CENTRE FOR EUROPEAN REFORM
policy brief

How to create a single European electricity market – and subsidise renewables

By David Buchan

★ National subsidy schemes for renewable electricity and back-up generation capacity threaten the attempt to integrate and liberalise Europe's electricity system.

★ Subsidy schemes are necessary to boost investment in renewable energy and to ensure sufficient non-renewable back-up generation. But rising subsidy costs are straining public tolerance.

★ Renewables could be promoted at lower cost and at less risk to energy sector integration if member-states subsidised in the same way, even if the amount of subsidy differed.

The European Union's energy policy-makers have a growing headache: how to achieve a low carbon economy that respects market principles of reasonable cost and efficiency. The headache is caused by renewable energy sources, especially wind and solar power. What makes the headache hard to treat is that renewables are, in a sense, its cure as well as its cause. Wind and solar power are part of the cure in that they are the fastest growing forms of renewable energy which is itself the fastest expanding element in low or zero-carbon energy, but they are still more expensive than carbon-based sources. So renewables require subsidies in the form of special tariffs. These subsidies distort markets in general, and because the 27 EU member-states have different types and levels of subsidy, they distort the European energy market in particular.

Most people care little about the purity of markets, but they do care about cost. And this is mounting. In 2010 German consumers paid €13.2 billion in 'feed-in tariff' subsidies to renewable generators, according to the latest OECD report.[1] This is, to put it gently, a de luxe way of avoiding carbon emissions. The same OECD report estimated that in 2009 Germans were effectively paying €74 for every tonne of CO_2 avoided through their renewables, or six times the carbon price on the European Emissions Trading System (ETS). Germany, with its large economy and high renewable ambitions, paid out nearly a third of all renewable subsidies paid in the 27 member-states in 2009.[2] Yet in the same year Spain and Italy also each spent €5 billion subsidising renewables, France €3 billion, and Sweden and the UK the equivalent of €2 billion each. According to the UK Treasury, UK renewable subsidies will rise from £2.09 billion in 2011-2012 to £3.87 billion in 2014-2015.[3]

Many governments have started to regret their expensive commitments to high tariffs for solar photo-voltaic power generators, now that finances are stretched. Some have been scrambling to cut these tariffs for new projects as fast as they legally, and sometimes illegally, can. Last year, a judge ordered the UK government to temporarily reverse a cut to its solar feed-in tariff because it was made without completing a public consultation. Germany has been steadily cutting solar subsidies, with another 30 per cent reduction for new projects announced in April 2012. On taking office in January, the new Spanish government suspended all subsidy schemes for new renewable projects to arrest the growth of payments

[1] *OECD, '2012 economic survey of Germany', February 2012.*

[2] *Ecofys, TUWien, Fraunhofer, Ernst and Young. 'Financing renewable energy in the European energy market', January 2011.*

[3] *UK Treasury, 'Control framework for DECC levy-funded spending', December 2011.*

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owed to utilities, which currently stand at €24 billion. In February more than 100 Tory MPs wrote to UK Prime Minister David Cameron to complain about subsidies for wind farms.

Big renewable energy companies fret that increasing political risk discredits the very existence of public subsidy. They therefore seem ready to accept smaller golden eggs in order to keep subsidy-laying geese alive. For example, Ignacio Galan, chairman of Spain's large renewables firm Iberdrola, said that the high cost of Spanish subsidies was "irrational", and that he agreed with his government's freeze.

The issue of renewable energy subsidies is prompting a wider debate over European energy market reform. The need to redesign the market arises because intermittent renewables – wind and solar power – affect the stability and economics of the rest of the electricity market. This discussion about integrating renewables complicates the general thrust of European action: energy liberalisation. Energy liberalisation aims to end national protectionism. Inevitably, tensions arise when non-market mechanisms like differing national renewable energy targets and subsidies are super-imposed onto an EU energy strategy that uses market forces to drive down consumer costs.

