European energy policy:
meeting the security of supply and climate change challenges

Abstract

The paper critiques current European energy policy. The key market failures are identified and the reasons for intervention set out. In addition to the traditional concerns with monopoly and market failure, the public goods aspects of diversity and security of supply, together with environmental failures are highlighted. Whilst in the 1980s and 1990s, market power dominated in the context of excess supply, the new priorities of security of supply and climate change require new policy instruments – notably network interconnection, capacity markets, strategic storage, and enhancements to the EU Emissions Trading Scheme. The paper sets out the necessary reforms, together with the institutional structures at the EU level which would provide credibility.

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1. Introduction

It is now widely recognised that Europe faces major security of supply and climate change challenges, and that the myriad of current national energy policies and the underlying market structures are not fit for purpose. Europe requires major investment in its energy sector, after two decades of asset-sweating and cost reductions. This investment needs to meet not only the new realities of gas import dependency, particularly from Russia, but also the transformation from a high- to a low-carbon capital stock. To be fit for purpose – to achieve what the European Commission has called 'a new industrial revolution' – requires a new European energy policy framework.

Despite these challenges and the interdependency of Europe's energy market, remarkably after a decade and a half of trying to complete the internal energy market, Europe still consists of a set of national markets, many with national champions, connected together by a series of bilateral links. There is not yet much of a European market at all, and only the rudiments of a European electricity grid and pipeline network (see Helm 2006 and European Commission 2007a). This is reflected even in the EU Emissions Trading Scheme (EU ETS), which is very much national in its workings.

This national, rather than European, physical structure of the market is reflected at the policy level too: almost all European countries have national energy policies, and indeed almost all are engaged in national energy policy reviews. In many of these cases, the European dimension has to date received scant attention.

A national approach would not matter if the domain of the problems confronting energy markets remained national too. But a core characteristic of energy policy is that the objectives of security of supply and climate change are now, respectively, European and global. The former necessarily requires a European policy response, and the latter requires Europe to take the lead in gaining global agreement and reducing its own emissions. The third objective – competitiveness – is better addressed too at the European level through the economic efficiencies that arise from integrating energy markets and their networks.

The main purpose of this paper is to outline a rational European policy response to Europe's energy challenges. To this end, Section 2 sets out key energy policy objectives and market failures that require intervention. These failures have a variety of domains, but a core part of the argument for a European energy policy is that they increasingly have a European dimension. Bearing this in mind, Section 3 considers the changing environment in which a European energy policy needs to be set. A salient feature of this change is that Europe, and the world in general, has moved from a situation of ample energy supply capacity in the 1980s and 1990s to one where major investment in capacity will have to be made in the next couple of decades. Cognisant of these investment needs, Section 4 turns to the challenge of ensuring a sufficiently reliable external supply of energy for Europe and Section 5 considers the climate change problem. Having thus prepared the ground, Section 6 presents the main message of the paper, namely that a successful European energy policy needs to be cast in a credible long-term institutional framework. Section 7 concludes.

2. Defining the problem: what is energy policy for?

The objectives of energy policy – like any other aspect of economic policy – are aimed at the broad public interest. But in the case of energy, there are some special features, market failures in particular, which provide a focus for the priorities. Energy is a complementary good and it has public goods characteristics (Section 2.1), its provision is characterised by natural monopoly elements and market power (Section 2.2), and its production and consumption create significant negative externalities (Section 2.3). Recognising these special features and multiple market failures, energy policy ought to provide the framework within which private companies can be incentivised to promote the broad public good. A starting point for considering European energy policy is therefore to identify what those failures are, and at what level they arise.

2.1 Energy: a complementary good and a public good

Energy is a fundamental input into production and consumption: its ready availability is a necessary condition for economies to function. In economic terms, it is a complementary good. A moment's reflection on a power cut or a crisis in petrol supplies confirms that energy supply is of much greater significance than its apparent share of GDP and – at the limit – its scarcity undermines defence. A number of European and Eurasian countries (notably Ukraine, Belarus, and Georgia) have recently discovered these unpleasant realities in the interruptions in supplies from Russia.

Complementarity is reflected in the fact that the costs of over- and under-supply are asymmetric: over-supply places a relatively small cost over a large number of customers whereas under-supply leads to much sharper cost effects. But since electricity, in particular, cannot at present be stored on a large scale (and storage is expensive for gas), demand and supply have to be instantaneously matched. Moreover, since demand is uncertain and capital investments tend to be characterised by large, fixed and sunk costs and take time to bring on stream, continuous supply means excess supply capacity in power station capacity and their fuel supplies, and in network infrastructure.

This simple observation has radical consequences: the requirement for excess supplies is one that the market will not meet on its own. Excess supply drives down prices, which has the impact of reducing the returns on assets below their economic level. In the absence of intervention, excess supply is likely to be insufficiently supplied, unless some mechanism is found to reward peak capacity. There are several options, including mechanism such as those under New Electricity Trading Arrangement (NETA) in England and Wales and capacity markets. The former attempts to incorporate the latter in a single market price, but to succeed requires very demanding conditions – notably that governments and regulators do not intervene at moments of peak demand (so that the potential to 'win the lottery' arises) and that generation (and supply) is competitively provided. Capacity markets require a specific market design and regulation, with an external (system) setting of the capacity margin. This is then auctioned, with the added benefit of allowing competition in new generation to compete on equal terms. It does, however, need to be backed up by a duty to supply, which is translated into a duty to contract on suppliers.

If security of supply requires excess supply, it is important to recognise too that the capacity margin in plant and the network itself are together a public good – it is non-rival as well as non-excludable in its benefits. It cannot be disaggregated into a set of individual benefits. And the corollary is that a set of disaggregated decisions in a competitive market will not provide enough of the public good. Therefore, its economics needs to be considered as a whole, and this top-down domain is defined according to the underlying economies of scale.

In the early years of the electricity industry this was at the local level, with each municipality providing electricity systems. In the middle of the twentieth century, the grids moved to the national level – in the case of Britain and France, a high-level grid was defined by nationalised industries and planned accordingly. Power station locations were also part of the planning process. More recently, the domain moved up towards the European level, but without the corresponding coordination and planning. It is this shift in domain that provides part of the rationale for a European approach to both the planning and investment and the regulation of grids.

