The European Energy Conundrum: Power Failure*

2.1 Introduction

European energy policy is currently poorly coordinated between the member states of the EU, although substantial gains could be achieved through enhanced cooperation both at the European and the global level. The argument in favour of a European energy union – a genuine common energy market with common regulation – may even be stronger than the case that was successfully made in the 1980s and 1990s for a monetary union. The economic principle of a single wholesale price is uncontroversial, but establishing the interconnections (creating the appropriate trade channels) in practice is difficult and requires considerable investment.

2.2 Coordination problems

The opportunities and pitfalls for Europe in the energy context are similar to those arising in all other economic and monetary union policy areas. The advantages of a common coordinated approach are obvious. Pooling energy needs and consumption affords gains from trade and the diversification of risks. This is not only because wind patterns and other renewable sources of energy are imperfectly correlated geographically, or because of different degrees of access to imported energy sources, but also because the risks of nuclear energy production are shared by all European countries and carbon emissions create a world-wide externality, regardless of where in Europe they occur. The failure to achieve greater coordination reveals how the greater part of policy formation and preference accumulation primarily occurs at the national level.

There are analogies with Europe's problematic path to monetary union in the development of energy policy. Energy coordination in respect to coal, the primary fuel and basis of industrial prosperity at the time, was at the centre of the first major push for post-war integration and the institutional forerunner of the EU, the European Coal and Steel Community (1953). Integration was underpinned by the notion that coal and steel represented the base for industrial capacity and military potential, and that a coordinated regime would produce political cohesion and European peace. As with monetary union, the European experience was frequently held up as a model worthy of imitation in other parts of the world – until its flaws appeared. In particular, the carbon emissions trading scheme was widely touted as a model for a global initiative to reduce the threat of global warming posed by CO_2 emissions.

A coordinated approach to energy, however, needs to address equally obvious problems that are often not recognised explicitly. Just as in the case of the European Union's overall "growth, stability, and cohesion" objectives, the 1996 Internal Energy Market directive's[1] goals of (1) secure, (2) environmentally compatible, and (3) competitive energy sources are in conflict with each other: renewable energy may be environmentally sound, but is neither secure nor inexpensive; foreign supplies of oil and gas may be inexpensive at a point in time, but are subject to geo-political risks etc.

From the economic point of view, a "we-want-it-all" approach to conflicting objectives is nonsense, and dogmatic anti-energy and anti-emissions attitudes can hardly be justified. Like the classic inconsistent trinity of national macroeconomic policy, capital mobility, and fixed exchange rates, such trade-offs can and should be addressed by careful economic assessments, and by coherent and pragmatic policy compromises. Policy choices need to provide a framework to guide the myriad choices of market participants, producers and consumers, through a pricing mechanism that is accepted as fair and transparent. An economic argument can be made for security-oriented policies like renewable energy subsidies that increase both current costs and self-sufficiency.

Since the necessary policy compromises are difficult to formulate and enforce without unified politics, the

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[1] European Parliament and Council of the European Union (1996).

European integration process has typically tried to leapfrog such difficulties by relying on market mechanisms, in the hope that the latter not only enhance economic efficiency, but also bring about a common perspective on common problems.

Energy is no exception to this pattern. The European Commission has aimed to use market competition and deregulation as a means for achieving at least some of the ultimate goals of its energy policy, stipulating that energy transmission and production should be operated separately, and fostering the development of central energy exchanges at the national level at least.

In practice, policy remains highly relevant, and it is dangerous to try and sweep an obvious politico-economic trade-off under the carpet. In the energy field, the heterogeneous priorities assigned to conflicting goals by different actors across and within countries trigger inefficient competition among tax and subsidy systems in ways that are reminiscent of another long-standing European policy problem: the Common Agricultural Policy (CAP). The CAP was nominally motivated in its early phases by security considerations similar to those that are currently relevant to energy (and related to them, through bio-fuel production and regulation). It was also rooted in distributional considerations, however, and tightly linked to political considerations within each country, where agricultural markets were heavily regulated. Adoption of Europe-wide policies unleashes national as well as within-country rent-seeking activities, and results in distortions, which, in the CAP case, eventually obscured any security considerations. Similarly, renewable energy subsidies in the energy sector clearly trigger political haggling and redistribution. The Emission Trading Scheme suffers from some of the same problems, as each national government lobbies for the assignment of plentiful quotas to its country's firms.

Policy is also crucial because no market is perfect, and all markets need an infrastructure of rules. The energy market also needs a physical infrastructure that requires large, slowly depreciating investments, and hence consistent and predictable policies and market conditions. As policy preferences shift to an increased dependence on renewable energy resources, the basis of price calculations shifts. Instead of a production system in which operating costs (paying for fossil fuels) constitute a major component of pricing, fixed capital costs form the largest element in the cost of producing useable energy, and marginal costs fall to a minimal level.

Like welfare policy, energy policy can play a useful role in remedying financial market imperfections, and sharing appropriately long-term risks neglected by atomistic market participants. A case can be made that while markets can efficiently supply energy at a point in time, longer-term security can only be assured by policy.

Security concerns and worries about the extent of risk generate considerable pressure to implement very dirigiste measures. The French government's General Commission for Strategy and Economic Foresight (French: Commissariat général à la stratégie et à la prospective), for instance, concluded that: "In a more fundamental approach, the role of marginal costs pricing as the pillar of electricity markets should be revised. They give an efficient dispatching of means of production on a day-ahead basis. But, in a market with an important electricity production at low marginal costs, coming for instance from a great development of renewables, structural reforms are necessary to let economic signals emerge allowing for long-term efficient investments. They need to be, as much as possible, the result of a coordinated reflection between the Member States in order to define jointly the trade-offs between security of supply, climate change and affordability."[2]

The problem arises, however, that the individual priorities are set by the separate member states, and are incompatible with each other. Energy issues were highlighted in the 2007 Lisbon Treaty[3], where Article 194(1) recognised the reality that national states were primarily in charge of determining energy policy, but set out the four principal overall aims of EU energy policy as:

- Ensuring the functioning of the energy market
- Ensuring the security of supply in the Union
- Promoting energy efficiency and energy saving, and developing new and renewable sources of energy
- Promoting the interconnection of energy networks

This article did not give the EU the competence to adopt measures significantly affecting a member state's choice between different energy sources and the general structure of its energy supply; but such measures might be adopted under Article 192(3) by a spe-

[2] French Government, General Commission for Strategy and Economic Foresight, (2014), p. 13.
[3] European Union (2012).

cial legislative process of the Council, in practice requiring unanimity, rather than majority voting.

In reality, however, these ambitious goals were not really achieved: major vulnerabilities remain in the energy market, no realistic scenarios predict any dramatic reduction in overall dependence on energy imports, the task of managing energy efficiency is handled idiosyncratically and has perverse effects, and while there is some interconnectedness, many energy markets are quite cut off from each other, with inadequate facilities for allowing a ready commercial exchange of energy. An expansion and completion of the energy market remains an area that offers significant potential gains in the efficiency of energy distribution, and that, in turn, could produce both productivity gains and substantial savings.

Implementation of the Lisbon Treaty's provisions has taken place only in sporadic fits and starts. In 2008, the EU laid out an ambitious programme for changes by 2020: the reduction of greenhouse gas emissions by 20 percent, a 20 percent share of renewables, and a 20 percent improvement in energy efficiency. The programme was highly ambitious as the reduction goals were meant to be binding for each individual country.

