Benchmarking Electricity Liberalisation in Europe

Richard Green, Arturo Lorenzoni, Yannick Perez and Michael Pollitt

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Richard Green, Arturo Lorenzoni, Yannick Perez and Michael Pollitt[*]

University of Birmingham

Bocconi University, Milan

University of Paris XI

University of Cambridge

Abstract

In this paper, we discuss the choice and use of benchmarks in each of five areas relevant to an assessment of the progress of EU electricity sector liberalisation. These areas are market design, market power, EU enlargement, regulation, and sustainability. Our aim is to discuss the most important benchmarks for each area, and to do so in the context of that area. Where a benchmark can be used as a signal that things are going well (or badly) we will discuss the values associated with a good (or bad) signal. This paper forms part of the final report of the EU funded Sustainable Energy Specific Support Assessment project (SESSA, see www.sessa.eu.com).

1 Introduction

The aim of the SESSA research project from which this paper arises has been to identify good and bad practices affecting the electricity industry in the EU. Benchmarking is one way in which we can make comparisons across countries, and can contribute to that task. The European Commission has already begun this process, publishing four benchmarking reports over the past three years (European Commission, 2001, 2003, 2004, 2005).

The key to benchmarking is collecting comparable data from each country, and using to infer how well that country is performing. Three points immediately come to mind. First, it is important to collect information that actually sheds light upon the industry's performance, rather than gathering data simply because it is available. Second, some types of data give useful information about the industry's performance,

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but cannot be used in themselves as indicators of good or bad practice. For example, population density in a country is important in explaining the level of transmission and distribution costs, but a country cannot be accused of good or bad practice on the basis of its population density! Third, even when the data is suitable to indicate how well an industry is likely to be performing, there may be exceptions, and so each case should always be the subject of further interpretation before final judgments are made. Benchmarks should be seen as signals rather than definitive indicators. The right choice of benchmarks, however, can minimise the number of times that a misleading signal is sent.

In this paper, we discuss the choice and use of benchmarks in each of the five areas on which SESSA research has focussed. These areas are market design, market power, EU enlargement, regulation, and sustainability. It should be obvious that a number of benchmarks are relevant to more than one of these areas; however, our aim is to discuss the most important benchmarks for each area, and to do so in the context of that area. Where a benchmark can be used as a signal that things are going well (or badly) we will discuss the values associated with a good (or bad) signal.

In some cases, our benchmarks have been included in the European Commission's reports, but we also include suggestions of our own, where these can give additional useful information. Before moving on to benchmarks of good or bad practice, however, we list a few important pieces of information that can help put the overall performance of a country's electricity industry in context.

First, what is the level of electricity consumption, both in absolute terms and per capita? The greater the consumption, the easier it is to obtain economies of scale in production, and economies of density in distribution.

Second, what primary energy sources does the country's electricity industry use? A country with a high proportion of hydro-electricity may not be exposed to fluctuations in the prices of fossil fuels, but is vulnerable to years with low precipitation. Historically, oil prices have been more variable than coal prices, and so countries with a high proportion of oil-fired generation have seen greater changes in their input prices.

2 Market Design

When discussing market design, we are concerned with a mix of market rules and market structure. The former should be self-explanatory, but the latter has several dimensions. A full description of a market's structure would include information on the number and relative sizes of the firms within each part of the market. Where part of the market is heavily concentrated, we might expect to have problems with market power. Since market power is itself the subject of the our next theme, benchmarks that are primarily concerned with horizontal market power are discussed in the next section of this paper.

The first question is how much of the market is open to competition. There can be a competitive wholesale market, even if no final consumers are able to choose their retailer, provided that enough retailers are competing to buy power from generators. The European Union's policy, however, is to create competitive retail markets for electricity. Some Member States have already opened their entire markets to competition, while others have only opened part.[1]

The natural benchmark to use, and the one used by the European Commission, is the proportion of consumption (in TWh) taken by customers who are allowed to choose their retailer. We believe that customers should only be included in the competitive part of the market if they can choose their retailer directly. Where there is a system of concessions, so that all consumers in an area must buy from the concessionaire, we would not count allowing the concessionaire to decide how to buy its power in the wholesale market as an instance of retail competition. The proportion of consumption in the competitive market gives a better indication of its economic importance than a benchmark based on customer numbers, since the largest customers are generally the first to be given this choice, and they are relatively small in number. The European Commission also publishes the thresholds at which consumers become eligible to join the competitive part of the market – these currently range from a consumption of 40 GWh a year to all non-household consumers (and of course, all consumers). These thresholds provide useful supplementary information, but the relationship between the threshold level and the proportion of the market open to competition is generally a straightforward one, and it is the latter that is the key indicator of good or bad practice.

The European Commission signals that anything less than 100% market opening is undesirable, by shading these entries in red in its summary tables. Some economists, such as Newbery (2002) have questioned the benefits of giving household customers a choice of retailer, which would imply that the optimal level of market opening was rather lower (between 60% and 70%, depending on the national pattern of demand). We also note that the legal act of opening a market does not of itself ensure that customers can effectively exercise a choice, and that there are some markets which have had little customer switching, despite being legally 100% open for several years – a matter which we benchmark in the next section. Legal market opening is a necessary, rather than a sufficient, condition for liberalisation.

It is generally accepted that competition in an electricity industry can be greatly weakened if the transmission operator also has interests in generation, and is in a position to favour them in its operating decisions. The second European Directive on electricity liberalisation therefore required that there should be vertical separation between transmission and the rest of the industry, and between distribution and the rest of the industry, except for networks with fewer than 100,000 customers. Our benchmark, which is reported by the European Commission, is whether this vertical separation has been adopted, and the type of separation used. The Commission reports

[1] One of the newest Member States, Malta, has not yet allowed any consumers to choose their retailer.

list four levels of separation: Ownership separation, legal separation, management separation, and accounting separation. In a few cases, it also reports distribution networks that have not been separated from other activities in the industry. Accounting separation is the weakest form, in which a company keeps accounts for its network and for its competitive activities, and must charge the competitive businesses the same fees for using the network as it charges third parties. This is intended to prevent cross-subsidies between the network and the competitive activities. Management separation requires that different people are responsible for the network business and the competitive activities, and that the network business cannot pass on information about rival concerns. Legal separation goes further, with a completely separate legal entity to run the network. Even in this case, however, staff working for the network business will be aware of the financial interests of their parent organisation and its competitive activities, and may take decisions to further these. Only full ownership separation, when the network is an independent organisation rather than a subsidiary, can completely remove the incentive to favour one market participant over others.

The Commission signals that ownership separation and legal separation provide the best conditions for effective competition, and shades any other positions in red as a warning sign that competition may be impeded. In the case of transmission, we agree unreservedly with this assessment. Distribution networks are generally managed in a passive manner, allowing electricity to flow from the transmission network to the consumers with little intervention from the system operator. In this case, the operator has little scope to discriminate between network users in physical terms. The access charges for the network will need to be regulated, and it is harder to regulate a company that is active in several segments of the industry than one that is specialised in distribution alone – there are opportunities for it to shift costs from a competitive segment of the business into the regulated activity. There may be branding advantages to a retailing business that also operates the local network. We thus agree that competition will be more effective, the greater the degree of separation. However, we believe that incomplete separation will do less damage in the case of distribution networks than in the case of transmission.