The gains from higher-level integration are not, however, confined to the technical efficiencies from high voltages and larger power stations. The gains are also in the plant margin and security of supply. The greater the interconnection, the smaller the required aggregate plant margin – from the portfolio effect – and interconnection brings its own insurance by providing greater resilience to shocks. Finally, interconnection reduces the costs of providing diversity. For example, as France becomes more interconnected, others can benefit from base-load, non-fossil fuels, whilst France benefits from having a broader mix of fuel sources.

2.2 Technical economies of scale, natural monopoly, and market power

Because of technical economies of scale, electricity and gas networks have significant natural monopoly elements. As a result, they are almost always explicitly or implicitly regulated, and subject to licensing regimes that place major public-interest requirements on their operators. For most, the prices are regulated on the basis of capital and operating expenditure assumptions, sunk capital assets (often called regulated asset bases), and an appropriate rate of return for the industry. Access to networks is also regulated – indeed, this is a major aspect of the attempts to complete the internal energy market. The Directorate General (DG) Energy and Transport of the European Commission (European Commission 2007a), with its supporting reports from DG Competition energy sector inquiry (European Commission 2007b and 2007c), focuses almost exclusively on the access problem. It argues that ownership unbundling is a necessary condition for upstream and downstream competition.

It is very unlikely that the fundamental property of falling long-run average costs will be much altered by technical change, making natural monopoly an enduring feature. It follows that network regulation is likely to remain an important aspect of energy policy. The growth of distributed generation is unlikely to alter the fundamental natural monopoly characteristics of energy networks. And since network regulation includes (again explicitly or implicitly) oversight of capital expenditure, regulators (and hence governments) not markets, in effect, determine the investment and interconnection programmes.

Economies of scale have not only arisen in networks, but also in power plants. The trend throughout the twentieth century has been towards larger power stations. Although this assumption may be challenged by the growth of small-scale distributed generation, it is important to recognise that this is a property with some fundamental engineering science behind it, and even in distributed generation, such as wind, it applies at the plant or turbine level. The reason this is important is that it tends to encourage oligopoly as the natural market structure, and limit the possibility of radical micro-level competition. Add to these technical plant characteristics the advantages of operating portfolios of plants in a vertically integrated structure to address the demand and supply uncertainty, and the market form commonly observed in the electricity and gas industries throughout the twentieth century becomes comprehensible. Hence the issues relating to competition and competition policy are necessarily the complex ones of oligopolistic, rather than atomistic, competition.

Some have argued that the portfolio benefits and vertical integration have been radically altered by the coming of modern information technology – that what had to be done by planning within firms (because of the transaction costs before information technology) can now be done through markets. The argument runs: the costs of information coordination have fallen, so that the inefficiencies of central planning are no longer more than compensated for by transaction cost gains from planning.

There is much merit in this argument – cost conditions have been fundamentally affected. But the main effects have not only been within networks, and within generation and supply, but importantly between them. The most radical effect has been to enable transmission and distribution, as natural monopolies, to be operated and developed separately from generation and supply. This possibility is what facilitates the unbundling agenda and the possibility of competition in electricity markets. Prior to the 1980s, this would simply not have been feasible, and an element of command-and-control was then essential to coordinate.

But unbundling does not necessarily solve all the market failures, and it does not follow that there can therefore be many buyers and many sellers in generation and supply. For while information technology has enabled the possibility of a split between generation and supply on the one hand, and transmission and distribution on the other, within generation it has encouraged an element of consolidation of portfolios, and within supply it has added greatly to the economies of scale, scope and density in servicing larger portfolios of customers. Therefore, whilst information technology has facilitated the idea of arm's length networks through which all competitors can access markets, it has also tended to reduce the number of competitors. The result is the rather constricted model in Europe of a small number of very large companies dominating the market.

If unbundling is an effective tool for encouraging greater competition in generation and supply, it now confronts a highly concentrated set of companies. There are not many competitors (and far fewer than in the 1990s) to compete through the independent grids, not just because the European Commission's competition authorities have allowed this concentration to take place, but because the underlying cost structures militate against anything other than an oligopoly model emerging.

2.3 Negative externalities of producing and consuming energy

So far, we have established that energy is a complementary good, with public good characteristics, supplied under oligopoly or natural monopoly, and hence the determination of its capital expenditure (the challenge in meeting the policy objectives in the next couple of decades) will very much be influenced by regulators and governments. However, not only the volume, but also the type of investment matters. A main reason is climate change and carbon emissions. Energy is the core part of the carbon economy, and it is the use of fossil fuels that facilitated the great industrialisation of the twentieth century, and is driving the Chinese and Indian expansions today.

There are a significant number of externalities from energy production and consumption that have required intervention, of which climate change is only one. Coal burning – the main twentieth-century fuel source for electricity generation – produces nitrogen oxide (NO_X), sulphur oxide (SO_2) and carbon dioxide (CO_2). Coal mining generates methane, transport of coal creates emissions externalities, the mining itself consumes energy and coal stockpiles contain radioactive materials. There is heavy metal pollution of water systems and land, as well as health effects on miners, subsidence, and local amenity loss.

Some of these externalities are local, but two are beyond the national level. Acid rain (largely caused by emissions of SO_2 and NO_X) has required a regional approach to policy, and the EU's Large Combustion Plant Directive has proved an effective mechanism. Global warming is, by definition, global, and hence national policies are likely to be ineffective unless they have an impact on the global level. No individual economy in Europe is likely to make much difference on its own by cutting its emissions.

If climate change is now the dominant environmental problem facing the energy sector, and if it is global in its effects (it is a global public bad), then the policy issue is in two parts: can the EU, by cutting EU emissions, make a difference to the rate of warming and can it act to help create a global agreement for global action? As we shall see in Section 5, the answer to both questions is positive.

2.4 Summary

The energy sector is then characterised by multiple market failures. These are sufficiently serious to require significant intervention. This intervention has traditionally been local or national, but the security of supply and climate change concerns both have important European dimensions. Any intervention to address one of these market failures will affect the others – and, in particular, recent proposals (European Commission 2007b) to promote competition need to be considered in terms of their impacts on security of supply and climate change. These linkages are far from obvious. Competition may have mixed effects and it is, at best, not even a necessary condition for solving these other market failures – as demonstrated throughout much of the twentieth century. Indeed, for much of the period, it was assumed that competition was sufficiently pernicious as to require its legal prohibition. Nevertheless, properly applied, it can increase the efficiency of policy delivery. Competition is not a substitute for policy – it will not on its own achieve either security of supply or reduce CO_2 emissions. It is one possible means, and needs to operate in an energy policy framework. But before elaborating on this framework in Section 6, we turn next to the changing energy environment against which such a framework needs to be developed.