It is now widely recognised that all energy markets need government intervention if low carbon renewable and nuclear energy is to overcome the innate cost and convenience advantages of fossil fuels. But previous efforts to deliver this on a pan-European scale have been flawed. The ETS makes industrial users of fossil fuels use allowances for every tonne of carbon they emit. These are tradeable: if a firm needs more allowances, they must buy them from firms that do not need all of their quota. This rewards carbon-efficient firms. But the ETS market needs constant intervention to work: the number of allowances must be reduced to ensure that demand for carbon allowances significantly outstrips supply, to ensure that the carbon price penalty is high enough to wean the economy off fossil fuels. And so far the ETS regulators – meaning member-states and the European Commission – have been unwilling to ensure a sufficient shortage of carbon allowances, because of the extra cost this would impose on European industries and utilities.

Strengthening the ETS would go a long way to boosting renewable energy (by making fossil fuel use more expensive), but there is not enough time to reform it to meet the EU's 2020 target of a 20 per cent renewable share in overall energy consumption. To meet this target, all 27 member-states have negotiated differing national renewable targets, and have been allowed to continue to subsidise and support their own renewable energy sectors in their own differing ways. The EU has thus created a patchwork of subsidies that is increasingly fragmenting the unity of the European electricity market.

This patchwork will become even more complex as governments subsidise coal, gas and nuclear power generators with 'capacity' payments to be available as back up for intermittent wind and solar energy. (Technically, this capacity remuneration is a payment for a service not otherwise available, rather than a subsidy. But if it exists in some markets and not in others, then it will distort trade just as a subsidy would.) France is to launch a capacity payment system this year. The UK government is proposing such a scheme, and capacity payments are also being debated in Germany. It is unlikely that all 27 member-states will create capacity mechanisms or markets. But those that do will – through their different national subsidies to conventional power generators – be adding to the regional distortions in the market that different national subsidies to renewable power generators are already creating.

Separate renewable and capacity schemes could lead to a nationalisation, or re-nationalisation, of Europe's energy market – and so undo 20 years of modest progress towards integration. To alleviate this danger, there needs to be at least some EU co-ordination of national renewable schemes, to halt divergence and promote convergence. Such convergence could fall well short of total harmonisation – which would be politically unfeasible – and still be effective.

Electricity and intermittency

Electricity markets need to be well-designed; otherwise they make inefficient use of all the energy sources that go into generating electricity. Moreover, failure causes black-outs, the costliest and most dramatic failure in any energy market, short of nuclear reactor meltdowns. For Europe, electricity is also the main route to its ambitious plans for de-carbonisation, first in power generation, then in heat and eventually in transport through electric cars.

Renewables are the only way to fully de-carbonise electricity markets. With the exception of liquid bio-fuels for cars, all renewables – wind, solar, hydro, geothermal, even biomass and biogas – usually end up as electricity. But electricity and renewables have some characteristic problems that compound each other.

Electricity cannot be easily stored. Much work and research is going into battery development, but so far the only large scale storage of electricity is 'pumped storage' in the mountainous reservoirs alongside

hydro-electric plants. Pumped storage involves pumping water-up hill, using electricity which is produced by the hydro plant at a time when the electricity is not needed. The water is then available to generate electricity when demand rises. Only two European countries, Norway and Switzerland, have significant pumped storage capacity, and are thus an essential part of the EU's energy market. That electricity cannot easily be stored does not matter if the means to make the electricity can be, as with fossil or nuclear fuel. Some renewable fuels are also controllable: hydro-electricity, geothermal electricity and biomass. But if the 'fuel' is the sun, the wind or the waves which cannot be stored, controlled or precisely predicted, then it has to be used when it occurs – a real case of use it or lose it.

