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The Scissors Effect:

How structural trends and government intervention are damaging major European electricity companies and affecting consumers

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Introduction

The major electricity companies (the 'majors')[1] in Europe have not recovered from a significant decline in their combined market value that began in early 2008. Although the situation obviously differs by company, the difficulties faced by the majors as a group raise questions about whether the causes are temporary or structural, whether they reflect fundamental flaws in market design, regulation and corporate strategy, and what the prospects are. If the problems are structural, as argued here, these companies may be unable or unwilling to finance the investments[2] required to meet the EU policy goals of energy security, environmental sustainability, and acceptable costs (economic efficiency).

How should one characterize and explain what is happening? This research paper argues that the problems facing the European majors reflect a 'scissors effect', which has two interpretations. On the one hand, it is a dynamic process whereby certain revenue streams fall, while costs rise, literally cutting profitability in certain European markets and business segments.

The scissors metaphor extends to a second interpretation: that profitability is being hit (or will be) both upstream and downstream. It is widely reported that wholesale market prices are falling, reducing upstream margins for conventional power generation. This reflects a growing gap between the costs of new generation capacity and the prices in the wholesale energy market. The gap is discouraging investment in generation that does not receive out-of-market payments, which are revenues in addition to those earned in the energy market. The loss of market share to renewable power further complicates the recovery of investment costs for power stations whose revenues are earned only in the energy market. But it is less well understood that while wholesale prices are falling, final retail prices are rising. This poses, or will pose, another problem for the majors. The higher final prices reflect rising taxes and the costs of supporting public policies (relating to, for example, renewable power and co-generation) that contribute to excess generation capacity and lower wholesale prices. Higher final prices also create incentives for consumers to curtail demand, generate their own electricity, sell it back to the grid, and even to disconnect altogether from the system.

What explains the scissors effect? This paper emphasizes the external effects originating from underlying structural trends and public policy. On the one hand, there are three structural trends that help to explain the scissors effect:

- stagnant or falling electricity demand growth;
- increasing renewable electricity generation at the expense of conventional fossil fuel-fired generation; and
- the growing importance of final consumers and decentralized energy resources, such as demand response and autogeneration.

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1 Many of the largest companies in the European electricity sector are also active in non-electricity activities, notably in natural gas. In this paper, I am principally interested in the electricity activities of those companies, while recognizing that this is only one part of their business. When I refer to the electricity majors, I am referring to the electricity activities of these companies in the EU.

2 A recent European Commission document contains a similar diagnosis of the problems and of the need for market redesign, although I do not share its views on the resolution of the problems. See "Investment Perspectives in Electricity Markets" Energy Economic Developments, Institutional Paper 003, July 2015. http://ec.europa.eu/economy_finance/publications/eeip/pdf/ip003_en.pdf

On the other hand, governments have encouraged these trends and in some cases have initiated them. This intervention has distorted electricity markets and raised costs for final consumers, at least in the short term. However, it has also facilitated entry by new agents, notably renewable generators, and promoted greater consumer participation in electricity markets in the form of demand response and autogeneration. This combination of structural trends and government intervention helps to explain the problems now faced by the majors.

So what are the implications? Although these structural trends seem now to be irreversible, the future of the sector still depends importantly on government decisions. This paper argues that current electricity regulations and market designs are unsustainable. To address this, it is necessary to clarify the respective roles of government and markets and to design new regulations and markets for a decarbonized electricity model and for the transition to that new model. Where markets do have a role to play, it is essential that they be left to play that role. The proposal summarized here draws on the original spirit of liberalization, but reflects the importance of decarbonization and the technological changes that make active consumer participation in electricity markets a reality. While the majors have to rethink corporate and regulatory strategy, their first priority should be to engage in the debate about the future role of government and competitive markets in a decarbonizing electricity sector where consumers will be increasingly active.

In addition to this introduction, the paper has eight sections. Section 1 summarizes the evidence of financial difficulties facing the majors and explains the hypothesis of a scissors effect in more detail. Sections 2–4 explore the three structural trends behind the scissors effect, while Section 5 considers briefly the implications for natural gas and coal suppliers to the European electricity sector. Section 6 argues that EU governments have reinforced the scissors effect and, in some cases, have been responsible for initiating it. Section 7 is a short case study illustrating the argument, focusing on efforts to close the new and efficient Irsching power plants in Germany. Section 8 concludes with proposed first steps towards addressing the challenge posed by market designs and regulations that are no longer fit for purpose.

1. The majors in trouble: the scissors effect

a. The problem

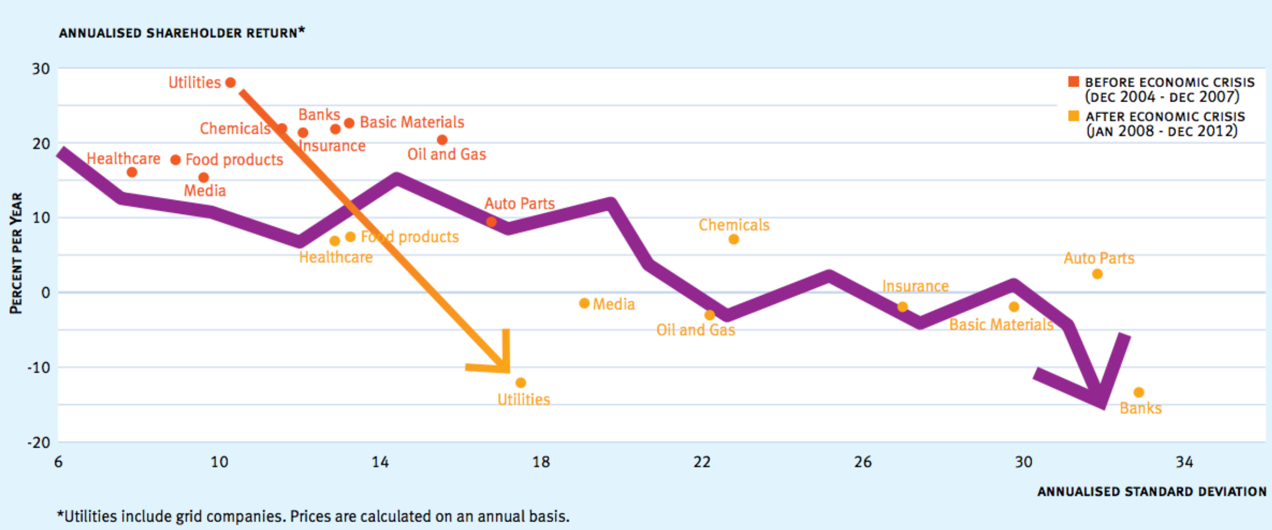
As a group, the major electricity companies in the EU have been unable to recover from a sharp fall in share value that began early in 2008. One Bloomberg chart traces the history of the MSCI European electricity utilities share price index; according to that graphic, in early June 2015 the index stood at 116, compared to a maximum of 241 in early January 2008. Although the index has risen from its minimum in 2012, when it reached 53, it is still a long way from the maximum[3].

One could argue that this is a reflection of slow economic recovery in the EU and no doubt this is a contributing factor. However, many other sectors have rebounded more strongly, and indeed the value of European stock markets is now approximating the 2007 peak.[4] Figure 1 illustrates that annualized shareholder returns for the main EU electricity companies (including grid companies) fell from over 25 per cent during the period 2004–7 to negative values over the period 2008–12. Furthermore, volatility of returns increased. Although shareholder returns for many other sectors also deteriorated, the return for electric utilities appears to have fallen by more than that for any other sector.

3 I have permission to quote the index numbers in the graphic.

4 Stock Price Indexes: MSCI Europe Sectors and Industries, Yardeni Research Inc., 16 July 2015, page 1. www.yardeni.com/pub/eurostmkt_bb.pdf.

Figure 1: EU utilities stock market performance



Source: *Power Statistics and Trends 2013*, Eurelectric, page 7.

One could also argue quite reasonably that the problems are specific to a small number of very large electric companies, not to all of them. For instance, three of the largest ones (GDF Suez, RWE, and E.ON) have been among the hardest hit over a number of years. RWE declared a net loss of €2.8 billion in 2013, the first time it had declared a loss in 60 years.[5] E.ON posted a loss of €3.2 billion in 2014.[6] GDF Suez posted a net loss of €9.3 billion in 2013.[7] The share prices for these three companies fell heavily after 2008, contributing a large part of the reduction in the combined market value of 20 majors between 2008 and the end of 2013.[8]

It is therefore important to stress that the analysis in this paper does not pretend to explain the share prices of individual companies. There are obviously many different factors that will determine their results, not least the geographical spread of assets (within the EU and outside), the range of their businesses (within the electricity sector and outside it, for instance in natural gas), exposure to country-specific risks, and their management, strategy, financial resources, and history. Nevertheless, as Figure 2 illustrates, many of the electricity majors have seen their market valuation fall steeply. It is now widely recognized that the sector faces a serious problem in relation to its EU businesses, especially with respect to the conventional generation of electricity from fossil fuels.[9]

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5 'Germany's RWE slides into €2.8bn net loss for 2013', Financial Times, 4 March 2014. www.ft.com/intl/cms/s/0/70ed184a-a375-11e3-aa85-00144feab7de.html#axzz3Y2BKuFEx.

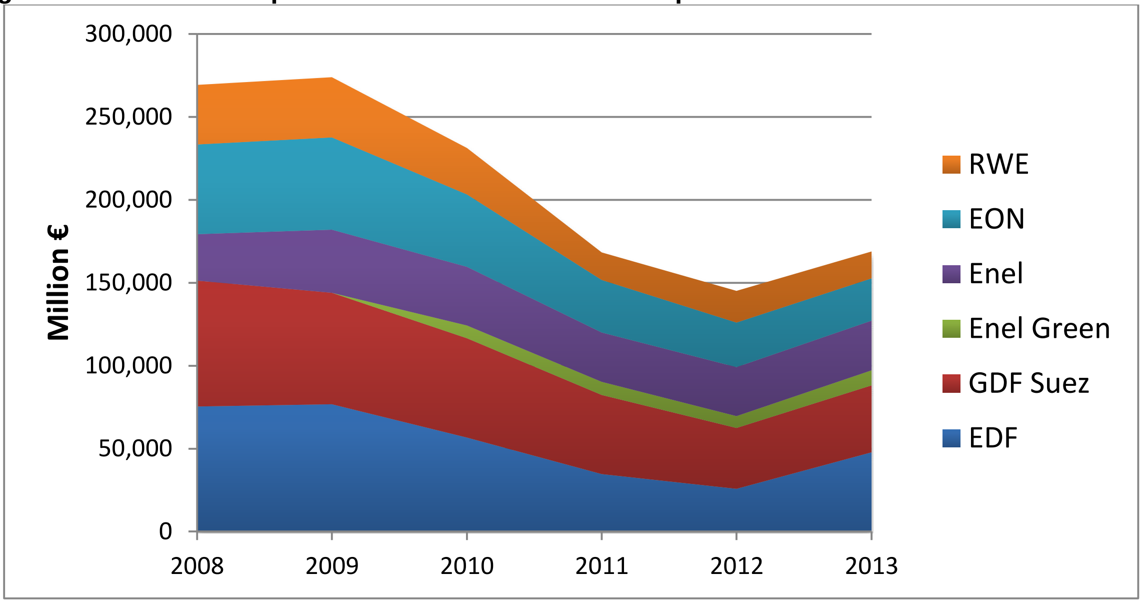
6 'EON Posts Record 3.2 Billion-Euro Loss After Writedowns', Bloomberg, 11 March 2015. www.bloomberg.com/news/articles/2015-03-11/eon-posts-record-loss-of-3-16-billion-euros-following-writedowns.

7 'GDF Suez Earnings: Utility Takes $20.4 Billion Write-Down', Wall Street Journal, 27 February 2014. www.wsj.com/articles/SB10001424052702304255604579408362026916346.

8 'How to lose half a trillion euros: Europe's electricity providers face an existential threat', The Economist, 12 October 2013.

9 For example, see the recent report, Coal: Caught in the EU Utility Death Spiral, Carbon Tracker, June 2015.

Figure 2: Selected European electric utilities: market capitalization 2008–13



Source: Author figure, based on Bloomberg LP data, reproduced in *Coal: Caught in the EU Utility Death Spiral*, Carbon Tracker, June 2015.

This research paper analyses a number of explanations for the decline in share value for the majors including: stagnant demand, the increase in renewable generation, decentralized energy resources (DER), and, more generally, government intervention in electricity markets. The critical questions addressed are how these explanations fit together, whether they reflect structural trends that are unlikely to be reversed and, if so, what the implications are.

These questions are important not only for the companies and their shareholders, but also for policy makers who expect the majors to make significant investments to support the transition to a decarbonized electricity sector. The IEA estimates that US$21 trillion are required for expansion and refurbishment of global electricity through 2040, of which OECD Europe accounts for US$3 trillion.[10] If the underlying reasons for the financial difficulties are temporary and can be resolved through incremental adjustments to regulation, markets, and corporate behaviour, then investment by the majors and by others need not be a major concern. However, if the problems are more structural, as suggested here, they may require important reforms at a policy level, and within the companies themselves.