In 2009, the EU introduced the Third Energy Package (TEP) aimed at allowing greater transparency in energy markets and enhancing collaboration between national energy companies and governments. The package rested on five principles:

1. "Unbundling" of national energy markets, meaning the separation of suppliers from energy producers and delivery systems (pipelines, grids). Each stage of the provision of energy process was to run via transparent market operations.
2. The operation of a market required regulatory consistency, or greater cooperation and dialogue between domestic regulatory organisations.
3. An "Agency for the Cooperation of Energy Regulators" was established to "[…] promote cooperation of, and complement, [the national regulatory authorities] at EU level."
4. Two separate European networks of transmission system operators were established so as to "[…] ensure optimal management and sound technical evolution of the European transmission network."
5. Greater investment in national gas networks and better coordination in the operation of these networks.

The TEP immediately ran into opposition from multiple energy players, including national energy companies, governments, foreign energy exporters, and consumers. These parties believed that the TEP threatened their individual interests and control over domestic markets that had long been protected by regulatory privileges. Eastern European critics saw the TEP as creating a regional divide, and primarily benefitting Western European countries that already had significant energy infrastructure in place, as well as diversified suppliers that could deal with the reforms. In short, a vision of how market coordination at an EU level might be achieved does exist, but it has not been implemented completely or satisfactorily.

The same can be said of the planned emissions reductions. On 24 October 2014 an EU Summit postponed the emission reduction goals to 2030, stipulating:[4]

- A reduction of CO_2 output by 40 percent (relative to 1990)
- An increase in renewable energy as a share of total energy consumption to 27 percent
- An increase in energy efficiency by 27 percent

It is remarkable that the two latter goals are now little more than mere declarations. Moreover, all national goals for expanding renewable energy have been abolished.

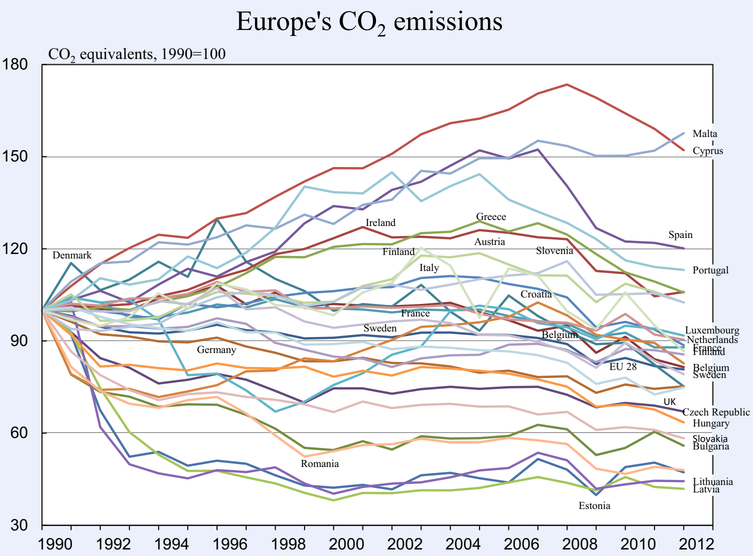
Figure 2.1 shows the greenhouse gas emissions of EU countries and their reductions over time. While all countries have reduced the emissions, it remains to be seen what fraction of the achievements can be attributed to special effects like the current economic crisis or the dismantling of ex-communist industries (Germany). In terms of relative reductions since 1990, the ranking is led by Latvia, Lithuania, and Estonia. However, as Figure 2.2 shows, the absolute emissions per inhabitant are still highest in Luxembourg, Estonia and Ireland.

2.3 Global interactions

The concrete outcome of the European level policy initiatives is difficult to assess, because the European

[4] European Council (2014), "Cover Note," EUCO 169/14, Brussels, 24 October, http://www.consilium.europa.eu/uedocs/cms_data/docs/pressdata/en/ec/145397.pdf.

Figure 2.1



Source: European Environment Agency, last accessed on 24 November 2014.

projects interact with local conditions and global markets. Overall European demand for energy, which rose slowly over the period 1995–2006, subsequently declined by around 8 percent. Part of the decline was due to efficiency gains and structural changes, but a major cause of the energy consumption slowdown is the worldwide financial and economic crisis, which has had a particularly dramatic impact in the Southern Eurozone.

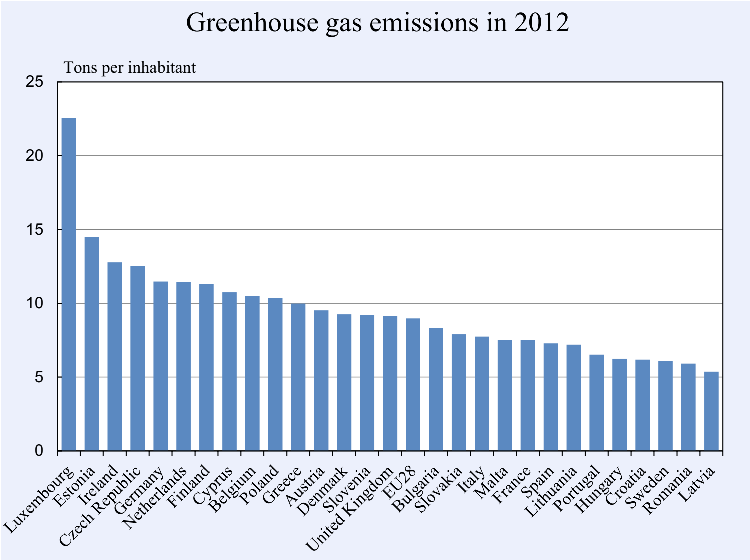
The EU 2008 Climate Change Package 20-20-20 emissions guidelines were unfortunately timed, as they were issued in 2008 just before the global crisis. It was not policy, but the crisis that drastically reduced emissions in developed countries. The crisis also had uncomfortable implications for the European cap-and-trade emissions trading scheme: the market price collapsed as market participants struggled to cope with the interaction between the economic crisis and an equally unprecedented policy experiment that was likely to be reformed.

The behaviour of European consumers had little impact on global levels of energy consumption, or on CO_2 emissions. Currently, most projections also show an energy future in which the world's major energy resources will remain the fossil fuels oil, gas and coal, which release carbon into the atmosphere. A recent assessment by the International Energy Agency (2014) suggests that global energy consumption will rise by 37 percent from 2013 to 2040, with coal and oil rising at a rate of 15 percent and CO_2 emissions from power production increasing from 13.2 gigatonnes to 15.4 gigatonnes. In that sense, Europe's ambitious attempts to reduce carbon emissions on a global level – which should surely have been a policy priority – have proven at best irrelevant and at worst counter-productive.

Figure 2.3 shows the time path of aggregate worldwide CO_2 emissions. It is clear that the two oil crises of the 1970s and the 2009 world recession had an impact on emissions. Europe's special attempts to curtail emissions are not visible, however, in this graph, which indicates that other countries compensated for any reductions that took place in Europe.