Effective competition also requires a well-functioning wholesale market. Newbery (2005) has demonstrated how important the details of market design can be, but it is still useful to list broad categories of market institutions. The European Commission lists three main categories of wholesale market – those based upon bilateral trading (the majority), those using a Pool and contracts for differences (Ireland, Lithuania and Spain), and those with a hybrid model (the Nordic countries). Newbery (2005) suggested that a Pool (or hybrid) model had significant advantages in providing a transparent reference price, as long as the market was not so concentrated that the transparency enhanced positions of market power.

Balancing arrangements are also very important – in the end, arbitrage against the final stage of the market (or the possibility of accepting an imbalance between a company's contracted and physical positions) will affect the whole structure of market prices. The European Commission lists three main ways in which balancing charges

are set – through a market, by the regulator, and by the transmission system operator. The three two-way combinations of these options also appear in *table 1*.

We believe that market-based balancing is likely to produce the best results, at least as long as the market is sufficiently competitive. If the market is concentrated, then incumbent generators may be able to manipulate it, damaging entrants. This would be made worse if the transmission system operator is still linked to those generators. Charges set by a transmission system operator are likely to be second-best, while the regulator is unlikely to have the information to set charges that reflect the rapidly changing conditions on an electricity system. While we repeat the importance of drawing conclusions only after investigation, we would expect that balancing charges set by a regulator would be an example of bad practice.

To create a truly integrated European market for electricity, companies must not face artificial barriers in sending power across national borders. At the same time, the capacity on many cross-border inter-connectors is less than the demand for it for a significant part of the year. The question then is how that scarce capacity is allocated among users. On the grounds of economic efficiency, the best methods are to have an explicit auction, or to adopt the market-splitting used in Nord Pool, where a single market covers both sides of a cross-border inter-connector. Many inter-connectors within Europe, however, are allocated according to past use, which does not guarantee that those with the greatest value for the inter-connector will use it, or by scaling down the requests for capacity to meet the available capacity, which can encourage gaming when making those requests. We suggest that the method of allocating inter-connector capacity is suitable for benchmarking. Since most countries in Europe have inter-connectors with several other countries, a possible summary statistic would be the proportion of their inter-connector capacity that is managed by explicit auctions or by market-splitting.

All of these benchmarks have reflected the way in which the market is organised. We will propose one benchmark that reflects the way in which it is performing. This is the level of liquidity in the wholesale market, looking separately at the day-ahead market (or other market operating close to real time) and the forward markets. In a liquid market, agents can make reasonably large transactions without affecting the market price too greatly, whereas it can be very difficult to find a counter-party in an illiquid market. Liquidity in forward markets can also reflect market participants' view of how well the underlying spot market is performing. The very high liquidity in the Nordic forward markets shows that traders view Nord Pool as a well-functioning market which is unlikely to create losses by posting inexplicable prices. In contrast, the British regulator argued that the low level of forward trading around the Pool in England and Wales showed a lack of confidence in that market's price formation process.[2]

[2] Government-brokered long-term contracts also reduced liquidity in the commercial forward markets until 1998, and liquidity actually rose while the Pool's abolition was being discussed and implemented.

In general, the more liquid a market is, the better. No electricity market has reached the stage that the transaction costs of repeated trading have outweighed the benefits of better price discovery. Liquidity in day-ahead markets will naturally be lower than in the forward markets, since the main purpose of these markets is to allow generators and retailers to adjust positions that they have already reached in earlier trading. (The exception is where a gross Pool is used to schedule plants at the day-ahead stage, as in Spain). There is no "bright line" between a market with sufficient liquidity and one that is too illiquid to allow traders to adjust their positions easily, but spot markets with a turnover of less than ten per cent of demand, or forward markets with a turnover of less than three times demand, are likely to be undesirably illiquid.

3 Market Power

The second theme concerned market power. Many academic papers on firm behaviour have been written in what is known as the structure-conduct-performance paradigm. The structure of the market, including such features as the number of firms and the type of product they are selling, affects the way in which they act (their conduct) and the market outcomes, such as prices (its performance). While more recent work recognises that firms make strategic decisions that affect the structure of the market, it is useful to think of benchmarks in this area as those related to structure and those related to performance.

The potential for market power is clearly related to market shares. We should stress that this potential may be ameliorated by, for example, competition from imports, and that the possession of a dominant position does not necessarily mean that it will be abused. The Commission's benchmarking reports list the market shares of the largest generator, measured by capacity, and of the three largest generators taken together. These are easily understandable measures, and since the Commission includes the potential import capacity in each national total, the measures take account of the reduction in domestic market power that comes from foreign competition. While higher levels of concentration increase the likelihood of problems, there is no clear dividing line between acceptable and unacceptable levels. The Commission gives a red warning signal to single firm market shares of more than 40%, and three-firm shares of more than 70%. Markets where the largest firm had less than 20% of capacity, and the three largest less than 40%, are given a green signal of health. While unconcentrated markets are less likely to suffer from problems of market power, it is worth noting that the three largest firms in California owned just 30% of the capacity in the state at the time of that State's electricity crisis, and that the five firms most often accused of exercising market power owned no more than 32%.[3]

An alternative to these concentration ratios would be the Herfindahl Hirschman Index (HHI), which takes the share of each generator in turn, squares it, and then sums the squares. The index takes a value of 10,000 where there is a monopoly, 5,000 where there are two equally sized firms, and falls towards zero as the market becomes

[3] The two largest firms in terms of generating capacity were net buyers and had no incentive to raise prices.

less and less concentrated. It has the advantage that it is potentially affected by the size of every firm in the market, whereas two markets with the same concentration ratio could behave differently because of the size distribution of firms outside the top group. One disadvantage of applying the HHI to shares of capacity in European electricity markets is that it is not obvious how to treat interconnector capacity. Treating each interconnector as a single firm might actually raise the measured concentration in a small, well-connected, market, and this would be inappropriate if the neighbouring markets were competitive. It might be best to divide each interconnector's capacity according to the capacity shares (excluding imports) in the neighbouring markets. As to the level of this benchmark to aim for, the European Commission's Merger Guidelines state that "the Commission is unlikely to identify horizontal competition concerns" if the post-merger HHI is below 1,000; increased by less than 150 as a result of a merger, or increased by less than 250 when the post-merger HHI is between 1,000 and 2,000 (the equivalent of five equal-sized firms).[4]

As an alternative to measures based on shares of capacity, we could calculate shares of output. Energy-limited generators, such as hydroelectric plants, or intermittent sources, such as wind farms, may have less influence on the market than their shares of capacity would imply. Base-load generators which run continuously will have relatively more impact on an output-based measure of concentration than a capacity-based measure. Since a firm's financial incentive to raise prices is generally directly proportional to the output it is producing, this might imply that the output-based measures are a better indicator of firms' incentives to exercise market power. Most electricity markets have few problems of market power when demand levels are low, however, even including the notorious case of California (Borenstein et al, 2002). Market power in generation is most likely to be a problem at times of high demand. At these times, however, most capacity will be in use, and so the capacity-based measures give a better impression of the state of the market than output-based measures. We therefore support the use of capacity-based measures in generation.

One disadvantage of the measures discussed so far is that the relationship between concentration and prices in electricity markets is a complex one. Various specialised indicators are used by electricity market monitors, particularly in the United States, to give a better signal of when a market may be vulnerable to the exercise of market power. For example, the pivotal supply index can be defined as the proportion of hours during which any supplier in the market is pivotal – that is, that demand could not be met without some output from that supplier's plants. In the absence of effective demand side response, the supplier could (in theory) ask for almost any price it wanted at such times. Another indicator is the residual supply index. Calculated for a given company in a given hour, it is the ratio of the total capacity owned by all the other companies in the market to the level of demand in that hour. A figure of 110% or less implies that the company is nearly pivotal, and may have scope to raise prices. The proportion of hours in which the residual supply index for the largest company was above 110% could be used as a summary benchmark to allow cross-country comparisons. Other specialised measures are discussed by Twomey *et al*. (2005).