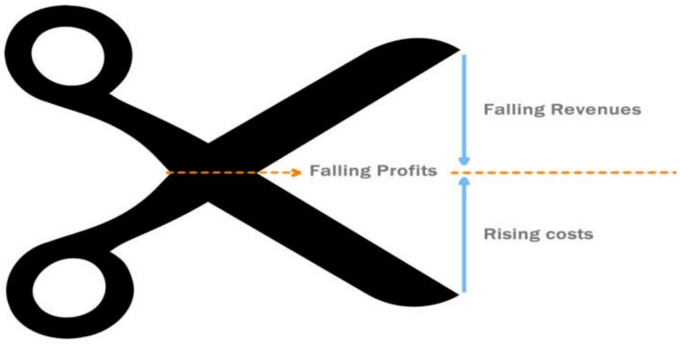
b. The hypothesis: the scissors effect

The hypothesis is that the majors are experiencing the consequences of a dynamic process called the ‘scissors effect’, which has two interpretations. First, profitability is reduced as a result of diminishing revenues and increasing costs in conventional electricity activities, as illustrated in Figure 3. Upstream, the majors’ revenues, margins, and market shares have fallen; this is largely due to falling wholesale energy prices and declining generation output, which in turn reflect falling electricity demand, rising output from renewable generation, and excess generation capacity. There is now a growing structural gap between the costs of new generation capacity and the falling prices in wholesale energy markets. This gap makes needed investment in new generation very unlikely unless additional payments are made outside of the energy market itself. Furthermore, while revenues and

10 World Energy Outlook 2014, IEA, Paris, page 219.

margins in conventional generation have fallen, costs faced by the majors have risen, in particular to meet tightening environmental standards for coal plants and to integrate renewables. The result of falling revenues and rising costs is falling profits, especially in conventional generation.

Figure 3: Scissors effect



The second, complementary, interpretation of the scissors metaphor is that the majors are seeing (or will see) their profits cut both upstream *and* downstream. The problems upstream are widely reported: lower wholesale energy prices, margins, and market shares for the reasons just mentioned. Less well known, but potentially of more importance, the majors will face growing pressure on profitability in their final markets, in spite of the fact that final prices are rising. Higher final prices reflect taxes and the cost of a number of public policies; these include financing out-of-market payments to renewables, co-generation, fuel suppliers, and certain consumer groups. In other words, higher final prices generally finance entry by the majors' competitors, while cross-subsidizing certain consumers. Furthermore, higher final prices encourage auto consumption, energy efficiency, and demand response. All of these distributed energy resources reduce the consumers' reliance on generation from the system, posing serious concerns about recovery of the system's fixed costs, especially where tariffs recover fixed costs through a volumetric component. This explains the concern about a 'death spiral' whereby rising tariffs lead more consumers to reduce their demand for conventional electricity from the system, leading to further rises in tariffs, and so on.

The scissors effect has two types of explanation. The first is that underlying structural changes in the sector – stagnant demand, the rise of renewables, and the growth of decentralized energy resources – are depressing the majors' revenues and raising their costs. The second is that governments have accelerated these trends and, in some cases, are responsible for initiating them. In future, governments may accelerate, shape, or slow these structural trends, but they are unlikely to reverse them. This research paper tests the scissors effect hypothesis by exploring the structural explanations as well as the role of government intervention.

c. The scissors effect and financial difficulty

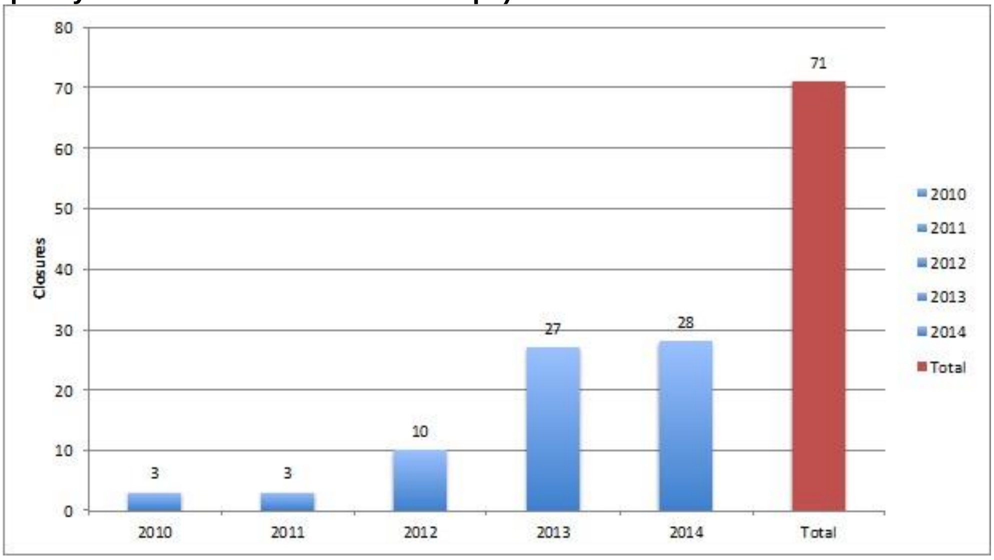
Because there are so many determinants of a given company's results, it is difficult without more information to prove the hypothesis for any one company, let alone for a group of them. However, there is at least one easily quantifiable connection: impairments in generation. In 2013, for instance, over €32 billion were wiped off European utility balance sheets. Of that amount, 66 per cent of the impairments were related to generation assets and reflected downward pressure on margins, especially for conventional power stations.[11] Each of the structural and political explanations for the

11 'Benchmarking European power and utility asset impairments', E&Y, 2014. www.ey.com/GL/en/Industries/Power---Utilities/EY-benchmarking-european-power-and-utility-asset-impairments-infographic.

scissors effect is linked to lower output and prices for conventional power stations, among other consequences.

Figure 4 offers some additional evidence of the link between the scissors effect and the declining share prices of the majors. It shows the acceleration in capacity closures since 2010, with 71 GW having closed since 2010, most in the last two years[12]. This trend seems likely to continue, with one report forecasting additional closures of over 50 GW of coal and gas-fired plants[13] and another predicting significantly more closures than that.[14] Indirectly, through their impact on conventional generation, these structural changes also diminish the European electricity market for coal and natural gas.

Figure 4: Coal and CCGT closures show acceleration over time (vertical axis is the number of GW of capacity that have been closed in Europe)



Source: Author figure based on: Giles Parkinson, 'UBS: closures of coal and gas fired power plants in Europe accelerating', Carbon Tracker, May 4, 2015.

In short, the hypothesis is that there are underlying structural trends reducing the profitability of the electricity majors. However, as already mentioned, the scissors effect is closely related to government intervention. If the scissors effect hypothesis is correct, then it is time to rethink the roles of government and markets, and to design regulations and markets for a decarbonized electricity model, as well as for the transition to the new model. Where markets do have a role to play, it is essential that they work efficiently and be allowed to do so.

2. Stagnant or negative demand growth

One obviously important determinant of electricity company revenue is final electricity demand. The industry's business model and traditional regulatory regimes were designed on the premise that demand would grow. Growth in final demand means that the fixed costs of capital intensive and long-

12 By way of comparison, peak demand in Spain is approximately 40-45 GW.

13 'UBS: closures of coal and gas fired power plants in Europe accelerating', Giles Parkinson, Catch 2030, 4 May 2015.

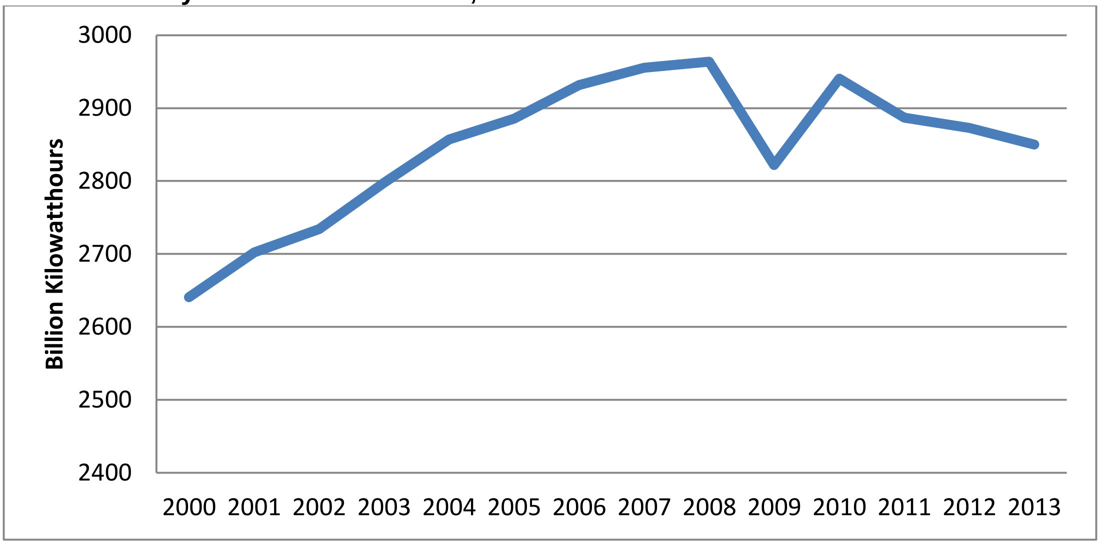
14 Coal: Caught in the EU Utility Death Spiral, Carbon Tracker, June 2015.

lived assets can be recovered from a rising volume of sales, potentially allowing average costs and final prices to fall.[15]

a. Why is demand falling?

After growing steadily until 2008, electricity demand in the EU fell sharply in 2009, as reflected in Figure 5.[16] Demand recovered partially in 2009, but has been falling since then and is now well below the peak of 2008. Eurelectric's forecast demand for 2020 is virtually the same as the 2008 figure. Furthermore, over the years, Eurelectric has been reducing its forecast demand for 2020, which reflects the uncertainty, and indeed the pessimism, surrounding future demand. There are also Eurelectric forecasts for 2020 that are well below the 2008 peak.[17]

Figure 5: Electricity Demand in the EU-27, 2000–13



Source: *Power Statistics and Trends*, Eurelectric, various years.

The average decline in demand masks differences among the EU countries, reflected in Figure 6, which compares a sample of smaller countries with the largest ones.[18] Demand has been growing fastest in the small and less developed economies, but has been flat or falling in the larger and more developed countries, notably Germany, Spain, Italy, the UK, and France. Indeed, Figure 7 understates the extent to which demand has fallen in the larger countries. In Spain, for example, electricity demand in 2014 was below 2005 levels.

15 Traditional rate of return regulatory regimes give utilities an incentive to increase consumer demand because most of the costs are fixed; increasing sales is a way to raise profits between tariff reviews, and also enables regulators to lower the tariffs at the upcoming review.

16 Power Statistics and Trends 2012, Eurelectric, Synopsis.

17 Power Statistics and Trends 2012, Eurelectric. Forecast 2020 demand for EU-27: 2955 TWh (actual demand of 3168 TWh in 2008).

18 Power Statistics and Trends 2013, Eurelectric, page 11.

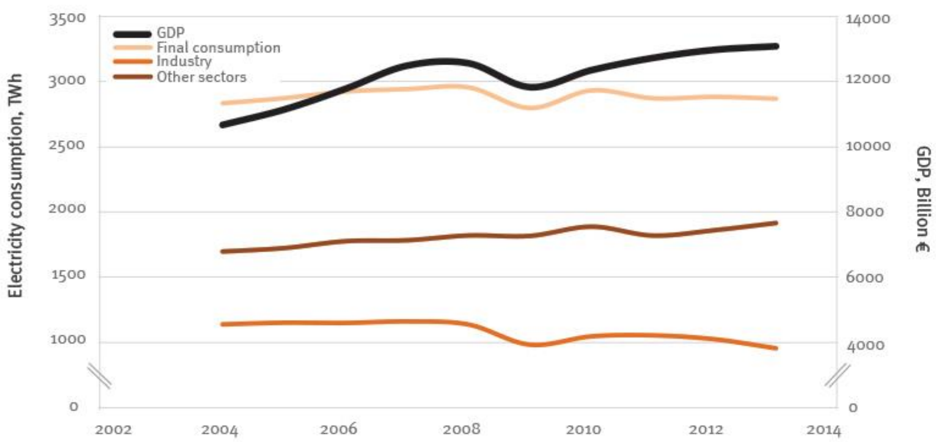
Figure 6: Demand in the EU 27 in a sample of small and large countries

Country	Total Demand in TWh				Year-on-Year		Annual Growth rate
	2010	2011	2012	2020	2011/2010	2012/2011	2020/2010
	Small EU Countries						
Bulgaria	33	34	38	53	5.85%	9.88%	6.22%
Malta	2	2	2	2	4.76%	4.55%	0.43%
Slovenia	12	12	13	16	5.98%	1.85%	2.51%
Slovakia	26	28	29	35	5.94%	2.35%	2.28%
	Large EU Countries						
Germany	569	563	551	507	-0.99%	-2.08%	-1.08%
Spain	280	273	271	340	-2.50%	-0.73%	2.14%
France	513	479	490	508	-6.63%	2.15%	0.38%
UK	380	370	372	346	-2.74%	0.57%	-0.91%
Italy	330	335	328	329	1.27%	-1.91%	0.02%
Total	**3159**	**3096**	**3082**	**3251**	**-2.058%**	**-0.447%**	**0.55%**

Source: Power Statistics and Trends, Eurelectric, 2013.

The experience in the larger EU countries is symptomatic of a structural trend of stagnant or declining demand in the developed countries as the latter become more efficient in their use of energy. Of course the economic crash in 2008 helps to explain the drop in demand in 2009, but there is something more fundamental going on, namely the decoupling of economic growth and electricity consumption. This decoupling effect in the EU is reflected in Figure 7.

Figure 7: EU 28 Electricity Consumption versus GDP



Source: Electric Industry Trends and Figures, Eurelectric, March 2015.

The decoupling of electricity demand and economic growth in the EU and in other developed countries is occurring for a variety of reasons, including the following.[19]

19 'Decentralized Energy: Is it as Imminent or Serious as Claimed?', F. P. Sioshansi, in F.P. Sioshansi (ed.) Distributed Generation and its Implications for the Utility Industry, Academic Press, Oxford 2014, pp. 4–14.

- Structural change in the composition of mature economies, which are moving away from energy-intensive industrial activity and focusing increasingly on services and activities that are less energy-intensive.

- Demand saturation, whereby consumers reach a point where they have consumed as much as they want of particular products. There may be important new uses for electricity, such as electric vehicles and space heating, but at some point demand saturation will limit demand growth.

