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REGIONAL INITIATIVE: WHICH APPROPRIATE MARKET DESIGN?

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Abstract

The European Union has a long experience and many success stories when it comes both to build a borderless Europe and to ensure that benefits are fairly distributed among producers and end-use customers. In some sectors results and benefits arise quickly, but sometimes borders remain difficult to cross despite numerous initiatives. A typical example of this is the completion of the single market for electricity. The process has been ongoing since the early 1990s and major progress has been made. However, we are still far from a borderless and truly competitive electricity market across Europe. A new legislative framework, the Third Package, will enter into force shortly and yield strong expectations. However, growing concerns become apparent among policy makers and in the market place on its ability to effectively foster the completion of the internal market and tackle market power issues. This paper argues that the approach adopted in the Third Package is not adapted to the challenges the European Union faces in electricity. The current lack of focus on implementing a better market design architecture leads the EU regulatory framework to overlooks important issues such as the promotion of power exchanges. The paper reviews the current state of the art on ‘smart’ market design in the economic literature and confronts it with the concrete experiences pursued at the regional level, in the European Union and beyond. Some of the issues discussed in depth include the TSOs’ roles and institutional design, generation adequacy and the design of capacity mechanisms and the development of demand-side response programs. It shows that the EU should learn from some of the on-going initiatives pursued at the domestic and regional level and that a sound market design based on a pool/TSO central dispatch is probably the way forward.

Keywords

Market Design, Electricity, European Union, Regional Initiatives

Introduction

The EU target of one single electricity market has been on the agenda since the mid-1990s but a real breakthrough is not only missing but still arguably far ahead. Both the 1996 and 2003 Directives had the best intentions with regards to removing trade barriers and ensuring efficient national electricity markets. Most national markets have been restructured and a better management of interconnection has contributed to increase electricity trade across Member States. More cross-country trade was also an outcome of the active participation of all stakeholders in new public organizations such as the Florence Forum[1], CEER[2] and ERGEG.[3] These organizations have been a catalyst for this fruitful development, but the main target is still remote.

The DG COMP Sector Enquiry (2007),[4] together with the constant DG TREN's monitoring efforts, identified the major shortcomings and barriers to the emergence of efficient electricity markets. The need to improve regulatory tools and remove market barriers was evident and urgent actions were needed. These findings initiated a major regulatory reform: the '3rd Package'. This initiative aims to fix all the 'missing' links in the current regulations and to create a pan-European regulatory agency called ACER. However, the proposal to impose full ownership unbundling of the Transmission System Operators (TSOs) encountered the opposition of several Member States.[5]

However, this major regulatory 'update' is still pending and, during the consultation process, the initial optimism has somewhat cooled down. Most elements of this new regulatory update are related to monopoly activities, but a much needed regulation specifically targeting more *competitive* markets is still missing. The latest update is on the new pan-European regulatory body, ACER. The recent developments indicate that ACER will enjoy very limited powers, which means that the objective of creating a strong European 'FERC'[6] has largely been abandoned.

Creating coordinated power exchanges is still not an issue at EU level. Regional solutions for efficient congestion management, coordinated balancing markets and settlements emerge on a voluntary basis and are shaped by national regulatory traditions. The creation of an EU legislation to facilitate the regional initiatives is still not on the agenda.

This paper tries to emphasize the main challenges remaining unaddressed in the 3rd Package. This contribution relies on the main findings of papers looking for a Market Design which will boost the development of efficient markets at the regional level. Most of these papers are based on concrete experiences of 'good' Market Design. The selection of contributions has been made exclusively by the author and is of course not neutral. It is the author's hope that it can contribute to the debate on establishing better markets, both domestically and regionally.[7]

In the concluding part, a critical assessment is made in order to study how regulatory proposals are integrated into EU legislation. A critical issue is that a large number of prerequisites for well-functioning markets are not included in Directives or Regulations. One such example is the role and importance of power exchanges in ensuring efficient wholesale markets, as well as their role in the

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1 The European Commission initiated this forum as a 'meeting place' for national regulators, representatives of ministries and the main stakeholders in the power sector.

2 Council of European Energy Regulators (CEER)

3 Consultative body for the EC in the comitology process.

4 DG Competition, Report on Energy Sector Inquiry, SEC(2006) 1724 final of 10.01.2007.

5 France and Germany were the main opponents.

6 FERC is the US Federal Energy Regulatory Commission which- handles interstate regulation.

7 The innovative discussion of Market Design issues took place during a relative short period of time in 2004–2006.

dispatch process. Voluntary agreements will not work when the parties cannot even agree on the opening hours of power exchanges!

There are still a large number of issues addressed by EU law which are not efficiently enforced by national regulation and thus create some sort of regulatory ‘gaps’. DG COMP mapped several of these gaps and for the most part they served to protect incumbents from competition. The fact that these regulatory gaps still exist in spite of the major efforts of the EU since 1996 indicates the lack of coherence of energy policy and practice in Europe.

1. The Current (Non-)Approach to Market Design in Europe

Where did it all start – any cross-country lessons learned?

The development of competition in the power sector took place in the late 1980s in an almost parallel way on two continents. Chile and Argentina in South America, and England & Wale and Norway in Europe, were the pioneers[8] in the restructuring of the electric industry. However, the transfer of experience and knowledge between South American and European experiments was very limited.[9] The main focus was on domestic issues. Power trade and regional initiatives were not on the agenda.

The Argentinean reform mainly focused on domestic issues. The key elements of success were: spot market, a competitive structure in the generation market with no single dominant firm, nodal prices, well-organised dispatch, good investment incentives, etc. The absence of a fruitful dialogue with the other South American countries can be considered a limiting factor in the introduction of a broader debate on competitive power markets in Europe.

In Europe, the regulatory system in England & Wales soon became the dominant model, although the early progress slowed down and dominant generation entities created obstacles to an efficient wholesale market. The rapid progress in Norway and the Nordic market attracted attention but a hydro-dominated system ‘far north’ was of limited interest to Central and Southern Europe.

We note that the very few examples of regional initiatives took place mainly in hydro-dominated systems. Some of the first developments were in Norway in the late 1960s when the largest hydro generators formed an organisation to lower the risk of water shortage[10] during dry/cold winters. Later on this organisation was transformed into a new pool named NordPool. When Sweden introduced competition in 1996, and by the same time joined NordPool, the first true international power pool was born.

Very soon the other Nordic countries joined NordPool and the first organised regional initiative became a reality. The owners of NordPool were the Nordic TSOs. The long and fruitful Nordic cooperation in several other areas secured a smooth and long-lasting cooperation in the Scandinavian power sector. The net effect of power trade was evident and supported a trend of ever closer cooperation. This regional development was accomplished without any cross-Nordic legislation or regulation. This Nordic model was supported politically by the Nordic Council of Ministers, as well as by Nordel, the association of Nordic TSOs. The cooperation was complete with the creation of NordReg, the organisation of Nordic Regulators. A fully integrated governance structure[11] was in place from very early on and contributed to a sound Nordic Market Design. It is important to

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8 Chile and Argentina were the fist countries to introduce competition in South America and at the same time introduced some of the most innovative regulatory solutions.

9 Stephen Littlechild published papers on the developments in South America, Argentina in particular, which have been innovative and of concrete relevance for Europe.

10 Similar power exchanges were organised in the US and served the same goal.

11 Each TSO had the same ownership part and equal representation in the board of Nordel.

emphasise the fact that the EU energy Directives did not represent a driving force; rather, an efficient Nordic market was perceived to be in the interest of all Nordic countries. In terms of governance and bureaucracy, this framework can be viewed as an independent, smaller, Nordic version of the EU.

This Nordic model of Market Design was used as a benchmark when DG TREN wrote the draft *Strategic Paper*.[12] This Market Design has passed several tests, of which the most severe was the situation in winter 2002–2003, when the hydro reservoirs almost ran out of water and spot prices 'sky-rocketed'![13]

EU regulations and efforts to create regional initiatives

The introduction of competition within EU Member States' power markets had a very different rationale from that of the pioneering countries.[14] Liberalisation and legislators thus faced different challenges and strategic elements. The Electricity Directives of 1996 and 2003 in fact did not introduce regulations and tools similar to the ones implemented in the Nordic and South American countries.[15] Of course, elements from the Nordic Market Design could not be 'blue copied' into the EU legislation. But the Nordic model represented a fully coordinated Market Design covering the whole value chain from generation to retail sales, household customers included. The goal of restructuring was very much the same worldwide but the prescription, the 'how to get there', varied to a very large extent.

The most basic element, the organisation of the wholesale market (NordPool), was organized first in the Nordic model, whereas the main EU building blocks were not introduced in the same logical order, and no clear path or direction was evident.

Compared to the Nordic Model, the current EU legislation appears more fragmented and important 'cornerstone' organisations such as power pools are hardly mentioned at all. In order to facilitate trade, a new Regulation was adopted (1228/2003[16]). This regulation covers the harmonisation of tariffs, congestion management and compensation for transit (ITC). The full transposition of this Regulation is still pending and important components have yet to be implemented.[17] The idea behind this Regulation is to create new mechanisms to facilitate trade but it has not yet led to successful results.

It is timely to quote the "lessons learned" from market reforms[18] by Paul Joscow:

- Economic textbooks provide a sound guide for successful reforms,
- Departure from economic textbooks is likely to cause problems,
- Spot prices integrated with TSO operation are needed,
- Spot markets need demand response,

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12 The first draft had a clear view on power pools, but this element was not retained in later versions. See e.g. in the final version *Strategy Paper – Medium Term vision for the Internal Electricity Market* of 1.3.2004.