As a result, EU rules require transmission system operators to give priority access to the grid to renewable electricity whenever and wherever it is generated. This is logical insofar as it promotes renewables, but it also means that renewable electricity can be dumped on the grid without regard to demand. Thus renewables suppliers face none of the market discipline, exerted through prices, that suppliers of conventional power have to obey. In electricity markets, where supply and demand must always match, power suppliers are, for instance, normally held responsible if they throw the system out of balance, and have to pay a penalty. There may be ways – discussed in the conclusion below – to incentivise renewable generators to behave as more normal citizens, or 'gridizens', in the electricity market.

The need for back-up capacity

Installed generation capacity from wind and solar together now amounts to 15 per cent of all EU power generation capacity, a proportion equal to that of today's hydro-electric capacity.[4] Hydro-electric capacity is not increasing; environmentalists have criticised dams in recent years, and in any case most of the best sites for dams have already been used. So the intermittent wind/solar portion of EU electricity capacity will increase further. Eurelectric, the main industry association of European electricity generators, published a study tracking the ratio of wind energy output to installed wind capacity for Spanish and German generators in 2008.[5] It found that wind in the two countries was reliable only 5 per cent of the time.

4 European Wind Energy Association, 'Wind in power: European statistics for 2011', February 2012.

5 Eurelectric, 'Integrating intermittent renewable sources into the EU electricity system by 2020: Challenges and solutions', 2010.

Back up conventional capacity is one way to deal with wind-less or cloudy days. There are, however, other ways to deal with intermittency in the supply of electricity. A drop in supply can be matched by an arranged drop in demand – or an increase in demand to cope with a surge in supply. This can be done through demand-side management techniques, such as contracts where heavy electricity users agree to cease using power if there is a surge in overall demand. Demand-side management will become more effective with the development of smart grids and smart meters, enabling and encouraging energy users to shift their consumption to off-peak hours. Another way to cope with intermittency is to draw on the capacity reserves of other countries or regions inside the EU, through the building of more cross-border interconnectors and cross-border management of demand and supply. Denmark provides a powerful example of the benefits: it has the enormous advantage of having interconnection capacity with other countries equal to 80 per cent of its own peak demand. Denmark is therefore able to cope with considerable fluctuations in its renewable energy production (mainly wind) which average out over a year to 20 per cent of its actual electricity output.

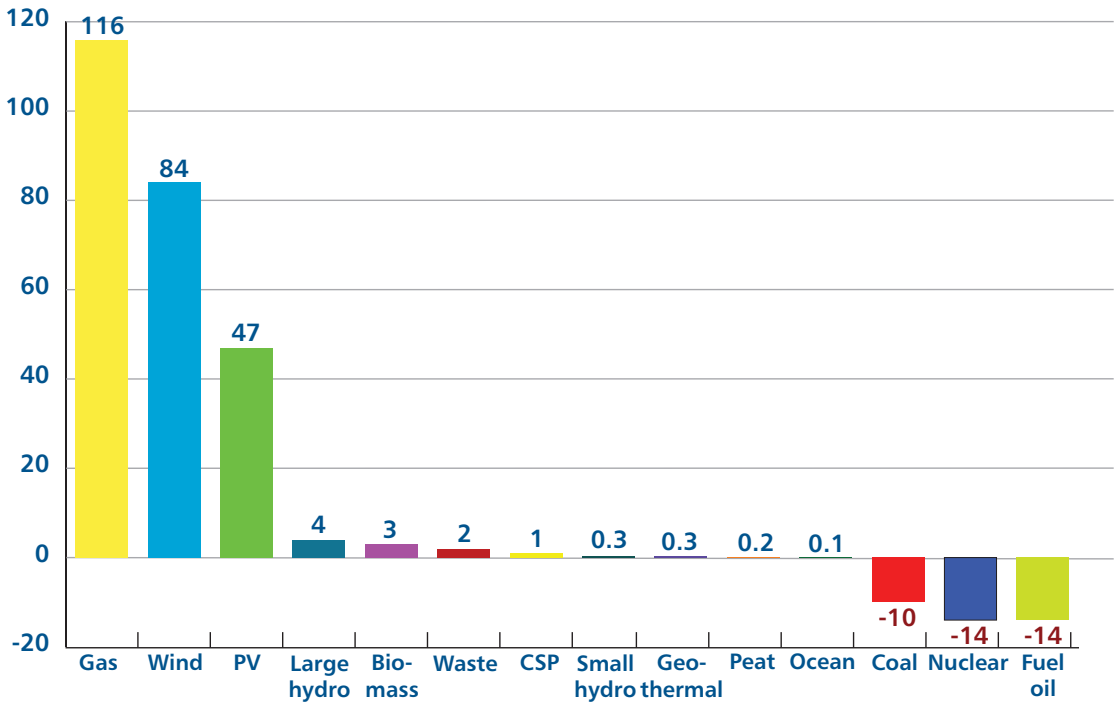
But there is no denying that considerable back-up capacity will be needed. Eurelectric argues that a system with 50 per cent intermittent renewable generation capacity could need almost as much conventional plant as would a system with no renewable capacity whatsoever.[6] Over the last decade, gas-fired power has grown most in absolute gigawatt generation capacity followed by wind and then solar photovoltaics (See bar chart on page 4). But taken together, wind and solar outstrip gas capacity (though not output, due to the low load factors mentioned above). Gas plants are a flexible form of power: they are quicker to start up and easier to ramp up or down than coal or nuclear plants. So gas is particularly well-suited for back-up. Combined cycle gas turbine plants are also the most energy-efficient form of fossil fuel generation.