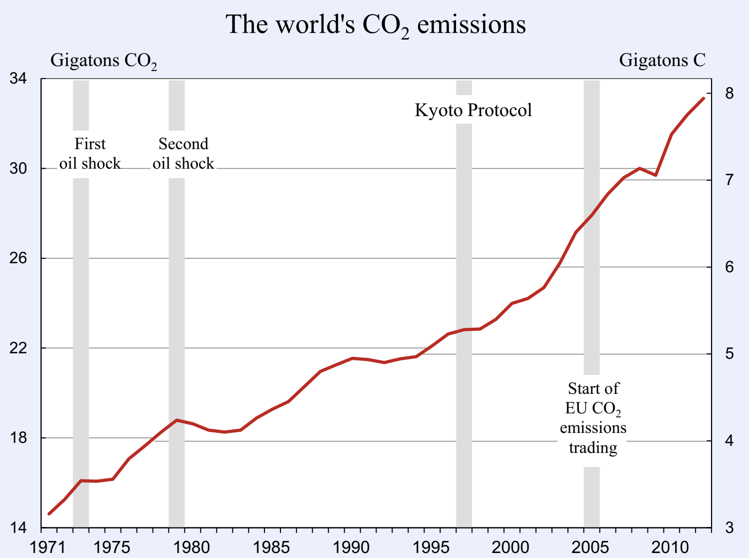
But there are now signals that the big emitters of CO_2, notably the United States and China, are more willing to contemplate an international plan than they were in 2009, when the UN climate change conference in Copenhagen failed. In November 2014 the US agreed to cuts of 26–28 percent from 2005 levels by 2025, and

Figure 2.2



Source: Eurostat, last accessed on 19 November 2014.

Figure 2.3



Source: International Energy Agency, Database, CO2 Emissions from Fuel Combustion, last accessed on 24 November 2014.

China agreed to plan a reduction in emissions after 2030. But these agreements still look rather provisional – and belated – and will need to be worked into a more comprehensive global framework. That prospect raises the question of the most appropriate negotiating strategy for Europeans.

2.4 Assessing different risks

The difficulty in formulating a forward-looking energy policy arises from the difficulty in comparing different types of risk and drawing appropriate policy lessons. There are at least four different perceptions of risk, and while all are clearly present, they tend to be seen in quite contrasting ways in different European countries, and consequently produce varied and mutually incompatible responses from national political authorities.

1. There is a near certainty, backed by a massive body of scientific evidence, that CO_2 emissions are leading to a rise in world temperatures. The consequences include the risk of more extreme weather events, the melting of polar ice caps, a rise in the sea level with devastating consequences for low lying densely inhabited regions, the likely desertification of some parts of the world nearer to the equator (including Mediterranean Europe), as well as the extension of the cultivable area (that might benefit Northern Europe, as well as Canada and Russia).

A policy response to this phenomenon would include systematic efforts to reduce CO_2 emissions, although even such measures could only be expected to slow, rather than halt or reverse global warming. The circulation of greenhouse gases occurs at a global level, meaning that there is no obvious link between the extent of loss as a result of measures to reduce CO_2 emissions (that might impede industrialisation efforts in emerging markets) and the gains from preventing the negative effects of global warming. The widely cited 2006 Stern report commissioned by the UK government[5] concluded that the costs of inaction on CO_2 were high (5 to 20 percent of annual GDP) and could be mitigated by relatively cheap anticipatory measures, costing some 1percent of annual GDP; but that the implementation of such measures poses an acute collective action problem.

2. Nuclear energy is an obvious way of producing power without the harmful effects of CO_2 emissions. It carries some direct environmental risks (warming of river water used for reactor cooling); but the major fear is of unlikely and very rare catastrophes (that might be induced by human action, such as terrorist attacks). The dangers arising from catastrophically uncontrollable nuclear reactions in power generating plants, as seen in Chernobyl in 1986 and in Fukushima in 2011, are great and terrifying. In the aftermath of events like Fukushima, calculations made primarily by the nuclear industry that sought to demonstrate plant safety are called into question. On the other hand, new research published after the Fukushima event has shown that nuclear power has proven far less harmful than the coal power it replaced. According to Kharecha und Hansen (2013), nuclear power stations globally saved 1.84 million lives in net terms between 1971 and 2009 by lowering the number of deaths related to fossil fuels, primarily in terms of lung diseases.

Europeans do not approach the assessment and evaluation of nuclear risks in the same way. There are very different national orientations to the risks arising from nuclear power. The most obvious contrast is between the widespread enthusiasm in Finland and acceptance in France of nuclear energy as a clean source

[5] See Stern (2006).

and equally general scepticism in Germany and outright hostility in Austria.[6] In the aftermath of Fukushima, a majority of French respondents in opinion poll surveys were still sympathetic to France's reliance on nuclear energy, which the French government reaffirmed its commitment to; while in May 2011 Germany's government announced a phase-out of nuclear energy by 2022.[7] Older nuclear reactors elsewhere will also face redundancy and decommissioning: the International Energy Agency (2014) estimates that by 2040 200 of the world's 434 nuclear reactors will be shut down. At the same time, however, over 530 new reactors are likely to be constructed.

In addition, Europe has two fundamentally different systems of nuclear power generation. Western design reactors usually involve separate contracts for different stages of production (uranium mining, conversion of uranium into gaseous form, enrichment, fuel assembly). By contrast, in Eastern Europe (Bulgaria, Czech Republic, Hungary and Slovakia) Russian designed reactors rely on bundled supply services provided by a single Russian company, TVEL. Historic choices establish a path dependence. Hungary, for instance, recently rejected a Westinghouse reactor in favour of a Russian system that was compatible with its existing infrastructure. The two alternatives in different parts of Europe reflect not only contrasting perceptions of safety standards, but also varying degrees of willingness to escape dependence on a single source of supply, and of trust in market processes.

3. Most industrial countries are dependent on imported energy, and particularly on oil and gas. Even with a dramatic shift towards the enhanced use of renewable energy resources, carbon fuels (gas and coal) offer a degree of flexibility in response to demand surges to which no obvious or cheap alternatives exist. The history of interrupted supply threats include dramatic episodes, like the 1941 U.S. blockade of energy imports by Japan, or most importantly, the two major oil crises of the 1970s. The resource curse, whereby abundant natural resources (and above all energy) promote rent-seeking behaviour, means that many large energy exporters are prone to corrupt politics, instable and erratic policies, and a proclivity to resort to blackmail. It also means that the export of manufactured goods becomes more difficult because the revenue from selling the resource typically increases domestic wages and income aspirations (Dutch disease).

[6] OECD, Nuclear Energy Agency, (2010).
[7] Foratom (2014); also GlobeScan (2011).

For modern Europe, the most obvious threat is posed by the extent of its dependence on Russian gas. Although there were incidents in the past in which disputes between Russia and Ukraine over the pricing of long-term gas contracts led to a cut-off of supplies to some areas, notably in January 2009, when there were major shortages and cut-offs in Bulgaria and Romania; the issue only reached a high level of political and popular salience as a strategic threat to Europe in the aftermath of the collapse of the Yanukovych regime in Ukraine and the subsequent Russian annexation of the Crimea and destabilisation of Eastern Ukraine. In 2014, tensions with Russia escalated to an extent reminiscent of Cold War conflicts, and made Europe's dependence on imported Russian gas seem like a security liability.

Europe's dependence on imported gas, by far the cleanest fossil fuel, has increased. EU domestic production of gas has fallen since the late 1990s, in line with the depletion of the resources of the UK and the Netherlands in the North Sea. Only the Netherlands and Denmark are net gas exporters. There are some shale gas resources, but these may prove largely unusable, for economic as well as political reasons (including worries about the environmental consequences of shale extraction). Only Poland has the potential to become a major producer of shale gas, with 4.2 trillion cubic meters of unproven technically recoverable shale gas reserves (France has 3.9 trillion, while the EU as a whole has 13.3 trillion, compared with 16.1 in the US).[8] Gas consumption is also higher as a proportion of total energy requirements in the smaller EU countries, and especially in Eastern and South-Eastern Europe (Figure 2.4).