[4] The guidelines do note some exceptions, such as if one of the merging firms had a market share of more than 50% before the merger.

In the retail sector, the Commission collects information on the market share of the largest company, and the largest three companies, in terms of sales in TWh. Once again, these are intuitive measures, easily related to the potential for market power, and relatively easy to collect. The Commission's figures are collected and calculated on a national basis, however, which might be inappropriate. The problem is that competition to sell electricity to households has a strong regional (or local) basis, and that the incumbent former monopolist in each area generally has a high market share. The incumbent may well have market power within its area, but when we aggregate across areas with different incumbents, the market will look much less concentrated.

As an example, in December 2003, British Gas had a 24% market share among household electricity consumers in Great Britain, PowerGen had a share of 21%, and National Power a share of 15%. The three-firm concentration ratio was thus 60% (in this part of the market). Within any area, however, the incumbent electricity company alone had an average share of 59%, implying a three-firm concentration ratio of nearly 90%. Competition to supply non-household consumers is more national in scope, which will dilute this effect when data for the entire market are collected. Note that collecting data on a regional basis, computing the concentration ratios, and then taking their average will have little impact on the values obtained when competition is truly national, since market shares in each region should be similar. For this reason, we recommend that data should be collected and concentration ratios calculated on a regional basis, but taking national averages to present the results.

The level of vertical integration is an important structural feature of a market. If there is a lot of vertical integration between generators and retailers, then it can be difficult for non-integrated entrants to break into the industry. This in turn helps the incumbents to keep prices high. We suggest that data should be collected on the proportion of electricity that is retailed by a company in the same corporate group as the company that generated it. This would then be an indicator of the level of vertical integration. High levels of integration are unlikely to be consistent with best practice unless both generation and retailing are unconcentrated, in which case entrant companies should face many options for obtaining, or selling, power.

When it comes to the performance of an electricity industry, we would like to discuss two measures. First, what about the level of wholesale prices? The absolute level of wholesale prices is relatively uninformative, since costs can vary significantly over time and across markets. It is better to relate wholesale prices to the marginal cost of generation. In a competitive market with spare capacity (at a particular point in time), competition should drive prices down to the level of marginal cost, whereas prices significantly above marginal cost would be an indicator of market power. At peak times, however, when there is little or no spare capacity, marginal cost is hard to define, and prices should certainly rise above marginal operating costs, or generators will be unable to recover their fixed costs. A possible measure of performance is thus to compare prices with calculated marginal costs, but taking only those periods in which capacity exceeds demand by a specified margin. If this margin is too small, however, scarcity rents will be interpreted as the result of market power, whereas if

the margin is too high, some potentially high-priced hours, in which market power might be exercised despite the presence of a small amount of spare capacity, might be excluded.

The standard way in which this comparison is presented is the Lerner index, which is equal to (price minus marginal cost) divided by price. A Lerner index of close to zero is a sign of a competitive market, whereas the Lerner index in California exceeded 0.5 in many hours during the summer of 2000.

The disadvantages of this measure include the significant effort required to calculate it. Although simple models of the industry can be built and maintained at low cost, and regularly updated with fuel prices and demand levels to calculate new figures for marginal costs, these models typically ignore many of the operating constraints that the real system faces. These constraints force the system operators to run expensive but flexible plants in place of cheaper, inflexible, generators, and thereby increase marginal costs. Models which do not take such constraints into account are likely to over-estimate the level of the Lerner index. Bergman (2005) gives a much fuller account of these problems, and shows how serious they may be in practice. This paper also discusses the tension between the regulator's comparison of prices with short-run marginal costs (often fuel alone) and the company's need to recover all of its costs. The tension can only be resolved by allowing peak prices to rise above short-run variable costs.

Furthermore, if an official body regularly estimated the level of marginal (or average) costs, and compared out-turn prices to its estimate, this would surely affect the development of the market. If prices were found to be regularly above the level of marginal costs, there could well be calls for action that would reduce them. Generators might decide to keep prices close to their prediction of the official estimate of marginal costs. The outcome would be a very unusual market, to say the least. For this reason, it is probably better to think of the Lerner index as a measure that could be calculated from time to time to give a "snapshot" picture of market performance, than as a benchmark to be collected on a regular basis. It might be possible to measure the index for all the hours in a sample period, and then to check whether instances of a very high index could be explained by (legitimate) capacity shortages.

Our second performance measure concerns the retail market. It is possible to measure the number of customers (or share of consumption) switching between retailers, either over the whole period since the start of competition, or over a more recent period, such as the last year. Measuring the total number of customers who have switched at least once implicitly tells us how many customers are still with the incumbent ex-monopolist, and may signal something about that company's market power. Measuring the total number of switches over a long period does not tell us whether a small number of customers are switching frequently, or many customers are switching, but only infrequently, and is therefore a bad measure of the state of competition. At least once the market has been open for a few years, the best benchmark will be the number of consumers who have switched in the past year.

This measure does need to be interpreted with care, however. We could conceive of a really competitive market in which it was easy for customers to switch between firms, and the fear of losing customers would force every firm to offer a very good price and a high standard of service. As long as they did so, customers would not need to switch, and so we would observe very little switching. At the other extreme, if switching is sufficiently difficult, customers might stay with their existing retailer despite high prices and poor service. It is not obvious that we could tell these markets apart, purely on the basis of the observed switching rates. In practice, however, there is some differentiation between companies, in terms of tariff design or fringe benefits (several British companies sell electricity with reward points – such as Air Miles – attached), giving customers positive reasons to switch between companies. In these circumstances, low levels of switching are likely to reflect barriers to doing so, and to be an indicator of bad practice.

4 Regulation

The fourth theme concerned regulation. By regulation we mean the sector specific economic regulation that governs the electricity sector. Such regulation normally involves the promotion of competition in the generation sector and the setting of network tariffs for transmission and distribution. Benchmarking regulation is very difficult because it is not that easy to know what aspect of regulation to benchmark. Regulation of private or mixed ownership systems is a necessary evil which is required when the normal processes of competition cannot be left to take their course. Thus a well functioning electricity market should consist of a minimal amount of regulatory intervention combined with the utilisation of market or private decision making wherever possible. The more favourable the market conditions and initial endowments the less need for regulation there is. Relatively small electricity markets dominated by nuclear or hydro power should require proportionately more regulatory intervention than larger markets dominated by gas or coal power.

In seeking to characterise the lessons from the European experience of regulation we look at three aspects of electricity regulation: the form of regulation, the process of regulation and the outcome of regulation. The form of regulation concerns the how regulation is organised (e.g. via an independent sector specific regulatory agency). The process of regulation is to do with the way that the regulation is actually conducted (e.g. RPI-X price control of electricity distribution with X set using comparative benchmarking). The outcome of regulation is to do with an overall assessment of the contribution of regulation to the performance of the industry (e.g. the impact of price controls on regulated prices).

4.1 The form of regulation

The 2003 Electricity Directive discusses electricity regulation in some detail (Article 23 on Regulatory Authorities). Each country is required to set up an

independent regulatory agency (or agencies) responsible for 'ensuring non-discrimination, effective competition and the efficient functioning of the market.' (L 176/49)

There seems to be empirical support for the idea that electricity market reform requires an effective independent regulatory system (Bergara et al., 1998). An independent sector specific regulatory agency is seen to be part of this regulatory system. Independence itself is not enough. This would need to be combined with the regulator having power over the key elements of electricity regulation to promote an effective market. These include the power to: set network access conditions (and thus not to arbitrarily deny market access to new competitors); resolve disputes between parties (particularly between generators and network companies); determine regulated prices in advance (thus providing clearer incentives to regulated firms and reducing the scope for lobbying); and acquire relevant information from companies. The 2003 Electricity Directive does not discuss the methodologies that should be employed in regulation.