6 Eurelectric, 'RES integration and market design: Are capacity mechanisms needed to ensure generation adequacy?' 2011.

The difficult economics of back-up

Potential investors in back-up plants are daunted by the prospect that these will not be allowed to operate for enough hours in the year to pay their way. According to Red Electrica, the Spanish grid, combined cycle gas turbine plants operated for only half as many hours in 2010 as they did in 2004 (see line chart on page 5). This constraint on output would not matter to generators if they were paid for it. For instance, investors might not mind their plants only operating for a couple of hundred hours a year at times when renewable supply plummets, provided they could capture the peak prices a free market would produce at those times. But many investors suspect that politicians dare not risk such peak prices upsetting voters, and will instead cap prices.

Net electricity generating installations in the EU 2000-11 (in GW)



Source: The European Wind Energy Association, 'Wind in power – 2011 statistics'.

The economics of back up capacity are made more complex by the way that renewable energy plays into what is called the 'merit order': the traditional line-up in which electricity grid operators call upon generators to supply demand. This dispatching system starts, logically, with the source of power that can supply an extra unit of energy at the cheapest rate. and moves to the most expensive source until all demand is satisfied. Financially, this means that the marginal cost (the cost of the last unit of power supplied) sets the price for the whole market.

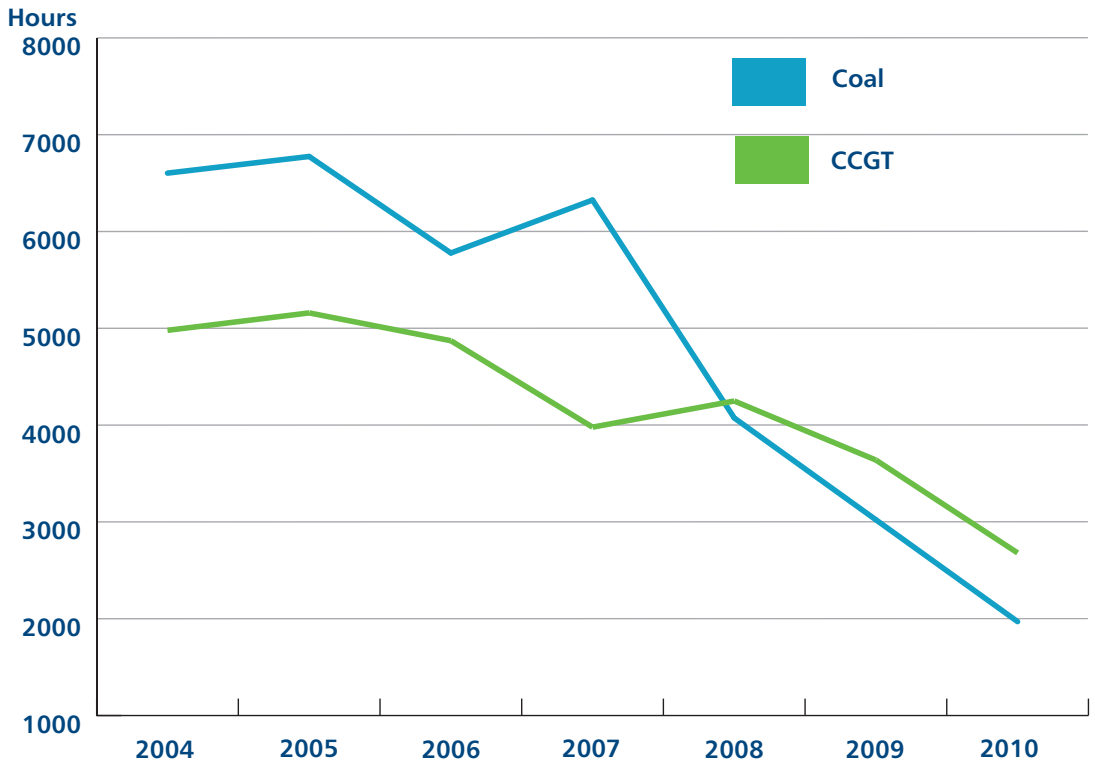
This system may end up driving out the back-up capacity needed. Gas and coal have high marginal costs arising from expensive fuel. Wind and solar do not use fuel and have low operating costs, but have high average costs, because the plants cost a lot to build and that investment must be recovered. But the order defines merit by the short-run marginal cost, and thus prioritises renewables over coal and gas. Renewables also benefit from EU rules on priority dispatch. The EU's targets have led to ever-increasing amounts of wind and solar power, which has