- Rising retail prices, which encourage energy saving and more efficient use. The reason for rising tariffs differs around the world, but a key explanation in the EU is the increase in taxes and levies collected through electricity retail sales.

- Policies and technologies that involve more efficient use of energy, energy saving, and 'negawatts' (demand reduction equivalent to the megawatts of generation capacity).

For all these reasons, it is reasonable to expect continued stagnant, or even negative, demand growth for electricity in the most developed countries, at least until 2020. The main source of incremental demand that could change this conclusion is the electrification of road transportation.[20] At the end of 2012, 180,000 passenger electric vehicles had been bought worldwide, but they represented only 0.02 per cent of the total passenger car stock. Announced targets are ambitious (over 20 million worldwide by 2020), but actual and expected penetration has been slow in most countries. This reflects a number of market barriers including cost, range, recharging time, re-charging infrastructure, competitive alternatives and risk aversion.[21] Technological innovation and sustained government support (including a regulatory design to support the building of an electrical charging infrastructure) will be required to overcome these barriers, especially if oil prices remain low and if the performance of internal combustion engines continues to improve. This is an area that deserves further study to determine whether, when, where, and how electrification of road transportation will slow or reverse the trend towards stagnating demand for electricity in the EU. Although the impact could eventually be significant it is very uncertain and, in any case, unlikely to be very noticeable in this decade, or potentially even in the next one.

b. Impact of stagnant or declining demand on the scissors effect

Stagnant or declining demand contributes to the scissors effect in four ways: lower average revenues from electricity sales, redistribution of revenues away from the majors, lower margins from peak demand, and the potential for stranded costs.

Lower revenues to the sector: Falling demand reduces total revenues for the sector, for any given set of electricity prices. Obviously total revenue can rise if prices rise by more than demand falls. And indeed final electricity prices have been rising, but mainly due to rising taxes and levies. Higher prices for electricity, like those of most other goods, encourage lower consumption. Eventually, with rising prices, revenues to the sector as a whole will fall.

Redistribution of revenues to new entrants: As final electricity prices rise, the incremental revenue is used to finance out-of-market payments to new entrants. Figure 8 illustrates that taxes, levies, and other charges (the 'government wedge')[22] accounted for close to half of the final price for residential

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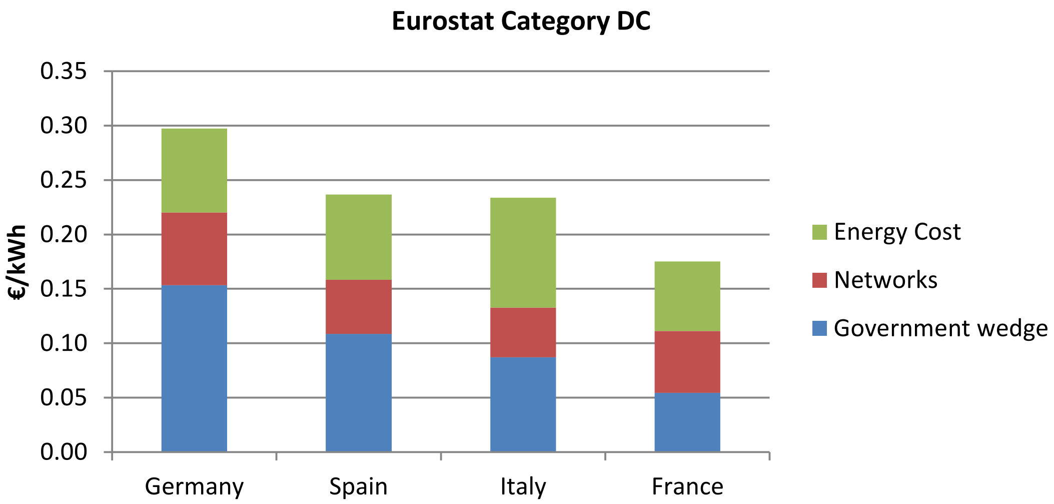
20 'Global EV Outlook: Understanding the Electric Vehicles Landscape to 2020', IEA, Clean Energy Ministerial and Electric Vehicles Initiative, April 2013.

21 'Consumer Acceptance of Electric Vehicles in the US', International Council on Clean Transportation, December 2012. http://www2.epa.gov/sites/production/files/2014-09/documents/kodjak121312.pdf.

22 The government wedge has risen significantly in EU countries, by far more than the cost of networks and energy, as shown in Figure 21 of this report.

consumers in Spain and Germany in the second half of 2014. This wedge finances a range of public policies, especially out-of-market payments to renewable generators. The majors obtain some of this additional income to the extent that they are themselves investing in renewable energy and in other activities receiving out-of-market payments. However, as explained later, most of these payments go to entrants who are now competing with the majors through their investment in renewable generation.

Figure 8: Composition of average final electricity prices (including taxes) for residential consumers in selected EU countries. Second half of 2014



Source: EUROSTAT.

There is also potential for new entrants to buy electricity in wholesale markets for sale to final consumers. For example, they may do so as aggregators that purchase on behalf of large consumers, or as specialized suppliers of green energy, such as Good Energy in the UK. This re-distribution means a smaller share of the pie for the majors that own the baseload conventional generation capacity.[23]

Lower margins from peak demand: To the extent that demand falls at times of system peak, it lowers peak wholesale prices, thereby reducing an important source of infra-marginal rents for investors in conventional baseload generation plants. As explained in Section 5 of this paper, consumers may shift their demand away from peaks in order to avoid paying higher prices. Since infra-marginal rents earned at peak times are critical to the recovery of fixed investment costs for baseload plants, lower peak demand is a serious concern for the majors[24].

Stranded costs: When demand grows less than anticipated, or falls, many fixed costs remain, which means that the unit (per kWh) costs of electricity supply rise. In order to recover these fixed costs, either unit prices have to rise or the owners of the affected ('stranded') assets take a hit. In businesses without regulatory guarantees of cost recovery, investors will normally be expected to take the hit, hence the impairment charges related to thermal generation in the EU. Ernst & Young published a report in 2014 that analysed impairments at 16 major European companies. They identified €32 billion of assets and goodwill impaired in 2013, and a total of €62.7 billion between 2010 and 2013, most of which was related to unprofitable generation assets. (See Figure 9.)

23 It is possible that new entrants will buy stranded assets (CCGT, coal plant). However, this strategy does not have much appeal among investors, precisely because of the issues outlined in this paper.

24 In some US markets, notably in California, rooftop solar PV during peak hours also lowers demand for electricity from the network during the peak. However, this is less true in the EU where solar PV typically does not correspond to peak hours.

Figure 9: Impairment by 16 major power and utility companies, 2010–13[25]

	2013	2012	2011	2010	Total
Impairment of goodwill	€9.6b	€3.9b	€1.8b	€2.4b	€17.7b
Impairment of assets	€22.4b	€8.9b	€7.5b	€6.2b	€45.0b
Total Impairment	€32b	€12.8b	€9.3b	€8.6b	€62.7b

Source: Benchmarking European power and utility asset impairments: Impairments at a high in 2013 as utility sector transforms, EY, 2014, page 5.

Even when regulation ostensibly guarantees cost recovery, for instance for regulated network assets, it may be impossible to recover all the costs. This appears to be the case in Spain, where the government introduced measures to cut revenues to virtually all of the regulated activities, including distribution and transmission networks, in order to stop its 'tariff debt' (which is the accumulated annual tariff deficits) from growing.[26]

To summarize, stagnant or negative electricity demand growth appears to be a structural problem in the most developed economies. This trend has contributed to the scissors effect in the EU's largest economies in different ways. It seems very likely that it will continue to do so, although the electrification of transport and space heating could alleviate the effect and might even reverse it in the longer run.

3. The growth of intermittent renewable power

The expansion of renewable power is now a global phenomenon. The IEA's New Policies Scenario forecasts that generation from all renewable power (including hydro) will triple between 2013 and 2040, replacing coal to become the largest source of generation. The questions addressed here are: what has been driving this growth and could the trend towards renewables be reversed?; and what are the implications for the scissors effect?

a. What drives the growth of renewable power and could the trend be reversed?

The expansion of renewable power in the EU is clearly policy-driven, as it is almost everywhere. The EU has been a leader in the industrial development and installation of intermittent renewable power, especially wind and solar (PV and thermal). EU governments have levied significant funds through electricity tariffs to finance out-of-market payments[27] to the developers of renewable power. EU support for renewable power is driven not only by the goal of lowering CO_2 emissions, but also as a

25 Source: 'Benchmarking European power and utility asset impairments: Impairments at a high in 2013 as utility sector transforms', EY, 2014, page 5. The 16 companies included in the report were: Centrica, CEZ, EDF, Energias de Portugal (EDP), E.ON, Enel, Fortum, Gas Natural, GDF Suez, Iberdrola, RWE, Scottish and Southern, Suez Environnement, Vattenfall, Veolia Environnement, and Verbund.

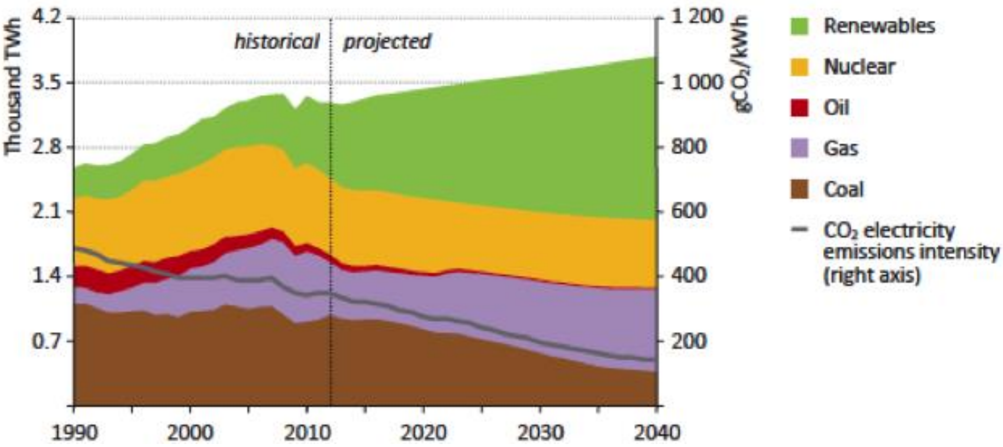
26 The tariff debt refers to the accumulated difference over 15 years between regulatory commitments and regulated (access) tariffs. It is currently over €25 billion. See Section 6.d for further explanation.

27 The term 'out-of-market' refers to payments received outside of wholesale energy markets. These payments are sanctioned by government and may be financed through the tax system or via electricity tariffs.

way of reducing dependence on imported fossil fuels, establishing new industries with global markets, and of achieving an electricity generation mix that reflects the full economic costs of electricity, including environmental and health externalities.

In the past 10 years, 80 per cent of new generation capacity in OECD Europe has been renewable capacity.[28] Although, wind and solar power in 2012 accounted for only 18 per cent of installed capacity and 8 per cent of generation in the EU as a whole, in Spain and Germany they accounted for significantly more than that. Furthermore, most forecasts suggest continued growth. To take one example, the IEA New Policies Scenario (Figure 10) forecasts that wind and solar power will account for 37 per cent of capacity and 26 per cent of generation in the EU in 2040.[29]

Figure 10: European Union electricity generation by source and CO_2 intensity in the New Policies Scenario



Source: *World Energy Outlook 2014*, IEA, page 232.

The rise of renewables is only one part of a policy that aims to reduce the carbon intensity of the economy, as reflected in Figure 10. That policy also involves a significant decline in electricity generated from coal and oil, and an increase in generation from natural gas. Although coal has gained market share at the expense of natural gas over the last few years, this is very likely to be reversed over the coming years, as emission standards tighten and as CO_2 prices increase.

The growth of renewables continues to depend on government policy support. In a number of EU countries, governments have withdrawn or reduced that support. Spain, for instance, replaced its feed-in tariff support (per kWh) for existing and new renewable capacity with a new system of support (per MW), as part of the government's effort to stop the growth of the tariff debt.[30] Other countries, including Germany and Italy, have also been looking for ways to reduce the costs associated with supporting renewables.

Nevertheless, we have probably passed the point where policy decisions or markets could fundamentally reverse the trend towards renewables in the EU in the foreseeable future, although they could certainly slow it down. There used to be an inverse relationship between the price of oil and investment in renewables; this was most evident in the USA when the policy enthusiasm for solar

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28 World Energy Outlook 2014, IEA, page 232.

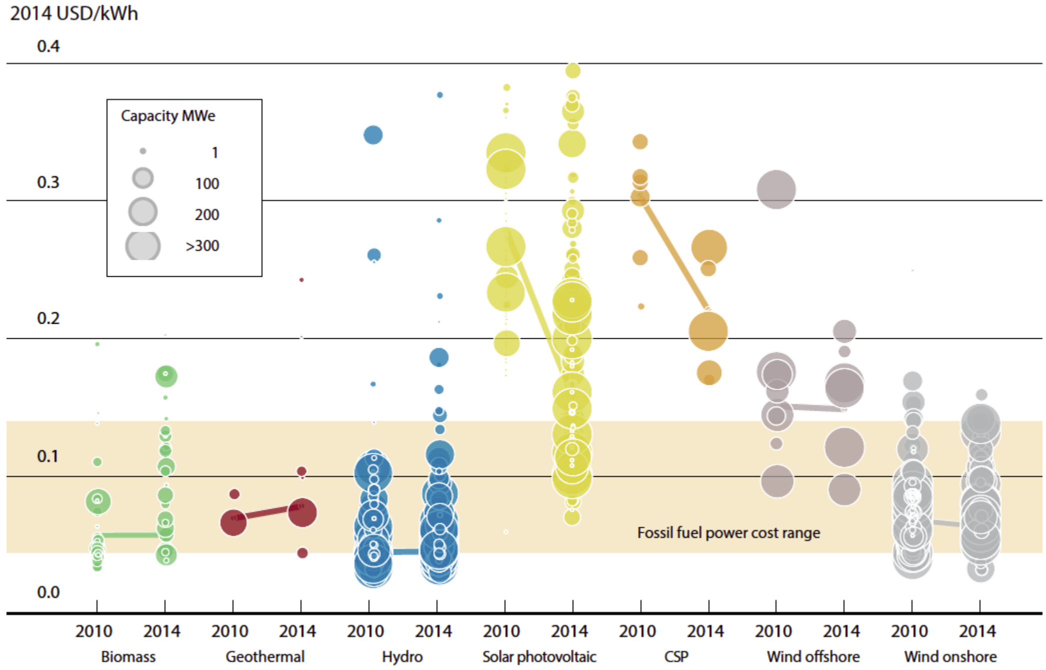
29 Ibid, page 628.