13 Most contributors have made comments on this period.

14 England & Wales (privatization), then Norway and later Sweden – and finally enhanced Nordic cooperation.

15 At the fist Florence Forum meeting, Norway and the USA (FERC) were invited as main speaker. The USA had just showed interest in restructuring the power industry but the coordination of State Regulators with FERC was lacking and the final outcome was later the 'collapse' of the Californian experiment.

16 Regulation 1228/2003 of 26 June 2003 on conditions for access to the network for cross-border exchanges in electricity, O.J. 15.7.2003, L 176/1.

17 Compensation for hosting transit (ITC), which still lacks a proper and operational definition, is often missing. Many stakeholders are still opposed to this arrangement, which may not promote trade and acts as a transaction-based mechanism. A full revamping had to be included as part of the 3rd Package but no efforts was ultimately made.

18 Joskow, "Lessons Learned from Electricity Market Liberalization", *The Energy Journal*, Special Issue (2008). The Future of Electricity: Papers in Honour of David Newbery, 9-42.

- Transmission investment is still a challenge,
- Market power is a significant problem but the cure may be worse than the disease,
- Strong political commitment to reform are essential,
- Reform adjustment and fine-tuning will be needed, depending on the adequacy of the original design and its execution.

These lessons represent important issues when Market Design is set or revised. These bullet points highlight some shortcomings of the EU legislation, such as spot market integration and how adjustments or revisions of legislation should be conducted when changes are needed.

The regional approach: What is missing? Do we have a proper Market Design?

One of the most comprehensive studies of regional markets is the *The Regional Approach in Establishing the Internal EU Electricity Market* by Jacques de Jong.[19] The report provides a good overview of the development both in the EU and in the US by focusing on the ongoing debate regarding the FERC's initiatives on regional wholesale markets.

The report emphasises that a large number of technical and political issues still need to be settled such as industry structure, market power, cross-border trade and integrating cross-border markets. The discussion will continue on many levels and the issues are numerous and complicated. The US is also subject to this ongoing discussion and challenges are very often the same such as regional market organisation and regulatory design.

The report recommends the following:

> "to develop a legal framework for regional electricity markets with a set of minimum requirements. These requirements should include a physically and commercially strong interconnected system, a common view from the regulatory authorities on the prospects of regional markets, a clear and effective cooperative scheme between national TSOs and national regulators, a comparable level of TSO unbundling together with a set of mutually consistent rules for third party access (TPA) together with the intention of achieving integrated regional balancing markets and power exchanges […] And finally, the appropriate EU legal framework should be provided to establish the regional market procedures in a new EU regulation on regional electricity markets."

To sum up the recommendations, it seems that a major revision according to a pool/TSO dispatch Market Design is the way forward.

The current EU approach looks like a big 'toolbox'. If progress is slow or insufficient, the box is opened and an ad hoc 'repair' is made. The repair very frequently represents a stricter and more detailed prescription for how regulation must be conducted case by case. This trend represents a sort of 'continuous fixing' policy which very rarely promotes proper incentives to create innovative and sustainable solutions. This paper presents instead a first step towards a smart EU Market Design, including suggestions for appropriate incentives. When this overall design has been set in motion, guidelines and more details can be added. Continuous small-scale repairs should not be the primary tool.

The EU strategy has indeed perhaps reached a crossroad. Will stricter and more detailed regulations, rules and codes bring us closer to the objective, or will more support to incentives and a better Market Design be a better alternative?

Markets do not happen over night – they need to be created and continuously supported in order to be competitive. Too many rules and regulations may hamper innovation and create barriers rather than

[19] Clingendal International Energy Programme (CIEP), December 2004.

opportunities to improve the functioning of markets. Fostering innovation and supporting new ways of thinking are often preferable to waiting for repeated regulatory 'fixes'.

Major updates needed – the revision of the 3rd Package

CEER, ERGEG and EC all publish status reports, compliance documents, etc, to obtain feedback on how current regulations work and to discuss the need for updates and revised regulations. Combining these lessons learned and the critical outcome of the DG COMP sector enquiry, a major updating of the energy Directives was inevitable.

This process of revision was labelled 'the 3rd Package', and it is in fact a major and comprehensive update of the 2003 Directive. The 3rd Package is targeting the missing links when it comes to cross-border trade monitoring and proposes to organise cooperation between regulators and EC (the new agency ACER in a more committed and stronger structure than the loose and bureaucratic ERGEG). TSOs will also be more strongly committed into the regulatory process through the establishment of ENTSO-E[20] and its link to ACER.

The 3rd Package represents a much more consistent approach than the previous updates, and power trade and regional initiatives are now high on the agenda. The creation of ACER as a separate agency for regulation will represent a substantial improvement, although the decision mandate is not very strong. A more distinct role for the TSOs and the new organisation ENTSO-E should contribute to mitigate the current shortcomings on calculating the optimum capacity of interconnection and to organise trade more efficiently.

The 3rd Package has a strong focus on power trade. The revised legislation tries to remove barriers to trade and to provide a fresh approach to the coordination of Member State regulators, as well as obtaining a more efficient harmonisation of rules.

Among the main inputs of the 3rd Package are the recommendations from the DG Competition power sector enquiry, which revealed a rather large number of barriers to competition. One important obstacle is the full ownership unbundling of TSOs, which is still a pending issue for the EC. As to the main arguments: without ownership unbundling and transparency, proper incentives for new investment will not be provided.

The most important obstacle to make real progress when it comes to regional market development is the lack of a consistent Market Design across the EU. The current focus is still mainly on monopoly functions and too little attention has been paid to the creation of markets and how they can work efficiently. Several member states have a long experience of creating power exchanges which have contributed both to robust price settings and tools to better handling congestion management. This recipe is not integrated and coordinated well in the 3rd Package.

The *Strategic Paper* proposed a role for power exchanges but pools are not included in Directives or Regulations.[21] However, the obvious advantage of a power pool has become apparent and national or regional pools were created across Europe. This development was welcomed, but harmonisation and coordination among member states are still missing, and the full benefits have not been achieved.

To compensate these imperfections, efforts were made to create second-best solutions, named 'market coupling', to improve the daily cross-border capacity utilisation among member states.[22]

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20 This is a new and updated ETSO, which will coordinate and propose new codes on how TSO operations should be conducted.

21 The strategic paper also proposed a timetable for the implementation. 2004: co-ordinated congestion management (combined TSO and PX coordination – implicit auctions); 2005: ITC into force and market-based solution in operation (Nordel Model?); 2006: access of all the Member States to a PX and congestion fully coordinated!

22 Market coupling seminar in Brussels, ETSO, 9 April 2008.

These market coupling mechanisms have not always been successful[23] and more robust solutions must be considered. The most efficient way to improve trade will be to coordinate and harmonise power pools to cover all regions of the EU. The need for harmonised and coordinated national/regional power exchanges becomes quite apparent when market participants try to benefit from regional markets and thus want to increase the volume of trade. Why the European Commission did bring these sound principles to a halt is still an unanswered question.

2. A Full Debate on Market Design is Needed – 'Repair Only' Will not Work

A sound Market Design for electricity was heavily debated in the USA in the early to mid-1990s. A Market Design based on the integration of a pool-based, short-term electricity market coordinated by a central dispatch operator provides a foundation for an open access system based on competition.[24] This approach could be used to handle critical issues such as congestion problems and to ensure efficient technical operation, and at the same time be consistent with economic efficiency. To ensure optimal utilisation of the grid, the dynamic location of prices according to pool bids is necessary and contributes to the optimal flow of electricity. Some countries have successfully implemented basic elements of a design of this kind.

The European debate on Market Design has so far mainly focused on security of supply and generation reserves. The baseline for most contributors has been that no market is perfect and that electricity is no exception. The main focus becomes to map market 'anticipated' failures and fix problems. An alternative strategy aiming to establish a robust design based on dynamic pricing, combined with central dispatch to optimise the use of resources, has usually been disregarded. A re-opening of the Market Design issue in connection with the 3rd Package would have made sense but this opportunity was missed during the consultation process.

In Europe, the Market Design concept has not been debated as frequently as in the US even though the SESSA project made some very useful contributions, such as the David Newbery's *Consensus on good Market Design* (Stockholm, October 8, 2004). The David Newbery's Market Design paper focuses on:

- Confidence in supply security
- Sustainable competitive outcomes
- Efficient free entry and investment
- Efficient cross-border trade
- Socially efficient emissions

David Newbery explains that the choice of Market Design is unlikely to offset poor market structures and avoid gaming while supporting integrated spot and interconnected markets. Newbery gives a warning on merger issues, especially when they take place between dominant gas and electricity companies. When Sweden introduced competition in the power sector in 1996, creating a common Norway-Sweden platform into NordPool was important. Vattenfall was indeed still overly dominant in generation and splitting the company in several entities could have been a possible solution. Sweden however had an international strategy of expansion for Vattenfall, who indeed subsequently acquired a strong market position for instance in eastern Germany through mergers and acquisitions. Enlarging market size through joining a coordinated power exchange was thus considered the best solution to mitigate potential abuses of market power.

[23] The latest example is Denmark – Germany.

[24] This argument was often used by William Hogan and papers published by the Harvard Energy Policy Group.

The Florence School of Regulation initiated a workshop on critical Market Design issues

The Florence School of Regulation organised a workshop in July 2004: "The European Market for Electricity: Where Do We stand?" Some of the conclusions were:

- The capacity margin is lower than what is considered adequate.
- Focus should be on price signals, investment and generation adequacy.
- Experience shows that when markets are left to operate freely and send correct price signals, investors do respond.