There is a continuing debate about how heads of regulatory agencies or commissioners should be selected. The formal literature from the US seems to suggest that elected regulators are to be preferred in that they achieve lower prices (Besley and Coate, 2003) and keep the costs of regulation down (Mixon, 2001). However in other jurisdictions the situation is not so clear cut. In developing countries elected regulators may just represent different interests rather than being independent (see Estache and Martimort, 1999). In mature democracies with little tradition of direct election to specialist jobs (such as most countries in Europe) election does not seem appropriate. However it clearly is important to appoint individuals without clear conflicts of interest and to protect them from arbitrary political interference. This can be done by limiting the conditions under which they can be dismissed and fixing their term of office.

In Table 4 in the annex, under Strength of regulator, we score each country on whether they have ex ante regulation (= 1, ex post = 0), ministerial involvement (1 = no, 0.5 = some, 0 = yes), network access conditions set by the regulator (1 = yes, 0 = no), dispute settlement by the regulator (1= yes, 0 = no) and strong information acquisition powers (1 = yes, 0 = no).

The table suggests that in 2003, these strong conditions were met in only 7 countries. Germany continued to have no regulatory agency until mid July 2005, when the Federal Network Agency for Electricity, Gas, Telecommunications, Posts and Railway (Bundesnetzagentur) was established. Until then the oversight of the electricity sector was in the hands of the German Competition Authority (the Bundeskartellamt).

As part of the SESSA research programme Larsen et al. (2005) conducted a detailed survey of European electricity regulators to review their responsibilities and organisation. They found that there was a significant variation in the objectives of

independent regulatory agencies. Of the 15 they examined, 14 had the promotion of competition as one of their legislative objectives, however only 6 had socially responsible prices as an objective. Indeed the total number of objectives varied between 7 for Ireland and 1 for Sweden.

Larsen et al. also showed that most heads of the regulatory agency had 4-6 year terms, could not be sacked for matters related to policy, and could not hold offices in government. Regulatory agencies are mainly funded by fees levied on regulated firms, have control of their own expenditure within their budget limit, and personnel appointments. It is supposed that regulatory agencies which do not rely on government for their income and are not restricted to civil service pay scales for staff have the capacity to act more independently of government (see Domah, Pollitt and Stern, 2002). However Larsen et al. find that in Europe there is a wide variety in who appoints the head of the agency with only 4 countries having the head appointed by legislature and the executive and 5 countries, including the UK, making the appointment by one or two ministers. Some countries do not allow an industry figure to be head of their agency (e.g. Austria). In terms of which competencies a regulator had freedom to exercise, Larsen et al. found that only Ireland and Norway were fully competent in tariff setting, network access terms, issuing of licences, setting terms of delivery, settling disputes and enforcement (see Table 4). The UK, Italy and the Netherlands were fully competent in five out of the six areas and partially competent in a sixth area.

We suggest the following indicators of the form of regulation: Functions of regulatory agency and degree of freedom over these, tenure and terms of appointment of head of regulatory agency, how the regulatory agency is financed (eg. Industry levy or by taxpayer) and salary scales of staff (i.e. civil service or independent).

4.2 The process of regulation

Regulatory agencies must carry out their work competently and use state of the art methods. They should demonstrate a willingness to be transparent and a process of appropriate stakeholder engagement in the course of decision making. This is important for two reasons. First, transparency is important for the democratic legitimacy of any regulatory agency that operates at arms length from political control. Second, transparency and stakeholder engagement should lead to better regulatory decision making as regulators can benefit from the informed comment which stakeholders and independent observers can make on their decision making processes.

Casual observation of European regulators reveals wide differences in the degree of transparency between regulators. Ofgem in the UK and NVE in Norway have comprehensive information available on their website and readily respond to requests for information and regulatory data. By contrast CRE in France do not publish much material (for example with respect to the performance of the distribution departments of EdF) and E-Control in Austria is not allowed by law to publish certain types of data

on the performance of regulated companies that is readily available in the UK and Norway.

An efficient process of regulation involves procedural efficiency on the part of regulators with timely reporting and a pro-active agenda. Ofgem publish regular work plans and issue consultation reports on issues such as how to set prices on the distribution network to encourage embedded generation. For their regular price reviews of electricity distribution and transmission charges they adhere to well worked out 18 month work plans which deliver final proposals 4-5 months prior to the start of a new price control review period (see Pollitt, 2005). By contrast, other countries have had serious procedural efficiency problems. For instance the Netherlands first electricity distribution price control review, undertaken by the DTe, was only completed more than two and a half years after the initial deadline and only just ahead of the subsequent price control review period (see Nillesen and Pollitt, 2004).

Systematically comparing the process of regulation in different European countries requires some objective measure of what a good regulatory process would look like. The work of Jamasb and Pollitt (2001) provides some information on this with respect to transmission and distribution price reviews. For a sample of 18 OECD countries, of which 14 were in Europe, they examined the use of benchmarking methods. They identified 6 countries that could be thought of as leading countries who were using sophisticated benchmarking techniques (such as data envelopment analysis) – Chile, UK, Norway, Netherlands, US (California) and Australia (New South Wales). All but California also employed ex ante regulation (in the sense of not adjusting regulated prices and revenues in the light of outturn costs, as for example is the case in rate of return regulation). Most also had a process of consultation and incentivised supply quality of service and investments. These countries also published information on the web and were open to third-party studies of benchmarking. This study strongly suggests that where it is possible to specify what a good process of regulation might look like it is possible to identify countries which practice such a process. Fillipini et al. (2005) provided updated information on the use of benchmarking methods by European regulators and showed that the UK, Norway and the Netherlands have continued to provide the lead in their process of regulation.

Reviews of regulatory decision making are important in capturing the lessons from review processes and holding independent regulatory agencies accountable for the process of regulation. These reviews are particularly appropriate following major regulatory decision making processes such as the introduction of new trading arrangements or the completion of a network price review. Importantly they offer opportunities for stakeholders to formally feedback on the performance and decision-making processes behind regulatory decisions. These reviews can be conducted by the regulator itself, parliamentary committees, public spending watchdogs, or expert panels. The UK's regulator, Ofgem, consulted stakeholders on the process of its 2004 distribution price control review (Ofgem, 2005), while the UK's National Audit Office (2002) questioned the cost of RPI-X regulation that involved demanding large amounts of information from companies which were not subsequently used. However

to our knowledge no EU regulator has conducted independent expert reviews of electricity price control processes such as is the norm in the UK water industry (see for example Independent Steering Group, 2005). We would suggest that independent ex post reviews should be the norm for major packages of work carried out by regulators.

Leading European regulators are increasingly co-operating on matters of mutual interest (often via the Council of European Energy Regulators or CEER). This is imperative in the area of electricity transmission where almost all countries have too few domestic comparators to make a meaningful assessment of the scope for cost savings and hence X factors. This issue is becoming more important in the area of electricity distribution, where initial conditions and mergers have begun to reduce the number of effective comparator firms. Co-operation is required to standardise definitions and data collection and to share lessons from the use of different methods. It is interesting to observe that the same group of countries is frequently seen to be taking the lead in the area of co-operation: the UK and Scandinavia. This contrasts with the absence of France, Germany and Spain from many of these discussions.