3. The paradigm shift – from the 1980s and 1990s to the new millennium

Throughout most of the twentieth century, national governments relied as far as possible on their own natural resources to meet energy demand. In electricity, that meant domestic coal (often heavily subsidised) and, after the OPEC twin shocks of the 1970s, nuclear power. By the last decades of the century, the three major economies in Europe had energy mixes that reflected these natural resources: for Britain and Germany the mix was coal and nuclear. In both cases the electricity generators were encouraged to purchase fuel supplies from indigenous sources – though, imports were required too, of course, especially in Germany. For France, with very few coal reserves, nuclear became the dominant source in the search for self-sufficiency. The arrival of natural gas provided an additional opportunity to be self-sufficient. The Netherlands and Britain took this route in respect of the North Sea.

As the OPEC shocks of the 1970s – particularly the 1979 shock following the Iranian revolution – took their toll, two key (and related) developments in the European economies had an impact on their energy sectors. First, the sharp recession in the early 1980s reduced growth below the level that had been predicted in the 1970s (and which had been built into the assumptions that determined power station construction programmes), and then changed the composition of developed economies more towards services and away from energy-intensive industries such as steel, chemicals, and aluminium (and indeed coal mining too, which itself is very energy-intensive). Second, and partly as a result of the recession but also because of the break-up of OPEC discipline, fossil-fuel prices fell back sharply, rendering two decades of low prices, well below the assumptions that had motivated the investments made in the 1970s in anticipation of the expected demand and costs of the 1980s and 1990s.

Taken together, these two developments meant that Europe as a whole experienced excess supply (and cheap energy) in the 1980s and 1990s, in some cases – such as that of Britain – massively so. There were exceptions but, for the main economies, this feature had the policy corollary that the priorities were asset-sweating and cost reductions, and the natural instruments to achieve these objectives were privatisation, liberalisation, and competition. They were broadly the right policies for that particular historical context and provided the rationale behind both domestic policies (at very different speeds, according to the political circumstances) and the EU's strive for an internal energy market.

The important point to note is that security of supply did not arise as a serious problem for these two decades at all. Given excess supply and low prices, these market failures did not matter much. There was excess supply and, thus, no need to incentivise companies to invest. And, because there was excess supply, complementarity and coordination problems simply were not manifest. As a result, almost all European countries moved towards energy policies that neglected these concerns – and, in the process, did not address the investment problem.

And, whilst excess supply reigned across Europe, for at least the 1980s, global warming did not figure as an important market failure either. The only serious environmental externality was acid rain, and the politics of the acidification of Scandinavian lakes and the death of Bavarian forests provided the impetus for command-and-control regulation that has largely (but not entirely) solved the problem. Fitting flue-gas desulphurisation to coal-fired power stations, and then bringing on gas-fired power stations at the margin in the 1990s, provided an effective European solution – one of the major successes of the EU to date.

But by the 1990s, the scale of the climate change problem was beginning to be recognised, and the mismatch between a predominantly fossil-fuel-based set of economies, and the need to decarbonise them, began to exercise policy makers. When the 1980s and 1990s came to an end, so too did the predominant market conditions in which they had operated – but, sadly, not their policies. At the end of 1999, oil prices started their fundamental shift (against expectations). Oil prices first doubled from around $10 and then tripled to reach $70 in 2006, before falling back (and with a falling dollar) in early 2007. Very cheap oil – and gas – came to an end in a gradual, sustained way. But so, too, did the excess supply conditions across the energy sector (including in oil refineries and oil and petrol delivery systems).

Eventually, asset-sweating and low investment meant that demand and supply came back into balance. The early signs came in networks where a series of apparently unconnected failures produced power cuts in a number of different areas within Europe (and in the United States). The causes were often trivial – from 'fitting the wrong fuse' in London, to a tree breaking the line in Switzerland blacking out Northern Italy, to a bridge being opened on a German river causing power failures across northern Europe. But these individual and separate cases were symptoms of networks under stress from cost-cutting and low investment. Similar events happened in the oil industry too – notably the BP refinery accident in Houston and the pipe leakage in Alaska, both widely blamed on a dominant strategy of asset-sweating and cost cutting, the predictable response to very low oil prices.

Next came signs that the capacity margins in generation might be under pressure. The dash-for-gas in a number of European countries from the 1990s onwards was not matched by a corresponding development of pipelines and storage. This was most apparent in Britain, where reliance on the main gas interconnector and a single major gas storage facility (Rough) produced a security of supply crisis in the winter of 2005/06. This resulted in a very sharp rise in prices – the way most security of supply crises are reflected – and (almost) compulsory physical demand reductions. Further vulnerability was displayed in the winter of 2006/07 as major faults appeared in the British AGR (Advanced Gas-cooled Reactors) nuclear power stations – a vulnerability mitigated in large measure by extremely mild weather.

The scale of the investment requirements across Europe to replace ageing power stations and to provide the infrastructure for electricity and gas is very large. It is fortuitous that precisely at the time when such investment is needed, it is also necessary to switch from a carbon to a non-carbon capital stock. The new paradigm priorities of security of supply and climate change are primarily investment problems, and it is apparent that the legacy of the asset-sweating decades of the 1980s and 1990s has left the individual countries and Europe as a whole ill-prepared to meet these challenges.

In addressing these challenges, a core requirement is that they are solved jointly in a consistent fashion by encouraging investment that fosters both supply security and a reduction in greenhouse gas emissions. To date, each challenge has been addressed separately, and this is a feature too of the most recent policy proposals of the European Commission (European Commission 2007a, 2007b, and 2007c). The Commission has to date concentrated on competition and internal aspects, that is, completing the internal market. Whilst this has merits, what is not shown is how promoting the particular model of competition advocated by the Commission, solves the security of supply and climate change problems too. Indeed, it is notable that many of the proposed interventions on security of supply and climate change are (unlike the internal market approach) explicitly not market-based, but rather pick technologies and involve political and regulatory interventions.

