime Minister to end his country’s fossil fuel dependence within fifteen years represents one form of response to the new conjuncture (Sustainable Industries Journal 2005).
Sustainable energy policy

Sustainable energy policy provides an appropriate policy frame to approach energy issues ‘beyond oil’. Political decision making on energy matters should be related to the broad goal of sustainable development. According to the oft quoted definition, sustainable development is a process of social advance that ‘meets the needs of the present without compromising the ability of future generations to meet their needs’ (WCED 1987). It implies a development trajectory that enhances societal welfare, while paying particular attention to the plight of the world’s poor and to respect for environmental limits. It expresses the intuitive idea that in working to improve our own lives we should not neglect those who have the least, and we should avoid ‘fouling the pond’ for people who come after us. Thus it embodies ideas of inter- and intra-generational justice, while emphasising the importance of protecting global eco-systems. It is a normative concept – much like ‘democracy’ or ‘freedom’ -- that reflects widely accepted values (Lafferty 1996). And while disagreements about its meanings and practical implications are inevitable, it can provide an important grounding for public debate and decision making (Meadowcroft 1997).

‘Sustainable energy policy’ is energy policy oriented to contribute towards sustainable development. It is not just about the environment, for it engages with energy in relation to the overall welfare of societies. Nor is it just concerned with ‘renewables’ -- energy systems than can in principle operate indefinitely because they harness recurrent natural flows such as sunshine or wind. Such alternatives already make a contribution, and their dramatic expansion will be critical to the emergence of a carbon-neutral, and low environmental impact, energy economy (Boyle 2003). But fossil fuels underpin present livelihoods, and they will continue to dominate global energy supply for decades to come. So sustainable energy policy must also be concerned with non-renewables,
with how they can be used effectively and in the least damaging fashion. Issues of energy efficiency, energy conservation, and demand reduction are therefore central. So too are techniques to minimize the environmental impacts of non-renewables. Carbon sequestration may prove critical in this regard, but so too are measures to reduce other environmental burdens imposed by fossil fuels and nuclear power. Above all, sustainable energy policy is concerned with orienting action to meet current economic and social needs while accelerating the transition towards a carbon-neutral, low-environmental-impact, energy future. So it is a perspective that sets current decisions within the framework of a long term transformation of the energy system (Doern 2005). Key considerations for such an orientation include:

- Integrating economic, social and environmental dimensions in decision making. Energy issues should be approached ‘in the round’, with their potential impacts on economy, equity and environment kept in focus.

- Strengthening the resilience of energy systems. Traditional problems of ‘security of supply’ are important, but so too are broader questions about managing the development of energy infrastructure in the face of uncertainty, managing risks, and avoiding premature technological ‘lock-in’.

- Incorporating an international and internationalist perspective. It is not just that energy markets are increasingly international, and that events abroad can affect domestic supplies and process. It is also that the environmental consequences of energy decisions can affect the whole world. So, for example, ‘energy assistance’ (including technology transfer) to developing countries may become an essential strategy for domestic (and global) environmental protection.

Socio-technological transitions
The energy economy involves an array of more or less tightly coupled socio-technical systems, concerned with various aspects of the production, transformation, distribution, and consumption of energy. These systems involve complexes of interdependent technologies that cross-link to other parts of the energy sector and outwards to the wider economy. Technologies are embodied in physical infrastructure, but they also involve interactions among the social organisations that own and operate facilities, provide finance, furnish equipment and services, consume outputs, conduct R & D, train personnel, and regulate the sector (Bijker, Hughes and Pinch 1989). The oil and gas industry is physically embodied in oil rigs, pipelines, refineries and retail filling stations. But its technologies and infrastructure are institutionally linked to the operation of business corporations, to markets for stock, futures, and insurance, to bodies charged with regulatory oversight, to the curriculum of engineering schools, and so on. Over time, nested hierarchies of technologies co-evolve, with changes in one system sparking adaptation and adjustment in related fields (Geels 2002). And these technological developments are bound up with the evolution of the related social organisations (Bijker 1995; MacKenzie and Wajcman 1999). Because each technological component is tied to other elements (even if on the macro scale the degree of overall integration among sub-systems remains loose), technological innovation usually proceeds in small steps – with continuous improvements in performance, manufacturing techniques, cost efficiencies, and so on. Larger scale adjustments, characterized by the wholesale replacement of one technology by another (from gas to electric lighting, for example) are less common, with higher risks but also with potentially larger rewards for innovators.