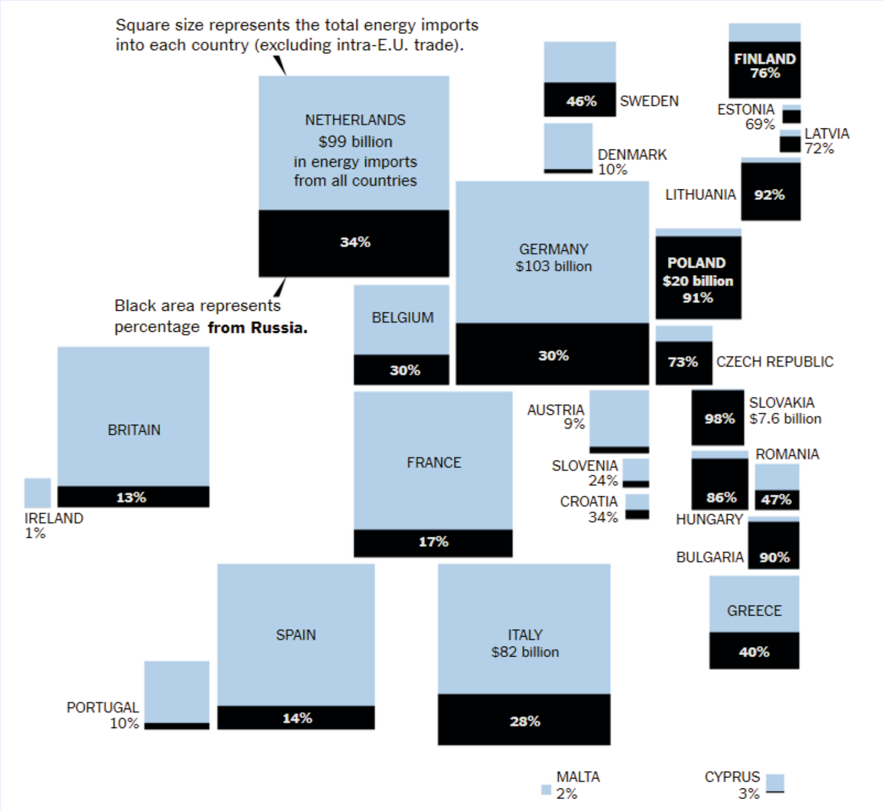
The share of gas imports in the EU has risen steadily from the mid-1990s (when it was around 40 percent) to approximately 70 percent today. In 2013, 39 percent of extra-EU imports (in volume) came from Russia, followed by Norway (34 percent), Algeria (13 percent) and Qatar (7 percent). Almost all of this gas comes through pipelines, with Nord Stream supplying Finland and Germany, and the older Yamal-Europe line supplying Poland and Germany. Slovakia, which obtains a major competitive advantage from low energy prices, is almost exclusively dependent on a single (Russian) source.

The history of discussions about gas supply is fraught with suspicions that a monopoly (or near monopoly)

[8] European Commission (2014), "Energy prices and costs report," *SWD* 20 final/2, http://ec.europa.eu/energy/doc/2030/20140122_swd_prices.pdf (accompanying European Commission (2014), "Energy prices and costs in Europe," *COM* 21 /2).

Figure 2.4

Dependence on energy imports



Source: "How Much Europe Depends on Russian Energy," *New York Times*, 2 September 2014, http://www.nytimes.com/interactive/2014/03/21/world/europe/how-much-europe-depends-on-russian-energy.html?_r=0.

supplier is attempting to cut special deals with individual countries in a divide and rule strategy. Russian President Vladimir Putin cultivated strong ties with the former Italian Prime Minister Silvio Berlusconi. Berlusconi, in signing a project for a pipeline (South Stream, recently cancelled by Russia) that was to send substantial quantities of Russian gas to the Balkans and also via an extension pipeline to Italy and the Italian state-owned firm ENI, advised Brussels to "cultivate the same kind of good relations that Rome enjoys with Moscow."[9] In Germany, Chancellor Gerhard Schröder cultivated an analogous relationship with Putin, and after he retired from politics took a position with the energy giant Gazprom. When Russia negotiated the construction of a new sea pipeline in the mid-2000s (North Transgas, then Nord Stream) to bring Siberian gas to North-Western Europe, despite the higher costs and potential environmental threat of an underwater line, the Baltic states and Poland felt that they were being cut out, and that they would consequently be vulnerable to Russian pressure over their own supplies. In 2006 the then Polish Defence Minister Radek Sikorski made the extreme comparison between the German-Russian negotiations on Nord Stream and the Molotov-Ribbentrop Pact. In fact, however, Poland's safety may have been increased by this pipeline, as the country has become more independent of the conflict in the Ukraine, given that it can now receive Russian gas via Germany. The key is a network that provides the maximum flexibility: the EU has stipulated that all gas pipelines in the EU be reconstructed so as to allow for flows in both directions.

4. Electricity supply networks are vulnerable to systemic breakdowns as a result of overloads caused by random factors (climatic conditions, the failure of a particular unit). In the absence of flexible capacity, a demand spike can lead to massive failures. These affect electricity supplies to control centres and internet communication, with further shutdowns of power plants resulting in a cascade. Such failures occurred in the US in August 2003 and in France and Italy one month later, in September. The prospect of network

[9] "Putin and Berlusconi Seal 'South Stream' Pipeline Deal." *EurActiv*, 18 May 2009, http://www.euractiv.com/energy/putin-berlusconi-seal-south-stre-news-221827.

failure also increases the risk of nuclear accidents, as control systems are incapacitated in widespread power outages. Many European countries are operating electricity systems at levels precariously close to their capacity limits.

The question of flexibility has become a major issue with regard to renewable energy sources. In particular, solar energy and wind generated power cannot be easily switched on or off, and it may be delivered by nature at times when it is not needed. In fact, electricity made from wind and sunlight is extremely volatile. In Germany, in 2013, electricity from wind had a nominally installed capacity of 35 gigawatt, peaked at around 25 gigawatt at certain hours of the year, was delivered at an average of 5.4 gigawatt and provided a "safe" supply of 0.42 gigawatt at a relative frequency of 99.5 percent of all hours of the year. Germany is occasionally, at moments when there is sun and high winds, exporting electricity to its neighbours at negative prices, because the capability to smooth the green electricity by temporarily shutting down conventional power plants has been exhausted. There is clearly not enough hydro-electric capacity to smooth out the demand and supply fluctuations that arise from increased use of renewables. Smoothing the volatility of green electricity has become a major issue in the debate about whether or not Germany's green energy revolution will be successful.

The problem is that electricity cannot be easily and cheaply stored. The most effective solutions to the storage problem so far have mainly tended to involve rather simple mechanical arrangements, notably pumping water uphill in periods of surplus capacity and then using it to power turbines when demand increases (which currently accounts for over 95 percent of power storage). The wider the area that is connected in a "smart grid", the greater the potential should be to compensate for random shocks. Telephone systems, for instance, are today more interconnected than they were fifty years ago, and as a result are much less prone to periodic overloading and breakdown. The use of reservoirs as energy storage facilities could work well across frontiers: the development of a German-Norwegian transmission system means that German surplus electricity will be exported to Norway and used to fill hydro-electric reservoirs, and Germany can then import the electricity when it is required as a result of a German supply shortfall. However, the potential to smooth the energy supply through pump storage lakes is very limited. For example, the Ifo Institute has calculated that around 3,500 average-sized pump storage stations would be required to smooth Germany's 2013 actual wind and solar power production.[10] Germany currently has about one hundredth of these, and plans for a plant at Jochberg in Bavaria has already caused furious protests by environmentalists.