30 'Spain Gets Specific on Cuts to Renewables Energy Subsidies', The Wall Street Journal, 3 February 2014, www.wsj.com/articles/SB10001424052702304851104579361103986679382. Note, however, that the end of the feed-in tariff regime did not mean the end of support for renewables. In some cases, support increased.

energy, following the rise in oil prices in the 1970s, disappeared when oil prices fell in the 1980s. Today, in electricity, if there is an inverse relationship, it is a very weak one in the EU. In part this is because there is now a powerful industrial lobby behind renewables, as well as strong public support, notably in Germany. The fact that renewable power is a central part of the EU's de-carbonization strategy is also significant. But even more significantly, some renewable technologies are now competitive with fossil fuels, while costs are falling very quickly for other renewable generation technologies.

Figure 11 illustrates how the levelized costs of energy (LCOE) for different types of renewable power fell between 2010 and 2014, and how a number of renewable generation technologies are now clearly in the cost range of generation from the burning of fossil fuels, even when the negative externalities (for example CO_2 emissions) of coal and gas are ignored. Where they are available, biomass, geothermal, and hydro generation are already competitive with generation based on fossil fuels. Onshore wind and solar PV have also become competitive with coal and gas-fired generation under certain conditions, at least when measured in terms of LCOE. Solar PV is a particularly striking example of cost reduction. Solar PV module prices in 2014 were 75 per cent lower than in 2009, while the total installed costs of utility-scale PV systems fell by between 29 per cent and 65 per cent between 2010 and 2014, according to IRENA.[31]

Figure 11: LCOE of utility-scale renewable technologies, 2010 and 2014



Source: IRENA, Renewable Power Generation Costs in 2014, January 2015.

LCOE comparisons can be misleading, however, because they do not reflect the economic value of different technologies to the system. In particular, they often ignore the costs of backing up intermittent renewables and of the networks required to integrate them. It is also important to recognize that intermittent renewable power has greater value if it is replacing expensive peaking generators (such as solar PV during afternoon air conditioning peaks) than if it is replacing baseload power in off-peak periods (wind during the night, for example). Most importantly, the economics of renewable power are location and system specific, with the net benefits depending on what costs can

31 Renewable Power Generation Costs in 2014, IRENA, January 2015, page 27.

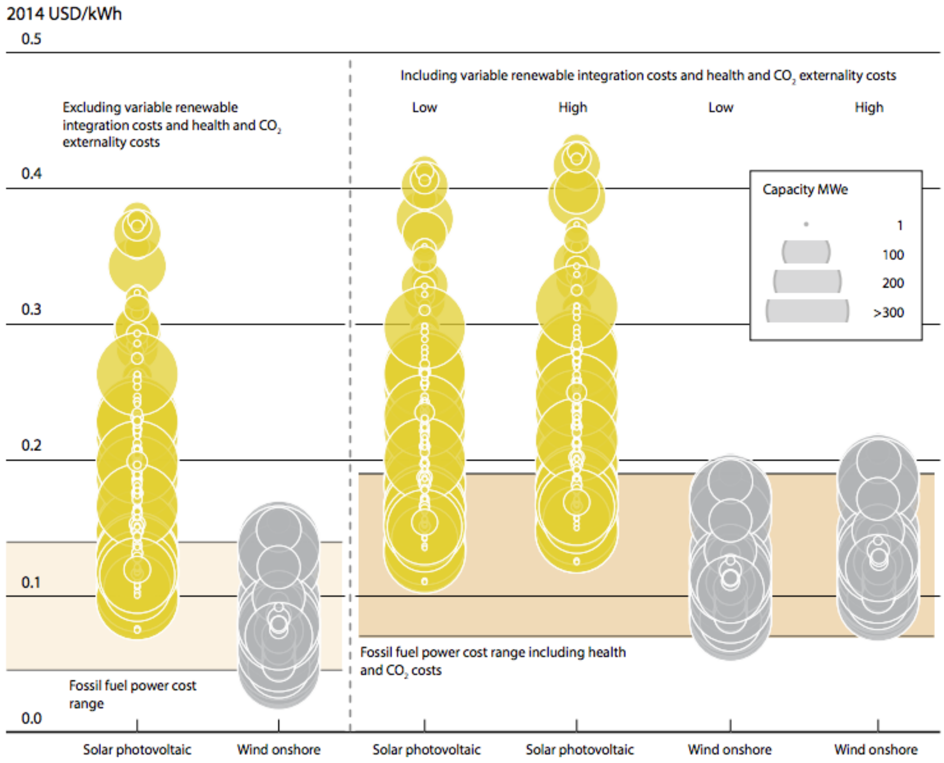
be avoided by the system through the deployment of renewables, and whether these avoided system costs are less or greater than the costs of the renewables themselves.

In spite of these caveats, technological advances are driving down the cost of renewables and allowing for higher penetration. In particular, the development of new storage technologies (for example: utility-scale batteries, flywheels, and aggregation of EV batteries) and demand response will facilitate the integration of rising volumes of intermittent renewables in electricity systems. The absence of electricity storage or flexible demand has been a problem, because very high penetration of intermittent renewables can impose high costs on a system, for instance maintaining fossil fuel-fired plants in a standby mode to cope with very substantial changes in renewable output.

Finally, policy makers are increasingly focusing on internalizing the externalities of burning fossil fuels – in particular those related to the environment and to public health. Measuring and putting a value on these externalities is controversial, but few people would dispute that they are real costs that should be reflected in investment, operation, and consumption decisions. Figure 12 is IRENA's estimate of the costs of wind power and solar PV, taking account of their estimates of externalities and the costs of grid integration.

These technological developments, along with falling costs and the expectation of continued government support, mean that at least renewable power from wind and solar PV will continue to grow for the foreseeable future. Growth will no doubt slow as penetration rises, but the impact on wholesale markets will be increasingly evident.

Figure 12: LCOE of intermittent renewables and fossil fuels, including grid integration costs (at 40% penetration), external health, and CO_2 costs[32]



Source: IRENA, Renewable Power Generation Costs in 2014, January 2015.

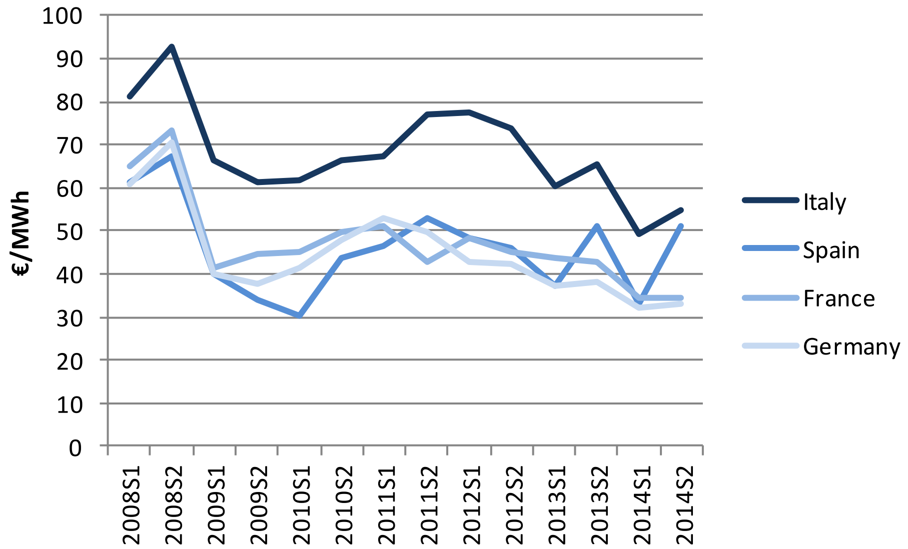
32 The results presented in the figure as relating to external health effects are hard to quantify and open to challenge.

b. Impact of renewables on the scissors effect

The growth of intermittent renewable power contributes to the scissors effect by reducing the majors' revenues and by increasing some of their costs. The penetration of renewables has affected the majors' wholesale revenues and margins in three ways, by bringing about: lower average wholesale electricity prices; lower peak prices; and a reduction in the volume of electricity generated by thermal plants, especially plants burning natural gas. All three effects reduce the infra-marginal rents needed to recover fixed investment costs in conventional power stations. In addition, the high penetration of intermittent renewable power has introduced new system costs, including for networks and ancillary services. Furthermore, out-of-market payments for renewable power plants and co-generation have essentially financed entry into the wholesale market by new players.

Average wholesale electricity price effect: Owners of conventional generation assets earn most of their revenues in wholesale electricity markets.[33] Figure 13 summarizes the changes in key continental European wholesale electricity prices over the period 2008–14. These prices exhibit significant volatility, and differ by region. Nevertheless, average wholesale prices clearly fell after 2008, and since then have not returned to the levels of 2008. The downward trend is especially marked in Germany, where negative wholesale prices are common.

Figure 13: Wholesale market prices in selected EU countries 2008–14



Source: OMIE, EEX.

Determination of the impact of renewable power on the average wholesale price of electricity is not straightforward because many factors are in play, including falling demand, excess capacity, regulatory distortions (for example must-run coal), feed-in tariff design (for example, provisions that encourage negative bids to run in Germany), and transmission constraints. Nevertheless, the econometric evidence suggests that the penetration of intermittent renewable power has depressed

33 Until recently, only Spain and Italy had capacity payments. In both cases, the revenues earned through these payments were a relatively small component of revenue. In addition, companies earn revenues through the sale of ancillary services. Although revenues from ancillary services are growing, they do not compensate for the decline in the main wholesale market revenues.

average wholesale prices, basically because it usually has zero marginal costs and displaces plants that have positive marginal costs.[34]

The lower average wholesale prices hide an important dynamic, whereby wholesale prices flip between zero when renewables are at the margin, and the cost of fossil fuel-fired plant when the latter are at the margin. This dynamic introduces the need for flexible backup plant to reduce production (when renewables begin to generate) and to increase production (when renewables stop generating)[35]. Gas-fired plant is frequently used to provide flexibility, for instance in Spain, but in Germany, coal-fired plants also provide this service. An increasingly important issue for electricity systems is the provision of adequate compensation for this flexibility. However, where fossil fuel-fired plants are primarily kept open to provide flexibility, they run very little, and burn significantly less coal or natural gas than was anticipated when the plants were built. As Section 7 of this report illustrates with a case study, it remains unclear whether new flexible plants will be built without payments that are additional to those earned in the energy market.

Peak price effect: If peak prices fall in wholesale markets, this reduces the ability to recover fixed costs for plants that are compensated solely through the energy market. Indeed, high peak prices have always been the key to profitability for conventional baseload power, including nuclear, coal, and natural gas plants. According to the Fraunhofer Institute for Solar Energy Systems, German peak-hour prices were €14 per MWh above baseload levels in 2008, but in the first six months of 2013, the premium was only €3/MWh.[36] There are many possible explanations for this, including rapid capacity build and stagnant demand. However, the growth of wind and solar energy is certainly one important reason. With virtually zero marginal costs and dispatch priority, solar and wind power will run whenever the weather permits and assuming there are no other transportation or other constraints. If they do generate during periods of peak demand, they depress peak prices.

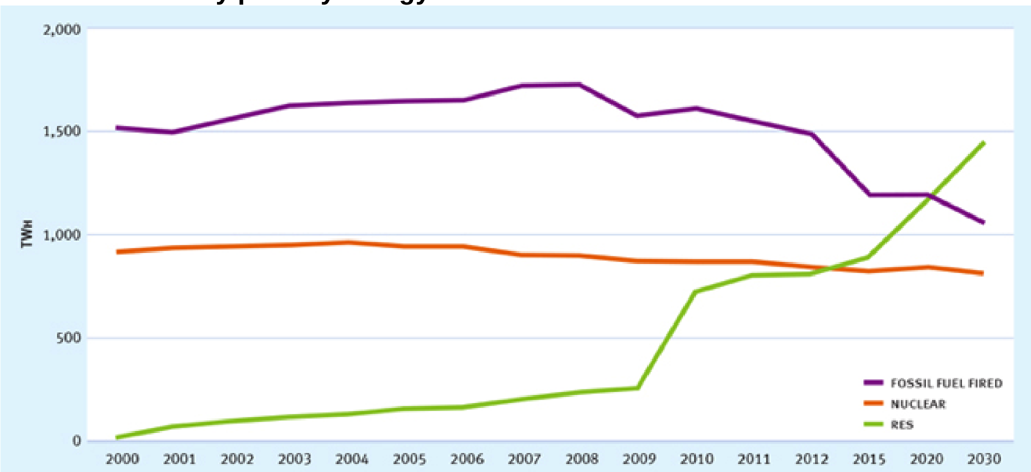
Output effect: For conventional thermal generation plant to recover fixed investment costs, it must run a sufficient number of hours at prices that are greater than marginal operating costs (thereby earning 'infra-marginal rents'). The required number of hours depends on a number of factors, including the fixed investment costs, the marginal operating costs, and the level of market prices. For instance, CCGT plants were financed on the assumption that plants operating around 4,000–5,000 hours a year (46–57 per cent capacity factor) would recover their fixed costs. In practice, CCGT plants have run significantly less than this, partly because coal-based generation has had lower marginal costs, but mainly because renewable generation has replaced thermal generation.