Historical experience with the transformation of large socio-technological systems suggests a number of lessons that are worth keeping in mind when reflecting on the emergence of a new
energy economy. First, technological change is not just about scientific discovery and engineering prowess. It is also about altering patterns of social organisation and interaction (Bijker 1995; ). Changing technologies means altering established behaviour. All sorts of obstacles -- in addition to the purely technical -- stand in the way of doing things in a new way. It is not just that an emergent technology must be operable, and be operable in a cost competitive manner. It must also be cast in a form that is compatible with, or that forces an adjustment to, established business practices, existing policy frameworks, entrenched customer expectations and dominant social attitudes. Issues as apparently distinct as the functioning of capital markets, the practices of the insurance industry, the operation of regulatory regimes, and the tastes and concerns of consumers can influence the relative success of specific technological ventures. The point here is that if we intend to accelerate technological transitions in the energy sphere we must be at least as concerned with innovation in the business, regulatory, and consumption spheres as with the actual process of scientific and technological discovery.

Second, socio-technological change is characterized by great uncertainty (Berkhout and Gouldson 2003). It is impossible to know in advance which technologies will prove to be ‘winners’ and which will result in failure. Encouraging leads may go nowhere, while an area of enquiry that has been stagnant for years may suddenly come to life. Governments do not have a good record of predicting technological trajectories. But even in the private sector grand technological visions are far more likely to end in fiasco than to be realised in anything like their original form. Change often turns out to be both quicker and slower than expected. The most fruitful application of a discovery may be far from the realm that originally motivated research. There are almost always unforeseen economic, social and environmental impacts. Perhaps the most important lesson for policy-makers here is to focus on the broad picture, improving general framework conditions for technological
advance in a targeted area, rather than trying to micro-manage the innovation process. Thus multiple technological options should be pursued and the early reduction of alternatives should be discouraged. In other words, policy is best directed to functional ends (Kemp and Rotmans 2003) – based on the identification of societal needs (for example, the need for efficient, cost-effective, low carbon emission fuels), rather than to backing favoured technologies (say those that appear closest to market, or that have strong national champions).

Third, ‘old’ technologies do not go quietly. In fact, they typically undergo repeated cycles of adjustment -- improving performance and cutting costs – as they attempt to hold off rivals. The first steam powered vessels did not put an end to sailing ships. Instead, they ushered in a period of intense technical and commercial competition, which saw improved design and fabrication of sailing vessels, increased speed, and a reduction in crew size. In the end the decisive factor was not speed or cost, but the greater reliability of steam (Berkhout, Smith and Stirling). Even when the age of sail had passed, wind-driven vessels remained in service in less developed regions. And eventually a new niche was carved out for sail in recreational, sports, and training applications. So ‘old’ technologies may survive long after their obituaries have been written. With respect to the energy sector the implication is that the oil and gas industry will not just roll up and die because some scientists claim to have come up with a nifty alternative fuel, or because others warn of long term environmental catastrophe. Oil and gas are too convenient; they remain too readily available; the technologies for their extraction and combustion are already highly perfected; and there is no reason to believe that options for further technological innovation (to increase extraction, increase efficiency, and mitigate environmental impacts) have been exhausted. Thus emergent renewable technologies will have to compete with a moving target: their rival is not just the oil and gas industry of today, but the fossil technologies of tomorrow.
Forth, technological transitions have distributional consequences. The fortunes of individuals, companies, occupational groups, towns and geographic regions can be tied to the career of specific socio-technological options. Change will always bring winners and losers. Even if society gains as a whole from the shift to a new technological trajectory, some groups will suffer. Jobs will be lost, and established skill sets may become redundant. The incomes, profits, or tax revenues, as well as the standing and influence of some groups will decline. Thus ‘progress’ has its costs, and its victims. And because such distributional consequences may be acute, technological transitions provoke resistance from established groups (companies, unions, professions, particular regions, and so on) that believe their interests to be threatened. From a policy perspective it is important to be alive to these realities. Broad coalitions may be required to isolate powerful groups that are opposed to change. And substantial social resources may have to be devoted to cushioning the impact of change both for powerful interests that might otherwise undermine the process, and for vulnerable groups that may be ill-equipped to bear the burdens of adjustment.

