why not have in the nuclear field the sort of variable geometry successfully tried in other areas, such as the euro currency zone, Schengen or EU defence? This would allow the Austrias and Irelands to opt out of Euratom, and turn Euratom into a sort of 'coalition of the nuclear willing'.

The snag is that no one wants to opt out of Euratom. As long as it exists, Austria and Ireland want to participate, if only to keep an eye on their neighbours' nuclear power plans. There was a moment in 2004 when change seemed briefly possible. During negotiations on a new constitution, five countries – Germany, Ireland, Hungary, Austria and Sweden – declared their interest in an intergovernmental conference to review the terms of Euratom. But they found no wider support, and the issue was dropped and is likely to stay dropped. Subsequent events with the Treaty of Lisbon have shown that EU treaty negotiation, and especially ratification, is contentious enough without adding in the nuclear power issue.

In reality, countries that are undecided about nuclear power may be more of an obstacle to Europe's low-carbon energy development than the outright opponents to it. In the undecided camp must be counted those countries – Belgium, Spain, Germany and Sweden – which have agreed to phase out nuclear power, but necessarily over long periods that provide opportunities for politicians to change their minds. Such countries fall between two stools. They make no plans to build new reactors, but as long as the possibility of a U-turn exists, they also shy away from committing themselves absolutely to replacing all their nuclear power with alternative energy. Germany and Spain have increased their renewable energy enormously, but not by enough to fill the energy vacuum that phase-out of their reactors will leave. How to plug this nuclear vacuum in the future is one of the challenges for Europe's energy research and development programmes to which we now turn.

CHAPTER 14

ENERGY R(ELUCTANCE) AND D(ELAY)

> *This market gap between supply and demand is often referred to as the 'valley of death' for low carbon energy technologies.*
>
> The European Commission on launching its energy technology plan in November 2007

Develop a new technology in every other sector of the economy, and you will usually have a market for it. As long as it does something new – not even necessarily useful (think of kids' electronic games) – or does something old but in a cheaper or better way, then you will have ready customers. Not so in energy. There seems to be an inbuilt lack of market interest in new energy technology that makes energy innovation especially difficult.

The problem is not a question of long lead times (except in nuclear fusion which always seems to be 40 years from commercialization). It is only partly the network challenge of connecting new energy sources to grids or transforming grids to suit decentralized power sources so that energy reaches everyone. Mainly, the problem is that low carbon electricity technologies are almost always more expensive than those they replace, but provide nothing more than the same old electrons. Equally, carbon capture and storage (CCS), which is another way of keeping carbon out of the atmosphere, is in a sense an assault on productivity, a step backwards. CCS is perfectly justifiable, because it is for the greater good of the planet, but is nonetheless a technology that has the effect of reducing the electricity output of the average power plant to what it was some years ago. This is because the process of capturing the CO_2 and pumping into underground storage itself requires power.

Energy efficiency measures, examined in Chapter 15, have a payback in lower energy bills. But in the case of households, this may accrue to the advantage of tenants rather than landlords who took the measures in the first place. In general, the benefits of most low carbon technologies often flow more to society than to the buyer.

Moreover, the innovation process, the introduction of low carbon energies has to take place in energy systems that have been optimised over decades. Yes, the lights went out across Italy in 2003 because a tree fell on a pylon in Switzerland, and across a wider area of north Central Europe in 2006, when a Germany utility had to switch off a power line to let a ship on the Rhine pass underneath, and other power lines became overloaded. Yes, too, for a few hours at the beginning of 2006 gas flows were reduced to several European countries as a result of a Russian dispute with Ukraine. But energy supply, at least in Western Europe, is reliable for 99.99 percent of the time.