Figure 14 illustrates the general trends in output in the EU, with fossil fuel and nuclear generation falling, while output from renewable generation rises sharply, especially in the period from 2009.

34 Some studies have shown how the decline in wholesale prices resulting from renewable generation may lower wholesale energy costs by more than the value of the out-of-market payments to the renewable generators who caused the decline in wholesale prices. See for instance: 'An ex post analysis of the effect of renewables and co-generation on Spanish electricity prices', (August 2011), www.sciencedirect.com.proxy.uba.uva.nl:2048/science/article/pii/S0140988311001575#. This is, however, much less likely for more expensive forms of renewable generation, such as solar PV, especially when they have limited impact on wholesale prices during peak demand periods.

35 Intraday and balancing markets are the key mechanisms for valuing flexibility provided by generators or demand response.
36 'How to lose half a trillion euros: Europe's electricity providers face an existential threat', The Economist, 12 October 2013.

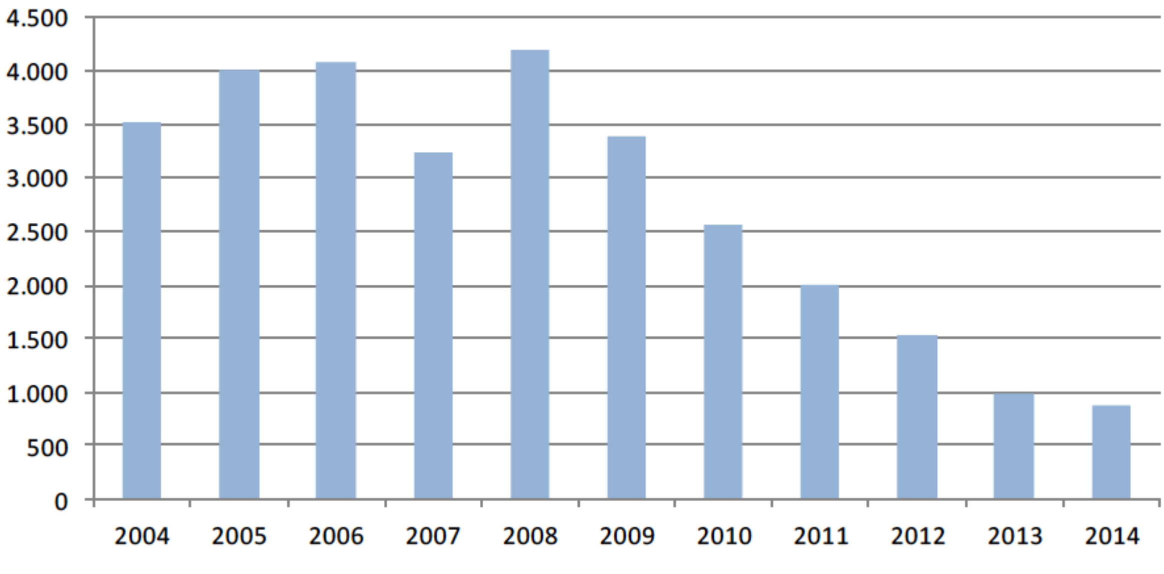
Figure 14: Generation by primary energy - 2030 outlook in the EU 27



Source: *Power Statistics and Trends 2013*, Eurelectric.

The problem of fixed cost recovery has been particularly severe for CCGT in Germany and Spain due to the decline in the number of hours of operation. Figure 15 shows that effective operations of CCGT in Spain fell, on average, from over 4000 hours in 2008 to less than 1000 hours in 2014.

Figure 15: Hours of effective operation of gas fired plants in Spain (left hand axis) 2004-2014.



Source: CNMC

New costs: The growth of intermittent renewable power has introduced a number of incremental costs to the system, apart from the specific out-of-market payments to renewable operators. In particular, large-scale renewable power has implied significant network costs to connect renewable power stations, for instance wind power in remote offshore areas. Distributed renewable generation also requires upgrades to local distribution networks to cope with variations in flows, which in some cases turn distribution companies into net exporters of electricity. This helps to explain why network tariffs in the EU rose by 10 per cent for residential consumers and by 17 per cent for industrial consumers between 2008 and 2012.[37]

Furthermore, intermittency of wind and solar power introduces new system costs, associated with balancing the electricity system, in particular to provide flexible reserves to cope with changing wind and solar conditions. The incremental cost of providing flexibility to cope with intermittency is difficult to identify, but includes the costs of ancillary services such as reserves.

The majors will initially bear some of the additional costs and may be unable to pass all of the costs through to consumers. For instance, the need to run existing plants more flexibly requires more stopping and starting, raising wear and tear and requiring more operation and maintenance. It is unclear whether the majors will be able to recover these costs of running more flexibly.

Entry and competition: The expansion of renewables opened the door to new entrants in the generation business. Competitive entry is important for consumers because it lowers the level of concentration and diminishes market power. On the other hand, it has contributed to the scissors effect by increasing capacity and competition for the majors.

Non-majors have been especially important investors in renewable energy. Some majors, for instance Iberdrola, entered the large-scale renewable energy business early on. Others, especially the four large German energy suppliers, were late to join; they accounted for only 5 per cent of renewable generation capacity in Germany in 2013, whereas private individuals (35 per cent), project firms (14 per cent), industry (14 per cent), banks and investment funds (13 per cent), farmers (11 per cent), and other energy suppliers (7 per cent) accounted for more.[38] Entry into solar energy was particularly easy for financial interests; photovoltaic panels are relatively cheap and tiny and allow thousands of small investors to participate.

Co-generators are another source of competition for the majors. Industrial companies, for instance some companies in Spain, received out-of-market payments (in the form of feed-in tariffs) when they generated. This not only encouraged them to generate their own heat and power, but also to supply electricity to the network even when this involved replacing renewable power on the system.

There are a number of factors – each of which is influenced by government decisions – that could limit the impact of renewables on the majors. One is the introduction of capacity payment mechanisms, which would enable the majors to recoup some of their fixed costs of conventional generation outside the energy market. A second is a higher CO_2 price. This would raise prices at peak, when coal or gas-fired plants are running at the margin, facilitating the recovery of fixed costs for infra-marginal plants, especially gas-fired and nuclear plants. A third is the early closure of conventional power stations, a process currently underway; this would raise average wholesale prices. Fourth, demand growth through electrification of transport, or lower final prices, could help to increase capacity factors. Fifth, lower final electricity prices would slow, or perhaps reverse, the decline in electricity demand. Finally, reforms of wholesale markets are under consideration, including efforts to compensate flexible power stations more for providing ancillary services.

In short, the growth of renewable power has contributed to the scissors effect in a variety of ways, especially by replacing output from thermal plants and by reducing generation margins. Although politics are the original and the main driver behind the growth of renewable energy, the trend appears now to be structural and very unlikely to be reversed. Nevertheless, political decisions continue to be critical to the prospects for renewables and to the latter's impact on conventional power. Even if policies are introduced to limit that impact, it is hard to escape the conclusion that renewable power

37 Power Statistics and Trends 2013, Eurelectric.

38 'Germany's Decentralized Energy Revolution' Christoph Burger and Jens Weinmann, in F.P. Sioshansi (ed.) Distributed Generation and its Implications for the Utility Industry, Academic Press, Oxford 2014, page 56.

will continue to grow and to threaten the profitability of fossil fuel-fired power plants, and to lower the demand for fossil fuels.

4. The growing importance of consumer demand response

Interest is growing in electricity demand response (DR) and in other distributed energy resources (DER) such as autogeneration.[39] This section concentrates on the growing role of demand response and its impact on the scissors effect.

DR refers to changes in a consumer's electricity consumption, normally in response to changes in the price of electricity or to incentive payments. The underlying issue is that electricity is difficult and expensive to store, especially on consumers' premises. Supply and demand generally need to be matched at all times to ensure the stability and safety of the system. The question is how to maintain a balance between supply and demand.

In the past, centralized generation (supply) was used to maintain system balance, and demand was largely taken as given. This was partly because it was easier to control a small number of large power stations than millions of consumers, and because the transaction costs of coordinating generation were much lower. Also, the economics of flexibility favoured generation over demand, because flexibility involved a small additional cost for some generators, whereas for consumers, electricity is a complementary good and the opportunity cost of losing that good (in other words, the value of lost load or VOLL) was considered to be very high. It also reflected the absence of hourly metering for most consumers; if consumers were charged on the basis of a standard demand profile rather than their actual demand, they had no reason to manage their demand in response to changing market conditions. However, the reliance on supply is changing for a variety of reasons.

a. Why is consumer demand response (DR) growing?

DR is becoming an increasingly important energy resource for the system for four main reasons. First, technology is changing on both the supply and demand sides. Large-scale intermittent renewables make the supply side less predictable, while distributed generation sources, such as rooftop solar PV, are changing traditional patterns of supply. Meanwhile, on the demand side, the introduction of smart meters, smart appliances, and distributed generation contributes greater flexibility and control. Significant reductions in the cost of storage on consumer premises (for example using batteries) are also important because consumers will find it easier to reduce consumption when called on to do so. More generally, it seems very likely that costs of storage will continue to fall, making intermittency less of a concern.

Second, as markets liberalize, system operators are more used to the idea that price signals can help to balance the system and that demand-side resources can help to manage the system.

Third, the economics are changing. On the demand side, smart technologies are reducing the costs of coordination and aggregation, and of the remote monitoring and control over use on consumer premises. It is also easier now to identify consumers for whom the VOLL is quite low; they are prime candidates for DR. On the supply side, the costs to generators of being flexible are rising because of the greater frequency with which plants are being called on to stop, start, and ramp up or down.

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39 For a detailed look at distributed generation, see F.P. Sioshansi (ed.) Distributed Generation and its Implications for the Utility Industry, Academic Press, Oxford 2014.

Finally, with the growing emphasis on de-carbonization, governments are encouraging the building of intermittent and non-dispatchable (such as renewable energy) plants, thereby making the supply side increasingly hard to control. They are also emphasizing the value of avoided CO_2 emissions, including encouraging demand reductions that will avoid the building or operation of fossil fuel-fired power stations.

b. The impact of DR on the scissors effect

DR contributes to the scissors effect in at least three ways: consumers make decisions 'behind the meter' that may lower the majors' revenues and raise their costs; the consumer may be in a position to add value to the system, potentially becoming a competitor to the majors; and DR facilitates entry downstream in the retail and aggregation businesses.

Decisions on the consumer side of the meter can lower the majors' revenues and/or raise their costs: Large consumers and, increasingly, smaller ones are able to produce their own electricity, manage how much electricity they consume at different times of the day, and in some cases build net zero-energy buildings or micro-grids. All of these decisions reduce the revenues of the majors. For instance, shifting demand from peak to off-peak reduces both peak prices and the infra-marginal rents required to recover the fixed costs of conventional generation. Furthermore, reducing demand at peak, autogeneration, local storage, and micro-grids may all reduce the need for parts of the transmission network (although they may also increase the need for more sophisticated distribution networks).

DR also introduces incremental costs, some of which are borne by the majors and may not be fully recoverable. For instance, the incremental costs of smart grids and smart metering in the EU are substantial. UBS estimated that the cost of smart distribution grids (including smart meters) will range from €500–€1300 per customer, depending on the equipment utilized and how intelligent the grid will be. Overall, they estimate capital expenditure of between €168 and €430 billion.[40] Although some analysts think the economic benefits will easily outweigh the costs, I question that assessment, which depends critically on how effectively consumers respond to price signals.[41] Investors want to ensure that the regulatory conditions enable cost recovery, but in some countries, like Spain, regulatory risk is high; this is reflected in a higher cost of capital or by choosing not to invest.

DR also contributes to the stranding of existing assets, both regulated networks and competitive generation. It is clear that most of the majors in the EU have written down significantly the value of conventional generation assets. In Section 6.d, I explain why the majors in Spain have had to accept lower revenues even for their regulated businesses.

The active consumer may add value to the system and become a competitor for the majors: The consumer is now a source of competition for the majors in the provision of energy resources to the system. DR offers alternatives to (among other resources): new generation capacity over the long term, incremental energy in spot markets, and short-term flexibility in balancing and ancillary services markets. These demand-side alternatives reduce revenues for the majors in two ways. Through competition, they lower prices for capacity, energy, balancing, and ancillary services. To the extent that they also displace conventional generation, they also lower revenues earned by the majors.

40 'European Utilities: Expect a smart grid boom', UBS, 22 April 2014.

41 This will depend in large part on whether demand response is sufficient to reduce system costs (e.g. avoided generation and network costs to meet the peak) by more than the costs of the smart systems. See 'Unlocking the €53 Billion Savings from Smart Meters in the EU: how increasing the adoption of dynamic tariffs could make or break the EU's smart grid investment', Ahmad Faruqui, Dan Harris, and Ryan Hledik of The Brattle Group, October 2010.

It is not easy to measure the effect of this competition in the EU since it is relatively new. However, two data points serve to illustrate the magnitude. In the PJM market, consumers received approximately $750 million for demand response services in 2014, almost entirely in the capacity market. Another study, this one by Ofgem (Figure 16), estimated annual avoided generation capacity costs of approximately £265m to £536m for a 10 per cent shift of the peak.

Figure 16: Avoided generation capacity and network costs in the UK

	Shift 10% peak load (between 4.6 and 5.6 GW)	Shift 5% peak load (Between 2.2 and 2.8 GW)
Annual Capacity of Cost Savings	£265m to £536m	£129m to £261m
Annual Network Investment Savings	£28m	£14m

Source: adapted from Ofgem (2010), Demand Side Response, Table 2-1, available from:
< https://www.ofgem.gov.uk/ofgem-publications/57026/dsr-150710.pdf>.