The solution with respect to long-term generation capacity adequacy may be to introduce capacity support mechanisms. The debate on Market Design for this issue did split into two alternatives:

- As concerns whether competitive electricity markets provide sufficiently strong and early investment signals, the main focus inclines towards measures to repair market 'failures'.
- A pool-based, short-term electricity market coordinated by a central dispatch operator provides a sound Market Design. The main challenge is dynamic efficient pricing throughout the whole value chain in order to create incentives for efficient operation and investments.

Research about power Market Design in Europe has focused on the first point. The baseline for the first group was that the European Market has several features that veil or distort investment signals and incentives. Given examples are: no mandatory power pools, limited trade or trade only with neighbouring markets, demand side not sufficiently robust, demand management and real time meters not in place, limited cross-border capacity. Most European markets are capacity-constrained rather than energy-constrained. This sceptic approach has dominated the Market Design debate for the last 10 years, but no common large-scale capacity markets have been implemented.

The advocates of the need for new capacity mechanisms often use the lack of demand response and inadequate generation incentives as arguments to focus on capacity markets. Various crises such as in California, Italy, New Zealand and Scandinavia are given as evidence to question the ability of competitive markets to provide proper investment signals. However, all these crises have been scrutinised and no common market failure has been identified.

Most electricity legislations and regulations have addressed activities with natural monopoly elements, such as wires and system operators, to ensure transparency, low monopoly profit, quality and reliability. But the fact that the market cannot solve all problems on its own is an important insight that regulators must acknowledge and take into account. The main dilemma is how to combine the technical efficiency of the power system while implementing superior solutions from an economic point of view. The way forward will be to study the whole value chain carefully and decide which activities can be exposed to market forces and which ones must be left as monopolies in need of strict regulation. It will be important to obtain a full understanding of, and consensus on, why and how all these activities are linked. This Market Design approach may represent a major change to current EU legislation development and reshape energy policy for the future.

Critical Market Design issues – some academic contributions

The first paper is from The Faculty of Economics at Cambridge (2004)[25] and was a joint project between E-Control[26] (Austria) and NVE (Norway). The background of the initiative was the debate on 'energy-only' market and the introduction of reliability options (ROs) as well as their role in Market Design.

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[25] Newbery, Neuhoff and Roques, "Generation Adequacy and Investment Incentives in Liberalised Markets", Faculty of Economics, University of Cambridge, 5 August 2005.

[26] E-Control is the national regulator in Austria.

The second academic paper, *Electricity & Gas – Market Design and Policy Choices*[27] by L. de Vries, F. Correlje and P.A. Knops focuses on security of supply and Market Design. The paper underlines the weaknesses of energy-only markets and maps the current barriers to a better Market Design as well as generation adequacy shortcomings. By adding the Norwegian paper on TSO investment, a debate on generation adequacy and transmission investment will be possible. To illustrate a successful Market Design, *Why the Nordic Market has Worked so Well?* by Lars Bergmann is added at the end of the chapter.

The introductory remarks for the Cambridge report underlines: "Opinions differ on whether liberalised 'energy-only' markets will deliver efficient, adequate and timely investment, or whether additional instruments, such as capacity payments, obligations or options are necessary and even desirable." Poorly designed mechanisms could easily be counterproductive, distorting the market and leading to replacement of profit-motivated investment by tendered or system operator (SO)-contracted investment.[28]

Standard economic theory as applied to electricity markets (e.g. Caramanis, 1982[29]) shows that a well-designed set of competitive (nodal) spot markets give prices that, if correctly predicted, would induce the efficient level and type of investment. The practical question is whether such market will function as predicted by the theory, whether investors will forecast future conditions and/or prices sufficiently accurately or whether they will be otherwise deterred (by risk aversion or the fear of regulatory intervention) from responding to those signals in a timely manner. There are subsidiary questions which are relevant in certain circumstances, such as whether generators with market power tend to over or under-invest (in base, mid-merit and/or peaking units) when the market is small relative to the size of generation units Similar questions can be raised in the specific context of hydro-based systems bordering a low-cost generation country and/or in the presence of significant (and subsidised) wind-power.

As an oversimplification, whether or not competitive reforms included mechanisms specifically designed to ensure capacity adequacy depended on the initial conditions in each jurisdiction. In some cases (England and Wales, the Northeast US, among others) the vertically integrated utility had a well-defined planning margin for reserves, and it was considered important to protect this during the transition to competitive markets by a mechanism that would deliver the same degree of security. In other markets, continued state-ownership of the bulk of generation may have provided assurance that investment would be forthcoming when future margins would appear uncomfortably tight. In yet other jurisdictions, surplus capacity, concentration and the slow evolution of workable markets may have reduced the urgency to consider whether capacity payments were needed, and whether when created they might over-reward incumbents, given the fact that a satisfactory design would be challenging.

Finally, there are important institutional differences between countries that may preclude some desirable solutions. If generation and transmission cannot be legally separated, or if there are many separately owned transmission systems, it may not be feasible to have a single TSO which manages dispatch and balancing. Instead an Independent System Operator (ISO) may be preferred. It is difficult to provide significant financial incentives to an ISO, while a TSO has adequate assets to bear the risk associated with such incentives, and makes the task of the efficient organisation of balancing, ancillary services and reserve procurement more straightforward. It follows that different countries may need to adopt different solutions, although it also seems reasonable that there should be some convergence to a

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27 A larger part of the paper seems to be based upon the dissertation of De Vries (2004): De Vries, "Securing the Public Interest in Electricity Generation Markets: the Myths of the Invisible Hand and the Copper Plate", PhD Thesis (2004), Delft University of Technology. The theoretical part provides a good overview of the needs and design of capacity markets. Recent developments outline other solutions, however.

28 Joskow, 2008.

29 Caramanis, "*Investment Decisions and Long-term Planning under Electricity Spot Pricing*", IEEE Transactions on Power apparatus and systems, Vol. PAS-101, No. 12, December 1982.

similar set of good practices, as countries become better interconnected and address similar issues of market power.

There are thus a variety of questions that might be asked in response to how best to assure capacity adequacy. In a system that already has in place some mechanism to address a particular problem, such as a US style installed capacity requirement, or ICAP, the question may be how best to modify that mechanism. ICAP was the natural successor of the capacity obligations of the previous power pool rules after liberalisation. Only gradually was it perceived to offer a significant contribution towards financing new investment, and to offset the potential low average price resulting from price caps. In a market with extensive market power and an energy-only spot market with adequate current capacity, the question may be whether the market delivers generation adequacy, and how best to ensure that the market evolves towards a workably competitive or contestable state, while ensuring timely investment. In a competitive energy-only market (such as Britain) the question may be whether a mechanism is needed and if so, can be devised, to increase confidence in the delivery of efficient and timely investment without distorting the existing markets, or whether changes to existing institutions (such as the role of the TSO) can provide that assurance at a lower cost.

The Cambridge paper is primarily directed to the situation found at present in the EU-15, which can be very roughly characterised as follows. Britain is a workably competitive energy-only market that has arguably still not been properly stress-tested as to whether new investment would be sunk on time if a future capacity shortage is predicted. Newbery discusses this case at length as it seems to present the most extreme case in which its market philosophy may be found inadequate. We argue that when the role of the TSO is appropriately defined and when an independent body is entrusted with producing high quality forecasts for demand and supply, it may not be necessary to devise any additional mechanism. The Nordic market is hydro-based, workably competitive, and has faced a serious drought in 2002/03.[30] It is now contemplating new generation investment (in Finland in nuclear power, and in Norway in gas-fired capacity), as well as additional interconnection capacity (to the Netherlands).

In their report, Henney[31] and Bidwell (2005)[32] cite a range of official views as to whether an energy-only market will be economically viable and whether it will be able to ensure generation adequacy:

- The British and Australians believe that it will, but they still have non-market back-up mechanisms.
- The authorities involved in the Nordic market are debating (even though Denmark, Finland, and Sweden have back-up reserve arrangements), while the Dutch government hopes that adequacy will be assured by the system operator buying relatively short-term forward contracts to cover the peak of the forthcoming winter. Henney and Bidwell call their policies the ‘middle way’.
- The Spanish, Irish, Argentineans, New Zealanders and the US FERC believe that a capacity payment is necessary to ensure generation adequacy.

It may be helpful to comment on these apparently differing approaches, to put them into context. First, the British and Australian approach is one in which the System Operators (SO) have a duty to balance the system in real time. In Britain, National Grid (NGC) as TSO has incentives to procure these

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30 David Newbery does for the most part look at each single country in his comments but seldom includes Norway, Sweden, Denmark and Finland in a regional market approach. What ‘saved’ this market in 2002/03 was (i) close to optimum use of generation resources in the region and (ii) that high spot prices made a high import from ‘thermal’ EU member countries outside Scandinavia.

31 Alex Henney made a project proposal on ROs to Norway, but NVE wanted a broader report on critical issues before such a ROs project would be considered. The Cambridge report served this purpose.

32 See also Bidwell, “Reliability Options: a Market-Oriented Approach to Long-term Generation Adequacy”, 18(5) *Electricity Journal* (2005), 11-26.

balancing services at least cost and is allowed (indeed, even encouraged) to contract ahead if this reduces the cost.[33] Australia has an ISO, NEMMCO, and a not-for-profit company managing the physical spot market and power system security over the entire national electricity market, NEM. To that extent, there is a less sharp distinction between these apparently energy-only markets and the 'middle way' described above. They are similar in relying on market signals feeding back from the balancing market to the spot, OTC and contract markets as the scarcity value of existing capacity is revealed in the various markets.