We suggest the following indicators of process efficiency: all documents are routinely published on the regulator's website (Y/N), whether important documents are additionally available in English for non-English speaking regulatory agencies (Y/N), the presence of a work plan on the website (Y/N), whether targets for work delivered are routinely met in a timely way (Y/N), whether use is made of external advice (Y/N), which benchmarking methods are used, whether regulator's action are ex post assessed (never, randomly, routinely), whether the country is an active member of the CEER by serving on one of its working groups (Y/N) and the number of named CEER collaborations it has been involved with.

On the above criteria both the UK and Norwegian regulators score very highly. The UK's Ofgem scores yes/routinely to all of the above. Both these agencies have the longest and most consistent experience in Europe with electricity reform and seem to provide the most obvious role models for other European countries.

4.3 The outcome of regulation

Measuring the performance of a regulatory agency in terms of outcomes which are valued by society is complicated by an identification problem. Regulation is just one factor explaining the performance of an electricity sector. Regulation may be implemented at exactly the same time as restructuring or privatisation, making it difficult to access its unique impact. The strength of initial legislation or general competition policy may also be important factors behind the success of regulatory processes.

In developing countries the measurement of performance can be measured by the general health of the electricity sector. This can be easily gauged by the size of system losses, shortages of capacity and the amount of investment in the sector. All of these we would expect to see strongly correlated with the exact timing of reform. For developed countries these indicators become difficult to interpret. For example

increased efficiency may mean less investment for a fully developed electricity network.

It is possible to conduct cost benefit analyses of individual pieces of regulation. For major discrete changes in market design or regulatory process may lend themselves to this sort of analysis. A good example of this is Green and McDaniel (1998) which looks at the impact of the introduction of full retail competition in the UK. They found that the benefits in terms of lower prices and improved induced efficiency barely matched the considerable implementation cost in terms of new information technology aimed at facilitating residential customer switching. This analysis suggested that at the very least a cheaper IT system, which the regulator failed to deliver, would have been necessary to deliver unambiguous benefits to society. In a subsequent study Evans and Green (2003) found that the introduction of the new electricity trading arrangements (NETA) which replaced the power pool in England and Wales may not have delivered lower prices of wholesale energy in spite of costing at least £1bn to implement. The effect of this decision was masked by the fact that regulator-initiated changes in generation market structure took effect around the same time.

The 2001 – 2003 electricity distribution price review in the Netherlands provides a further example of how ex post assessment of regulatory outcomes may be possible. Nillesen and Pollitt (2004) report that the X factors were revised three times and implemented almost 3 years late, with the final X factors delivering around 200m Euros less benefit to consumers than might otherwise have been the case. This example of regulatory failure to deliver was a much the fault of the original badly drafted legislation as it was the fault of the badly managed process of regulation. The combination of these two unfortunate factors led to quantifiable losses for electricity consumers. It was also partly responsible for the need for the Dutch parliament to pass subsequent legislation strengthening the powers of the regulator and correcting the previous ambiguous drafting of the legislation.

Ideally, we would like to do an efficiency assessment of regulatory agencies in order to judge their performance. Cost of regulation would be the input to the efficiency analysis. Sector performance controlling for size and complexity of the task would be the outputs. Domah and Pollitt (2002) have gone some way towards this by calculating the efficiency scores of a sample of 33 regulators in developed countries using cost as an input and measures of system size and complexity (such as electricity sales and number of firms) as outputs. They found that the Swedish regulator performed very well on this measure due to its very low costs per customer (see also the final column of Table 4).

It is interesting to note that recently Ofgem subjected itself to a revenue cap of RPI-3 for 5 years from 2005-2010. Such an approach has the merit of limiting potentially damaging and expensive regulation but does obscure the point that direct regulatory costs are usually small in relation to total electricity revenue and that the benefits of small increases in regulatory expenditure in terms of improved social

welfare can be very large. Thus it may be that unmeasurable benefits and unmeasured external costs may drive an accurate social cost benefit analysis of regulation.

Indicators suggested for the outcome of regulation: the performance in social cost benefit analysis of regulation, the size of X factors and savings from price control reviews, the cost of the regulatory agency per customer, the trend in electricity price relative to European average since beginning of reforms and the presence of incentives on regulator to be efficient.

4.4 Conclusions

There is widespread agreement that independent regulation aimed at promoting competition in generation and supply markets while providing for incentive based regulation of transmission and distribution tariffs is the best form of economic regulation of electricity markets. Best practice processes of regulation are those which involve transparency and effective engagement with stakeholders. Such processes must involve learning from the successes and failures of other regulatory jurisdictions. This is particularly true for technical issues such as how to set network prices for embedded generation or how to benchmark network utilities. The overall outcome of regulation is difficult to measure, but the success or otherwise of major regulatory decisions should be quantified using social cost benefit analysis. There also seems to be further work that is possible on trying to develop good measures of the performance of regulators over time.

It remains interesting to observe that while the principles of good regulation in the electricity sector are increasingly well established, the speed of their implementation across Europe is strongly correlated with the strength of general competition policy and a pro-competitive government policy. It is also the case that good regulatory outcomes are facilitated by the comprehensiveness of initial market structure reforms in the sector, such as horizontal and vertical unbundling (compare the strength of regulator score (and to a lesser extent the competencies of the regulator score) in Table 4 to the indicators of market structure in Tables 1 and 2). Thus it is that Norway and the UK that continue to lead in the practice of regulation with scores of 5 out of 5 on strength of regulator, while having among the most competitive and vertically dis-integrated electricity sectors in Europe.

5 EU Enlargement

Eastern European countries are physically integrated with the west European grid, and took the first steps towards adopting the “western model” with regulated third party access for the larger customers, partial privatisation of companies within the industry (except in Slovenia) and reducing barriers to international trade. But like in the rest of Europe, each reform is unfinished regarding its market design and the existing market power let to the dominant player. One specific problem of EU enlargement is of course the rather underdeveloped academic & empirical studies regarding these countries. In EU 15 countries, information, indicators and data have

existed for years and are easily available. Such development in monitoring is just starting for many of the new Member States and candidate countries.

Some of the challenges faced by the New Member States are common to other countries in Europe, and can be assessed through the benchmarks we propose in other sections of this report. In particular, many Eastern countries have surplus capacity at present, which will be picked up by benchmarks for security of supply, and have a fuel mix that is heavily weighted towards coal, which will be picked up by benchmarks on carbon emissions. The limited penetration of renewable generators, and dependence on feed-in tariffs for support, is also shown in the benchmarks for sustainable investment, in the next section. Many countries have dominant companies, and their influence can be picked up in the benchmarks on market power. Wholesale markets are typically embryonic, with low liquidity, as shown in the benchmarks for market design.

In this section, therefore, we concentrate on features of the electricity market that are more prevalent in the New Member States than other EU countries, even though they are not unique. One of these is the distorted price structure that a number of Eastern countries retain. This is generally the legacy of a system in which domestic consumption of electricity was subsidised at the expense of industrial and commercial consumption. This can be benchmarked by taking the ratio of a specified domestic price (or prices) to an industrial price. In Table 3, we take the ratio of the Eurostat price for domestic customers (Eurostat type DC) to the average of the price for industrial customers (Eurostat types IB and IC). The higher cost of serving domestic customers implies that this should almost certainly be greater than one, although the level that would accurately reflect the relative costs will vary from country to country. Countries with very low levels are almost certainly suffering from distorted tariffs.