Facilitating entry downstream reduces the majors' revenues and margins; The conventional retail electricity market has been heavily concentrated, especially for smaller consumers. In Spain, for instance, retail companies associated with the incumbent utility (currently the local distribution wires company) frequently have local market shares in excess of 80 per cent for residential consumers. As consumers learn more about how competitive markets work, they become more demanding of their retail suppliers, whether related to the incumbent or not. This stimulates greater competition among the established companies, and also creates opportunities for new entrants, for instance through 'collective purchasing' auctions organized by consumer organizations (such as OCU in Spain) and private enterprises. In these auctions, entrants compete with established retailers for tens or hundreds of thousands of consumers at a time, thereby lowering the entry cost per consumer[42].

The aim of entrants downstream is, or should be, not just to earn retail margins on commodity energy sales, but to participate in a growing market for new consumer services, including the provision of advice, working as contractors for consumers who make investments themselves, jointly investing with consumers, acting as aggregators working on behalf of multiple consumers, and building micro-grids. Initially, entrants competed with the majors in the market for selling services to the largest consumers. Over time, as smart systems drive down the costs of distributed energy resources, it is likely that competing suppliers will target smaller consumers too.

What might slow this process? Probably the most important factor has to do with the flattening of the load curve. Partly as a result of DR, but also due to the growth of solar PV and storage, we can expect to see a reduction in the differential between peak and off-peak prices, as witnessed in Germany. This will reduce the potential benefits of DR. Nevertheless, even a flat demand curve may not reduce the need for demand response because of supply side fluctuations. Furthermore, demand response will become more important in providing the flexibility required to cope with growing penetration of intermittent renewable power.

In short, the trend towards greater demand-side participation in markets is structural and unlikely to reverse, largely because it relies on technological innovations that facilitate DR and because DR is potentially a valuable energy resource. DR contributes in different ways to the scissors effect, in particular by reducing wholesale and retail revenues for the majors, as well as by raising costs that the majors may not be able to fully recover. It also creates new sources of value for the customer and

42 Some people I know in the electric industry argue that experience with collective purchasing has been quite bad, but my personal experience with it as a consumer has been favourable. In any case, I consider retail competition for commodity electricity to be far less important than competition that helps consumers to be smarter in the way they consume, produce, store and sell electricity.

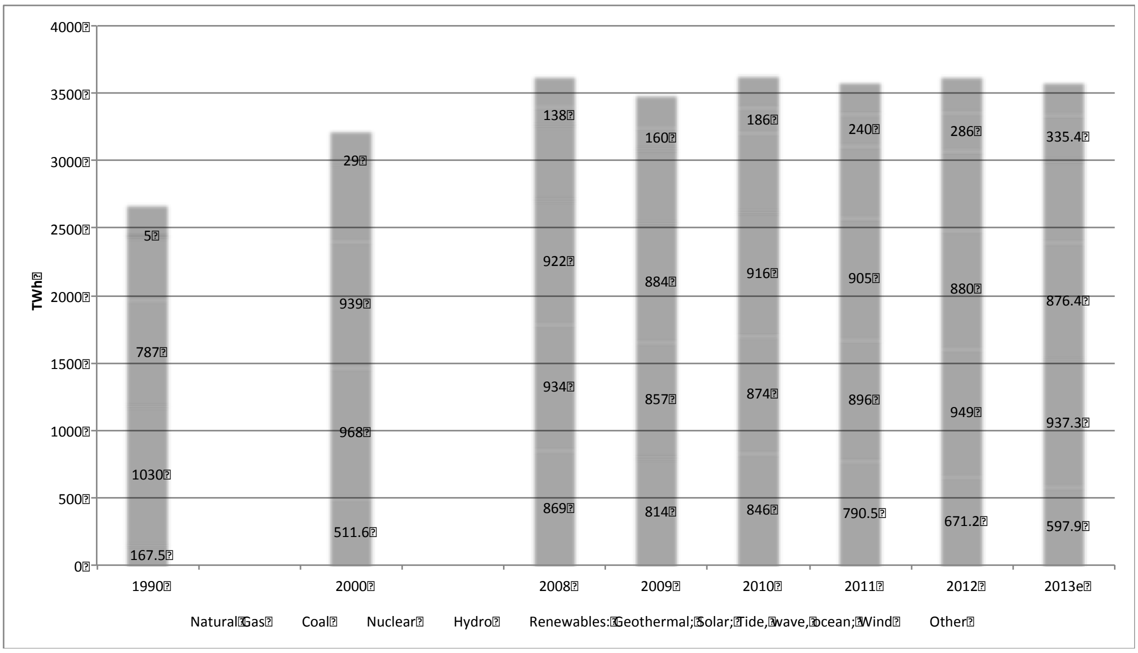
for the system, turning consumers into competitors. Sharing these savings with consumers is potentially a new business for the majors and for their competitors.

5. Impact of the scissors effect on markets for natural gas and coal[43]

The combined effect of demand stagnation, increasing penetration of renewable power, and DR services has been a reduction in the output and margins for thermal plant and, indirectly, a reduction in the electricity market for fossil fuels. Although it may be possible to slow this trend and dampen its impact on specific fossil fuels (for example, to favour natural gas over coal), the trend appears to be structural.

Between 2008 and 2013 (estimated figure), generation from renewables more than doubled while generation from coal and natural gas fell 14 per cent (see Figure 17). Within the market for generation from fossil fuels, natural gas lost share to coal. The explanation for this includes relatively high and rising natural gas prices, low prices for CO_2 emissions, as well as low and falling prices of coal. Natural gas prices in Europe have subsequently fallen due to ample supply of Russian gas and LNG, low demand for natural gas, and the decline in oil prices (often the basis for indexing prices of natural gas). But coal prices are also falling. Consequently, natural gas has not yet won back market share from coal, except in the UK, due to the existence of a CO_2 tax floor, which favours natural gas over coal.

Figure 17: Electricity Production - OECD Europe from 1990 to 2013e (estimate)



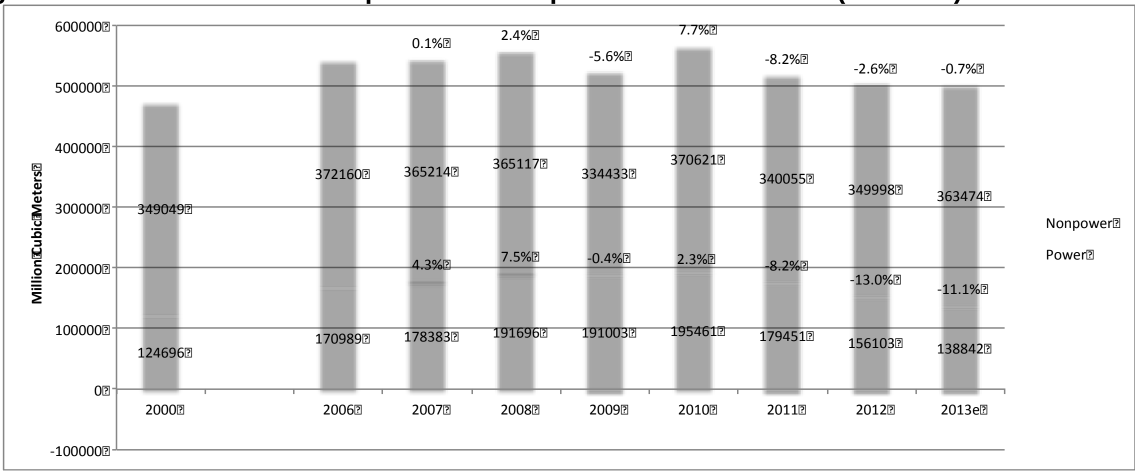
Source: IEA Statistics: Electricity information 2010 and 2014

Due to lower output and lower margins, many gas-fired plants have shut. Those that remain open are running at very low capacity factors. Consequently, as Figure 18 illustrates, European demand for

43 For an analysis of the development of natural gas and LNG markets, see Howard Rogers, 'The Impact of Lower Gas and Oil Prices on Global Gas and LNG Markets', OIES, 10 July 2015. www.oxfordenergy.org/2015/07/the-impact-of-lower-gas-and-oil-prices-on-global-gas-and-lng-markets-3/.

natural gas in the power sector has fallen sharply. From 2008 to 2013 (estimated figures) gross consumption of natural gas fell by 54.5 bcm, while consumption in the power sector fell by 52.9 bcm, about 97 per cent of the total decline in European gas consumption.

Figure 18: Natural Gas Consumption IEA Europe from 2000 to 2013e (estimate)



Source: IEA Statistics: Natural Gas Information 2010 and 2014

Although coal-based generation managed to take market share away from gas between 2008 and 2013, sales of coal to the EU power sector were down by approximately 4 per cent over the period. Furthermore, the prospects for coal plant are poor. Between new coal plants and closure of existing ones, the net closure of coal-fired power stations is reported to have been 19 GW since 2000. The number of plants that are likely to shut increases along with the prospect of rising CO_2 prices, growing public and investor opposition to coal-fired generation, and with EU Directives (discussed in the next section) requiring closure of plants that do not meet increasingly strict NOx and SO_2 emission performance standards. A recent analysis also concludes that new coal-fired power stations are unlikely to recover their fixed investment costs.[44]

The majors have stressed that the closure of many coal and gas-fired powered stations could threaten security of supply. They have proposed capacity payments of various kinds in order to justify keeping these plants open, or building new ones. However, even if they are introduced, it is very unlikely that these capacity payments will increase the demand for coal or natural gas. Rather, they may slow the decline, especially for domestically produced coal, and enable a number of plants to be available to provide backup capacity for intermittent renewables.

In summary, although the long-term prospects for natural gas appear to be better than those for coal, both of these fuels face serious difficulties in trying to return to previous peak levels of demand in the European electricity market.

6. Government Intervention

Government involvement in the electricity sector is inevitable, but there will always be a debate about the respective roles of markets and government. There are sound economic arguments for government intervention in the electricity sector, mainly to correct market failures. Examples of such

44 Coal: Caught in the EU Utility Death Spiral, Carbon Tracker, June 2015. www.carbontracker.org/wp-content/uploads/2015/05/CTI-EU-Utilities-Report-v3-050615.pdf.

interventions include regulation of natural monopolies (for example transmission and distribution networks), requiring polluters to pay for the costs they impose on society (such as for the 'negative externalities' associated with CO_2 emissions), introducing and policing markets to encourage effective competition where economic conditions permit (for example in wholesale and retail markets for electricity, and markets for CO_2 emission allowances), and protecting vulnerable consumers. There is also an economic argument for governments supporting infant industries along with Research, Development and Demonstration (RD&D).

While recognizing the potential benefits of intervention, this section examines ways in which government intervention has contributed to the scissors effect. In particular, it concentrates on five forms of intervention that started, or at least accelerated, the structural trends mentioned earlier: the poor signals offered by the European Union's carbon emission trading scheme; the out-of-market payments promoting renewable power that contributed to making the wholesale market unsustainable; emissions standards; increased taxes and other levies collected from consumers that have encouraged demand reduction and lowered wholesale margins; and inefficient tariff designs that have reduced demand for electricity and encouraged autogeneration. I am not arguing that the policy objectives were mistaken, although some certainly were. Rather, I explain how the intervention has contributed to the scissors effect.

a. Climate change and the EU ETS

The original competitive wholesale (energy-only) market model is, in principle, compatible with the de-carbonization of electricity. That was one of the reasons for making the European Union Emission Trading Scheme (EU ETS) the central feature of the EU's policy for addressing climate change. The idea was that EU ETS would provide short and long-term CO_2 emission price signals. Each tonne of CO_2 from a power station and from other large stationary sources would require one emission allowance. The price of CO_2 emission allowances would be treated as a marginal cost of generating electricity, favouring supply sources with lower carbon content (such as renewables, nuclear, and natural gas-fired plant) and penalizing those with higher carbon content (for example burning oil and coal). In the short term, lower-carbon generation would replace coal in merit order operations. In the longer term, the extra cost of CO_2 would raise expected electricity prices, when fossil fuels were at the margin, and motivate innovation and investment in lower-carbon energy resources. In principle, apart from ensuring that the EU ETS worked properly and sent adequate price signals, no other intervention would be required to encourage decarbonization of the electricity sector.

However sensible this idea is in theory, in practice the mechanism has not been effective, at least not so far. This is for at least three reasons. The first is that governments did not wish to wait for the mechanism to work or to set CO_2 prices at levels that would deliver the de-carbonization they sought. Consequently, they introduced parallel mechanisms that effectively undermined the EU ETS market. By introducing mandatory targets for renewable energy and policies to encourage energy efficiency, the EU reduced the demand for electricity and the production of electricity from fossil fuels. This in turn reduced the demand for emission allowances, thereby lowering the price of those allowances and the wholesale price of electricity. By lowering actual and expected allowance prices, EU policies discouraged innovation and investment in technologies that were not receiving government support outside the energy market. Second, by allocating too many permits, the EU created an excess supply of them, which contributed to lower prices both for CO_2 allowances and for electricity. Third, the mechanism was not designed to deal with an economic recession. When this occurred in 2008, demand for energy and for emission allowances fell further, contributing to lower prices for emission allowances and electricity.

As a result, the price of EU emission allowances (EUA) collapsed, falling from almost €30/t CO_2 in 2008 to well below €10/tCO_2 since 2012. These lower EUA prices were instrumental in lowering wholesale electricity prices in recent years. In the short run, this contributed to an increase in coal-based generation at the expense of gas-based generation and, generally, to lower margins for natural gas-fired plants and other low-carbon generation operating in the market. In the longer term there is little, if any, confidence that future emission allowance prices will be high enough, or stable enough, to drive low-carbon investment, which means that the latter will continue to depend on government decisions and out-of-market payments.