4. Security of supply: Russia and Europe's external gas dependency

Unless there is very substantial policy intervention, a defining feature of European energy markets over the coming two decades will be the growing dependency on gas imports, in the context of a further dash-for-gas as the fuel of choice for electricity generation. That gas will come from two primary external sources – Russia and Norway – for the bulk of European demand, augmented by North African supplies into Spain and Italy. North Sea gas will continue for some time to come, but it has been depleted rapidly at a time of low prices in the 1980s and especially the 1990s – indeed, this rapid depletion in the British sector, has been a corollary of the overall asset-sweating approach. There will also be some LNG supplies.

The focus of policy will be on Russia, and for a variety of reasons. It is not only the largest supplier, but also the marginal one, in both economic and political terms. Norway is a reliable supplier, with its volumes determined by the pipeline capacities and the supporting long-term volume contracts. But given Norway's small population and relatively large oil and gas reserves, it has no need to maximise depletion, or to price below the market price for European gas (which will be set by Gazprom). Its gas has nowhere else obvious to go to, except via LNG. The North African supplies are similarly somewhat pipeline-constrained. The North Sea operators may find new ways to extend the lives of fields and small additional reserves, but there is little scope to expand production from what is a mature set of fields. Pipeline gas is almost always cheaper than LNG, except for very long pipelines, and hence LNG will be concentrated on those markets where there is no other alternative – because of geographic isolation – and on those areas where access to market necessitates LNG in the absence of pipeline alternatives. In Europe, LNG will act primarily as a price cap, against the monopoly power of pipeline suppliers.

Russia has pursued a strategy of maximising the economic rents from its carbon resources, and taken a path similar to other oil- and gas-producing countries in renationalising its resources (some 90 percent of worldwide oil and gas reserves are now in state hands). For gas, this has taken a variety of forms, including asserting a legal monopoly over all pipelines in Russia in Gazprom's hands, forcing (through political and other means) incumbents to give up resource rights to Gazprom (for example, most recently, the Sakhalin II project), forcing near neighbours to cede pipeline control, and insisting on long-term contracting methods for supply. Gazprom itself has become highly political and an integral part of the Russian political regime – to the extent that its management is largely politically appointed; it has deep connections with the security services (the FSB); it has bought into the national media to assist the government; and has been used as part of the wider aims of reasserting Russian prestige abroad through Russian foreign policy to near neighbours. Recent events in the Ukraine (winter 2005/06), Belarus (winter 2006/07), Chechnya (ongoing), and Georgia (ongoing) have all had both narrow rent-seeking economic rationales and broader political contexts. The Russian government and Gazprom cannot be considered as independent entities and, given Europe's dependency on Russian gas, security of supply becomes largely a matter of political cooperation and agreement, rather than driven by independent commercial activities.

In this political context, the Gazprom strategy is already fairly clear – at least in outline. Gazprom has identified a series of 'strategic partners' and entered into bilateral deals with individual countries. It has tended to avoid dealing with the EU as a whole, and the slow progress over negotiating a new Partnership and Cooperation Agreement (to replace the current one that expires in December 2007) illustrates this well.

The European position has been focused on the Energy Charter and the Transit Protocol within it (which, in turn, has had a wider context in the negotiations for Russia to join the WTO). The core of the Charter argument between the EU and Russia is a clash of models: Europe favours what might be called the 'British model' – the separation of pipelines from production and supply, and full third-party access to pipelines not only for the EU itself (as set out in European Commission 2007a), but externally too. Russia favours the fully vertically integrated model, with a statutory monopoly over pipeline access conferred on a single monopoly, Gazprom.

So far, this conflict of approach has produced a stalemate – or, rather, enabled Russia to maintain, and indeed enhance its position. Whilst the Energy Charter negotiations have been going on without result, Russia has reinforced Gazprom's monopoly over Russian pipes, and indeed used this control actively to squeeze independent reserve owners into 'cooperation' with Gazprom in return for access to markets for their gas. Furthermore, as noted above, it has pursued an active strategy of gaining control of pipelines downstream from Russia, notably by forcing both Ukraine and Belarus to cede control of pipelines on their territory in return for more gradual price increases.

This strategy has taken a step further with the agreements over the Baltic pipeline and the associated decision about the Shtokman field. Russia has identified Germany as its preferred partner and gas hub in Europe, and Gazprom and Ruhrgas (owned by E.ON) have consolidated this relationship in a number of agreements. In addition to Ruhrgas' long-term shareholding in Gazprom and the long-term contracts between them, Gazprom has publicly supported Ruhrgas and others against the EU plans to force the ownership unbundling between pipelines and gas supply.

But the most significant aspect of this relationship between Russia and Germany – what might be called the 'special relationship' (Helm 2006) – is the Baltic pipeline. This provides a powerful physical link, bypassing Poland and the Baltic States. It increases Gazprom's control over Belarus and Ukraine and, by concentrating the point of entry, it strengthens Gazprom's market power. The fact that the pipeline was approved by the Chancellor Gerhard Schröder in his last weeks in power, and that he has become chairman of the company overseeing its development, graphically illustrates the political content of the project.

These developments demonstrate that Gazprom has pursued with the Russian government a coherent and well-designed (from the Russian perspective) strategy in respect of gas exports. It is highly predictable. Russia is likely to concentrate its efforts on limiting independent access to Caspian gas reserves, and in the short term to focus on Georgia (having dealt with Ukraine and Belarus, and with the Baltic pipeline bypassing the Baltic States and Poland). Its downstream pipeline acquisitions and control agreements are likely to continue to feature in its strategy – currently focused, after Germany, on agreements with Italy, France and Hungary. It is likely to resist the Commission's efforts to further the Energy Charter – either by watering down the Transit Protocol or through outright opposition – and (if allowed) it may gradually build up its downstream supply presence in EU countries. This may be gradual and small-scale, or involve larger acquisitions, as the much-discussed Centrica option in Britain.