Each of these threats – climate change, nuclear accident, geopolitical blackmail, system disintegration and wind and sunshine volatility – is treated in very different ways. Since public debate is often driven by single headlines, a nuclear accident such as Fukushima produces a greater sense of danger than the vaguer (but more certain) long-term threat of climate change. The risk of system breakdown only enters the political debate after a concrete instance. Politics thus tends to respond too late to threats.

In addition, the geographic areas that are affected by these four types of threat vary. Cascading failures affect at the worst neighbouring countries. Politically-driven energy blockades are also targeted at individual states, although the geography of supply chains and pipelines means that there will also be collateral damage. Nuclear reactor catastrophes prima facie involve a relatively localised area; in reality, however, radiation clouds may spread over very wide distances covering a number of countries. Thus, for example, the concentration of French nuclear power plants along the Rhine constitutes a direct threat for Germany, given that western winds predominate in Europe.

CO_2 emissions result in a long-term build-up of CO_2 in the entire atmosphere, and do not affect the regions where the CO_2 originated specifically. They produce global climate change, not local environmental degradation. Such emissions are, as a result, a powerful instance of a tragedy of the commons. No particular country has a stake in reduction, if that reduction is not generally followed. The application of an emissions trading scheme in one area leads to increased costs there; but competitive advantages elsewhere. Apparently altruistic action energy to produce better and more sustainable energy outcomes may even have a perversely harmful general outcome. For one thing, carbon not burned in one part of the world might be shipped to another and burned there (direct carbon leakage). For another, resource owners might anticipate their sales of carbon resources to avoid selling them when green technologies and emission con-

[10] See Sinn, H.-W. (2014), "Schafft es Deutschland, den Zappelstrom zu bändigen?," 65th Annual Meeting of the Ifo Institute, 26 June.

straints threaten market destruction. According to the so-called Green Paradox (Sinn, 2007 and 2008), the more serious attempts are to restrict future emissions, the greater the incentives to current producers to use their time-limited CO_2 producing sources as quickly as possible. The attempt to slow down climate change accelerates it. The logic of the Green Paradox predicts a dramatic fall in fossil fuel (including oil) prices as producers scramble to use the window in which they can still sell their products.

A European carbon trading scheme is not, and obviously cannot be a substitute for a global regime. Other major world producers of CO_2 emissions consistently produce powerful arguments why they should not take part in a common scheme. In particular, newly industrialising countries argue that a limitation on carbon output would harm their chances of catching up with advanced countries in terms of general prosperity, and would condemn a large part of their populations to continued poverty. The aftermath of the financial crisis, which brought a relative strengthening of emerging markets, has thus led to a decreased international willingness to cooperate on climate change.

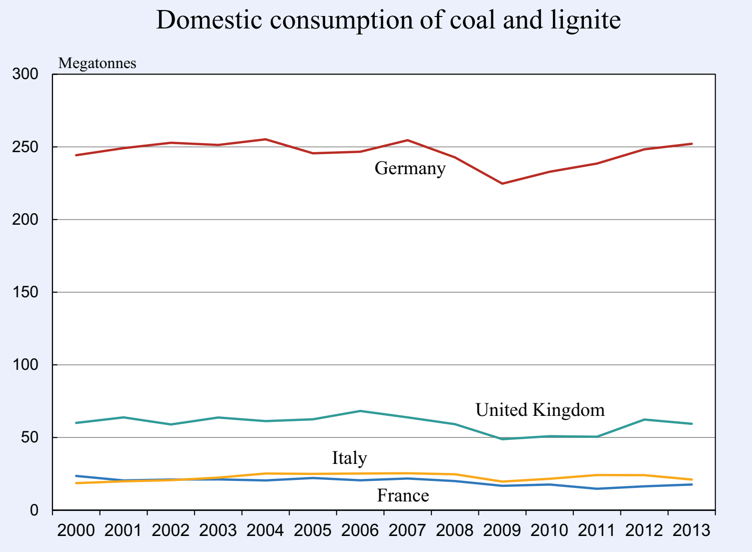
CO_2 trading would be a desirable global approach to the climate change issue, but its application in a more limited geographic framework produces inconsistencies. The EU ETS launched in 2005 was intended to represent a major effort on the part of the EU to achieve the targets set out in the 1997 Kyoto Protocol. It does not cover all of EU emissions, but focuses on high-polluting industrial sectors, including power generation, iron and steel, cement, glass, pulp and paper. This amounts to around two fifths of total EU emissions. Attempts to include aviation in 2012 were controversial and led to a dispute with the US, when the EU proposed to apply the restrictions to American airlines. "Cap and trade" allows companies to trade allotted carbon permits; while a "Linking Directive" allows carbon emitters to buy carbon credits generated from emissions savings or offset projects, in other countries, and above all in emerging markets.

The problems of the EU ETS are partly design flaws that followed from the particular path chosen. At the beginning, permits were over-allocated, and simply amounted to a subsidy for high polluting producers. Then the price of permits was affected by the economic slowdown after the financial crisis, and dropped precipitately, from 35 euros per ton in 2008 to 14 euros per ton in 2010, to around 5 euros per ton in 2013, and then rose slightly to 7.30 euros per ton at the time of writing (January 2015), rendering the signal that the price was supposed to generate meaningless. As a consequence, incentives resulted that undermined the fundamental concept behind the proposal.

The collapse of permit prices perversely led to a greater incentive to use coal than gas. Some Combined Cycle Gas Turbine (CCGT) plants with a higher thermal efficiency were mothballed. The others are operating at well below their capacity. Given today's prices of fuels the price of emission certificates would have to be about 70 euros per ton to make such plants profitable (Karl, 2012 and 2013). Coal consumption in the EU rose after 2005, especially in Germany (Figure 2.5).

The price collapse of emission certificates was not just a consequence of the financial crisis, but also followed from the interaction of national energy schemes that were poorly coordinated. This effect was magnified by separate national attempts to reduce emissions in a more limited context by means of favourable feed-in tariffs for green energy. On a national level, these incentives looked as if they successfully resulted in lower carbon emissions, as planned by the legislator. But

Figure 2.5



Source: Enerdata, last accessed on 10 December 2014.

when the results interacted with other parts of the policy framework, in an international context, the outcome looks much less satisfactory. As Sinn (2014) explains: "The green power produced in Germany not only replaces power from fossil fuels, but also sets free the corresponding emission certificates. These certificates migrate via the markets to coal-fired power stations in other EU countries, where they facilitate an increase in CO_2 emissions – or a reduction in savings – which exactly matches the German savings."

There are other perverse consequences of national choices regarding the desirability of environmentally sustainable energy production. Notably, biomass produced energy was defined as carbon-neutral, so that no permits are required for energy production from biomass. Yet studies suggest that carbon emissions from biomass are 50 percent higher than from coal. The subsidies for biofuel had the additional unwanted effect of increasing food prices, squeezing low income earners throughout the world and generating widespread popular unrest and political instability in 2006–7 (including the "Arab spring").

Another repercussion of the effective provision of a subsidy regime via feed-in prices was that it set off a race to capture the new rents produced. Europe, but not the US, experienced a substantial asset price bubble in alternative energy provider stocks in the mid-2000s, which collapsed in the wake of the general financial crisis in 2008 (Bohl et al., 2014).