In Australia, generators are paid a Value of Lost Load (VOLL), currently Aus$10,000/MWh, if the system cannot meet demand because of a shortage of generation capacity (but not, for example, because of a transmission failure). This should produce the same payments *ex post* than the capacity payments expected *ex ante* under the English Electricity Pool until its termination in 2001. In that market, generators were paid the VOLL times the Loss of Load Probability (LOLP) if declared available.[34] The advantage for generators was that the capacity payments were made even if the LOLP was less than 100%, so they were paid more frequently, although at a lower value, thereby smoothing the revenue streams. The difficulty in the British context was that generators could game the system by not declaring all capacity available.

The other markets all have special features that might lead to distorted signals for timely investment. The Spanish market was during the period of the Report overlaid with Competition Transition Contracts (CTCs) which were designed both to recover stranded costs and mitigate the substantial market power of Endesa and Iberdrola, who had about 80% of generation and supply, and faced little competition from imports (Crampes and Fabra, 2005).[35] The capacity payments appear to provide a modest incentive both to be available and to bid into the voluntary Pool, OMEL, although it does not in any meaningful way reward scarcity. Argentina had a system of audited cost-based bidding into the wholesale spot market which clearly needed a supplementary capacity payment. Not surprisingly, as with the former English Electricity Pool, bidders could (and did) consider the combination of the energy and capacity bids when competing for space in the market, so the distinction between the two components was to some extent arbitrary.

The Irish market is small and concentrated, generation is in a large part state-owned, and the market is in the course of an incremental regulatory reform with the North and South part of Ireland slowly integrating, possibly through interconnection with England and Wales. New Zealand is facing the problem of cheap, but unstable and only medium-term hydro storage and has yet to evolve toward a satisfactory solution.

The US is a special but important case of a long history of regulated franchise monopoly utilities under private ownership, still governed by the 1935 Federal Power Act. The Act imposes a duty on regulators to intervene if necessary to ensure that electricity prices are "*just and reasonable*".[36] If a

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33 National Grid Company merged with the gas transmission company Transco to form National Grid Transco, NGT, which is the holding company. We retain the original name NGC to stress its role in the British electricity system. This description of NGC's responsibilities is perhaps an over-optimistic simplification of a still-evolving debate over NGC's role in securing generation adequacy rather than system security.

34 The theory of VOLL-LOLP pricing implies that the *ex post* payment is the same as the expectation of the *ex ante* payment, but only if LOLP was correctly specified. Under the Pool the LOLP appears to have been systematically exaggerated (Newbery, "Competition, Contracts and Entry in the Electricity Spot Market", 29 *RAND Journal of Economics* (1998), 726-749).

35 Crampes and Fabra, "The Spanish Electricity Industry: Plus Ça Change…", 26 *The Energy Journal* (2005), 127-154.

36 This 'reasonable' regulation has introduced some market restrictions which limit the full transfer of experiences and knowledge to Europe. No restriction on prices at NordPool during the 2002/03 scarcity situation was an important component to overcome the severe hydro situation in Norway/Sweden. To avoid the use of market power – price caps are often used as well but this was not considered appropriate in Norway.

jurisdiction wishes to restructure its utility and de-regulate the wholesale market, it must provide FERC with evidence that the wholesale market is workably competitive, as competitive prices are by definition just and reasonable. If FERC is satisfied, it grants suppliers "*market-based pricing authority*" (Joskow, 2000).[37] It is unclear whether markets deemed to pass this test would therefore be exempted from subsequent restraints (assuming no change in market structure through e.g. mergers), or whether a market which, for a given level of spare capacity, would deliver effectively competitive prices, but with lower reserve margin, would be susceptible to market manipulation and would force FERC to deem prices no longer "*just and reasonable*".

In addition, unhappy experiences with long-term contracting under the provisions of PURPA caused regulatory mistrust in anything other than spot markets as a measure of the wholesale price of power. This reluctance to contract ahead may have been compounded by the over-optimism of suppliers (retailers) who considered that spot prices would necessarily be lower than contract markets under competitive conditions. As Joskow and Kahn (2002)[38] are able to demonstrate, given a reduction in supply from the Pacific Northwest, an increase in natural gas prices and a very sharp increase in the price of NO_x permits in the Los Angeles basin in 2000, one would have expected the competitive level of prices to increase substantially in any case. Market tightness combined with a large fraction of demand being met in the spot rather than contract market provided the opportunity for generators to exercise market power and bid substantially above marginal costs (and the now-higher competitive benchmark), as well as withholding plant to force a higher market clearing price. Eventually, FERC was forced to intervene as wholesale prices were no longer "*just and reasonable*."

The Californian events that have so coloured reactions regarding the ability of liberalised markets to deal with scarcity can only be understood in that context. If regulators are now predicted to intervene when prices rise, then investors and banks are likely to be unwilling to invest in states with liberalised markets if they are allowed to price at variable cost during times of adequate capacity but not to earn the rents needed to cover capital costs in times of scarcity. The peculiarity of the US problem is that it remains a regulatory duty to ensure that market power is not unreasonably exercised while scarcity is adequately rewarded. Given the particular difficulty in an interconnected electricity system of distinguishing between cases in which prices are high because of genuine scarcity or because of market manipulation, it becomes attractive (and perhaps even necessary) to devise non-market mechanisms or obligations to reward scarcity. These may then be combined with varying aggressive market power mitigation procedures to deal with energy pricing.[39]

Jurisdictions (like the whole of the EU) which are not subject to such regulatory requirements start from a different position, and regulators and policy-makers should not be overly influenced by the special circumstances of the US. That does not necessarily imply that some additional mechanisms to reward capacity availability are unwarranted, but it does mean that the legal and regulatory environments are relevant for any such design.

In addition to these institutional details, it may be important to distinguish between systems that are largely hydro (Norway, Austria, and to varying extents other members of NordPool), those that are relatively isolated or where imports are severely constrained (Britain, Ireland, Italy, Iberian peninsula)

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37 Joskow, "Deregulation and Regulatory Reform in the U.S. Electric Power Sector", in Peltzman and Winston (eds.), *Deregulation of Network Industries: What's Next?* (Brookings Institution Press, 2000).

38 Joskow and Kahn, "A Quantitative Analysis of Pricing Behavior in California's Wholesale Electricity Market Summer 2000", 23(4) *The Energy Journal* (2002), 1-35.

39 Another concern of US investors is market power mitigation procedures involving bilateral contracts with must run generators and dispatch of generators out of the merit order without increasing the market-clearing price. They imply that generators in the same area might receive different prices for the same output. In the past, investors anticipated that long-run prices would be sufficient to finance new investment and would therefore in expectation also provide sufficient remuneration for today's investment in future years. With differentiated pricing the reasoning might no longer hold – hence increasing the risk for today's investors.

and those that are largely thermal or nuclear and well interconnected (most of the rest of the EU). The final dimension is the extent of market power, which is the ability of generators to manipulate the wholesale price of electricity from a competitive equilibrium price,[40] but also includes the prevalence of vertical integration of generation and transmission. The extent to which vertical integration is a problem will depend on the efficacy of transmission regulation and the functioning of Third Party Access. Concentration in the supply of balancing and ancillary services can also distort prices and impede entry, reducing contestability.

The Cambridge report underlines the role of the SO for system security and questions the role of the SO for system adequacy

It is important to recognise that electricity requires a central SO to balance the system (or sub-system) in real time, and that any energy-only market must have such an SO function. The question then resolves into how that SO function is designed, and whether anything else is needed. Here it is important to distinguish between system security, security of supply and generation adequacy. System security requires the SO to balance the system in real time, if necessary by shedding load to prevent a rolling blackout. Security of supply is the ability of the system operator to meet short-run demand given existing capacity, if necessary by allowing imbalance prices to reach very high levels. Generation adequacy is a medium to long-term concept, and implies that there will be enough capacity available at each moment to guarantee security of supply at "*reasonable*" prices. Generation adequacy requires that investment in generation capacity is made in a timely manner to maintain an adequate reserve margin, and it is the main subject matter of this note.

The required reserve margin will depend on the reliability of the existing generation stock and on the associated fuel supply, on peak demand uncertainty, on system-specific factors such as transmission bottlenecks, the amount of fast response reserve available, and on the pre-determined target reliability planning objective used by the SO.

The SO in any electricity market must be charged to deliver system security, that is, to ensure demand and supply balance at all time. Ideally, this is achieved by ensuring adequate supply to meet demand at the relevant price (in the spot and balancing markets), rather than by shedding load. In many (possibly most) jurisdictions, the SO does not have any obligation to deliver generation adequacy, and thus may have to shed load if the imbalance price rises to its limit (a cap, if any, or the maximum offer that can be accepted). The requirement that system security and short-run balance is secured is thus not the same than ensuring either security of supply (no load shedding) or longer-term generation adequacy.

This raises the central question of whether the natural approach to ensuring security and adequacy in energy-only markets is to require the SO to be responsible for these additional tasks. The critical issue with an SO approach to generation adequacy lies in the difference in time scales between managing the system in real time (security of supply) and contracting forward to induce sufficient investment to maintain an adequate plant margin. Such a step arguably represents a major change in the duties of the SO, and will need careful thought (and possibly secondary legislation or, at least, changes in grid and balancing codes and licence conditions).

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[40] Market power can for example be measured by the proportion of time that the dominant generator is pivotal. A generator is pivotal when, without his capacity, the system cannot be balanced without shedding load. High import capacity not under the control of the dominant firm reduces the number of hours the dominant firm is pivotal. If two or more firms acting together are collectively pivotal, they may be able to tacitly collude to exercise market power. The extent to which they will be able to raise prices will depend on the elasticity of demand (likely to be low in most markets). Contracts reduce the incentive to exercise such market power, and ideally one would also wish to know the extent to which a generator's un-concentrated supply was pivotal, but such information may not be readily available without a legal obligation on generators to reveal their contractual position to the regulator.