Climate change, however, has altered the old order. In the past there has certainly been a close correlation between the oil price and energy R&D (see the chart below). When the oil price came down in the mid-1980s, so did energy R&D and it has only recently picked up. Had the 1980 peak in energy R&D been sustained, the situation would have been different because the EU and its member states would collectively now be spending Euros 7–8bn a year on energy, instead of Euros 2.5bn. But only a few countries took the 1970s oil scares seriously – these exceptions were France with its nuclear programme, and Denmark and Japan with their big investment in energy efficiency. Fifteen years of fairly low oil prices, from 1986 to the turn of this century, left the EU as a whole with, in the words of the Commission, 'accumulated under-investment [in energy R&D] due to cheap oil'.[1]

That period is over. Because of carbon constraints, we can no longer rely on oil prices triggering sufficient levels of research into alternative energy. Because of carbon constraints, we need to hurry on with this research regardless of what the oil price does. In any case, the oil price can no longer be trusted as a prop for energy R&D spending. It bounces around too much to be a reliable prop.

1 Memo/07/469, the Commission, p. 1.

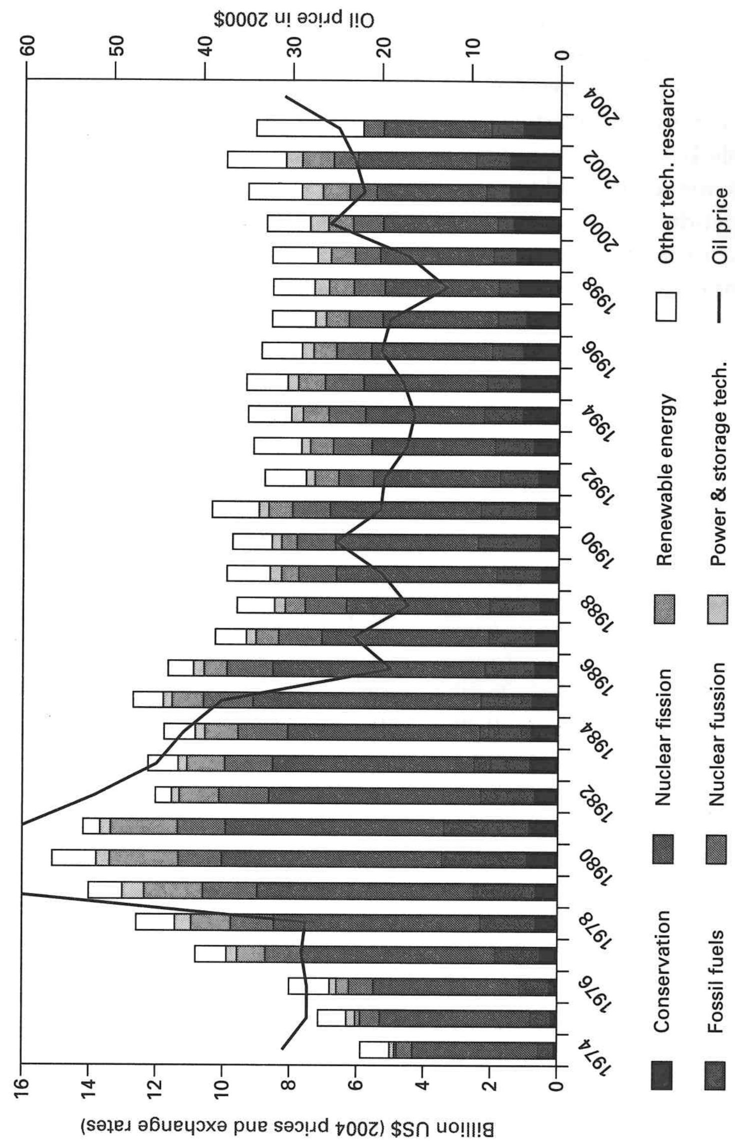

Figure 7: Energy R&D Spending in OECD Countries and the Oil Price

Source: European Commission Memo/07/469

The corporate energy sector is no better when it comes to R&D, though some of the research cuts in recent years may stem from privatization of many European energy companies and the liberalization of some European energy markets. The table below shows how little some of the major European utilities spend on R&D (new technologies), as distinct from capital expenditure (expansion and maintenance). The table also shows that oil companies are equally frugal on R&D – although their capex is high – because they can rely on research-intensive service companies such as Schlumberger and Halliburton.