The de facto collapse of the ETS has fuelled a new debate about substituting a less market-driven and more coordinated approach: a system of minimum prices with a built-in escalation (back-loading) in order to provide ever increasing incentives to cut carbon release. In this way, the scheme is starting to resemble what was originally presented as a simple alternative: a tax system.

According to some analysts, the tax approach has the advantage that it can be used to penalise products from third countries whose manufacture involves large and environmentally harmful carbon emissions. Such an approach clearly takes energy policy deep into the domain of trade policy (Helm, 2012). Taxes are a difficult policy tool if the time path of resource extraction either fails to react to price signals, or reacts adversely. The "no reaction" scenario is likely if extraction costs are never binding and if the expected present value of unit taxes is constant for all points in time. In this case, taxes will simply be borne by suppliers without inducing a slowing down in extractions and hence without improving the climate. The "adverse reaction" scenario is likely, if extraction costs are never binding and if the present value of unit taxes rises with the passage of time, as the expected growth rate of the tax is higher than the interest rate. In this case resource owners will again react according to the Green Paradox and anticipate their sales, which implies that world-wide consumer prices will fall as a result of imposing the tax.

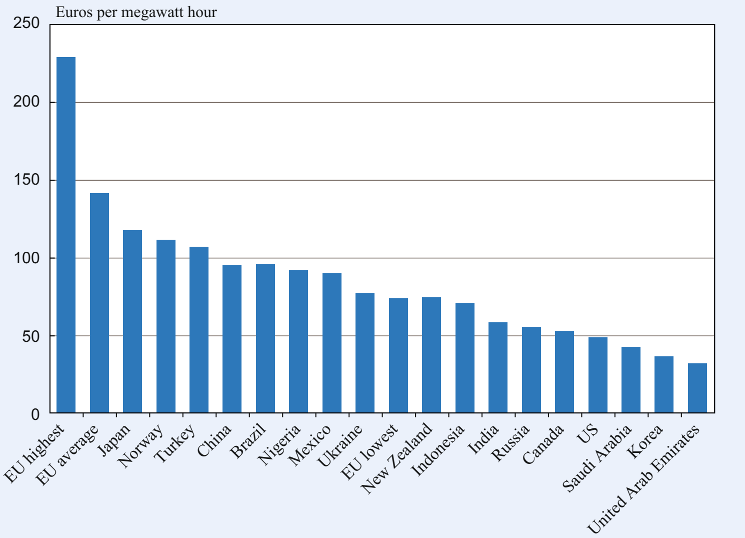
Thus, improving the ETS mechanism by incorporating all major consumer countries of fossil resources may be the better alternative. Currently, an ETS mechanism already exists that incorporates the countries committed to binding reduction goals under the Kyoto Protocol and representing about 30 percent of worldwide emissions. If the percentage is moved towards 100 percent by incorporating the USA, China, India and other important countries, a tool would be available to effectively constrain CO_2 emissions.

However, persuading other countries (especially big emerging markets) to adopt an energy trading scheme is a difficult bargaining process. In the lead up to a new Climate Summit in 2015, in which such bargaining is to be expected, there is a disincentive for Europe to fix the ETS prices before the negotiations, as an increase could be presented as a "concession" to the other negotiating parties.

There are similar bargaining dilemmas in Europe, where different countries have adopted contrasting approaches to energy conservation. National energy conservation or green energy laws are especially problematic. The 2000 German Renewable Energy Law (German: Erneuerbare-Energien-Gesetz, EEG), often regarded as a model for managing an economic transition towards an ecologically sustainable future, increased energy costs and represented fundamentally a tax on consumers. The government responded to complaints that high energy prices were putting German industry at a competitive disadvantage by offsetting the costs with subsidies. That action appears to run counter to the EU logic of creating a competitive market. Its German proponents argued that it was legal because it was not a subsidy financed by the government through taxation, but the payments were covered instead by payments made by energy consumers.

Figure 2.6

Retail electricity prices in 2012: industrial consumers[a)]



[a)] EU electricity prices for industry refer to consumption band IC, exclusive of VAT and other recoverable taxes. Electricity prices for industry for Canada refer to 2010 and for Korea to 2009. ECB annual exchange rates have been used. Industrial prices exclude taxes as reported by ERRA for Nigeria, Russia and Ukraine, by ANEEL for Brazil, by the IEA for Japan, Canada (2010) and New Zealand. IEA reports zero taxation of industrial prices for Mexico; ERRA reports zero taxation for Saudi Arabia and UAE. No data on taxation of industrial prices in South Korea (IEA); until 2009 natural gas prices reported by South Korea indicated 12–14 percent taxation of industrial natural gas prices. Prices reported by CEIC for China are actual averages of industrial use electricity prices in 36 cities; no consumption taxation on industrial retail prices in China, but prices include production tax (17 percent for electricity, 13 percent for gas, note that these are production taxes). Australian values are exclusive of general sales tax (GST). EIA numbers for the US include state and local taxes; electricity consumption is not taxed at the federal level in the United States, but it is taxed in some states.

Source: European Commission (2014), "Energy prices and costs report," *SWD* 20 final/2, http://ec.europa.eu/energy/doc/2030/20140122_swd_prices.pdf (accompanying European Commission (2014), "Energy prices and costs in Europe," *COM* 21 /2).

For many observers the German EEG offers an outstanding example of how a reorientation of energy policy might be achieved. Germany tops international rankings for renewable power per capita, and with 71 gigawatts it is the third largest renewable power producer in terms of capacity behind China (90 gigawatts) and the US (86 gigawatts) (Renewable Energy Policy Network for the 21st Century, 2013). There have been dramatic increases in the share of the sustainable energy sources of wind and solar energy. Some calculations try to put a price on the environmental gains achieved.

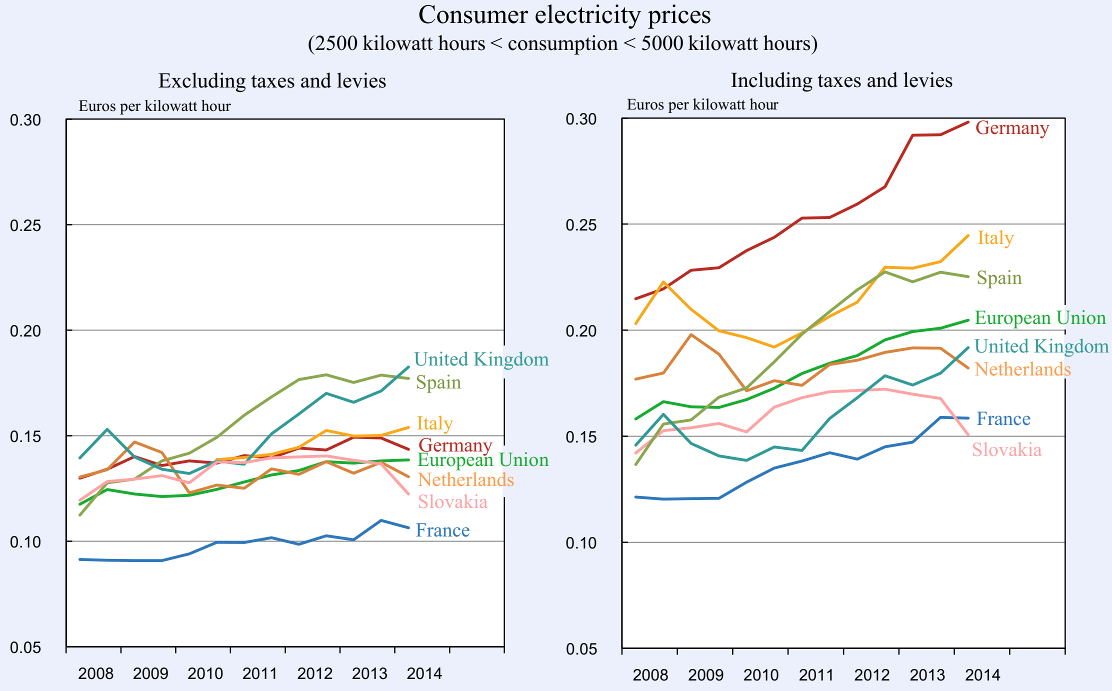
The exercise is costly, as consumers pay a high price for an outcome that reduces bad emissions. Industrial consumers pay a higher price for electricity in Europe than in any other part of the world, except for Japan: the contrast with the US is especially striking (Figure 2.6). The higher cost is a significant element in comparative competitiveness. There is also a consumer issue. From 2008 to 2012, EU household electricity prices increased considerably, at a rate of 4 percent annually.