These considerations point to one necessary component of a new European energy policy – the need to diversify away from Russian dependency and to improve Europe's bargaining power in this very political context. Both are essentially investment problems – in the former, in terms of new investment in power stations and alternative gas sources; in the latter, to provide greater resilience to shocks by better interconnecting and integrating Europe's physical networks. The former is not, in itself, a competition issue, but rather one of the incentive framework within which competition operates. The latter is a regulatory matter – networks are natural monopolies and hence competition cannot solve this problem in providing the appropriate investment. It turns out, as we shall see next, that the former has a direct tangency with the climate change requirements (although security of supply does not necessarily imply non-carbon sources), and the latter will have (beneficial) consequences for the optimisation of the system in ways that can reduce carbon emissions.

5. Climate change

5.1 The Kyoto Protocol – the current attempt to find a cooperate solution to global warming

The climate change problem has a number of dimensions. As noted in Section 2, climate change is a global public bad. Thus, the appropriate domain is at the global level, and the solution is an international carbon cartel in which all agree to reduce their carbon emissions. Such an agreement is wide open to the obvious free-rider incentives – it is better for each party if the others reduce emissions while it continues to emit them. Hence, the task is to find institutions and policies that create credible incentives for all to cooperate, and to prevent *ex post* cheating.[1]

This challenge is formidable – indeed, so formidable as to have few comparators. Perhaps only nuclear disarmament treaties fit into this category. Yet, given the scientific evidence, this is the challenge facing the international community. Europe's climate change policies should be viewed in this context: as attempts to encourage cooperation, through advocacy and adherence to the Kyoto framework and by European unilateral actions.

So far, the focus has primarily been on the Kyoto Protocol within the United Nations Framework Convention on Climate Change (UNFCC). This provided for quantity targets for a list of developed countries, and Europe's contribution has been in three main parts: to adopt targets for itself; to (successfully) persuade Russia to ratify so that sufficient countries had joined to bring the Protocol into force (by supporting Russia's WTO application); and to (unsuccessfully) persuade the United States to join. It has launched the EU Emissions Trading Scheme (EU ETS) as a market-based instrument to help achieve the Kyoto target, alongside a host of other interventionist policies.

Having got this far, the task facing both the international community and the EU is that this painfully constructed set of targets and policy interventions are, to a considerable extent, time-limited – they mostly come to an end in 2012 at the close of the first Kyoto period. The parties are now engaged in trying to agree what happens thereafter. So far, very little progress has been made. At its latest meeting in Nairobi, the Conference of the Parties to the Climate Change Convention (COP) and the Meeting of the Parties to the Protocol (MOP) did not agree on a substantive way forward, and despite the growing recognition of the scale of the climate change problem and the gradual change of sentiment in the United States, only Europe has proved willing to speculate on its

[1] See Barrett (2003, 2005) for an exposition of the climate change game and strategies to overcome the free-rider incentives.

contribution to a post-2012 agreement, with a proposed reduction of greenhouse gas emissions of at least 20 percent by 2020 compared to 1990, or 30 percent if the United States follows suit (see European Commission 2007a) – subsequently agreed at the European Summit in March 2007 together with an EU target of 20 percent for renewables by 2020.

5.2 The leadership argument and unilateral targets

The adoption of European (or, particularly in the British case, national) unilateral targets has a number of rationales. The first (notable in the British case) is that it shows 'leadership' – that, by demonstrating that emissions can be sharply reduced at low cost, this persuades others to follow suit. A global agreement, it is argued, will follow, as a response to the initial first-mover altruism of Europe. Yet, on this argument, Europe (and especially the British) has failed. In themselves, the targets set under Kyoto do not represent the sort of sharp reductions necessary to tackle the underlying scale of the climate change problem, and make little impact. And even these have proved difficult (and, for some countries, very difficult) to achieve. Few European countries are on course to meet their sub-targets, on the basis of internal policy efforts, and many will have to rely on buying in emissions reductions from outside – via the Clean Development Mechanism (CDM) and through Joint Implementation (JI). The costs – largely in terms of investment in wind power – have proved relatively high, and finally as yet there is little evidence that the United States, or more importantly China and India, have been persuaded by the European efforts.

A second argument is that there is an equity case for European unilateral action – that Europe's industrialisation is responsible for much of the stock of CO_2 in the atmosphere, and hence it should bear a greater share of the burden of de-carbonisation. Whilst this has a factual basis, it does not necessarily help solve the underlying problem, which is to include others within a forward-looking agreement. It is easier for others to agree if they have to contribute less (because Europe does relatively more), but the overarching challenge is how to facilitate the industrialisation of China and India, and accommodate another 3 billion people on the planet by mid-century, without significantly increasing emissions. The scale of this challenge needs to be appreciated: world CO_2 emissions are projected to rise by around 50-60 percent by 2030, when scientists suggest that a fall in emissions by around 60 percent by 2050 may not be enough to avoid serious climate change damage. As many environmentalists have pointed out, existing policy initiatives are trivial compared with the scale of the problem – mere marginal shifts in scale of the damaging consequences of climate change.

5.3 Bringing in other countries

International agreements, however, inevitably take time, and they tend to be built up in an evolutionary and piecemeal fashion, gradually creating expanding coalitions-of-the-willing. For the EU, this means bringing in the United States and Russia as important players. As far as the United States is concerned, the EU ETS plays an important part because this trading scheme is open to a gradual expansion by sectors, such as aviation, and by countries, like the United States, or states within countries, such as California.

But whilst the EU ETS provides a framework on which greater participation can be built, its achievements should not be overstated. To date, it has achieved very little in terms of tackling climate change and it has demonstrated just how hard it is to negotiate property rights in carbon even for a limited amount and for a very short period. The heated debates in Europe about the National Allocation Plans (NAPs) for both phase one (2005-08) and now phase two (2008-12) have demonstrated how hard it is for an agreement to be reached even over such very modest caps. The political necessity to grandfather permits and the recognition that competitive markets are necessary to efficiently price them have further complicated matters. The price of permits has been volatile, very susceptible to measurement and reporting, and there have been significant windfall profits. The value of permits to incumbents as entry deterrents has also been apparent.

The EU ETS, given that it expires in 2012, as yet provides no credible basis for investment in the energy sector – almost all the significant new investment required both to decarbonise the European economy and to meet the security of supply considerations discussed above will come on stream after 2012 and will be financed on the basis of the revenues (and hence incentives) available after 2012. This applies especially to renewables, nuclear and more speculative and R&D-intensive options, such as carbon sequestration and storage. The EU ETS does not (yet) provide a long-term price of carbon – perhaps the most important incentive to reduce carbon emissions. And since the price is a matter of political and regulatory risk, the absence of a long-term price of carbon increases the cost of capital, which is a key variable for nuclear, renewables, and R&D investment decisions.