Some countries may still have tariffs that do not allow producers to recover their costs. This might be benchmarked by taking the ratio of revenues to costs, although it will be important to measure those costs in a consistent manner. It would not be appropriate to use the replacement cost of assets if they have been privatised for a much lower value, as this would imply that the new owners should receive a windfall profit. Using the sale value, however, can justify the present level of prices, since investors will have based their decision of how much to pay for the assets on their predictions of future profits, which are linked to the level of prices. It is also unclear whether the replacement value should be used for companies that have not yet been privatised – this might show that state-owned companies were under-recovering, while private companies with similar prices were performing well. It is clear that the appropriate level of prices is a difficult subject to benchmark.

In a number of countries, companies were awarded long-term contracts to sell generation, or to use cross-border transmission lines, without meaningful competition. In some cases, long-term contracts were used to help finance traditional fuel suppliers (mainly coal mining) and environmental improvements, before creating competitive electricity markets; in other cases, long term contracts can be seen as a “quasi integration device”. In Eastern countries the two situations seem to coexist: many

international transmission lines are congested at the present[5] time, and there are a large number of long-term contracts that take up much of the potentially available capacity and reduce the impact of market opening. The other category of long-term contracts concerns generation. Now that there are attempts to increase competition, and long-term contracts that guarantee part of the market are likely to impede entry and give advantages to incumbent generators. This is not to suggest that all long-term contracts are bad, for competitively awarded contracts can be useful in financing new entry. If it is possible to isolate contracts awarded without competition, however, then we could establish benchmarks for these. We suggest that the proportion of cross-border capacity allocated through long-term contracts awarded without competition could be one benchmark, and the proportion of generation sold through long-term contracts awarded without competition could be another.

Long-term contracts for generation, and the presence in many countries of a dominant wholesaler, make competition from imports perhaps more important in Eastern Europe than in other parts of the continent, even though interconnection capacities are low relative to the size of national markets. However, there is one distortion which is quite often seen, and that is for retailing companies to be forced to import power in order to compete on the retail market, even when the net flow on the inter-connectors is in the other direction. If its position as a net exporter is justified, because the country is a low-cost producer, there must be a high margin between production costs and retail prices, or the competitive supplier would not find it profitable to import power. An alternative possibility is that the country is exporting, perhaps using legacy contracts, despite being a higher-cost producer - neither possibility is attractive. A benchmark for this distortion would be the correlation between the net export position of independent retailers in the country, and of the country as a whole.

Stronger competition on a regional level might offset the unsatisfactory domestic market structures. A regional approach to market design and restructuring would be a solution compared to the individual approach taken by most countries. Companies that are large on a national basis would be small or at most medium-sized on a regional scale. Effective regional markets could offset the limited competition within national markets, but require suitable cross-border arrangements. Where these exist, as in Nord Pool, it would then be appropriate to calculate benchmarks on a regional basis (as is done in parts of this report). If the markets are not truly integrated, however, benchmarking on a regional basis would merely make the figures appear better, without any change in underlying conditions.

6 Investment and sustainability

The liberalisation of the electricity sector has focused the attention of most stakeholders on the short term outcomes of the reform process, assuming that short

[5] Most of the transmission lines between countries are frequently congested, particularly those towards the importing countries of Austria, Germany and Hungary.

term efficiency automatically implies the capability of the industry to optimize investments in the long run.

Taking a long term perspective on the sector requires considering the issue of its sustainability in environmental, social and economic terms (Perez Arriaga 2004). These three dimensions of the electricity sector's sustainability are directly linked to the main targets of any energy policy: efficiency, security of supply and environmental impact (De Paoli 2001). In other words, a sustainable energy model has been effectively summarised by Perez Arriaga in having adequate capacity, low environmental impact, and widespread access to the best technological solutions.

A major issue in the economic literature and in the policy debate concerns the effects of the search for sustainability on the competitiveness of industry (Eikeland 1998). Even if looking for specific benchmarks on the electricity industry, it should be considered that a discussion on sustainability cannot be restricted to one industrial sector, but necessarily implies a view on the general economic and environmental policies of a country.

While evaluations of the environmental performance of the electricity industry are relatively common, the economic and social dimensions are far more difficult to assess and the related literature is much thinner. In this part of the work some indicators related to all of these three dimensions of sustainability are proposed, with a few being calculated.

6.1 Social sustainability

The social dimension of sustainability has several implications that are only partially perceived by the consumers, which do not have direct information on the national dependence of the economy on foreign energy sources. A focussed effort should be done to bring the long term social risks to the attention of European citizens and policy makers.

The European Union, after initially pushing the liberalisation of the electricity sector with the Directive 96/92/EC, has addressed its policy on longer term targets, with the green paper on security of supply issued in 2001 (EU 2001). This document started a process of confrontation at EU level that defined new drivers for the future energy policy.

The four political challenges that the EU identified in the revision of its policy for energy security are the following (EU 2005):

1) managing demand, with the aim to reduce energy consumption wherever possible,
2) diversifying European sources, enhancing the use of all internal energy sources,
3) streamlining the internal energy market, with strengthened coordination amongst operators even in the liberalised market,

4) controlling external supply, entering into strategic partnerships with major potential suppliers such as Russia and even far-off countries.

Three national indicators that can capture the risks involved in the dependence of the sector on imported energy sources are the following:

- Degree of energy independence (%),
- Degree of diversification of the imported energy sources,
- Spending on energy research relative to total spending on energy (or spending on research per unit of energy used).

The first indicator is rather simple and self explanatory, assuming that domestic sources are more reliable than imports. It is equal to the ratio of energy production in the country (including its continental shelf) to its primary energy consumption.

The degree of diversification can capture the effort made by a country to manage the risk of dependence from a single energy source and can be calculated as the sum of squared quotas of each source, excluding domestic resources not contributing to increase the social risk. The lower the indicator, the higher the security of the energy sector. If technical interruptions are the main concern, the index could be calculated treating each import route separately – a problem with the pipeline from a country would not necessarily prevent liquefied natural gas imports from that country. If the main concern is geopolitical risk, however, then the index should be based upon the ultimate source of imports, rather than on transit countries – problems in Russia could affect gas supplies from that country, whether they are routed through Belarus or the Ukraine.

The third indicator shows the effort made to improve the future conditions of the energy sector in relation to the incidence of the cost of electricity. It helps understand the readiness of a country to face the challenge of long term sustainability. A country can often use the results of research undertaken abroad, of course, but a strong local research base will help it to adopt innovations created elsewhere. If spillovers are strong, however, it might be that the overall level of research within the EU as a whole would be the most important variable.

Affordability can be a concern to many electricity consumers. Fuel poverty is defined to occur when a household has to spend more than a set percentage of its net income (typically ten per cent) to achieve an acceptable standard of lighting, heating and cooking, or lives in a home that cannot be adequately heated. The proportion of households in fuel poverty is an indicator of this aspect of social sustainability, although it will reflect both the performance of the electricity industry (in terms of average prices, and any special tariffs) and of the economy more generally (in the level and distribution of incomes).

From a broader perspective, the lack of universal access to electricity should be considered a serious matter of concern within the EU, although basically all of this lack of access happens outside European borders. Numerous studies have shown the strong relationship between lack of electricity and very low indicators of human development. In its energy strategy the EU cannot ignore that almost one third of mankind has no access to electricity or other advanced forms of energy, both because of solidarity reasons and also because of the many problems derived from the existing strong inequalities in human development. An adequate indicator here would be the amount of effort that the EU countries devote to international cooperation in energy matters.