Fifth, while few technological transitions have originated as ‘political projects’, politics is closely intertwined with technological development at almost every level. Political circumstances influence what is possible, encouraging or discouraging investment and innovation both generally and in particular spheres. Policy intervention can protect technological incumbents or expose them to challenge. Interests associated with particular technological options consistently exploit the political realm to advance their projects. And governments, for their part, routinely lend support to technological initiatives which they deem to be in the public interest. Support for R&D in the military sphere is a given, but governments have also systematically backed the introduction of new infrastructure technologies that have captured the political imagination -- such as railways, electrification, the highway network, and communications technologies. With respect to energy
systems, the current landscape is influenced by policy at every level. So it is perfectly reasonable to ask whether the existing patterns of governmental intervention correspond to the public interest, and to contemplate reformulating policy to tip development in more socially desirable directions.

Of course, the transformation of energy systems will not represent a single ‘technological transition’, but a family of transitions in associated systems that will stretch out over time. This will involve not only the way energy is produced but also the way energy is consumed. After all, energy is not an end in itself, but a means to satisfying other needs -- providing inputs for agriculture, construction, manufacturing, and transport, and direct services to households. Ultimately changes to energy systems will have profound implications for the organisation of industrial production, systems of transportation, the spatial disposition of cities, and patterns of domestic life.

Critical policy considerations

So far the discussion has pointed to a number of elements that should inform efforts to govern energy transitions. Reference has been made to the idea of ‘sustainable energy policy’ as an appropriate policy frame. Emphasis has been placed on the broad range of societal factors involved in technological change. The uncertainty surrounding such processes, the advisability of focusing policy to attain functional goals (rather than privileging specific technological options), and the centrality of distributional conflicts have also been highlighted. Moreover, the point has been made that governments should not feel bashful about intervening in a domain where the configuration of existing socio-technical regimes has been so heavily influenced by previous rounds of policy choice, and where the potential impact on long term societal development is so high.
Keeping such considerations in mind, it is possible to go further in specifying the general parameters of the necessary approach. A critical element concerns societal engagement, dynamism and inventiveness. On the one hand, citizens are entitled to have a say in decisions about defining the development trajectory ‘beyond oil’. And on the other hand, the successful negotiation of this change requires inputs from key stakeholders and the public. Since there are many possible energy futures -- exploiting different technological options, implying different packages of economic, social and environmental costs and benefits, and involving different risks and opportunities -- citizens should have some influence over the path that is ultimately chosen. Moreover, these are issues that cannot be successfully ‘sorted out’ behind closed doors by scientists, industry leaders, and top state officials. Their reach is too profound; their impact on diverse social strata and practices is too great. And the innovation-potential required to address them is widely distributed.

Thus the challenge is to progressively engage the public and key stakeholders; to enable them to appreciate the dilemmas, opportunities and choices related to energy; and to mobilize their creative power to transform current practices in a more sustainable direction. The response to climate change and the transition towards a new energy system must be seen as defining challenges for our generation. And policy should be oriented to involve groups and individuals at all levels -- schools, universities, professional associations, businesses, research labs, the media and artistic communities, charitable and religious groups, and so on. Energy and climate change should be set at the heart of the scientific and technological agenda, and the core of civic debate. They should be approached not in apocalyptic terms (we are running out of oil! the climate is going haywire!) but rather as defining elements of the sort of society we want for ourselves and for our children. Calls for enhanced ‘public participation’ in all sorts of policy contexts are fashionable at present, although officials are typically more concerned with formal than substantive processes. But in relation to
energy and climate change what is needed is progress in general understanding (to provide a political underpinning for an active policy response) and in practical involvement (to provide multiple sources of innovation). Thus policy should be directed to engage and mobilize society, and particularly major stakeholders.