Making the SO responsible for delivering generation adequacy efficiently thus requires three things: first, that the SO is legally responsible for maintaining generation adequacy (i.e. a pre-determined reliability criteria); second, that the SO is properly incentivised to do so at least cost, and third that the SO is adequately credit-worthy to bear the risk of the contract position it may need to take.

Britain provides a test case for the energy-only concept as the compulsory Pool with its capacity payments was deliberately abandoned and replaced with voluntary markets, a requirement to submit balanced schedules to the TSO, and a balancing mechanism to deliver system security, under the expectation that the model would also deliver security of supply and generation adequacy. This note therefore draws extensively on the British experience, recognising that other countries may also provide valuable evidence of market performance relevant to different circumstances.

NGC would then have an incentive to find the most cost-effective way to maintain generation adequacy, be it to contract forward, or to propose any more specific capacity mechanism such as a ROs approach.

The Cambridge report underlines also the importance of a balancing market that conveys scarcity signals

In an energy-only market, balancing markets and markets for ancillary services such as reserve capacity have a critical importance for signalling scarcity. There exists a great variety of balancing mechanisms or markets in Europe.[41]

Principally, there are two types of imbalance price mechanisms:

- Dual imbalance pricing where a different price is applied to positive imbalance volumes and negative imbalance volumes (Britain, Poland, France, Sweden, Slovenia, Denmark, Netherlands and Italy).
- Single imbalance pricing where a single imbalance price is used for all imbalance volumes (Norway, Germany, Luxembourg, Spain and Greece). A cost allocation method exists for Austria to allocate the cost of balancing energy to parties with an imbalance.

There are also two methods of determining imbalance prices:

- Average price of energy balancing actions (E&W, Poland, France, Denmark, Spain and Austria);
- Marginal price of energy balancing actions (Sweden, Italy, Greece, Netherlands).

Market fundamentals dictate that during times of shortage, electricity prices should rise to the marginal cost of generation required to meet demand. One problem is that the marginal *bid* may substantially exceed the marginal or opportunity cost. Balancing mechanisms such as the British one which use an average pay-as-bid calculation for the price of imbalances combined with a dual imbalance price mute scarcity signals by paying generators their bid price and not the marginal price (in order to mitigate market power and possibly reduce volatility).

But as Roques et al. (2005)[42] noted,

> "[this type of design for balancing raises] critical issue in energy-only markets [that] lies in distortions introduced as prices feed in from the balancing market into the contract markets. In a multi-market framework such as NETA, the ability of investment signals to convey scarcity

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41 The time resolution to which imbalances are settled is 15 minutes in Netherlands, Italy, Austria, Germany, Belgium, and Luxembourg; 30 minutes in England & Wales, and France; 60 minutes in Poland, Sweden, Norway, Denmark, Slovenia, Spain, and Greece.

42 Roques, Newbery and Nuttal, "Investment Incentives and Electricity Market Design: the British Experience", 4(2) *Review of Network Economics* (2005), 93-128.

> signals depends on the ability of the balancing price signals to feed in without distortion in the successive market layers characterised by different time scales. In Britain, the energy market is insulated to a degree from the costs of short-term balancing, both because of the average pricing formula and the lack of liquidity of the balancing mechanism. This insulation is most significant at times of scarcity, and creates the risk that the market will fail to deliver appropriate price signals for long-term investments. A price that might warn of impending shortage may indeed not materialise until the market is under severe stress, and the delay in the price signals might undermine timely investment decisions."

The events of December 10 2002 on the NGC system are worth studying in this respect. On this day the system demand was the highest thus far recorded, and it exceeded the level forecast by National Grid. Whilst the price in the day-ahead market showed only a slight increase over the system peak to around £30/MWh, as well as the average System Buy Price (£71.6/MWh) in the Balancing Mechanism, the SO accepted offers in the Balancing Mechanism at £9,999/MWh for the marginal System Buy price.

Price spikes and peaking units investment

Efficient spot and balancing markets should give suitable price signals to indicate when and what kind of capacity is required in electricity markets. Such prices can be both volatile and extremely peaky, creating two related problems. The first is that generators may be unwilling to invest in risky peaking plant without contractual coverage. The second is that consumers may not hedge the risk of very high prices, and so may not provide the counter-party to a desired peaking contract or option, but may complain vigorously if exposed to high spot or imbalance prices.

Experience demonstrates that peaking plants are likely to run a considerable number of hours per year. If the balancing mechanisms were changed to a single marginal priced market (as for example in the Netherlands) to reduce bidding risk and encourage bidding at marginal cost, and if peaking plants were then to bid competitively at avoidable cost, and if indeed as a result the peaking units ran for more hours, then it is likely that there would be both a greater convergence of spot and balancing prices and a lower average annual price of electricity. This brings us to the central problem of combining generation adequacy with competition.

Factors affecting generation adequacy

How far in advance construction of new plant needs to begin will depend on the type of plant, with combined cycle gas turbines (CCGTs) requiring the shortest time, typically less than two years from commissioning to operation (emergency diesel generation or open cycle gas turbine – OCGT - peaking plant may be commissioned even more rapidly.) Securing the necessary planning permits to build may take considerably longer, although building on existing generation sites (with grid connections, water for cooling and planning consent) may dramatically shorten this. How risky such investment will be will depend in part on the predictability of demand and future supply (which will be affected by the market structure and the extent to which other generators need to give notice of disconnections or new capacity plans).

Uncertainty, risk aversion and 'herd' behaviour

The impact of uncertainty about future demand on investment decisions depends on the considered type of plant. Uncertainty on demand can be thought of as either uncertainty over the average growth rate of demand (long term uncertainty) or as demand volatility in the short term. To consider only the extreme cases, the main criterion when considering an investment in a base load plant is the average demand growth, while investment in peaking units will be critically driven by the expectation of occurrence of high prices. While larger uncertainty over the long-term demand growth might adversely impact investment in base-load units, greater demand volatility in the short run should make investment in peaking units more attractive.[43]

Most continental electricity markets remain fairly concentrated, so that the impact of uncertainty about future demand on investment decision has to take into account the impact of uncertainty on strategic behaviour. In a risk-neutral world, rational investors in a concentrated market confronted with demand uncertainty have to weigh two effects which work in opposite directions. The first effect relates to the value of waiting to get more information before committing to an *irreversible investment*. This encourages investors to *delay investment* decision. The second effect of demand uncertainty in an oligopolistic industry is referred to as the 'pre-emption effect'. It captures the strategic advantage of being the first to invest. In the race to be first, investment may take place too soon. Demand uncertainty can therefore either speed up or delay the timing of investment for rational risk-neutral oligopolistic investors, depending on the relative strength of the two effects. Which effect is more important is therefore an empirical matter, as is the question whether there is a bias towards delayed investment that needs to be addressed by some mechanism to ensure timely investment. We return to this important issue below.

This leaves open the question whether, given the best available forecasts, a liberalised market can be relied upon to deliver investment in a timely fashion in an energy-only market setting (supplemented by a TSO securing the necessary reserves to balance the system). In the past, with a franchise monopoly, there was if anything an incentive to over-invest for two reasons. The first reason is that when the investment is adequately rewarded (as under rate-of-return regulation or with abundant state funding) then more is better than less from the utility point of view (empire building or for the reasons set out in Averch-Johnson, 1962, and discussed below). The second reason is more defensible and comes from the perceived costs of being short (economic, but also political/regulatory) which are higher than the costs of being long (particularly if the capacity is paid for by captive consumers).

In principle in liberalised markets the second benefit of adequate reserve is reflected in the higher revenue generators receive at times of scarcity. In practice, generators and society are risk averse. Neuhoff and de Vries (2004)[44] argue that risk-averse investors put more weight on the bad outcomes – the years with low income – than on the sparkling profits in scarcity years and therefore reduce the equilibrium investment volume relative to risk neutral investors. Risk-averse governments and to some extent societies also put more weight on their bad outcomes – electricity shortages – and therefore prefer higher reserve margins than the liberalised market might deliver. This asymmetry created by risk aversion suggests that competitive liberalised markets might under-invest. Long-term contracts are the least interventionist approach to resolve this issue. They allow investors and consumers to hedge and eliminate the risk. Currently, policies required to support retail competition (such as the ability of consumers to switch supplier at short notice without penalty) undermine the ability of investors to sign such contracts.[45]

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[43] Higher volatility of demand would normally translate into a higher volatility of prices. This means that the fraction of the year when prices are above average will increase, thereby increasing the profits of peaking plant which only runs in high price periods.

[44] Neuhoff and de Vries, "Insufficient Incentives for Investment in Electricity Generations", 12(4) *Utilities Policy* (2004), 253-267.

[45] If consumers have to buy out longer-term contracts (as in the mortgage market), and if they express a preference for longer-term contracts, this problem might be avoidable. Evidence from mortgage markets suggests that consumers may have a preference for short-term contracts when prices are low, again introducing a possible misperception and market failure. There are also difficulties to align generators and consumers incentives in a long term contract. See on this, Finon and Perez, "Vertical Arrangements in Decentralized Electricity Markets: a Long Term Efficiency Perspective", LARSEN Working Paper n°12 (2008).