reduced the amount of higher cost electricity that grid operators need to buy in order to satisfy demand. One might welcome this, because this higher priced electricity capacity is likely to be fossil-fuelled. However, if renewables and nuclear power push fossil fuels out of business, the grid loses a flexible back-up option for renewables. Paradoxically, well-wishers for the renewable revolution should want to see more capacity in – though not output from – fossil-fuelled generation, built alongside renewable sources as a back-up. Triumphalist statements that renewables account for most new generation capacity built in Europe are not necessarily the good omen for the low carbon economy they might seem.

Renewables make integration harder, but more necessary

The reality of different national subsidy schemes for renewable power, and the prospect of different national subsidies for back-up capacity, is straining whatever unity the EU electricity sector has acquired. Yet a low-carbon electricity system will only be possible with more European co-ordination. Wind and solar power are intermittent, but the sun is shining or the wind blowing somewhere in the EU at all times. When the wind drops in the North Sea, it is often blowing across Iberia, and vice versa. So intermittency in one country can be offset by drawing on renewable output or capacity reserves of other countries inside the EU, through cross-border interconnectors joining national markets together.

Germany's 2011 decision to accelerate its exit from nuclear power has added urgency to building such interconnections. Germany is already scrambling to replace the output of the eight nuclear reactors that it shut down immediately after the Fukushima accident. It has insufficient transmission lines to carry wind

Operating hours (full capacity) of CCGTs and coal plants in Spain



Source: Red Electrica, Spain

power from the north of the country to the south. So Germany has effectively been using its neighbours' grids to carry some of this power. In a new form of protectionism – or more accurately self-protection – the Poles and Czechs have in the past year put special equipment on their border to prevent this German power from swamping their own grids.