But the electricity prices in the EU vary considerably, and in this sense defy the logic of a single market that Europe established with the Single European Act in 1986 for most other sorts of economic activity. Countries with a higher share of renewable energy also have significantly higher consumer prices (Figures 2.7 and 2.8; see also Macchiati and Scarpa, 2014).

Figure 2.7 shows how tax and excises contribute to – but are not entirely responsible for – significant price disparities across the EU. Such price disparities violate the law of one price, one of the most fundamental efficiency requirements in economics, implying different marginal energy avoidance efforts among European consumers. If anything, such disparities could be explained by the different local or regional environmental impact of energy consumption. For instance, there might be a difference in local air or traffic congestion externalities that would justify a regional diversification of tax rates. However, the case for an international diversification can hardly be made. It is true that there may be a case for such a diversification for different national revenue needs due to different national debt and expenditure levels, for example, but broad-based taxes such as value added taxes and income taxes are arguably far better suited to cover such needs.

In Germany, national energy policy, which is largely responsible for the high domestic consumer prices, has come under heavy attack. At around 30 cents per kilowatt hour, German consumers now pay double the price for their electricity than French consumers. Thanks to the Renewable Energy Act, German consumers had to pay around 16 billion euros more for green power than the conventional power equivalent in 2013. Energy-intensive industries are either relocating away from Germany, or have to be kept afloat through painful wage restraint. In both cases, the result has no impact on overall carbon emissions, but simply alters in a globally irrelevant way, the geography of energy consumption. According to the German Federal Ministry of the Environment, the energy transformation will cost over a trillion euros. This amount equals around ten years' worth of German re-

Figure 2.7



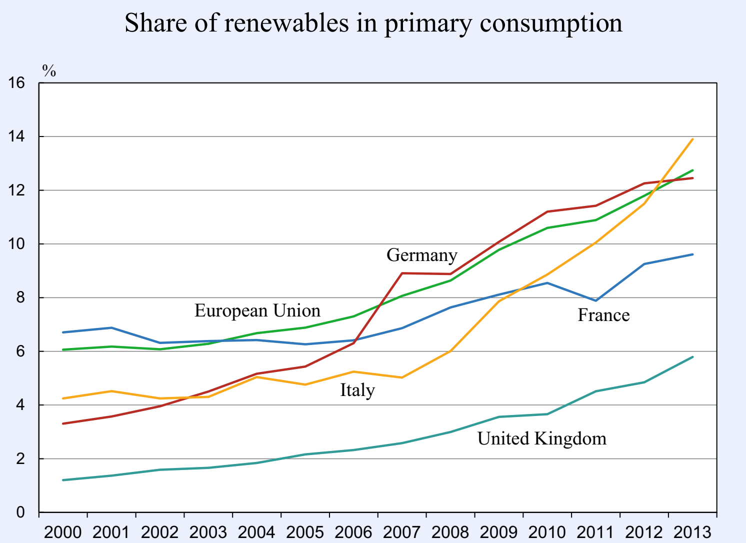
Source: Eurostat, last accessed on 8 January 2015.

unification transfers, or 330 high-speed rail links from Munich Central Station to Munich airport. The subsidies that have been pledged to the suppliers of renewable energy already amount to well over 200 billion euros. In 2013 the increased costs imposed by Germany's energy policy cost 0.6 percent of GDP. Arguably, these costs could have been far more productively invested in energy-efficiency measures, including capacity enhancing networks linking previously isolated or unconnected markets. The financial crisis has highlighted the unproductive side-effects of feed-in tariffs and subsidies: the crisis has led Spain to repeal renewable energy feed-in tariffs, and Italy to cap them (while sharply increasing gasoline taxes).

The subsidies to renewable energy producers also appear to be a violation of the underlying principles, if not the law, of the EU. Their legality was tested in the case of the Finnish wind farm supplier Alands Vindkraft, which complained that the Swedish Energy Agency Energimyndigheten had only awarded certificates to producers physically located in Sweden. Although the European Court of Justice ruled – surprisingly to most observers – against the foreign plaintiffs, it is difficult to see how a systematic energy policy can be built up on jurisdictional practice that allows discrimination against foreign producers.

The German and Swedish practice raises a fundamental conceptual problem that has not yet been solved. Is the best way of solving energy supply problems to allow market mechanisms to work, within an overall

Figure 2.8



Source: Enerdata, last accessed on 10 December 2014.

framework of priorities determined collectively by governments; or is it preferable to manage parts of the energy adjustment process separately in accordance with the preferences of particular national authorities? The latter course has led to a deep incoherence in energy policies, and its elimination requires more precise agreement about energy priorities.

2.5 Flexible pricing and incentives

A fundamental philosophical division is discernible in energy discussions, around the choice between long-term planning or fixing of prices in order to generate certainty about future signals on the one hand, and a response to short-term and noisy market signals on the other. The debate is most pronounced in the case of the two environmentally and politically most sensitive issues: gas pricing, and nuclear energy. The distinction reflects the long legacy of past (and frequently contradictory) policies, and the difficulty of quickly establishing all the institutions that are really required to let market mechanisms work effectively through the generation of price signals. The cases of gas and nuclear energy illustrate the fundamental nature of the choice facing Europe's policy-makers.

The greater the diversity of supply, and the more market alternatives exist (including different forms of energy), the more resilient the energy economy becomes against unanticipated events, including attempts to blackmail energy users. In other words, diversity of supply limits the power of the resource providers. Marketisation can thus also provide a substantial impetus to improve political conditions in other parts of the world, and reduce the monopoly rents that corrupt politicians extract in resource-rich countries.

A great deal thus depends on the adoption of an appropriate energy mix in consuming countries. Flexibility is discouraged wherever there is dependence on long-term price contracts. It is also discouraged by political considerations, as politicians see stable and low energy prices as a response to the demands of voters. An extreme example is the way in which Hungary's populist Prime Minister Viktor Orban legislated lower energy prices and even raised the question of whether this issue should be inserted into the Hungarian constitution.