6.2 Environmental sustainability

The most familiar aspect of sustainability is related to the effects of electricity generation on the environment. Many studies investigated the consequences of liberalisation on environmental performance, showing that strict environmental regulation is necessary to avoid an excessive focus on competition distracting attention from controlling the industry's environmental impact (e.g. Froggatt, 2000, Kemfert 2004, Hertin 2004). Leaving aside the aspect of the companies' performance, which is anyway important, the countries' policies are considered here.

The investments for sustainability cover a large spectrum of initiatives, ranging from research and demonstration of new technologies, to the reduction of pollutant emissions, to the support for cleaner energy sources and for energy saving initiatives. The evaluation of performance on these areas can be difficult for the lack of comparable data among countries, but some indicators for the environmental sustainability of the electricity industry can be proposed, concentrating on pollution and on the promotion of renewable generation.

- CO_2 emissions per kWh generated,
- expense for research on renewable energy,
- proportion of generation from renewable sources
- rate of increase of renewable generation,
- spending on the promotion of renewable energy,

Electricity from conventional sources produces various emissions, of which carbon dioxide is currently receiving the most attention. Carbon dioxide contributes to global warming and climate change, and is the subject of reductions under the Kyoto Treaty. The amount of CO2 emissions per kWh generated is a suitable benchmark for this pollutant. (The denominator should include all generation in the country, not just conventional stations.) Other important pollutants, which cause acid rain, are sulphur dioxide and nitrogen oxides. Once again, the emission per kWh generated can be used as a benchmark. Nuclear generators produce radioactive waste, and the weight or volume of this could be benchmarked. The International Nuclear Event Scale, developed by the International Atomic Energy Agency and the Nuclear Energy Agency of the OECD, is a standardised measure of the severity of operating

incidents (from anomaly to catastrophic failure) – this could be used to form a benchmark on nuclear operating performance.

Renewable energy is taken as benchmark thanks to its long term sustainability and security (EEA 2004). The absolute level of renewable generation may not be a suitable benchmark, because countries differ so much in their natural resources. The rate of increase in the share of electricity generation is considered as a sign of the country's commitment. This will tend to give "late developers" a better score than those countries which exploited their resources on a large scale in the past, however. An alternative measure would be the amount of renewable generation relative to the country's potential renewable resource. The problem with this measure is that the level of resource is not an absolute figure, for more energy could be produced at a cost of €100/MWh than at a cost of €80/MWh, and estimates of the exploitable resource may not take other constraints, such as the impact on the local environment, into account. We would not recommend placing too much weight on the measure as an indicator of the strength of policy without access to a set of consistent estimates of the resource in each country, calculated on a basis that is as objective as possible.

We can also benchmark the effort put into investing in renewable generation, measuring both the expenditure on research and development in this area, and the overall amount spent on supporting renewable generation. It is probably most appropriate to benchmark this figure per kWh of electricity consumption (from all sources) as a measure of the national commitment. A high figure per kWh of renewable generation could imply either that the country was supporting this in a very inefficient way, or that it had a very unfavourable environment for renewable power production, or that it aims at exporting its technology (it is the case of Denmark). The overall performance of a country emerges clearly from such indicators, covering most of the policy aimed at environmental sustainability.

Energy saving has also an environmental value and would deserve attention under this perspective, but thanks to its economic profitability will be considered in the following section.

6.3 Economic sustainability

The adequacy of capacity and the capability of the industry to supply electricity at competitive prices in the long term are major issues in the evaluation of sustainability. A particular emphasis is given to the efficiency in the final uses of electricity. This is well captured by the intensity of the electricity use and its trend. The burden related to the acquisition of energy sources can be defined by the incidence of the expense for importing of energy products on national income. The indicators proposed are thus the following:

- electricity intensity and its rate of change
- Energy imports/GDP

With reference to the security of supply in terms of capability of the industry to meet the long term demand with proper investments, the reserve margin of electricity generation capacity can be a suitable indicator. This is equal to the total capacity, less the peak demand, divided by that demand. When possible, the peak demand should be adjusted to reflect an average year for weather conditions, so that the reserve margin used to make comparisons across countries and over time is not depressed by an exceptionally severe winter. Note that a country with a high proportion of hydroelectric power will always tend to have a high reserve margin in terms of capacity, since the binding constraint on most hydroelectric plants is their reservoir size and annual energy production, not hourly energy output. In the European context, some countries may be able to rely on imports from their neighbours, although this is obviously not possible for all countries at once (Jamasb and Pollitt, 2005).

The average age of the thermal power plants could also affect their thermal efficiency (modern plants are more efficient, although new plants often have teething problems), while a high average age is a signal that replacement investment will be needed soon. The level of capacity, the rate of demand growth, and the ages of the existing power stations could be combined in an estimate of the amount of new capacity required in the next five or ten years. This would be based on the amount of existing capacity that would exceed a specified (and technology-specific) design life, adjusted for the effects of demand growth (or reductions). A specified margin of spare capacity would be required – if the current margin is greater than this, less new investment would be needed.

7 Conclusions

These benchmarks are signals about the performance of the electricity sector in the Member States of the European Union. A country may score favourably on some benchmarks, despite adopting inappropriate policies, while a country with good policies but an unfavourable background environment might score poorly on some benchmarks. As always with economic statistics, we need to be careful about attributing causation once we have discovered a correlation. Some of our benchmarks measure the potential for problems (and that perhaps imperfectly) rather than confirming the need for action – a company with a high capacity share within a national market may not have market power if it faces strong competition from imports, and the existence of a dominant position does not mean that it will actually be abused. Having given these warnings, however, a good choice of a range of relevant benchmarks can minimise the number of times that a misleading signal is sent.

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Tables

***Table 1:** Indicators relevant to market design*

Country	Market opening	Type of unbundling		Market model	Balancing prices set:	Turnover in	
		Tran	Dist			Power exchang	Standard contracts
Austria	100%	leg.	leg.	Bilateral	market	2%	
Belgium	c.90%	leg.	leg.	Bilateral	regulated	-	-
Denmark	100%	leg.	leg.	Hybrid	market	34%	340%
Finland	100%	own.	acc.	Hybrid	market	34%	340%
France	70%	leg.	Man.	Bilateral	market	2%	
Germany	100%	leg.	acc.	Bilateral	market	8%	69%
Greece	62%	leg.	None	Bilateral	TSO		
Ireland	56%	leg.	Man.	Bilateral	reg\mkt	-	-
Italy	79%	own.	leg.	Bilateral	Reg\TSO	5%	20%
Luxembourg	57%	man.	Man.	Bilateral			
Netherlands	100%	own.	leg.	Bilateral	market	15%	n.k.
Portugal	100%	own.	acc.	Bilateral	regulated	-	14%
Spain	100%	own.	leg.	Pool	market	99%	2%
Sweden	100%	own	leg.	Hybrid	market	34%	340%
UK	100%	own.	leg.	Bilateral	market	11%	660%
Norway	100%	own.	leg.\acc.	Hybrid	market	34%	340%
Estonia	10%	leg.	leg.	Bilateral	TSO	-	-
Latvia	76%	HH	acc.	Bilateral	TSO	-	-
Lithuania	n.k.	leg.	leg.	Bilateral	Reg\TSO	19%	-
Poland	52%	leg.	acc.	Bilateral	market	1%	-
Czech Republic	47%	leg.	acc.	Bilateral	market	-	-
Slovakia	66%	leg.	man.	Bilateral	regulated	-	-
Hungary	67%	leg.	acc.	Bilateral	regulated	-	-
Slovenia	75%	leg.	acc.	Bilateral	market	3%	-
Cyprus	35%	man.	None	Bilateral	TSO		
Malta	0%	n.a.	Single buyer	n.a.	n.a.		