There is also a need for a clear strategic orientation from central governments. This area cries out for strategic vision and long term planning. Not ‘planning’ in the sense of ‘command and control dictates’ – but ‘planning’ in the sense of forward oriented analysis, that reviews trends, explores scenarios, and establishes priorities. Such a vision plays an important communicative function, both within government (letting officials at all levels know what is expected) and in relation to society at large (Meadowcroft 1999. Precisely because processes of long term structural change are rife with uncertainty, societal actors (such as firms and households) need to understand the basic direction of government policy. For this allows them to orient their autonomous activities in relation to a long term perspective. A number of OECD states have recently made some progress in defining such visions, adopting longer terms energy and climate change objectives. But to give such a strategic orientation life, it is necessary to integrate energy and climate change concerns into the work of departments across government, and to the establish performance measures that hold organisations and officials accountable for their performance. Without such initiatives the governmental responses will remain fragmented and incoherent, with various ministries and agencies pulling in different directions. Of particular concern is the array of bodies with responsibility for energy regulation, especially in jurisdictions that have seen substantial deregulation of their energy markets. Sometimes the mandates of these institutions were defined almost exclusively in terms of competition policy, with no explicit reference to climate change and the long term energy transition. Another front on which a strategic orientation can guide action is
with respect to the comprehensive review of existing energy-related policies and expenditure. Much of existing energy policy reflects the accretions of earlier age, and it includes subsidies for fossil fuel industries and carbon-intensive sectors, and encouragement of energy wasting practices we now recognize as perverse. Cutting established subsidies and tax concessions is always a political challenge, but the attempt must be made to re-orient public expenditure in line with current priorities.

Another key consideration is that in making energy policy as much attention should be paid to usage and demand as to production and supply. So long as energy systems generate significant environmental costs, it is better to use less energy than more. In particular, while the energy mix continues to include sources that release greenhouse gasses to the atmosphere, reducing demand helps control emissions. This implies an active effort to promote energy efficiency, and to manage rebound effects in order to secure demand reductions. This is not so much about behavioural change in a static technological context (lowering speed limits, extending daylight savings time, or urging householders to turn down the thermostat and put on extra sweaters) – as it is about encouraging socio-technical innovation on the consumption side. This means driving the shift to more efficient heating, cooling, and lighting in domestic and commercial contexts. It means encouraging industrial innovation to reduce the energy intensity in manufacturing and construction. Possibilities for significant demand reduction in the medium and long term are significant, with innovation in the design of buildings, improved energy consumption of appliances and electronic equipment, and the transformation of industrial processes and materials towards lower energy pathways. But operating on the demand side is more difficult that concentrating on new supply technologies, because consumption is fragmented among many types of user (industrial, commercial, domestic). Moreover, technologies of ‘saving’ may appear less glamorous than technologies of production. Yet
if energy savings are linked to cost efficiencies, and to gains in functionality, they can appeal. And policy oriented to encourage movement in this direction is urgently required.

Also important is the design of packages of policy instruments suited to different dimensions of the problem. Over the past three decades there has been an enormous accumulation of knowledge about the deployment of different instruments in the fields of environment and energy (Golub 1998; Harrington, Morgenstern and Sterner 2004). To the established understanding of regulatory governance, has been added experience with market-based instruments, negotiated approaches, and informational techniques (OECD 2003). The use of mechanisms such as portfolio standards, renewables levies, targeted subsidies, tradable emissions permits, accelerated depreciation allowances, and product labelling, have shown the potential and the limitations of specific approaches, and the conditions where they are more or less likely to succeed. A key challenge is combining different sorts of instruments into balanced packages to achieve specific goals. With respect to science and innovation policy one important lesson has been that different instruments are required at distinct phases of the research and innovation cycle. Some measures can stimulate primary research, while others are more appropriate to encouraging applications-development, product roll-out, or consumer up-take. Attention must be devoted to identifying obstacles in innovation pathways, including obstacles on the business side (operation of venture capital markets, business models and practices) and on the government side (‘red-tape’, procurement policies, outdated standards, jurisdictional tangles).