Thus, the core energy policy requirement – low-carbon investment – is not much affected by the EU ETS. Indeed, it might be argued that some of its effects are actually negative as carbon-intensive interests are able to argue that while we are waiting for the post-2012 EU ETS framework, other actions, such as the introduction of carbon taxes, should be postponed. It is therefore not surprising that many carbon-intensive interests have been enthusiastic about the EU ETS – in fear of other, more effective, policies.

The European Commission (2007a) tries to address these concerns and shape this post-2012 context by proposing two targets. The first – adopted at the European Summit in March 2007 – is a 20 percent reduction by 2020; the second is a 30 percent reduction by 2020 if the United States joins in with reciprocal arrangements. But here we need to separate out the difference between a credible target – which can be banked as part of an investment appraisal – and a mere aspiration. If there is no agreement on a post-2012 EU ETS framework until, say, 2011, as seems likely, the prospects of the EU ETS including caps sufficiently tough to achieve the 20-percent or 30-percent targets may be slight, especially if large-scale investments are delayed until the outcome of the caps is known. For technologies such as nuclear, the timescale for large deployment is such that if a new investment programme does not start until 2011 or 2012, then not much could be contributed by 2020. In the meantime, much of the existing nuclear capacity would start to be decommissioned (especially again in Britain), and be displaced by gas, increasing relative emissions and reducing security of supply.

The approach to Russia is more complex. Last time, Europe used the WTO membership card as part of its negotiating strategy – EU support for Russian WTO membership was a *quid pro quo* for ratifying Kyoto – thereby allowing it to come into force. Next time around, the bargaining counters are less obvious. What inducements could Europe offer to what is largely a carbon economy? Despite claims to the contrary in the Stern Review,[2] the Russian political elite has little to gain by agreeing to a radical international climate change agreement. Global warming has a number of obvious benefits to an economy currently constrained by ice-bound ports and permafrost. And from the narrower political perspective of the Putin regime, global warming does not look that bad, and this will reinforce its negotiating position – and the effect of this negotiating position on its client states.

5.4 Summary

To summarise, climate change is, like security of supply, primarily an investment problem, with the added twist that it requires global cooperation and agreements. Whilst Europe can tackle security of supply as a problem determined by the external constraints (and, in Russia's case, it may just have to take these as given), on climate change the challenge is to persuade others. So far, the Kyoto targets do little more than scratch the surface, and although very timid relative to the wider problem, they have proved hard to achieve. The EU ETS as a chosen instrument has made a positive, but limited, contribution and is yet to be tested as a mechanism to create a long-term price of carbon. Neither the United States nor Russia has been persuaded to take significant action.

6. Creating a credible framework for a European energy policy

6.1 From liberalisation to a broader energy policy agenda

To date, European energy policy has been almost entirely focused on liberalisation and competition. The aim of the 1992 Single Market Programme was to complete the internal energy market, and the 1990s witnessed a long-drawn-out tussle between the European Commission and the large energy companies, primarily in Germany and France. Their

[2] See Stern (2006).

governments lent at least tacit support to this feet dragging, and the resulting Directives (1996 Electricity Directive, 1998 Gas Directive) were the lowest common denominator.

The war of attrition continued into the 2000s. The oil shock in 2000 resulted in all main countries having second thoughts – the 2000 EU Green Paper on Security of Supply (European Commission 2000) treated security as a separate issue to competition, with only the British maintaining that competition was the route to security. The United States similarly produced an energy plan in 2000, which mirrored the concerns in Europe over import dependency, but in the US case concentrated on oil dependency and self-sufficiency, rather than gas.

Quite separately from the energy concerns, the Lisbon agenda promoted liberalisation more generally, setting out a programme to free up a range of economic activities. Though services became a core controversial target, energy was kept on the agenda, and this eventually resulted in the sectoral inquiry launched by DG Competition in 2006. This quickly focused on one core issue: whether there should be ownership unbundling of networks.

The security of supply issue did not, of course, go away – on the contrary, the Hampton Court Summit under the British Presidency in November 2005 tabled a paper on energy policy (Helm 2005b), which was carried through to a new EU Green Paper in March 2006 (European Commission 2006). At the core of these papers was the idea of completing the physical networks – the European grids.

And whilst these two separate strands of policy – competition and security of supply – were being developed, a third strand was the development of climate change policy in general, and the EU ETS in particular. Finally, again quite separately, the EU was engaged in two parallel negotiations with Russia: on the Energy Charter and the Transit Protocol, and on the Partnership and Cooperation Agreement.

The communication "An energy policy for Europe" of January 2007 (European Commission 2007a) marks a further stage in this policy evolution. It has the merit of bringing all various strands within a single set of papers, but the connections between them are far from apparent. The reason for this is partly the timing: the main driver is the DG Competition inquiry (European Commission 2007c), and its conclusions dominate the communication. The other bits are tagged on – with a host of targets and measures, the result of a corralling together of the items on the energy agenda and a political compromise – playing to each of the interests and constituencies.

6.2 Building blocks for a credible framework for a European energy policy

It is a core result of economic analysis that there needs to be at least as many instruments as targets. An energy policy framework starts with the objectives and targets, before the instruments are set. For EU energy policy, as argued above, the two key objectives are security of supply and climate change. On security of supply, the EU does not have any formal targets at all. It wants more security through diversity, but does not say how much. Similarly on the networks and interconnections: interconnections are a 'good thing', but the Commission approach is then to identify specific links, without providing the rationale as to why these links are consistent with the objectives as compared with other candidates and, more importantly, what the desired target level of interconnection is. On climate change, the Commission provides no rationale for the targeted 20-percent reduction in greenhouse gas emissions for 2020 (30 percent conditional on United States doing likewise) as opposed to any other target (15 percent? 25 percent?) and no clear linkage between this target and the stabilisation of greenhouse gas concentration as proposed by the Intergovernmental Panel on Climate Change (IPCC) or other scientific bodies.