Source: European Commission (2005)

Turnover figures are relative to consumption in the country, or the Nord Pool area in the case of Denmark, Finland, Norway and Sweden. A dash indicates that no figure is reported by the Commission, a blank space that the country is not listed in the relevant table.

***Table 2:** Indicators relevant to market power*

Country	Capacity share in generation (%)		Market share of top 3 retailers (%)	Vertical integration	Customer switching in 2003	
	Largest	Top 3			Large	Small
Austria	45	75	67		7	1
Belgium	85	95	90		8	19
Denmark	15 [a]	40 [a]	67		22	5
Finland	15 [a]	40 [a]	30		16	4
France	85	95	88		n.k.	N/A
Germany	30	70	50	50	n.k.	n.k.
Greece	100	=	100		0	N/A
Ireland	85	90	88		6	1
Italy	55	75	35		n.k.	N/A
Luxembourg	n.a.	n.a.	100		n.k.	N/A
Netherlands	25	80 [b]	88		n.k.	n.k.
Portugal	65	80	99		7	1
Spain	40	80	85		5	0
Sweden	15 [a]	40 [a]	70		5	10
UK	20	40	60	50	n.k.	22
Norway	15 [a]	40 [a]	44		15	19
Estonia	90	100	n.k.		0	N/A
Latvia	95	100	99		0	N/A
Lithuania	50	80	100		17	N/A
Poland	15	35	32	10	7	N/A
Czech Republic	65	75	46		n.k.	N/A
Slovakia	75	85	84		3	n.k.
Hungary	30	65	56		19	N/A
Slovenia	70	95	71		10	N/A
Cyprus	100	=	100		0	N/A
Malta	100	=	100		0	N/A

Sources: European Commission (2005)

[a] Data for Denmark, Finland, Norway and Sweden are for the countries combined.

[b] Data are rounded to the nearest 5%, implying that the top 3 generators in The Netherlands each have a share very close to 25%, with an average of 26% or higher.

Market share in retailing includes non-eligible customers, except in The Netherlands, where the data are for household customers

***Table 3:** Some indicators relevant to regulation*

Country	Strength of regul (Max 5)	Compet-encies of regulator (Max 6)	Tenure of head of agency (years)	Ease of dismissal of Head	Agency Financing	Civil service pay	Website in English	Cost of regul
Austria	4.5	4	4-6	Diff	G	Yes	Yes	0.145
Belgium	5				P	No	Yes	0.283
Denmark	3	5	4-6	Diff	P	Yes	Yes	0.756
Finland	4	5		Diff			Yes	0.016
France	4	3	4-6	Diff			Yes	0.086
Germany	0						Yes	N.A.
Greece	3	4	4-6	Diff			No	0.293
Ireland	5	6	4-6	Diff	P	Yes	n.a.	0.833
Italy	4.5	5.5	7+	Diff			Yes	0.102
Luxembourg	3.5	2	4-6	Diff			No	0.100
Netherlands	3	5.5		Easy	P	Yes	Yes	0.109
Portugal	5	4.5	4-6	Diff	P	No	Yes	0.355
Spain	3	3	4-6	Diff	G	No	Yes	0.102
Sweden	4	5	4-6	Diff	P	Yes	Yes	0.022
UK	5	5.5	4-6	Diff	P	Yes	n.a.	0.170
Norway	5	6	4-6	Diff			Yes	0.016
Estonia	3						Yes	>0.300
Latvia	5						Yes	>1.700
Lithuania	4				G	Yes	Yes	>0.600
Poland	4				P	Yes	Yes	0.140
Czech Republic	5				G	Yes	Yes	0.253
Slovakia	4						No	0.375
Hungary	3				P	Yes	Yes	0.689
Slovenia	4						Yes	0.250
Cyprus	4						No	0.500
Malta	2						n.a.	>>>10

Sources:

Strength of regulatory agency on a scale of 1 to 5, 2003 data (Jamasb and Pollitt, 2005);

Competencies of regulator: Full=1, Partial=0.5, None=0 for each of tariffs, network access, licensing, terms of delivery, disputes and enforcement, (Larsen et al, 2005);

Tenure of Head of agency: Range of years, (Larsen et al., 2005);

Ease of dismissal: Diff=difficult to dismiss on policy grounds; Easy=no specific provisions limiting government dismissal (Larsen et al. 2005);

Agency Funding: G=government, P=private sector, 2000/2001 data (Domah, Pollitt and Stern, 2002);

Civil service pay: 2000/2001 data (Domah, Pollitt and Stern, 2002);

Website in English accessed 25/08/05 n.a.=English speaking countries;

Cost of regulation equals Annual Budget 2003 euros divided by size of open market in TWh (European Commission, 2004).

Table 4: ***Indicators relevant to EU Enlargement***

Country	Ratio of domestic to industrial prices
Austria	1.69
Belgium	1.46
Denmark	1.30 [a]
Finland	1.39
France	1.54
Germany	1.45
Greece	0.92
Ireland	1.20
Italy	1.65
Luxembourg	1.89
Netherlands	0.89 [a,b]
Portugal	1.67
Spain	1.37
Sweden	1.56
UK	1.61
Norway	
Estonia	1.23
Latvia	1.21
Lithuania	0.99
Poland	1.18
Czech Republic	1.32
Slovakia	1.35
Hungary	1.01
Slovenia	1.40
Cyprus	0.83 [a]
Malta	0.87

Sources:

The ratio of prices is the average of the ratios, taken in January and July 2004, of the Eurostat price for domestic customers (type DC) to the prices for type IB (larger) and type IC (smaller) industrial customers.

[a] Data are for smaller industrial customers only. In the countries with data for smaller and larger customers, the average for smaller customers is 0.95, for larger ones 1.76

[b] Data for 2001

***Table 5:** Indicators relevant to sustainability*

Country	Research effort		CO_2 emissions (g per kWh)	Increase in RES, p.a.	Proportion of RES, %
	In energy ($ per tep)	In RES (m €)			
Austria	1,029*	12.5	192	2.3%	62.7%
Belgium	1,074**	12.1	274	5.8%	3.6%
Denmark	1,301	24.0	336	19.8%	18.9%
Finland	2,163*	51.6	234	5.6%	23.6%
France	1,710*	52.6	70	1.5%	12.4%
Germany	0,872	294.8	508	7.1%	9.5%
Greece	0,343*	2.5	820	6.7%	10.9%
Ireland	0,505	0.3	660	4.8%	5.9%
Italy	1,876	32.7	500	3.3%	18.9%
Luxembourg		0.3	201	2.0%	27.9%
Netherlands	2,023*	115.7	439	13.1%	5.5%
Portugal	0,068	2.0	470	0.4%	39.3%
Spain	0,396	29.7	404	3.3%	23.5%
Sweden	2,152	30.1	37	-0.4%	43.9%
UK	0,231	28.3	458	5.0%	3.5%

Sources:

Research effort in energy is spending in the energy sector ($ 2003 per tep consumed) (IEA 2004) * = 2002 data, ** = 1999 data

Research effort in RES is total expenditure for RD&D for RES in each EU country in 2001, in millions of 2002 € (EC 2004)

CO_2 emissions in grams per kWh from electricity and heat generation (IEA, 2004b)

Increase in RES is the average annual percentage growth rate of renewable electricity generation from 1990 to 2002 (IEA, 2004)

Percentage of generation (gross) from renewable sources is from Eurostat, data for 2003