While risk-averse investors confronted with demand uncertainty might under-invest, suppliers contracting on behalf of their consumers are also likely to be risk averse given the high penalties they face in the imbalance market when they have under-contracted. However, under retail competition, the typical contracting time frame is measured in months rather than in years. Hence over-contracting by retail companies in the short time horizon for which they have to retain the tariffs fixed for final consumers may not give adequate and timely signals to assure the financing of new investment.

Hydro systems and capacity adequacy

There have been concerns that dominantly hydro systems like Norway may have particular problems to attract timely investment.[46] There is some truth in this argument, essentially due to the complicated political economy of these systems. Typically, the dams and related transmission systems were built in the past and were financed by low (real) rates of interest. Their written down book values may now be very low, underwriting cheap electricity. This in itself deters new investment.[47] Second, if the cheapest expansion option is more hydro capacity, then private investors may be reluctant to invest in a system that has high up-front financial costs but, given the near zero short-run financial cost, a tendency to set low average prices unless prices are set at the margin by conventional generation.[48]

To the extent that water management must take account of other non-electrical issues (river flow, irrigation demands, flood control, etc), private investors[49] may be vulnerable to non-economic forces and pressure groups which are hard to predict and raise risk. Higher risk for capital-intensive dams is lethal as it raises costs one-for-one, as the average cost is entirely a capital cost. The threat of state or municipally financed competitive dams would further undermine private investment. In short, the investment climate for an inflow of private capital in hydro systems is generally unfriendly unless the average price of power is set by conventional generation.

Fortunately, NordPool is increasingly well connected to neighbouring markets with nuclear and fossil generation. In long-run equilibrium, the average price in NordPool should therefore rise to equal the average price in neighbouring markets, which in turn will be the entry price for the most competitive generation needed, which with abundant storage hydro and adequate links would be base-load (although wind-power should be more attractive in hydro systems than fossil systems). The price characteristics of such a system are likely to be those of less daily price volatility, somewhat more seasonal volatility, and considerably greater annual volatility. That may or may not lead to a demand for multi-year contracting in order to smooth out the high price years (von der Fehr et al, 2005).[50] In low price years the fossil generation will run less, and so on average over a number of years it is likely to have a lower load factor than for base-load generation in other thermal systems, and hence a higher average cost. In response, it may make sense for such generation to be supplied by lower capital cost and higher running cost plant (i.e. more like mid-merit plant). Equivalently, keeping older plant in the system for longer than might make sense in a purely thermal system may be the least-cost solution in a hydro system. On the other hand, the need of peaking capacity will be lesser so the annual demand-weighted cost of electricity needs not be higher (and should be less, given that storage hydro allows for more efficient average utilisation). This is reflected in the current decisions to build base load

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46 In the hydro chapter, the Cambridge report may focus too much on country-specific terms and does not include the Nordel or NordPool co-operations which here represent a regional approach. In a normal year (as in 2009), Norway will operate under a surplus. In addition, a new big nuclear power station is under construction.

47 A regional NordPool approach should ‘soften’ this statement.

48 Recent investments do not fully support this statement however and this needs to be investigated further.

49 In Norway private ownership in new investments is low. The government and the municipalities still represent a large majority. It remains to be seen whether new legislations will favour the development of private investment.

50 Von der Fehr, Amundsen and Bergman, "The Nordic Market: Signs of Stress?", Cambridge Working Papers in Economics 0525, Faculty of Economics, University of Cambridge.

plants, like the 1400 MW of CCGT recently committed in Norway, or the construction of a nuclear power station in Finland.

One would expect rationing (load-shedding) in some years, but at least in a hydro storage system this is likely to be more easily scheduled, particularly given the amount of energy intensive industry which may prefer to shut down. In short, it is not clear whether hydro systems face particular problems with resource adequacy, especially considering their different temporal dimension. This different temporal dimension makes it easier for regulators and policy makers to deal with it. On the other hand, hydro systems are exposed to larger year to year volatility of supply, and therefore energy shortage might be more severe than in thermal systems.[51]

Roques et al. (2005) conclude that *"while electricity markets may be delivering adequate levels of investment, price spikes are testing government commitment to allow markets to sort things out."* In systems with significant reservoir storage capacity, there are two factors that should help give the government greater confidence to rely on market mechanisms to resolve capacity crisis. First, prices in a dry year are going to remain high during a relatively long period of time, but will be much less volatile than in a thermal system which is short of capacity. Thanks to arbitrage between reservoir capacity and energy, physical shortages are much less likely and emergency load shedding procedures easier to forecast and forewarn consumers. Second, policy makers under pressure to lower prices can point towards a rationale for the higher prices (the need to ration particularly energy-intensive demand) and a simple explanation (the lack of water in reservoirs). Such arguments appear to have worked in Norway in 2003[52] and limit public pressure from accusing deregulation or call for a temporary and inefficient Market Design fix. In addition, given the high proportion of electric heating in Norway, demand side responses were easier[53] than in most European countries, with a higher fraction of higher value applications of electricity.

Before highlighting and making some conclusions or recommendations on the Cambridge paper which is mostly focused on generation adequacy, the unbundling and investments paper of the Norwegian TSO investments paper should be scrutinized.

Electricity & Gas – Market Design and policy choices[54]

At the same time than the Cambridge report, L. de Vries, F. Correlje and P.A. Knops made a report focusing on security of supply and Market Design. There are many overlaps between these reports on some of the same conclusions, but some important differences in the assumptions and reasoning are worth emphasising.

The following statements are already well-known: power pools are not mandatory, some markets have significant traded volumes with neighbouring markets, market models (Market Design) vary greatly, and most of Europe is capacity-constrained rather than energy-constrained.

But the main challenges are however:

- Why have power exchanges not enabled a larger dissemination and coordination when benefits are so obvious?

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[51] There is an important contrast with hydro systems where the least-cost expansion plan is more hydro, as in Brazil, and where the economics of thermal power needed for backup can be problematic. On the continent, with reasonable interconnection to markets whose prices are driven by thermal power, this is less likely to be the case.

[52] Professor Lars Bergmann supports this view and further comments are given in his paper "Why has the Nordic Market Worked so Well".

[53] Demand response at the level of households and units in the service sector shows a 7% volume saving. But the aluminium industry was the main contributor, which far exceeded all other sectors.

[54] A larger part of the paper seems to be based upon the dissertation of De Vries (2004). The theoretical part provides a good overview of the needs and design of capacity markets. Recent developments outline other solutions however.

- Will regional power exchanges[55] manage to give proper price signals for 'optimum' investment in generation?

The starting point of the paper is: "In most cases little attention has been directed towards the issue of trade; how to prevent the investment incentives from leaking abroad and how to make capacity mechanisms immune from regional shortage".

The goal of the paper is to "outline a systematic framework for the selection of such a capacity mechanism to meet demand under reasonable conditions, considering normal outage rates."

Those who support capacity markets or ROs assume that an electricity market must have a stable long-run equilibrium[56] and that current energy-only markets have several failures which will disturb reliability and investment optimum. Demand close to the 'vertical' slope of the supply curve will create unacceptable high prices and lack of demand response combined with insufficient reserves will create unacceptable levels of system reliability and threaten security of supply. Capacity markets or ROs will change the supply/demand characteristics and create a stable equilibrium at a desirable reliability level outside a 'scarcity zone'.[57]

The Norwegian Marked Design is very close to the 'Economic Textbook' model. The report *Optimum Tariffs and Investments* (SNF Report of 32/92)[58] gives an update on how 'basic economics' can be applied in the competitive power sector in Norway and thus support efficient trade in Scandinavia. The report divides clearly between spot pricing for efficient use of current resources and on the other side basic economic criteria (long-run marginal costs) for decisions of new investments. In the debate on capacity market, this dichotomy is not that clear. The outcome may be that criteria for efficient short term allocation of current resources and investment criteria for optimum expansion are 'mixed'.[59]

Very seldom will there be a stable equilibrium over time because of business cycles.[60] Equilibrium will exist only when long run marginal costs equal current prices. Most investments in the power sector are 'bloc' investment and sometimes represent a 'substantial' increase in new capacity.[61] In Norway and the other countries in Scandinavia, the 'bloc' investments and business cycles have caused no major obstacles for generation adequacy.

In the *Electricity & Gas – Market Design* Paper, three characteristics are mentioned:

- Electricity is a time-limited product and cannot be stored,
- Marginal cost curve ends up with a perfectly price – inelastic section,
- The demand for electricity is also highly inelastic and customers receive no proper price information to adjust behaviour.

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55 Cambridge paper, p. 17.

56 Alex Henney and Miles Bidwell's study of generation adequacy (April 2005) and appendix on presentation of ROs.

57 The steep slope of the supply curve, insufficient reserves and unacceptable system reliability.

58 Author is Professor Steinar Strøm University of Oslo, Norway

59 In the mid 1970s when economist started to address the hydro power debate in Norway, a clear distinction between short-term marginal costs and long-term marginal costs as criteria for tariffs and efficient prices were hard to delineate. The outcome was a fundamental disagreement between engineers and economists on the relevant criteria for expansion of the current hydro generation system.

60 See the next section on TSO operations in Norway.

61 The new nuclear power station which is under construction in Finland is one such example. Big hydro projects in Norway are another example.

In the late 1990s several Nordic studies[62] indicated a high potential for demand response and demand side bidding options. The main barrier for a large-scale change in behaviour was the high transaction costs incurred to map and select efficiency options, and the lack of useful feedback information due to the uninformative billing[63] and settlements procedures.

IEA has for a long time focused on demand-side management (DSM) and 'Demand Response'. The IEA Demand-Side Management Programme is an international collaboration of 18 countries working together to develop and promote opportunities for DSM. Since 1993, the IEA DSM Programme has worked to develop and promote tools and information on demand-side management and energy efficiency. As a result of this collaborative work between countries in Asia, Europe and North America, the programme has created a 'toolbox' of resources and information for governments, utilities and energy companies in order to help them incorporate DSM measures in their energy policies and activities.