Table 14: The Corporate Sector's Poor R&D Performance

Company	*Research and Development Spending 2007*				
	£Million	*Percent growth over last year*	*Percent growth over average of last four years*	*Percent of operating profit*	*Percent of sales*
EdF	262	-3	-5	4.6	0.7
Endesa	26.98	-7	44	0.8	0.2
RWE	90.96	6	-52	2.3	0.3
Suez	57.94	1	-8	1.9	0.2
Gaz de France	56.60	15	-9	2.3	0.3
Scottish & Southern	6.30	350	530	0.6	0.1
Eon (UK)	5.0	67	100	0.5	0.1
RD Shell	452.18	51	61	2.0	0.3
Total	383.37	-16	-14	2.1	0.4
ExxonMobil	374.52	3	12	1.1	0.2
BP	201.82	-21	-5	1.3	0.1
Eni	149.58	10	-35	1.1	0.3
Schlumberger	316.43	23	14	11.9	3.2
Halliburton	141.53	15	14	8.1	1.2

Source: drawn from R&D scoreboard, UK Department of Business, Enterprise and Regulatory Reform

The EU has tried to play a part in remedying this situation. For reasons examined in Chapter 13, its energy research programme has been too tilted towards nuclear, and within nuclear too tilted toward fusion. But there is a wider energy research effort. The annual average devoted to energy in the EU's current 2007–13 research framework programme is Euros 886m, up from average Euros 574m a year in the EU programme for 2002–6. There is widespread acknowledgement, however, that too much of this has been increasingly scattered around in penny packets, because the trend has been towards smaller projects with more partners.

So, as part of its attempt to create a brave new world in European energy, the Commission came up in November 2007 with a 'Strategic Energy Technology' plan. It was specifically directed at low carbon technology 'for which there is neither a natural market appetite nor a short-term business benefit'.[2] In any other context or sector, the idea of Brussels backing technology it knew the market did not want would be anathema. But as we have seen energy innovation is especially problematic. The aim, in the words of one Brussels official, was to 'shepherd early energy technology through the so-called Valley of Death, which lies between the demonstration stage and getting big enough markets to survive'.[3] Further downstream, the Commission has a programme called Intelligent Energy. In the words of its director Patrick Lambert, it seeks to 'create market conditions for acceptance of new energy technology, such as designing EU-wide qualifications and courses for the training of installers of wind turbines'.[4]

The Commission has said the main EU technology goals over the coming decade are to:

- Make second generation biofuels competitive.
- Commercialize carbon capture and storage.
- Double the generation capacity of the largest wind turbines, especially for offshore use.
- Demonstrate the commercial readiness of large-scale solar power.
- Make possible a smart grid for Europe, able to take renewable and decentralized sources.
- Bring to market efficient energy conversion devices such as fuel cells for use in buildings, transport and industry.
- Improve the prospects of nuclear fission by solving the waste problem.

2 A European Strategic Energy Technology Plan, Commission communication, COM (2007)723 final, p. 3.
3 Author interview, 2007.
4 Author interview, 2007

These challenges are daunting enough to require a pan-EU effort. One of them – the smart grid – is also of a geographic scale that requires an EU effort. Indeed it is almost the technology equivalent of what the Commission is trying to achieve through liberalization and market integration.

In energy research, the EU, through the Commission, generally has two useful roles. One is convening and coordinating. Not every EU state belongs to the International Energy Agency, which generally requires that its members must first join its mother institution, the Organization for Economic Cooperation and Development. Only those EU states that do belong to the IEA (19 out of 27) have a dedicated forum in which to discuss energy research. Now, there is supposed to be a EU steering group, chaired by the Commission, to coordinate EU and national research efforts; a series of European Industrial Initiatives in the form of public-private partnerships in specific technology areas; and a European Energy Research Alliance linking universities and focusing more on basic energy science. The other use of the EU is its role in setting technical standards for its huge single market. 'Standards are a competitive element these days', says an outside specialist. 'No European company can afford not to bring a European standard to the table when it is, for instance, talking to the Chinese.'

But such powers of convening, coordinating and standard-setting are not enough to galvanize Europe into giving the world a lead in demonstrating the technical and economic feasibility of carbon capture and storage (CCS). This technology will take time to prove commercially, but is considered a vital contribution to preventing emissions from spiralling up in the 2020–30 decade before advanced renewable energy and revived nuclear power can take them down to much lower levels. The EU is keen to lead, by example, China and India, with their huge coal reserves, into adopting CCS technology. Yet in the January 2008 climate change package, the mismatch between the Commission's ambition and means was especially glaring in CCS.