The European Commission is taking action to correct some of these problems, in particular with the introduction of a market stability reserve. The reserve would address the surplus in allowances to be auctioned and also improve the system's response to shocks.[45] However, it is far from clear that this will provide the long-term signals that investors seek in order to justify investments in low-carbon technologies.

While I welcome a better EU ETS structure, the problem remains: unless investors in low-carbon generation technologies have a reasonable expectation of recovering their fixed costs through the electricity market, the only technologies that will be developed are those that will receive government-sponsored payments that occur outside the market.

b. Out-of-market payments

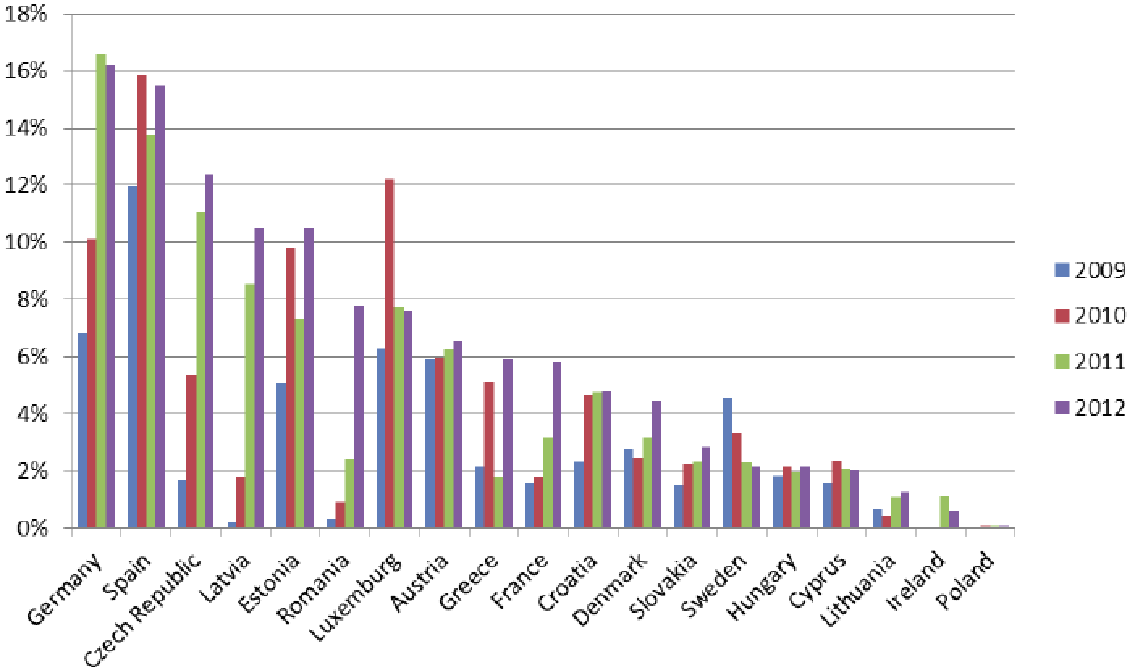
To meet its targets with respect to CO_2 emission reduction, lower dependence on imported fossil fuels and to promote the development of a new industry, the EU adopted Directives that required a significant increase in renewable power. The means of doing this has been through 'out-of-market' payments – payments that are supplementary to the revenues earned in wholesale energy markets. As explained earlier, these measures have contributed to temporary overcapacity in many EU wholesale markets, a decline in the average price in wholesale markets, and to what appears to be a structural gap between wholesale energy prices and the cost of incremental capacity. Essentially what has happened is that wholesale energy prices no longer provide adequate signals for investment. Governments determine what will be built through their choice of the technologies and specific projects that will receive out-of-market payments. Essentially, the wholesale market continues to drive short-term dispatch, but not investment.

Each country has adopted its own policies for promoting renewable generation and co-generation through out-of-market payments. The most common payment schemes are feed-in tariffs for each kWh sold to the system, or obligations to buy renewable energy (that receives extra income outside the energy market). In some countries, this strategy overshot the targets because the payments and other terms were more generous than they needed to be. In Spain, for instance, where feed-in tariffs for solar PV were very attractive, the government did not introduce a cap on the amount of capacity that could receive the tariff, and it underestimated the speed with which this capacity could be built. Consequently, solar PV capacity grew by seven times more than was planned (to 3500 MW compared to the plan of 500 MW) and has contributed significantly to the Spanish tariff debt, which is discussed below. But Spain is not alone; throughout the EU, the cost of supporting renewable power has been significant.

European countries have dedicated significant resources to supporting the development of renewable energy, through payments that supplement what the latter would receive in the wholesale market. Figure 19 shows that most EU countries support renewable energy with out-of-market payments and that this support increased over the period 2009–12. These payments accounted for more than 15 per cent of final residential tariffs in Germany and Spain in 2012; tariff levels and the share of tariffs that finances renewables in these countries have increased since then. These support payments have been the largest component of the 'government wedge' in Germany and Spain.

45 'Structural reform of the European carbon market', Climate Action, European Commission, May 2015.

Figure 19: Evolution of the Share of RES-E levies in the electricity price for households in selected EU countries (2009–12)



Source: 'Energy prices and costs report', EC Commission Staff Working Document 2014.

The speed with which intermittent renewables and co-generation entered the energy markets in the EU led to the different effects discussed earlier in the paper: lower average wholesale electricity prices, lower electricity peak prices, lower output from fossil fuel-fired plants, and also higher costs for the majors to integrate intermittent generation.

The growth of renewable power and co-generation financed through out-of-market payments explains a growing and structural gap between falling average prices in wholesale energy markets and the cost of conventional capacity that is required to maintain system security. Even if CO_2 prices were to rise, this gap makes the current wholesale energy market an unsustainable basis for financing new investment in conventional plant and in renewable generation. This is not simply a problem of excess capacity driving down prices, which will be resolved when the excess disappears. This is a structural problem because prices in energy-only markets are very unlikely on their own to remunerate the fixed costs of power stations. By way of illustration, when renewables are operating, they often drive prices to zero; and when they do not run, prices rise to the cost of the fossil fuel at the margin. In this case, renewable generation will never recover its fixed costs without some additional payments because it runs most when energy market prices are low or zero.

As long as this structural gap exists, investment in new capacity will not occur if it relies only on *existing* energy markets, even if CO_2 prices rise substantially. This means that the required investment in conventional plant may well not occur without changes in market design – for instance, the emergence of new markets to provide remuneration for providing firm energy. It also means that the current market structure does not provide a basis for remunerating low-carbon generation sources, except through out-of-market compensation. Deciding what technologies to finance, and discouraging investment in technologies that they choose not to favour, places a heavy burden on governments. It also means that there is no 'exit plan' from a regime of out-of-market payments. In short, the wholesale energy-only market is not sustainable if the aim is for it to remunerate generation investment costs.

c. Emission standards for power stations

While prices and revenues were falling in wholesale markets, governments introduced new regulations to reduce emissions from conventional power stations, especially coal-fired ones. The Large Combustion Plant Directive (LCPD)[46] and the Industrial Emissions Directive (IED)[47] imply either: early closure of coal-based generation plant or significant investment to keep them open. Plants that do not meet the requirements for the LCPD will close this year, if they have not already done so. The IED, however, could have an even more important impact. In Germany and Poland, a significant share of coal-based generation already meets the required IED standards, because new plant was built for an even more stringent standard. However, in a number of countries, including the UK and Spain, major new investments will be required for plants to meet the IED. In the absence of capacity payments or other out-of-market compensation, it is quite likely that many of these coal plants will be retired. In Spain, for instance, the electricity companies may close over 5 GW of coal plant.

d. The government wedge

In a recent report[48] I compared final electricity prices in EU countries and argued that an important reason for different price levels and trends was the national 'government wedge' (that is to say the taxes, levies, and other charges that are included in final electricity prices to finance public policies). This wedge is the difference between the final price of electricity and the cost of supplying electricity, where the latter includes the competitive price of energy plus the regulated cost of providing network services. Figure 20 summarizes the components of final electricity prices.

Figure 20: The components of final electricity prices

The growth in the government wedge is the main reason for the rise in retail electricity prices that has been seen in most EU countries since 2008. As Figure 22 illustrates, between 2008 and 2012, the

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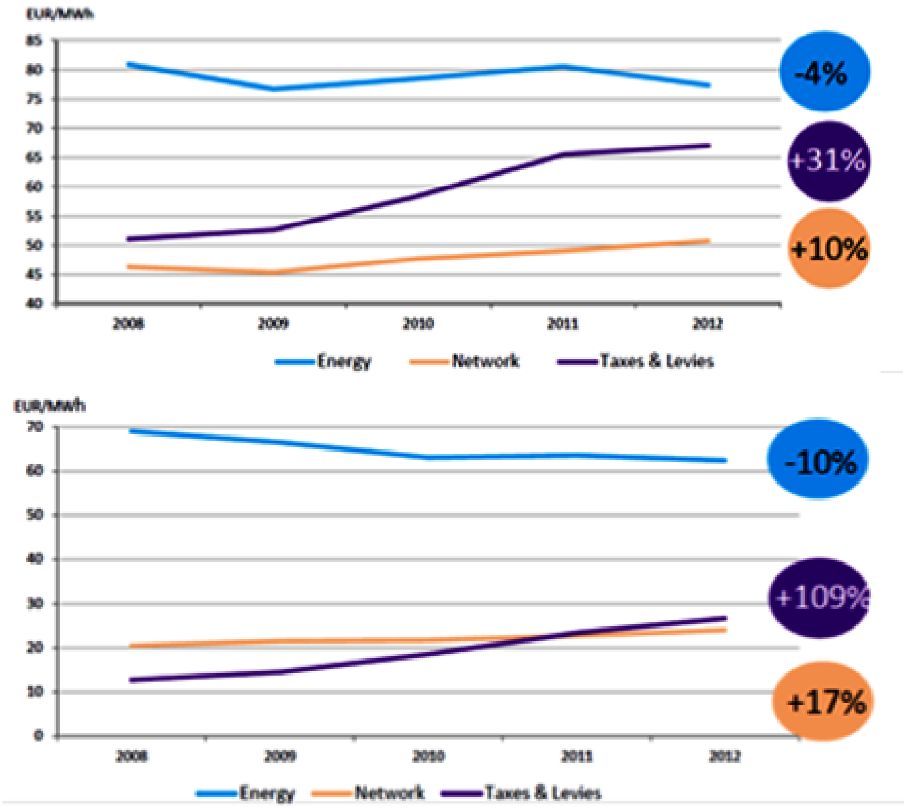
46 The LCPD, (2001/80/EC) is a European Union directive which requires member states to limit flue gas emissions from combustion plant having thermal capacity of 50 MW or greater. It specifies emission limits for sulphur dioxide, nitrogen oxides and dust.

47 The IED (2010/75/EU) commits European Union member states to control and reduce the impact of industrial emissions on the environment. The most stringent impacts of the IED are the setting of a new limit for the emissions of carbon monoxide (CO) and a more stringent limit for the emissions of oxides of nitrogen (NOx) for large combustion plant.

48 'Análisis comparativo de los precios eléctricos en la Unión Europea: una perspectiva española', Eurocofín, 28 April 2014: www.eurocofin.es/Informe_David_Robinson.pdf.

average government wedge (taxes and levies) grew substantially more than the average cost of networks, while the average cost of energy fell. Furthermore, the average government wedge is larger, and has grown more in absolute terms, for residential consumers (from €50 to €65/MWh) than for industrial consumers (from €12 to €25/MWh). However, the wedge has grown more in percentage terms for industrial consumers (109 per cent) than for residential consumers (31 per cent) because it started from a lower base.

Figure 21: Evolution of the components of electricity prices for residential consumers (top) and industrial consumers (bottom) in the EU: 2008–12

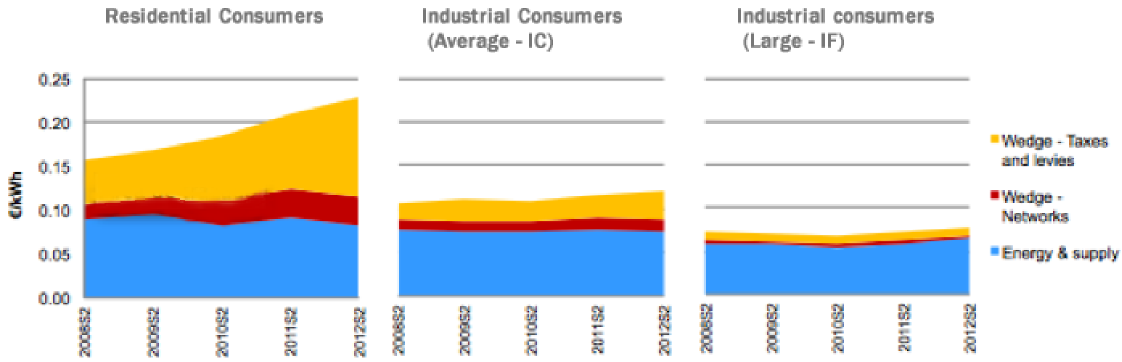


Source: Power Statistics and Trends 2013, Eurelectric.

Understanding what the government wedge finances and who pays for it, helps to understand the scissors effect. First, the wedge finances the out-of-market payments to renewable power and co-generation (with the consequences already noted), as well as other public policies. The latter vary from one country to another, but include support for domestic coal, nuclear power, consumer groups, regional development, industrial activities, interest on the tariff debt, and the central government budget, among other objectives. It is important to note that the wedge is not transparent, since prices are reported in different ways and most of the time the levies are not transparently reported as such, but included in network or energy charges. Second, the wedge raises prices and thereby supports the trends towards demand reduction, demand response and autogeneration. Third, by raising prices to unsustainable levels, the wedge increases the risk of policy reversals that may imply new taxes or stranded costs for the majors. Having already examined the impact of renewable power, let me focus on the other two effects.