The first task in creating a coherent EU energy policy is then to set clear targets, grounded in appropriate analysis. On security of supply, the diversity target does not need to be based upon specifying technologies. Rather, it should follow a route to rewarding investors for the system value provided by diversity in new plant and infrastructure. For example, LNG terminals reduce dependency on Russia, and might command a premium in the market for doing so. Similarly nuclear plant diversifies away from gas imports, as does new coal investment. The EU might set an overall target for the level of gas import dependency on Russia for example, but such a target is only credible (rather than an aspiration) if there are means to achieve it. Plant capacity margins within countries might be set, and these could automatically have a European dimension if interconnections are added into the calculation.

On climate change, the choice of a medium-term target has the merit of being achievable, but only if it is then embedded into the national actions of member states. The obvious way to do this is to set the EU ETS National Allocation Plans on the same basis.

We noted in Section 2 that security of supply requires excess supply and that there are a variety of mechanisms by which this might be achieved. On the assumption that NETA-type mechanisms will not suffice,[3] the first step in instrument design is to establish the required investment levels to meet the security of supply targets. These can then be auctioned through capacity markets. In the absence of interconnections, it has to be on a national level, but as interconnection grows, it could be European-wide. And in the meantime, as interconnection grows, it is important that member states harmonise their approaches to incentivising capacity margins, so that they become fungible. For example, Britain could build new nuclear plants in the south of England, or it could import through new interconnections from France, which could build the plants for Britain. As the evolution from different local electricity systems to national ones in the middle of the twentieth century shows, harmonisation across EU countries could foster an analogous European evolution and associated efficiency gains in the next decades. Given that incumbents are unlikely to welcome the competition that comes through new interconnections, they have little incentive to harmonise, and hence it needs to be imposed.

Diversity could similarly be rewarded through diversity markets. Traditionally, the approach has been to designate fuel shares (for example, a 20-percent share of renewables in total electricity generation). However, such policies require governments to pick technologies (and in the case of renewables, to define them first), and the history of

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[3] See Helm (2004), Chapter 17.

‘picking winners’ is not a happy one. The alternative is to create a ‘value for diversity’ – analogous to the loss of load probability – and reward technologies accordingly.

In both cases, harmonisation is not only an important feature of an efficient approach, but there needs to be a common base against which to apply the security and diversity costs. Many incumbents argue that this can be achieved through long-term take-or-pay contracts. These have merits, and are a core feature of competitive as well as monopolistic energy markets. But the tie-in still needs to be established and the most appropriate base is the suppliers’ licence. In effect, the duty to secure supplies is translated into a requirement for suppliers to contract for sufficient capacity margins, and for sufficient diversity. Both are purchased through the respective markets.

In Section 2 we also noted the public good characteristics of energy networks. To recall, interconnections allow portfolio benefits to be reaped from the mutual reliance on each other’s capacity margins and from greater diversity as a result of the heterogeneity of connected systems. In the case of emergencies, mutual support becomes feasible. For example, in the Ukrainian crisis in January 2006, the ability of EU countries to come to the aid of those facing shortages of gas supply was limited because the pipeline interconnections did not exist. Similarly, Britain’s exposure to shortfalls from continental suppliers was exacerbated by reliance on a single interconnection.

The public goods characteristic has another implication: the benefits of a particular interconnection arise not just between the two parties at each end of the wire or pipe, but to everyone else interconnected to the two parties. Thus, the gains from interconnection between the two will underestimate the broader value to the internal market as a whole.

From this observation follows an important implication: the optimal European gas and electricity grids will not arise in a piecemeal evolutionary way – they need to be thought through from a system-wide and top-down position. The task of the EU is not only to encourage particular interconnections, but also to provide the map within which they fit, and the target should be the completion of the overall map, and not just assisting particular new bilateral links.

Let us then turn to the external dimension of Europe's supply security and instruments to achieve it. Improving gas interconnections within Europe and further developing interconnections between Europe on the one hand, and the Caspian area and North Africa on the other (that is, alternatives to Russian pipelines) all improve gas security of supply, as does LNG. However, none of these is likely to make Europe entirely safe from a physical interruption of supplies from Russia (or an explosion or terrorist act on pipelines), since the demand for gas is growing at a rapid pace and a further likely dash-for-gas will exacerbate this trend. The Baltic pipeline and the coming on stream of the Shtokman field will add to the tendency towards dependency.

In such circumstances, it makes sense to consider strategic (as opposed to commercial) gas storage. The argument is analogous to that for electricity capacity margins. Commercial storage exists to match contract requirements. Strategic storage is additional to commercial requirements because it represents a deliberate excess supply to the system as a whole. Naturally, as with electricity capacity margins, incumbents resist the concept, since excess supply tends to suppress prices and hence profits. However, again as with capacity margins in electricity, the strategic storage is an insurance service to the system, and should be paid for. The extra requirements should be auctioned, and a strategic storage market created as a result.

Finally, there is the foreign policy dimension of import dependency on Russia. At one level, there is little the EU can do about it. Gazprom (and by implication the Russian government) is behaving very rationally, as argued in Section 4. The rents from natural resources are being maximised by control of the pipelines to the exclusion of all others. This approach is unlikely to change, but to the extent that Russia can be induced to act in a more benign way (in particular in refraining from interrupting supplies as a result of disputes with its near neighbours), the broad foreign policy pay-offs need to be taken into account. The EU-Russian relationship is multi-dimensional. As noted above, Russia ratified the Kyoto Protocol in part because the EU promised to help out on the WTO membership issue. Currently, the EU and Russia are engaged in debates about Iran and nuclear weapons, and human rights. Energy is just one component, and a priority for the EU must be to gain greater bargaining power through internal EU energy market reforms along the lines discussed above, that is, completing the physical European gas and electricity grids; creating greater strategic gas storage, capacity margins in general, and diversity of gas supplies; and further developing non-gas technologies.

Across Europe there is a host of different *ad hoc* interventions to address climate change, some directly and others loosely linked to the overall targets. Almost all member states have policies for energy efficiency, renewables, information provision, government procurement policies, forms of carbon taxes and levies, and command-and-control on large plant emissions. These have been built up in a piecemeal, national basis.

Within this patchwork of policy initiatives, the EU has tried to provide an overarching set of instruments. The primary one is the EU ETS. It has many merits, but as identified above, it has major limitations in its current form, notably the short-term nature of the scheme (with little impact over investment horizons), grandfathering, and the negotiating approach to the NAPs. The immediate task is to tie the EU ETS into the longer-term (2020) targets, so that a long-term price of carbon develops.