Likely costs and benefits of CCS are both big. By capturing carbon dioxide as it comes out of power stations, funnelling it underground (most likely depleted oil and gas fields) and keeping it there, CCS technology could reduce emissions in the EU by 13 percent of total power and steam generation emissions by 2030.[5] Failure to act soon might have larger negative consequences. One Commission study estimated that if the EU were to delay CCS demonstration technology for seven years, and if this led to the same delay around the world, this could mean over 90 Gt [gigatonnes] of avoidable CO_2 emissions being released worldwide by 2050. This would amount to 20 years of total current EU emissions.

Costs are high too. The bill for research into CCS might not be that large – in all Euros 1bn between now and 2020 – but the industrial costs would be on the same scale as nuclear fusion, running into billions. To prove various CCS technologies in various geologies in various places around Europe, the Commission has proposed, and EU leaders have agreed, that a dozen demonstration plants need to be up and running by 2015. The present experience in and around Europe with CCS is limited to Statoil's extraction of CO_2 from its Sleipner field (due to Norway's high CO_2 tax) and to a BP-Sonatrach project in Algeria (motivated by BP's internal carbon trading scheme).

Installing the capture, transport and storage equipment would add anywhere between 30 percent and 70 percent in up-front investment to the cost of a standard power plant. Moreover, operating costs of CCS plant would probably be 25–75 percent more expensive – mainly because of the power diverted to running the CCS equipment – than with non-CCS coal-fired plants. Climate Change Capital, the specialty investment bank, calculated in 2007 that the dozen CCS demonstration plants would need financial support of Euros 1.5bn–4bn a year or Euros 10.3bn–16.4bn in upfront grants.

This scale of money is out of the EU research budget's financial league. At one point in 2007, the Commission's energy division had hoped to divert some serious EU money, coming from unspent farm funds, into CCS development. In the end this money went to rescue the Galileo navigation satellite project. So when the Commission set out in January 2008 its draft directive for a regulatory framework for CCS deployment, it had no more

5 Supporting Early Demonstration of Sustainable Power Generation from Fossil Fuels, Impact Assessment, SEC (2008) 47, p. 35.

financial aid to offer than a proposal that safely stored CO_2 should be treated under the emissions trading scheme (ETS) as not emitted. This would mean that a CCS operator would not have to buy ETS allowances as his non-CCS rivals would have to. But the Commission admitted this incentive would be insufficient until the cost of avoiding carbon through CCS was equal or lower than the cost of emitting it with an ETS permit, and it acknowledged that this crossover point was unlikely to occur before 2020.

In terms of upfront investment money in CCS, the Commission said it was counting on government state aid and corporate finance. It said it would take a very benevolent view of state aid to CCS, but there has been little so far. Only a few governments have been come up with any firm aid promises. Among them are the UK, which has invited companies to compete for a grant to develop a relatively small CCS plant (300MW), and Norway. The latter, though not in the EU, belongs to the European Economic Area and has to abide by EU internal market rules, including state aid. In July 2008, Brussels happily allowed Oslo to put some of its oil riches into funding up to 80 percent of Norway's Mongstad CCS project.

To the companies, the Commission held out a weak mix of carrots and sticks. It appealed to companies' self-interest in gaining a first-mover advantage in CCS, and offering itself to give 'first movers a means of coordination, exchange of information and identification of best practices'. It ventured, rather endearingly, the notion that giving 'a European logo' to CCS projects might be an extra inducement for industrialists to part with several hundred million euros. But 'without bold funding decisions by the companies at the earliest opportunity, complementary public funding may not be triggered', it warned. It then managed to make a threat, and then in the same breath, withdraw it. 'The longer the power industry takes to start embracing the CCS technology, the more policy-makers will be obliged to look at the option of compulsory application of CCS technology as the only way forward.' But the Commission's own impact assessment acknowledged that the risk of imposing commercially unproven technology on the sector could not be justified.