The IEA Demand-Side Management Programme has put forward a large number of demand response opportunities fit to reduce load costs effectively, but very seldom these finding have been included in recommendations for a new regulatory toolbox. Regulatory options which are dependent on customers' response have often been neglected or not taken seriously. One reason may be that the traditional scope of regulation stopped at the meter which served as a simple tool to measure kWh to make an invoice only.

DSM has for a long time offered solutions to problems such as load management, energy efficiency, strategic conservation and related activities. The potential to reduce load to both serve reliability and activate customers' participation at the same time have been proven for a long time through large scale DSM programmes. However a large scale breakthrough is still missing in most EU member countries.

The list of projects in The IEA Demand-Side Management Programme portfolio is long and some completed projects in Sweden are of special interest (see Elforsk[64] rapport 06:41, Market Design Project, Demand Response Resources in Sweden, June 2006).[65]

Some of the main findings and conclusions are:

> "An important discussion in later years has been whether the necessary reserves in the Electricity market are to be generated through normal market mechanisms, i.e. with the price as the primary controlling parameter, or if it requires a collectively financed capacity reserve and how regulations in such a case should be shaped. The issue is first and foremost a matter of where the line is drawn between that which 'the market' should handle and that which can be assured through regulation. Autumn 2002 Svenska Kraftnät (the Swedish TSO) presented an investigation to the government in which it was suggested that the capacity balance should primarily be managed through the use of normal pricing mechanisms, but that the state should strengthen responsibility for the nation's capacity balance in the period up until 2008. When approaching an effect loss situation, spot prices and balancing power prices will skyrocket. Today, most people are in agreement that a condition for maintained delivery safety is that normal pricing mechanisms are in place and that consumption actually is affected by high prices. The main reason for this conclusion is that it is very expensive to keep production facilities in reserve for situations that are expected to occur very

62 Most of the studies were organized by the Council of Nordic Ministers, under the direction of Harold Wilhite.

63 Most electricity bills in EU member states have no or little focus on volumes to indicate saving opportunities.

64 Elforsk (Electricity research) is owned by the Swedish electricity industry. Its corporate business idea is to carry out research and development in line with the interests of its owners and carry out these research projects in cooperation with other parties in the market. The Market Design program was initiated in 2000 for the purpose of increasing the knowledge of how deregulated electricity markets work. The program is financed by Svensk Energi, EBL-Kompetanse in Norway and the Swedish Power Authority.

65 Peter Frtiz at Elforsk has been very helpful in selecting relevant reports in order to support a market design where customers' response would play an important role.

> seldom – it is cheaper to encourage large customers to reduce their consumption. The other reason is that increased price sensitivity creates conditions for a more stable and more predictable pricing development in strained situations. While being aware that a response to increased demand is needed, we see too little of that on the market today. The aim of this project is to present concrete measures that will awaken this slumbering resource.
>
> In order to judge how much demand response that can reasonably be expected and if there is any financial gain for customers, electricity suppliers and grid operators; it has been necessary to cast a few predictions about future price peaks. We estimate price peaks in the 3-10 SEK/kWh interval for an average of 40 hours per year. Judging from the work presented in this report, it appears probable that there is a significant ability and interest among customers to reduce their consumption as long as the economic incentives are large enough. With price peaks we have estimated it should be possible to achieve demand response of around 2 000 MW, probably more. It must be made clear that this is not a persistent capacity reduction. What we have mainly focused on are the consequences of a price peak over three hours in the morning. A large part of this untapped potential lies in the many electrically heated family homes. In order to extract this capability, a large obstacle must be overcome. With the metering equipment we have today, and even the minimum required equipment after 2009, this group is of disqualified to participate.
>
> In our report we have highlighted five different business models which can contribute to realizing the existing potential. They are clear concepts and relatively simple to implement, as well as having the potential to provide economic benefits to all those involved: customers, electricity suppliers and grid owners.
>
> Perhaps the most interesting business model targeted for smaller customers is the one we have called ‘Fixed price with the right to return’ after a model by Trondheim Energi in Norway. If this model were to be launched widely for smaller customers instead of today’s “Take and Pay contract” it would open up for many new possibilities.”

In autumn 2002, Svenska Kraftnät submitted a report to the government where it suggested that the capacity balance should primarily be achieved with the aid of normal pricing mechanisms, but that the state should strengthen responsibility for the nation’s capacity balance during the period up until 2008. This resulted in a government bill allowing Svenska Kraftnät, during the period 2003-2008, to sign an agreement giving them the use of 2000 MW of production and reduction of demand as a capacity reserve. The Swedish state’s expanded responsibility for capacity balance is thought of as a temporary solution aimed at giving market players the time to carry out necessary adjustments. The study covered several groups of end user, different tariffs and several incentive schemes. The overall conclusions showed the presence of a considerable ability and desire to reduce consumption, as well as that the target volumes could be reached given the current economic incentives.

The set of regulations implemented in the electricity market (laws, stipulations, Directives, agreements for balance responsibility etc.) thus does not appear to constitute any barrier to the measures which can promote flexibility on the demand side.

The project was operated with ‘traditional’ meter technology and the roll out of smart meters would open up for new opportunities and considerably less transaction costs both for the suppliers and end users.

The Electricity & Gas – Market Design and Policy Choices paper lists the following possible types of failures:

- Price restriction,
- Imperfect information,
- Regulatory uncertainty,
- Regulatory restriction to investment,
- Risk-averse behaviour by investors.

Within a good Market Design, price caps[66] will create 'serious' distortions and it will be difficult to issue good supporting arguments. In practice, it will be almost impossible to set a correct value of what is lost in terms of load.

Smart meters with a screen included will make easier for customers to receive proper information, both for more efficient energy use and to switch supplier.

The development and roll out of smart meters however face some coordination challenges regarding who will set the standards and ultimately bare the cost. In most EU member states, metering, billing and settlement tasks are the driving forces. However, there exists an interest from different stakeholders in expanding smart meters and let them operate as a two-way communication channel to promote energy-efficient behaviours. How much additional equipment will be necessary and who should pay remain open questions. Some suppliers offer user-friendly equipment, but this 'special' equipment belong to the supplier and must be returned if the customer makes a switch.

As mentioned in the Cambridge report, many of the market failures are country dependent. Due to regulatory gaps, coordination and harmonization are missing and may represent inefficient solutions or create marked failures. Hopefully the 3rd Package will close some of these gaps.

In the *Electricity & Gas – Market Design* paper, the lack of mandatory power pools and the fact that, when they are present, they not always provide proper price signals to ensure new investment are both underlined. Experiences from California and other US states are used to evidence that power exchanges do not always provide reliable price signals for investment.

The Market Design in Norway and the other Nordic countries however shows the opposite development. There exists a net positive power balance which is most likely to increase in the years to come. This will enhance export of electricity from Norway, as dispatch or balance services, to continental EU member countries which face very high balancing costs. This development will enhance the regional market cooperation and will help capacity-constrained countries cope with 'peak' problems.

The Electricity & Gas – Market Design paper pays a lot of attention to trade between electricity systems. It states that

> "in theory, trade between liberalized electricity systems should not change the basic market dynamics. If the involved systems are liberalized in similar ways, trade between them only represents a scale increase. A benefit of a larger interconnected system is, however, more stability, as the relative impact of individual generators and capacity additions becomes smaller."

The basic theory of electricity trade does not support this approach and the development of the NordPool regional market represents a good example which shows that trade will improve markets and facilitate system operations.

In practice, interconnected electricity systems often have quite different market rules. This has repercussions upon generation adequacy in the different markets. This lack of harmonization should be removed shortly according to the priorities of the implementation of the 3rd Package.

The *Electricity & Gas – Market Design* paper examines both the EU and US examples. However, many of the US mechanisms cannot be implemented in the EU in their current form. This argument is raised in the final part of the paper and limits the applicability and relevance of the US mechanisms in the EU context.

In the paper *Market Design* by David Newbery (February 2006 CWPE 0615 and EPRG 0515), different designs of power exchanges and capacity mechanisms are examined. One of the main issues concerning the initial market structure in England & Wales was the highly concentrated generation

[66] Price caps is mainly used in US and will not raise any major issue in EU member states

market, with two fossil generators setting the price 90% of the time. This issue was settled with the regulator through the divestiture of 6000 MW to a third company in 1996. Because of the failing price-cost margin and the belief that the Pool was manipulated, a new design was implemented in 2001 with the introduction of the New Electricity Trading Arrangement (NETA). NETA involved self- dispatch, voluntary bilateral contacting combined with pay-as-bid average priced balancing mechanism, and no capacity payments.

Britain thus abandoned the US FERC Standard Market Design (SMD) and moved closer to the dominant European model of decentralised trading through power exchanges. Newbery emphasises that in the run-up to NETA, continuing plant sales were encouraged by the anticipation that excess entry induced by earlier concentration and high prices would likely undermine the high-price equilibrium, while the uncertainty surrounding the consequences of removing capacity payments in the forthcoming NETA increased the attraction of acquiring strictly domestic customers and selling risky generation. This led to a remarkably atomistic industry shortly before NETA started in 2001.

Newbery brings up a recurring issue, which arguably still remain unsolved, that of whether capacity payments are necessary to ensure security of supply or whether they offer additional scope for market manipulation without enhancing security. Past examples have shown that manipulation exists when market concentration is high.

An alternative to capacity payments is to give the TSO the responsibility to ensure security of supply by setting relevant targets.