Lower demand and more demand response: Financing public policies of various kinds through the government wedge means that certain groups of electricity consumers pay higher prices to meet broad national or EU-wide objectives. For example, Figure 22 illustrates that residential consumers in Spain have borne the brunt of the rising government wedge.

Figure 22: Evolution of average prices and their components in Spain, 2008–13



Source: Eurostat & Regulatory Reports CNE.

Higher prices have provoked consumer dissatisfaction as well as consumer decisions that contribute to the scissors effect. These include: more active energy conservation, shifting consumption to lower-priced periods, reducing contracted capacity, demanding more of competing retailers, and generating one's own electricity, frequently from renewable sources. A specific example of this reaction is the increasingly widespread practice in Spain of reducing the level of contracted capacity in reaction to the government's rebalancing of tariffs in favour of a higher fixed component (linked to contracted kW capacity) and a lower variable one (related to kWh consumption).

Policy reversals: By pushing up final electricity prices, governments have also created the conditions that can lead to policy reversals, legal uncertainty, and efforts to reduce regulated payments to the majors and to other companies in the sector.

Spain offers the perfect example of how this can happen. There, the government guaranteed a 'tariff debt' that has been securitized and is now traded in international financial markets. This debt reflects the accumulated annual difference between the recognized costs of the system (in other words, the costs that the government recognizes as being regulatory entitlements, for instance to transmission and distribution companies, renewable generators, co-generators, and others) and the revenues that are collected through regulated access tariffs. The debt grew for almost 15 years, especially after 2008, because governments were unwilling to raise tariffs to cover the full cost of the regulatory entitlements. The tariff debt is now over €25 billion. The interest earned on these securities has become a major item in the government wedge. In 2012, for instance, the cost of servicing the tariff debt was €2.3 billion, roughly 5 per cent of the final residential consumer price before taxes.

The political decision in 2012 to stop the tariff debt from growing further, while limiting tariff increases, led to a number of new taxes on electricity generation, as well as cuts in remuneration to the owners of renewable generation, co-generation, transmission and distribution assets, and conventional generation. For instance, from January 2013, the Spanish Government introduced measures to reduce payments for regulated activities by €10 billion annually.[49] Among other measures was a 7 per cent tax on electricity generation revenue from all sources.[50] This tax is levied on revenues from the sale of electricity in wholesale spot markets and in bilateral contracts, as well as from capacity

49 'Reforma del Sistema Eléctrico: Una Reforma Necesaria', Ministerio de Industria, Energía y Turismo, slide presentation, 12 July 2013.

50 'Impuesto sobre el Valor de la Producción de Energía Eléctrica', ('Tax on the value of production of electric power'), Agencia Tributaria, www.agenciatributaria.es/AEAT.internet/Inicio_es_ES/Aduanas_e_Impuestos_Especiales/Impuestos_Especiales/Impuesto_sobre_el_Valor_de_la_Produccion_de_Energia_Electrica/Impuesto_sobre_el_Valor_de_la_Produccion_de_Energia_Electrica.shtml

payments and the sale of ancillary services. In addition, in 2013, the government cut regulatory revenues to the major Spanish electricity companies for their conventional activities, while reducing regulated revenues to renewable generators and co-generators.[51]

Most countries with large government wedges, including Germany, Portugal, and Italy, have recognized that continued growth of these wedges is unsustainable. In many cases, governments are considering how to reduce the out-of-market payments, or at least how to slow the growth of these payments. Although these decisions may not hurt the majors in some countries, the Spanish example suggests that all industry participants can expect to bear some of the pain when governments decide that final prices have reached unacceptably high levels. It is also a reminder that support for renewable power could well fall.

e. Volumetric tariff designs

The design of regulated tariffs can encourage consumer behaviour that contributes to the structural trends described in this paper and to the scissors effect. Tariff design is a complex and controversial issue. One topic, however, is particularly relevant to this paper, namely the relationship between the tariff design and the cost structure, in particular the fixed costs of the system (for example, relating to network assets) and the short-term variable costs (such as the incremental cost of generating energy from existing assets). If tariffs do not reflect the structure of fixed and variable costs, consumer decisions may be inefficient, raising the costs of the system and redistributing the burden from one group of consumers to another. This may also undermine the ability of electricity companies to recover their fixed costs.

The general principle behind efficient tariff design is that tariffs should reflect the incremental costs for the system associated with a consumer's decision. This is easiest to illustrate for peak and off-peak pricing. When a consumer buys an extra kWh of electricity, or reduces consumption by the same amount, the price paid should reflect the incremental cost or saving for the system resulting from the consumer's behaviour. In this way, high prices in the wholesale energy market during peak periods are reflected in the consumer's tariff through a higher variable (kWh) charge at the peak, discouraging consumption at peak times. This in turn lowers the energy bill for the consumer. Likewise, when prices in the wholesale energy market are lower during off-peak periods, tariffs should reflect this, encouraging a shift of consumption to off-peak periods. In this way, consumers have an economic incentive to reduce consumption during peak periods and to shift their consumption to off-peak periods. This lowers that consumer's energy bill and helps to lower the overall costs of the system.

Volumetric tariffs offer a particularly good example of how tariffs can encourage decisions that shift the cost burden to other consumers and may undermine the system's financial viability. Under volumetric tariffs, consumers pay solely or largely on the basis of the volume of electricity (kWh) consumed. In these cases, there is either no fixed charge, or the fixed charge does not fully reflect the fixed costs of the system, for instance the transmission and distribution network. When the consumer reduces demand, it avoids not only the variable costs of the system, but also its fixed costs. Since the fixed costs, by definition, do not vary with short-term consumption levels, volumetric tariffs encourage a reduction in demand that lowers that customer's bill by more than it reduces the costs of the system. Not only do these high volumetric charges contribute to demand reduction, they often require other consumers (if not the electricity company) to pick up the fixed costs that are no longer being recovered from the consumer who has reduced demand. This may lead to a 'death spiral' for regulated utilities, whereby average volumetric prices rise to recover fixed costs from fewer kWh,

51 'Pulling the Plug on Renewable Power in Spain', David Robinson, Oxford Energy Comment, Oxford Institute for Energy Studies, December 2013, page 3.

encouraging more and more consumers to reduce their demand, until it is impossible for utilities to recover their fixed costs.

Volumetric tariffs may also encourage consumers to generate decentralized electricity, even when this is more expensive than the electricity generated by the system, after taking account of any avoided network costs. For instance, if a consumer pays a volumetric tariff of €0.3/kWh and the cost of solar PV on his roof is €0.2/kWh, then the consumer has an incentive to generate its own electricity. However, if the true variable cost of the system (let us say for large-scale solar PV) is actually €0.1/kWh, then the consumer would not have the same incentive to self-generate if the tariff had been designed to reflect the true system marginal costs. Autogeneration further reduces demand from the perspective of the majors, leading to the redistribution of fixed costs to consumers who do not self-generate, and could lead to the death spiral. This is especially problematic from a distributional (equity) perspective because the losers are often those without the financial capability to invest in distributed generation.

Of course, tariffs may also be designed to *discourage* efficient autogeneration. Backup tariffs – ostensibly to pay for the system's ability to guarantee supply when the self-generator is not operating – may penalize efficient autogeneration, by charging more to the self-generator than the system's true marginal costs of providing backup. This may be due to a mistake in tariff design, but is more likely to reflect the fact that government wants to continue collecting sunk costs and public policy costs from all consumers.

The point is that tariff design matters and that volumetric tariffs have supported the trends toward autogeneration and reduced demand for electricity from the network in many jurisdictions. Although there is now pressure to restructure tariffs to better reflect underlying costs, it is extremely difficult politically to do this.

7. Case Study: the Irsching CCGT plants[52]

The decision by E.ON to apply to shut down the Irsching power plants offers a good illustration of the challenges faced by the majors in their upstream markets, and of the consequences for the suppliers of natural gas. E.ON has applied to the German energy regulator (BNA) and the transmission system operator (Tennet) to close two state-of-the-art CCGT plants – Irsching 5 (846 MW) and Irsching 4 (550 MW) – from 1 April 2016. These are two of the newest and most efficient CCGT plants in the world (according to the owners). Unit 5, with efficiency of 59.7 per cent, was commissioned in 2010, and Unit 4, with efficiency of 60.4 per cent entered into service in 2011.

Over the past two years, these two plants have been operating under a bilateral contract with Tennet that was negotiated by the BNA. It classifies costs according to whether the units are operating in a merchant mode, or under orders from the network operator. The plants supplied no merchant power in 2014 and were only despatched to maintain system stability. The owners argue that their current and prospective income is insufficient to cover the operating costs; consequently, they have applied to close the plants.

52 'Outlook grim for Irsching CCGTs', Sara Knight, Power in Europe, 13 April 2015.

To make matters worse for the owners, Tennet may prohibit closure, arguing that the plants are 'system relevant'; this is what happened to E.ON's Unit 3 at Irsching and its plant at Staudinger. Refusal to close is likely because the Irsching plants are in southern Germany, where markets are increasingly tight due to the anticipated nuclear closure and transmission constraints. Normally, one would expect wholesale energy prices to rise, but the growth of renewable output depresses wholesale prices, while reducing the capacity factor for conventional power. If the plants are declared system-relevant, the contract would apparently be even less attractive than the current one.

This example illustrates the challenges facing the owners of existing conventional power stations and their fuel suppliers. It also illustrates the inefficiency implied by the process. These are new, highly efficient plants, probably more competitive and environmentally acceptable than the average of plants that will replace them (both Germany and the Netherlands are building coal plants under special arrangements). Finally, it illustrates the extent of detailed government involvement. If the plants are declared system-relevant, this is because they are in southern Germany, which is feeling the impact of all the German government's decisions. In that case, the owners would in all probability incur even greater losses – because the scheme is not really designed for new plants.

It is these factors, compounding the basic supply/demand issues discussed in this paper, which make the process of trying to close these plants so painful. In an ordinary over-supplied market there would be a short-term process of adjustment, after which things would go on more or less as normal, but with a new equilibrium. In the European market there is no clear prospect of such a new equilibrium and it is difficult to know where things will settle, because of all the interventions.

This case study is an extreme example, but it reflects the nature of the problem well. More generally, the case for shutting coal and gas-fired power stations is becoming more evident in countries where wholesale prices are depressed and where intermittent renewables are gaining market share. The wholesale energy market currently only reflects part of the cost of electricity generation, with significant volumes of generation entering the market at zero (or negative) prices and being compensated through out-of-market payments. While it may be possible for gas and coal-fired plants to receive an out-of-market payment to help recover fixed costs, the Irsching case study illustrates the difficulties of doing so. Even if such a payment were made, this would not solve the problem facing coal and gas suppliers, whose market is declining.

8. Concluding comments

If the underlying reasons for the scissors effect are temporary and can be resolved through incremental adjustments to regulation, markets, and corporate behaviour, then future investment by the majors and by others need not be a major concern. Although the hypothesis needs to be examined further for specific countries and companies, this research paper argues that the causes are structural and will require fundamental reforms at a policy level.

This paper has focused on identifying and explaining a process that is affecting the major electricity companies and raising the costs of final consumers. It has not attempted in a systematic way to offer solutions. However, it is important to identify one major policy challenge that emerges from the study and to suggest a first step in addressing it. The challenge is to clearly define what are the respective roles of competitive markets and government in a decarbonizing electricity sector where consumers will be increasingly active. One view is that de-carbonization is incompatible with the liberalized market framework introduced in the 1990s and early 2000s, or indeed with variations on that framework. According to that view, decarbonization requires governments, or an entity operating on behalf of government (sometimes called a central buyer), to make the key decisions about how much capacity is required, what the mix should be, when and where it should be built, what the price should be, and to provide contractual guarantees because the chosen technologies cannot recover fixed costs in existing markets. This is essentially the route chosen by the UK, reflecting the high priority given (and indeed the legal obligation) to decarbonize the electricity sector very quickly.

The opposite view, which I hold, is that a liberalized market design offers a better way forward and that the problem is not reliance on markets, but rather the inappropriate design of markets and the specific government interventions that distort them. Accordingly, my proposed first step is a renewed form of liberalization. This approach is inspired by the original objectives of electricity sector liberalization from the 1990's, but with new market mechanisms to reflect new policy objectives and the technological advances that have changed the sector and that enable consumers to play a more active role. Without relying on out-of-market payments, the newly designed markets would allow for: the recovery of the fixed costs for conventional and renewable energy; the integration of wholesale and retail markets to ensure that consumers and demand side resources are able to play an active role in investment and operations; and the establishment of an effective CO_2 price or other mechanism, especially to send long-term investment signals and to encourage innovation. The new model would also assign an important role to government (or independent regulators), in particular to establish and police these markets, regulate natural monopolies, promote R&D, and protect the most vulnerable consumers. But, basically, the new approach would involve designing efficient, competitive markets and letting them work to achieve the policy objectives of resource adequacy, environmental sustainability, and economic efficiency.

Even if policy makers prefer the first route (relying on governments to accelerate the process of de-carbonization through out-of-market payments) they need to answer the question of the exit strategy and the sustainability of their current policies. The UK, for instance, insists that it has not abandoned the idea of competitive markets as the driver of investment, and that it will return to that idea once low-carbon technologies are competitive with conventional ones. But what is the market design that they have in mind and how does one make the transition to it? If governments cannot answer those questions, or do not intend to return to a liberalized market, we must question the economic sustainability of the model itself and its consistency with European legislation.

Whether or not the EU and its member states opt for a renewed form of liberalization in the near term, it is essential to be clear about what role should be left to competitive market mechanisms in a decarbonized electricity industry where consumers play a more active role. Once we have a clear idea where we are heading in the next 10 to 20 years, it will be possible to define paths that will take us there. For the electricity companies, corporate and regulatory strategy should focus on these questions before all others.