The European Commission has been working for years on integrating national networks in energy on the economic rationale that integration promotes competition, leading to convergence on the lowest possible prices and thus best value for consumers. Using a mix of anti-trust powers and market-opening legislation, the Commission has steadily chipped away at monopolies and protectionism in national energy markets. It has forced the 'unbundling' of transmission system operators – the companies that run Europe's main high voltage power lines and high pressure gas pipes – from energy suppliers, which could previously control access to their networks, and thus discriminate against rival suppliers. The Commission's aim has been to turn these networks into common carriers of energy for all, and to build more of them across national borders. The Commission must now use this long-standing focus on energy infrastructure, which now acquires even greater relevance with the arrival of large-scale renewables, which are often – indeed usually – remote from centres of energy consumption.

Knitting national energy markets together

Three developments will help to knit national markets together:

The 3rd package of directives passed in 2009. This made it harder for transmission systems to be used as weapons of discrimination and protectionism, by making grid operators more independent from energy suppliers, and by setting up new and stronger EU institutions. The Agency for Co-operation of Energy Regulators (ACER), will require the 27 national energy regulators to promote wider EU energy interests for the first time, and not just look after their own national bailiwicks. The European electricity and gas transmission system operators' institutions – respectively ENTSO-E and ENTSO-G – have been strengthened and, together with ACER, given the duty of working out ten year rolling network development plans for the European grid.

The Commission's infrastructure proposals of autumn 2011. Its main aim is to kick start 12 priority 'projects of common interest' across the EU by streamlining national planning procedures. The Commission hopes to more quickly resolve cross-border bottlenecks typified by the long saga over a new high voltage power line across the Pyrenees. (The permitting procedure for this line was rejected in 1996, re-started in 2001 and finally concluded in 2011.) Several member-states do not like the Commission's proposed

three-year time limit for national decisions on priority energy infrastructure projects. Others, mainly those with a federal system, dislike the proposal that each member-state should establish a 'one stop shop' agency for decision-making or co-ordinating decision-making. Nonetheless, the proposals look likely to be adopted in some form. The Commission also hopes to make some EU finance available to projects deemed in the wider EU interest but unattractive to commercial funding, but this must be agreed in the negotiations over the next EU budget.

Market coupling. The power industry, exchanges and traders are making their own contribution to energy sector integration through 'market coupling'. Market coupling allows buyers and sellers to trade electricity without explicitly having to buy the transmission capacity that is needed to make the trade. It does this with an automatic allocation of capacity that assumes that one country will continue to export to another for as long as the selling price in the first country is below the bid price in the second. This goes on until prices in the two markets converge or until all available cross-border capacity is used up. Initially, the power markets of France, Belgium and the Netherlands were joined in this way; then it was extended to Germany and Luxembourg; and now the UK and Nordic markets are partially linked in to the system. Eventually, all 27 national electricity markets are to be coupled.

This combination of legislation, regulation and market innovation has taken Europe quite a long way towards a single energy market. But distortions arising from national renewable schemes, and from the differences between these schemes, could undermine some of the achievement. Some distorting effects of subsidies are readily visible: why else would relatively cloudy Germany lead Europe in solar power capacity? The distorting effects on electricity markets are less obvious but equally pernicious. Market coupling is intended to achieve efficiencies of scale from national electricity markets through rational pricing. But renewable subsidies can make a nonsense of pricing, as they sometimes lead to 'negative prices', when operators actually pay the market to take their electricity so that they can continue to generate for the sake of collecting the subsidy.

Remedies

While it is important that the push for better interconnections be maintained, they are only a partial solution to the major challenges that renewable energy poses to the stability and unity of Europe's electricity market. The European Commission plans to address some of these challenges in two reports this year – one on renewables to appear before the summer, and the other on wider internal energy market issues, including capacity support mechanisms, slated for early autumn. However, at this stage, officials predict that these 'communications' may raise more questions than they answer.