Exercises combining the visioning of alternatives, practical experiments and networking – that bring together new constellations of actors interested in emergent technologies – are particularly important. They can help identify obstacles to, and opportunities for, innovation that cannot be appreciated fully by individual actors – be they from industry, government or civil
society. Such initiatives are central to the approach that has gained ground in the Netherlands over the past few years under the label of ‘transition management’ (Rotmans, Kemp and van Asselt 2001). Formulated initially by researchers working on the Forth National Environmental Policy Plan, the idea has been taken up to orient the long term movement towards sustainability in key sectors -- energy, transport, natural resources, and so on (NEPP4 2002). The Dutch Ministry of Economic Affairs has been particularly active with respect to the energy transition, funding an array of projects that explore socio-technological alternatives to current patterns of production and consumption. The preparation of a report presenting energy scenarios through to 2050 provided the basis for identifying five strategic transition ‘routes’ (green and efficient gas, enhanced production chain efficiency, green raw materials, alternative motor fuels, and sustainable electricity) that were considered ‘robust’ across varied scenarios (Bruggink, 2005). Further consultation with stakeholders allowed the formulation of aspirational goals (‘ambitions’), transition paths (strategies for change), and specific ‘options’ (technological and social innovations) for each strategic route. Projects organized by coalitions of stakeholders have been funded to explore transition paths (Kemp and Loorbach 2005). For example, one project focused on reducing energy usage in the paper and board sector by 50% by 2020, while another engaged with the agricultural glasshouse industry. An evaluation of existing research funding from the perspective of transition management has been undertaken, and the government has established a ‘Frontrunners desk’ to cut through ‘red tape’, reduce the regulatory burden on proactive firms, and identify bureaucratic obstacles to novel experiments.

‘Transition management’ has been described as ‘a deliberate attempt to bring about long term change in a stepwise manner, using visions and adaptive, time limited policies’ (Kemp and Rotmans 2003). Interactions among concerned stakeholders are central to the iterative processes at
the heart of transition management. Concerned parties are drawn into continuing discussions about goals and visions, the identification of interim objectives, and the assessment of progress. Thus transition management appears as a further extension of the interactive modes of environmental governance already institutionalized in the Netherlands.

Although particulars of this approach might be hard to reproduce in a country that does not have such a ‘consensus-oriented’ and ‘planning-friendly’ political culture, the fundamental impulse of ‘transition management’ is of general significance. For the establishment of networks involving novel constellations of public and private groups focused on innovation in the energy domain is vital. And these can only be truly effective if they operate within a context where government provides a clear strategic orientation signalling its commitment to long term change in the energy sphere.

**Transforming energy/environmental governance**

When discussions of energy futures get underway there is typically a tension between two opposed perspectives. On the one side there are the enthusiastic advocates of alternative technologies -- scientists, engineers, environmentalists and entrepreneurs -- convinced they have viable options that can meet society’s energy needs. From them one gets the impression that if only a few obstacles (technological, economic, or political) could be overcome, these new approaches would flourish. On the other side, there are the old energy hands, experts in existing technologies and markets, who emphasise the overwhelming place fossil fuels occupy in our present energy mix, and who disparage the possibility of any early or rapid shift towards alternatives. To the first group, the arguments of the second appear backward (failing to appreciate that the days of oil are numbered),
or worse, as an apology for the powerful interests that currently dominate the world energy order. To the second group, the arguments of the first are those of naïve dreamers, special interest pleaders, or ‘jonnie-come-lately’ analysts who don’t understand the real economics of energy, and the mountain alternative technologies will have to climb to present more than a trivial challenge to the overwhelming predominance of fossil fuels.