Industry has also played a game of financial bluff and bluster. An early European Technology Platform was created to develop CCS under the name of Zero Emission Fossil Fuel Power Plants (ZEP). Even after it was clear that the Commission's financial cupboard was bare, a group of some 25 utilities, oil and engineering companies belonging to this ZEP programme wrote to Mr Piebalgs, the energy commissioner, in February 2008 to ask for money. They claimed to have spent Euros 635m over the previous five years on CCS, and they went to say 'we expect that our companies in the aggregate will commit upwards of Euros 11.159bn over the next seven years.' But, stressing 'first mover risk' rather than 'first mover advantage', they said they faced 'unrecoverable costs...which cannot be fully justified to our companies' shareholders'. Therefore they needed 'transitional financial incentives' in the shape of a 'substantial' initial level of support.[6]

Chris Davies, a UK Liberal who was the European Parliament rapporteur on the directive to create a legal framework for CCS, said he was very conscious of the game the utilities were playing. 'I have yet to find any power generator without a hand sticking out and a begging bowl attached to it.'[7] Nonetheless, he believed that, in order to kick-start CCS, something quite big had to be dropped into the begging bowl. Bigger than the original Commission proposal that 60m allowances should be taken from the new entrants' reserve in the ETS, and be used to subsidize a dozen early CCS demonstration projects. The proposition was that not only would a CCS operator not have to buy an allowance for any tonne of CO_2 that was captured and stored, but he would also, for that same tonne of safely-stored CO_2, be given one or more ETS allowances that he could then sell.

Mr Davies won parliamentary support for increasing the 60m to as much as 500m allowances. But as part of the December 2008 agreement, EU governments decided that the subsidy should be 300m allowances, of which no more than 15 percent going to any one project. MEPs accepted this. The same

6 Letter dated 21 February 2008, see *www.zero-emissionplatform.eu*
7 Author interview, July 2008

agreement encouraged national governments to use a portion of their revenue from auctioning ETS allowances as a subsidy to CCS. With governments loath to make any immediate pledges of taxpayers' money for CCS, a future raid on the larder of ETS allowances seemed a very convenient solution. In theory, now there is legislation enshrining this subsidy in law, potential CCS operators can go to a bank and raise finance on the back of it. In practice, bankers will have to weigh carefully the future value of ETS permits as collateral for their loans, and they may not be reassured by the uncertain impact of the December 2008 deal on the ETS market.

Nevertheless this arrangement could mark the opening up of a new channel of funding for energy R&D in Europe. At their December 2008 summit EU leaders issued a declaration noting 'their willingness to use at least half' of ETS allowance auction revenue for climate control purposes, including R&D into low-carbon energy. Such a declaration is far from a binding commitment, but nor is it necessarily meaningless for the future.

CHAPTER 15

DOING WITHOUT

> *Negajoules represent the biggest energy source in Europe – ahead of oil, gas, coal and nuclear.*
>
> European Parliament, 2006

The EU has given itself a target to improve energy efficiency by 20 percent by 2020. But that does not mean an aim of using 20 percent less energy in *absolute* terms by 2020 – if it did, meeting it would almost automatically fulfil, and make redundant, the other target of cutting emissions by 20 percent. Instead, the energy efficiency goal is to save 20 percent of energy consumption *relative* to what the EU's energy is projected to be by that date if Europe just continued with its business as usual.

In other words, it is a pretty soft target. It differs from the 20 percent targets for cutting emissions and raising renewables in three ways. It is not binding. Its contribution is harder to gauge because it is measured not against a past base year but a future estimate. And its fulfilment depends on a wider range of actors, on the actions and reactions of virtually all of Europe's 500m citizens.

But progress in energy efficiency is very important because reduction in energy consumption, even if relative, will exert downward pressure on energy prices, and cut both imports and pollution – the three totemic goals of EU energy policy. Progress towards the energy efficiency target will also influence progress towards the other two targets. As regards the ETS, the higher the energy saving, the lower the demand to buy carbon permits and the lower the carbon price. The knock-on effect of that on, say, nuclear power may not be good. But the lower energy demand, the easier it becomes to meet it by renewable means.

But if the importance of energy efficiency is evident, the EU dimension is less obviously relevant to this aspect of energy