Some technical changes would help to make wind and solar generators behave more like conventional players in the electricity market. These generators cannot make firm forecasts of output much in advance of actual delivery. One solution would be to let them, and every other generator, trade nearer to the time of actual delivery. Some member-states, mainly new ones, require trading to cease several hours before actual dispatch of the electricity. This could be reduced to thirty or even fifteen minutes. Renewable generators could then also be made subject to retrospective 'balancing' penalties. Such penalties are already imposed on conventional generators that submit erroneous predictions of power generation and throw the market out of balance. Penalties would encourage renewable generators to forecast as accurately as humanly possible. One probable consequence of this would be to slow the development of renewables, because investors in renewables would face an added market risk. But slower development would be sounder development.

Such technical changes to the power market would have to be harmonised across the EU 27 to remove distortions in the wider European market. This would have to be accompanied by harmonisation of the structure – though not necessarily the level – of payments in national subsidy schemes. The predominant type of subsidy scheme – the pure feed-in tariff – effectively insulates renewable generators from the market. With a feed-in tariff, generators are rewarded entirely by subsidy, draw nothing financially from the market, and can therefore remain happily heedless of market conditions. It would be better to phase out pure feed-in tariffs – as Germany is beginning to do – and move to more market-related subsidies that exist already, in particular the variant of the feed-in tariff known as the 'feed-in premium'. This tops up the income that the generator makes by selling green electricity on the wholesale market, and thus exerts market discipline.

There are valid arguments against total harmonisation of national subsidy schemes. Member-states have differing national ambitions in clean energy, which they want to express in the relative lavishness or stinginess of their subsidies. Even more importantly, they have uneven income levels. Differences in geography and weather patterns will always justify different payments for different types of renewables. Obviously, less wildly different levels of subsidy would help to reduce distortion in investment decisions. But these payment differentials need not disappear entirely,

as they would in a totally harmonised scheme. By harmonising solely the structure of national schemes, along the lines suggested here, the EU would help to integrate renewables into the market and remove the most egregious distortions.

Radical solutions are unlikely. In an ideal world, the best answer might be to re-engineer the ETS so that it would produce a high price that reflects carbon's true environmental cost, and then harmonise national renewable subsidies down to zero. That will not happen. A truly European subsidy system – with, for instance, Germans subsidising Greek solar power – is equally implausible. The European Commission proposed a pan-EU renewable support scheme in 2008, which most member-states rejected on the grounds that as long as governments had national renewable targets, they needed to retain national financial means to meet these targets. The 2009 renewable energy directive does contain measures that allow member-state governments to buy and sell renewable energy between themselves in order to meet their 2020 targets. This will not necessarily involve green electricity actually flowing across borders. It just allows governments to make 'statistical transfers' of renewable energy. For instance, Italy and Luxembourg have already said they are almost certainly not going to be able to meet their national 2020 targets through their own national renewable energy programmes, and that they will be in the market to buy amounts of renewable energy from countries in surplus such as, say, Spain and Denmark. Such transactions will be accounting exercises, with a certain amount of green power being subtracted from the statistical score of Spain or Denmark and being added to that of Italy or Luxembourg. No such sales have yet taken place, though they may before 2020. The directive also encourages countries to launch joint renewable projects and to merge their subsidy schemes, but only Sweden and Norway have done so. (Norway participates because its electricity market is part of the combined Nordic wholesale electricity market.)

Whatever new shape Europe's energy market takes in order to accommodate renewables, energy costs must be reduced and renewables supported more efficiently. A co-ordinated approach would help. In order to meet the 2020 targets, the EU's 27 member-states acting separately would have to double collective annual renewable investment from today's €35 billion to €70 billion. But if a pan-European approach were taken to developing renewable resources, and to choosing renewable technologies and sites, a saving of more than 10 per cent could be made, bringing the necessary rate of investment down to €62 billion a year.[7]

[7] *European Commission staff working paper, 'Review of European and national financing of renewable energy', SEC 2011.*

In today's straitened times, the extra cost and inefficiency of national renewable schemes makes a compelling argument for co-ordinating, if not totally harmonising, renewable subsidies.

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