In fact, there is truth on each side of this divide. It is easy to become wrapped up with the potential of new technologies without appreciating the obstacles to their widespread adoption, the costs of transition, the problems a shift might eventually entail, and the long lead times between proof of concept and societal deployment. Moreover, since choices are made relative to other options, the emerging energy technologies described in this volume will often be as much in competition with each other as they are with the core of the established fossil fuel industry. Clearly change will take time, and some promising alternatives will not pan out. And yet it also easy to be mesmerized with the current state of the world, and to be overawed by the solidity of established socio-technical systems. Just because one practice holds sway today, does not mean that it will always be ascendant. Indeed, as we have seen, in the energy domain the factors driving change over the medium term are destined to grow. And within two or three decades the impact of non-fossil energy sources, cumulative efficiency and demand control innovations, and carbon storage technologies could be quite significant. Although this represents quite a long period in the life of an individual, it is short in relation to the duration of the fossil era or to the time scale over which climate management efforts will be required. And it is well within the potential planning horizons of major corporate and governmental actors.

Yet if governments are to steer societies in such a direction, they will have to move beyond the approach to energy and environmental issues that characterized the final decades of the
twentieth century. A number of necessary changes have been discussed over the course of this chapter. But two require further elucidation. First, there is an urgent need to integrate different dimensions of decision making. Energy policy, environmental policy, and science and innovation policy must be brought into closer contact. Energy solutions can no longer be defined without taking proper account of environmental factors (especially those related to climate change), while the advance of science and technology are critical to understanding and problem-solving in both the environmental and energy domains. Moreover, there are essential links between each of these three areas and sectoral policies – transport, construction, agriculture, industry, and so on. The idea of ‘environmental policy integration’, which has been much discussed over recent years and formally adopted as a goal in many jurisdictions (such as the European Union), captures part of this dynamic. So too does the more encompassing notion of sustainable development, which insists that economic, social and environmental elements be brought together in decision making. But achieving such ‘integration’ in practice is more difficult than achieving it rhetorically. And as the earlier discussion has suggested, what is required is not a ‘defensive’ integration – that simply subjects distinct sectoral policies to environmental review, and attempts to define supplementary measures to mitigate impacts. Rather environmental policy should contribute to redefining the desired sectoral development trajectories, while innovation policy accelerates technological advance in critical areas.

Second, there is the move towards more ‘interactive’ modes of governance. As recent literatures in political science have documented, the context in which governments operate have changed markedly over the past three decades. The situation is more complex and turbulent, the range of actors and the scope of issues have grown, and economic and political ties among states are more intimate (Pierre 2000; Pierre and Peters 2000). Governments now place more emphasis on
interactive approaches, relying on the ‘self governing’ potential of social organisations and ‘co-governance’ arrangements (Kooiman 2003). Nowhere is this more important than in the environmental and energy domains. Governments cannot ‘solve’ society’s energy problems; but neither will these problems simply disappear if they are left to market mechanisms, or voluntary initiatives. The state remains a powerful instrument for achieving collectively defined ends, but the way it defines and realises those ends is changing (Eckersley 2004; Barry and Eckersley 2005). This does not mean that regulation and expenditure – the two staples of governmental action are no longer required. But it does mean that it is at the interface among different types of organisations – including governmental agencies, corporations and business associations, and civil society groups – that much of the more dynamic work of governance goes on (Driessen and Glasbergen 2002; Meadowcroft 2004). And, in particular, these interactions can play an important role in spurring the social and technological innovations required to manage energy transitions.

Throughout this chapter it has been argued that the technological developments required to meet the energy and environmental challenges of coming decades are as much about societal innovation and transformation as they are about scientific and technological discovery. And political processes and policy decisions play a key role in shaping the way societies create and use energy. For two centuries economic advance has been closely tied to fossil fuel combustion. Not only do hydrocarbons meet the bulk of our energy needs, they also provide the feedstock for the modern materials economy -- plastics, chemicals, fertilisers, and so on (Geiser 2004). Our civilisation has prospered by tapping the solar energy captured by living organisms and laid down over geological time scales. But now worries about the supply of the most convenient fossil resources and above all a growing appreciation of the environmental consequences of current practices suggest that energy systems must change. Over coming years governments and citizens
will face critical choices about energy options and about how serious they are about tackling the issue of climate change. Clearly there are many possible energy futures ‘beyond oil’ – with some far less desirable than others. And by making wise political choices today we can help influence which of these alternative futures actually becomes reality.
References