There is a geographical divide in Europe between those countries that rely on spot markets and those that use long-term oil-indexed contracts to purchase and receive their natural gas supplies. Spot markets are more likely to develop in Northwest Europe with LNG import facilities and hubs that can provide gas buyers with access to multiple and geographically diversified suppliers. Oil-indexed contract markets, on the other hand, are more likely to exist in Central, Eastern, and Southern European countries, where only one or two suppliers provide gas to domestic markets and there is little gas supply diversification. The geopolitical strategy of President Putin is based around a pipeline view of the world, rather than a LNG vision (Melling, 2010; Wilson, 2014).

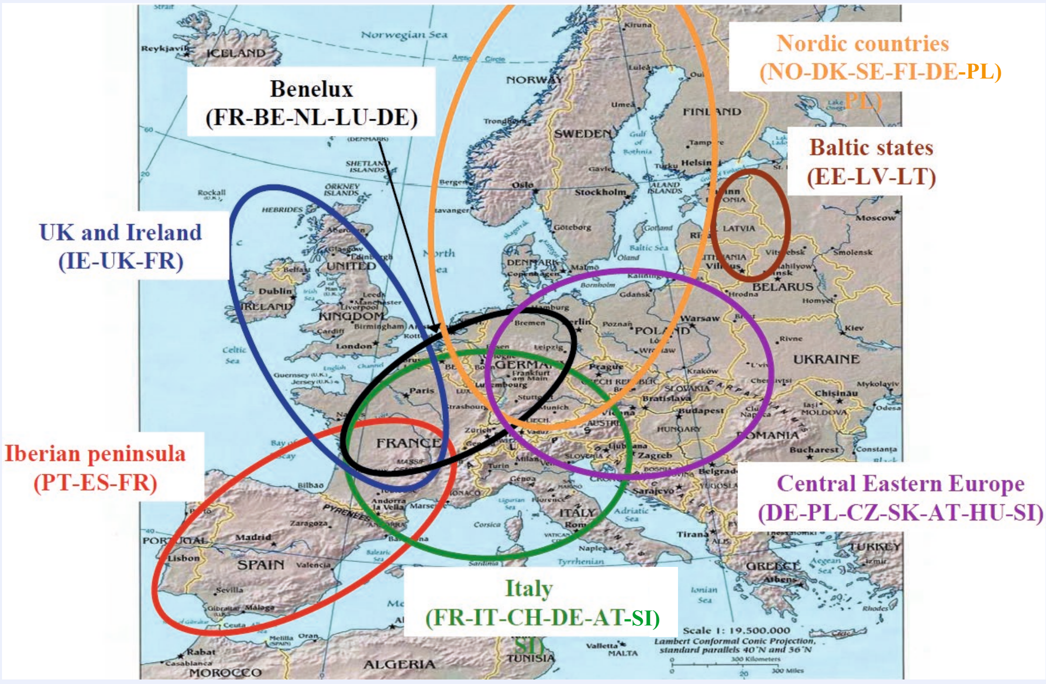
There is a substantial (and at present greatly underused) capacity for handling LNG imports in Western Europe (UK, the Netherlands, Belgium, France, Spain). Indeed, in recent years (after 2011), the proportion of LNG imports has fallen. EU Regulation 994/2010 provided for obligatory investment in infrastructure that would allow the reversibility of gas supplies, where economic calculations showed that such facilities would produce positive spillovers. Poland, which relies on imports for 74 percent of its consumption (almost all of which normally comes from Russia), may now, as a result, cover half of its demand through a reversal of flows in the Yamal pipeline, from Germany and the Czech Republic. On the other hand, Russian flows through Ukraine and Romania to Bulgaria, Greece and Turkey are not operated in accordance with the EU legislation, and there is no provision for reversibility. That result generates a political dynamic that undermines the formulation of a collective EU approach to economic aspects of European security policy. Long-term dependence reduces the opportunity for effective foreign policy coordination.

One result of the Ukraine-Russia crisis of 2014 may be a greater awareness of the security threat, an enhanced willingness to construct LNG facilities, and an expansion of the market principle of spot pricing as a result, rather than long-term indexation to other energy products. That development is harder to imagine in the case of Russian-designed nuclear power plants in Eastern Europe, where technology dependence is far greater.

Flexibilisation is an important principle in wholesale markets; but it can also play a major part in promoting domestic energy efficiency. From a consumer point of view, a move to flexible pricing may be an increasingly attractive way of steering demand away from

Figure 2.9

Regional energy networks



Source: Everis and Mercados (2010), p. 17.

peak times, at which the production costs/marginal costs are high. Consumers are increasingly exposed to pricing policies that vary substantially with time (on an hourly, weekly, but also seasonal basis): such an approach is now common in transportation (rail and air fares, taxi tariffs with Uber). They may also increasingly be able to use devices that react to price signals to reduce consumption for heating or for energy intensive activities (for instance, domestic washing or drying machines, as well as in industrial food freezers). Storage of energy can be encouraged at the level of individual consumers, with more effective batteries being used to avoid demand at peak energy times. High (and varying) prices at peak times would help to smooth out consumption patterns. Some of the distributional consequences of that move would require a delicate compromise: not all householders, for instance, can be flexible in timing periods of high energy use (think of the use of washing machines in apartment buildings with thin walls).

2.6 Inter-connectedness

Reducing extreme peaks of demand (and consequently of pricing) in an energy supply network that is pushing against capacity restraints requires a better linkage of supply systems that are still not fully integrated. The same is true for the potentially even bigger problem of smoothing peaks in green energy supply. If the national smoothing capacity becomes exhausted thanks to the closure of conventional power plants, as is regularly the case in Germany, there is a case for selling the excess electricity to other national energy markets and use their smoothing capacity. There has been some development in the integration of regional markets (Figure 2.9). But the linkage projects – such as the French-Spanish link across the Pyrenees or the Steiermarkleitung in Austria – are plagued by long delays (ranging up to 25 years); and a number of ENTSO-E (European Network of Transmission System Operators for Electricity) "Projects of Pan-European Significance" have been cancelled. A recent, widely-quoted estimate suggests that annual savings could amount to 2.5 to 4 billion euros. Even once networks are built, their limited capacity and significant leakages imply significant geographical cost differences. Network operators (and indeed whole countries, such as Switzerland) profit from price differentials without completely eliminating them.

Further improving the linkage requires a substantial investment in transmission systems. The European Commission assesses a need for 140 billion euros in investment by 2020, but it is difficult to see how this investment can be supplied by energy suppliers who are already burdened with very high levels of debts.

2.7 Conclusion

One response to the financial and debt crisis, which is also a crisis of European growth, is to demand higher levels of investment – both public and private – in Europe. The problem is that in the past, much public sector investment has been misdirected as a result of the political bargaining processes. However, private investment has also been misdirected (above all in large construction booms). Investment in energy networks may offer appropriate incentives to private producers looking at innovative ways of producing new clean energy sources. Since the search for funding also coincides with a widespread sentiment that Europe should investigate large infrastructure investment projects, it may be conceivable to fund the new energy transmission channels, both electricity gridlines and gas pipelines, with public or a mixture of public and private funding. A security levy on energy supply might be an appropriate way of ensuring the fiscal sustainability of such investment.

In the past, major increases in electricity availability (and reductions in price) were the result of increased transportation capacity. Can these gains be repeated as a result of innovations in storage and transmission technology? Research into this technology might allow a repetition of the productivity gains of the first electrification revolution, in the late nineteenth century, when electricity supply allowed the localised delivery of energy in appropriate quantities, replacing energy that had previously been generated at high cost through steam engines with mechanical transmission systems. Efficiency gains in energy supply holds out the best way of saving resources.

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