Renewables obligations are more difficult. The European Commission (2007a) proposed a 20-percent target for the share of renewables by 2020 (which was then adopted at the European Summit in March 2007). Although it is fashionable – and therefore politically expedient – to be in favour of renewables, the policy suffers from a number of obvious weaknesses: there is no distinction between zero- and low-carbon technologies; nuclear is excluded; network development is often not coordinated and the costs of developing networks are not taken into account in most member states' calculations of contributions to the target; and there is little or no trading of the renewables targets between countries. This last consideration is particularly important from a cost perspective: there is no reason why each country should have the same target to be achieved within their own geographical domain – it may be much cheaper to pay another member state to deliver (or another non-EU country since climate change is a global public bad, and hence it makes no difference to the overall climate change where the renewables operate).

If there is to be a zero-carbon technology quota, it should be as broadly defined as possible (i.e., include all zero- or near-zero carbon technologies) and it should be an EU-wide policy with trading in renewable certificates between Member States and with a buy-in mechanism, based around the CDM and JI in the Kyoto Protocol.

The rationale of a quota for renewables is better grounded in the new or infant technology argument. But this requires an R&D policy solution, for which European energy research projects, demonstration projects and subsidies are more appropriate than a general quota that has in practice focused overwhelmingly on wind power.

Energy policy needs a framework, within which companies compete, typically in oligopolies. The framework needs to be credible: private investors need to be able to rely on the framework, and predict how it will evolve. Given the incentives for *ex post* opportunism by governments to expropriate investors, and that these incentives are readily supported by examples (windfall taxes, changing the nature of renewables and nuclear support, altering taxes, and so on), credibility and the cost of capital are closely related. Gaining credibility involves institutional design – independent regulatory bodies and agencies, climate change agencies and related bodies are all part of the building-in of credibility by raising the cost to governments of *ex post* interventions.

This is where the issue of a European regulator comes in. Regulation of networks is inevitable because of the their natural monopoly characteristics. As the European networks develop, power stations will only be efficiently dispatched if the dispatcher has access to the system as a whole, and at prices which reflect the underlying (marginal) economic costs. But to date each network has developed its own accounting and regulatory principles. These need to be harmonised for an efficient dispatch, and hence regulatory competition between the national agencies needs to be replaced by a common approach. The existing college of national regulators needs to be brought together under a common set of rules.

It is in this area that separating out grids helps considerably. Separate grids, with independent system operator (ISO) functions of their own, will be licensed separately. Alongside the college of regulators, a college of ISOs might sit, and it is a small step to harmonise the licences they are issued with.

This is the minimum institutional step. But there is more to add at the European level. Next is the issue of the grid maps, of providing a common picture of the optimal grid to which the investments should be directed. The coordination benefits would be very considerable – and not just to the independent grids. The investment appraisal of future power stations and the choice of locations is much more straightforward if the future shape of grid investment can be predicted. Complementarity and coordination reduce the cost of capital.

The forms and operation of the capacity and diversity markets identified above also fit into a common European institutional framework. As argued, market designs need to be harmonised and this is best done according to European rather than national criteria.

The final institutional component comes from the climate change side. The EU ETS is already effectively regulated by the European Commission, which is also the focus for setting NAPs. By separating this out from the Commission to an independent regulatory body or European energy agency, the negotiations would become less amenable to capture by political lobbying, and the necessary expertise to develop the markets could be focused within a single body.

These various considerations point towards the creation of a single regulatory agency for European energy policy, within which the various dimensions of energy policy can be established and developed, from security and diversity markets, to the auctioning of strategic capacity, the development of an EU-wide renewables obligation certificates market, and the enhancement of the EU ETS.

7. Conclusions

Market failures are endemic to energy markets, and they are multiple. Energy policy is the design of a framework within which a number of different objectives can be met through markets, supported by appropriate instruments.

For the last two decades of the twentieth century, these failures were largely masked by excess supply and low fossil-fuel prices. Since 2000, this context has gradually changed. Europe now faces serious security of supply problems and, at the same time, the climate change challenge has become urgent.

Energy policy in Europe – as elsewhere – has been chasing to catch up with the agenda of the 1980s and 1990s, and liberalisation and fostering competition have been the main instruments. The latest policy proposals (European Commission 2007a) are aimed at completing that agenda. However, the world has moved on, and while competition might have many benefits, it cannot alone solve the other market failures. Recent fears over Ukraine and Belarus, combined with growing alarm over climate change, have begun to shift this complacency.

This paper has reviewed the main components of an energy policy in Europe and suggested a number of changes that might improve the current position. These steps are not, however, discrete and distinct – they need to be integrated into an overarching policy framework, and they need a significant element of harmonisation that goes well beyond enforcing liberalisation and grid separation, which are the Commission's main concerns (European Commission 2007a). A Europe-wide regulatory agency is required to achieve this necessary harmonisation and to ensure that capacity, diversity, renewables, and carbon markets function effectively on a EU-wide basis.

References

Barrett, S. (2003). *Environment and statecraft: The strategy of environmental treaty making*, Oxford University Press, New York, USA.

Barrett, S. (2005). "Kyoto Plus", in Helm, D. (ed.), *Climate-change policy*, Oxford University Press, New York, USA.

European Commission (2000). "Towards a European strategy for the security of energy supply". COM(2000)769.

European Commission (2006). "A European strategy for sustainable, competitive and secure energy". COM(2006) 105 final.

European Commission (2007a). "An energy policy for Europe". COM(2007) 1 final.

European Commission (2007b). "Prospects for the internal gas and electricity market". COM(2006) 841 final.

European Commission (2007c). "Final Report". DG Competition report on energy sector inquiry". SEC(2006) 1724.

Helm, D. (2004). *Energy, the State, and the market: British energy policy since 1979* (revised edition), Oxford University Press, Oxford, UK.

Helm, D. (2005a). *Climate-change Policy*, Oxford University Press, Oxford, UK.

Helm, D. (2005b). "European energy policy". Paper prepared for the UK Presidency of the EU.

Helm, D. (2006). "Russian gas, Ukraine and the implications for energy security". Paper for open democracy.

Stern, N. (2006). *The economics of climate change: The Stern Review.* Cambridge University Press, Cambridge, UK.