In the previous chapters the challenges related to the serious scarcity situation in Norway/Sweden in 2002/03 have been commented on several occasions. No price cap, no restriction on peaks of the spot price, high import capacity and good demand response all contributed to limit the need for rationing or curtailment. This ‘real time’ learning demonstrated that the Nordic Marker Design could handle the situation in an efficient manner. Most likely a capacity market may not have worked at all!

Demand response was quite high in Norway (about 7-10%) in the scarce years of 2002/03 and at the same time several projects in IEA (Implementing Agreement), as well as Elforsk, showed that peak and demand reductions could be organized and the lessons to be learned are numerous. However, implementing Demand Response in legislation and regulation to ensure further progress has been slow.

A consequence of the important lessons learned from EU countries has been the improvement of access and trade of hydro power as a ‘super’ dispatch and balancing instrument.

The new NordNed cable to the Netherlands and a new additional cable to Denmark demonstrate this clearly. Sometimes adjustments in Marker Design will be necessary but the net benefits are quite obvious.

Most of the usual market failures do not exist in the Nordic Market Design and the use of these failures to justify the use of reserve capacity option to ensure security of supply will stand as a relevant option for only a few member states.

Compared to the Cambridge Report, the main weakness of the L. de Vries, F. Correlje and P.A. Knops paper is that the main assumptions were not robust in the long term in the context of the EU.

The ‘Regional Approach’[67] showed lately considerable progress and contributed to more efficient trade. It also made member countries less vulnerable to security of supply issues and short term capacity problems.

The arguments that electricity is a time-limited product and cannot be stored, that the marginal cost curve ends up with a perfectly price–inelastic section, that the demand for electricity is also highly

[67] Heavily supported by ERGEG and the European Commission

inelastic and that customers receive no proper price information to adjust behaviour, are considerably weakened by the DSM and Demand Response programs organized by IEA and other organizations. Such DSM and Demand Response programmes are now well integrated in TSO operations[68] in several member countries.

TSO operations in Norway, unbundling and investment

Norway has organized Statnett SF (TSO) into a Market Design very close to the one described in the introduction of this paper.

Statnett is organised as a publicly-owned enterprise, owned by the State through the Ministry of Petroleum and Energy and governed by the State Enterprise Act. Statnett is divided into the following divisions: Grid development, Grid Operations, Commercial, Maintenance, Submarine Cables, Engineering and IT & Telecom.

In undertaking its business, Statnett shall:

- develop and maintain the main grid in a way which ensures the long term quality of the services provided,
- coordinate the generation and consumption of electrical energy in a way which ensures the short-term quality of the services provided,
- provide access to the network on equal conditions to all users.

The Norwegian grid structure

The Norwegian electricity grid is split into three levels: the main, the regional and the distribution grid. The main grid constitutes most of the transmission grid at the highest voltage levels: 420, 300 and 132 kV.

The Main Grid Commercial Arrangement is a nationwide system for settling the volume of electricity transmitted between different regions and parts of the country. Statnett manages this system and owns about 80 per cent of the main grid infrastructure, including the Norwegian section of power lines and submarine cables connecting Norway to other systems in neighbouring countries. The Main Grid Commercial Arrangement is based on a system whereby power lines, transformers and switching facilities are leased from the owners.

Tariffs and regulation

This arrangement allows a common national pricing system for transmission services and provides all players with grid access on equal terms. The costs for leasing infrastructure have to be calculated in accordance with regulations set by the regulatory authorities (NVE). The revenues are derived from the charges paid by users for transmitting electricity via the grid. In principle, costs and revenues should balance. If the revenues exceed the costs, the balance is charged to Statnett's accounts as a liability to main grid users, and vice versa.

System operation

In Norway, Statnett is responsible for securing the instantaneous balance between supply and demand in the power system.

The network regulation scheme implemented by NVE in the 1990s has intentionally focused on providing incentives for improved utilization of the existing investments.

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68 Current Satnett operations and the development of a Nordic Balancing Market are some examples.

Any new major investment by Statnett is subject to comments by the User Council and decided by the Board. User representatives have through their participation in these bodies the possibility to supervise and influence the level of efficiency of investments, and as such direct Statnett towards more cost effective operation and a better utilization of the current investments.

With growing consumption, overcapacity was gradually reduced (figure 1).

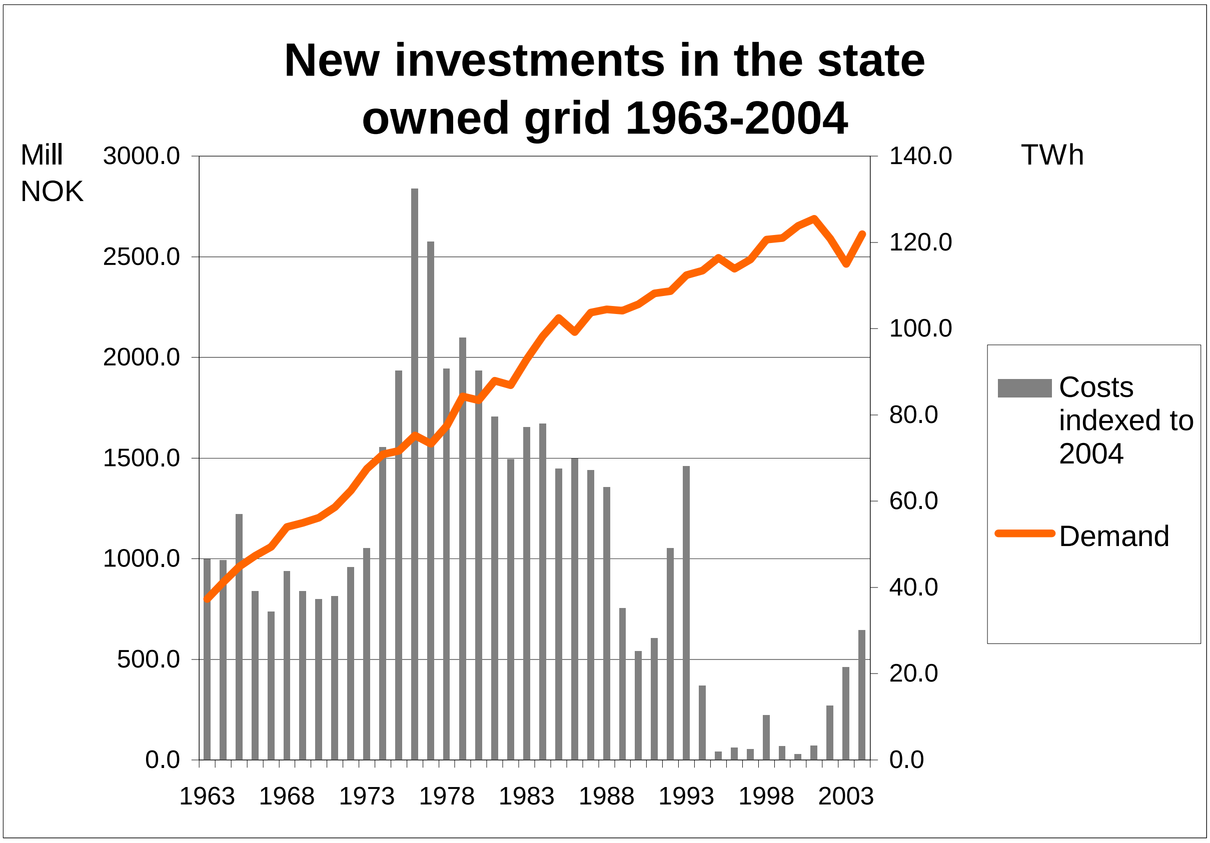

Figure 1: Development of new investment and demand (1963-2004)

Improved utilization of the existing grid may result in more constrained operations and over time this could threaten the quality of supply.

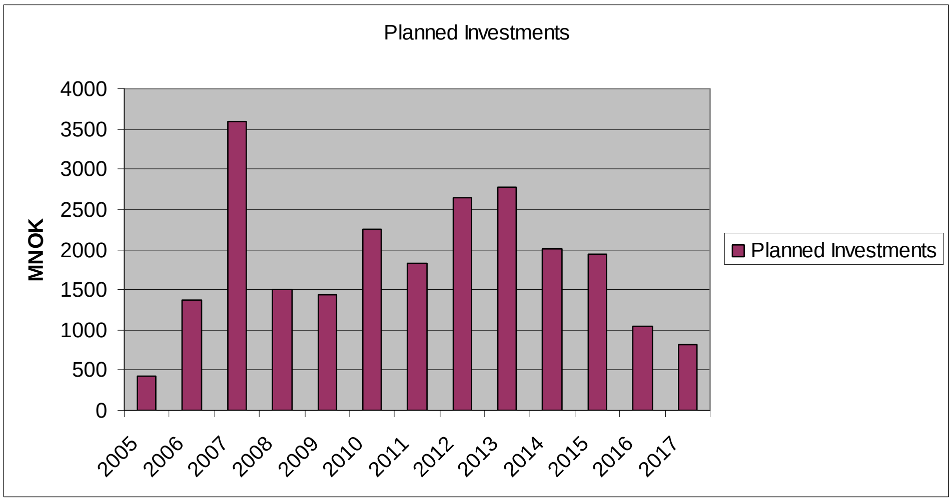

Figure 1b: New investment plan, extension to table 1.

Figure 1b clearly shows that the improved utilization period has come to an end and both figures 1a and 1.b may indicate Statnett's business cycles.

If most of Statnett's planned projects are carried out, a new boost in investment, as we have seen in the period 1973–1988, will take place.

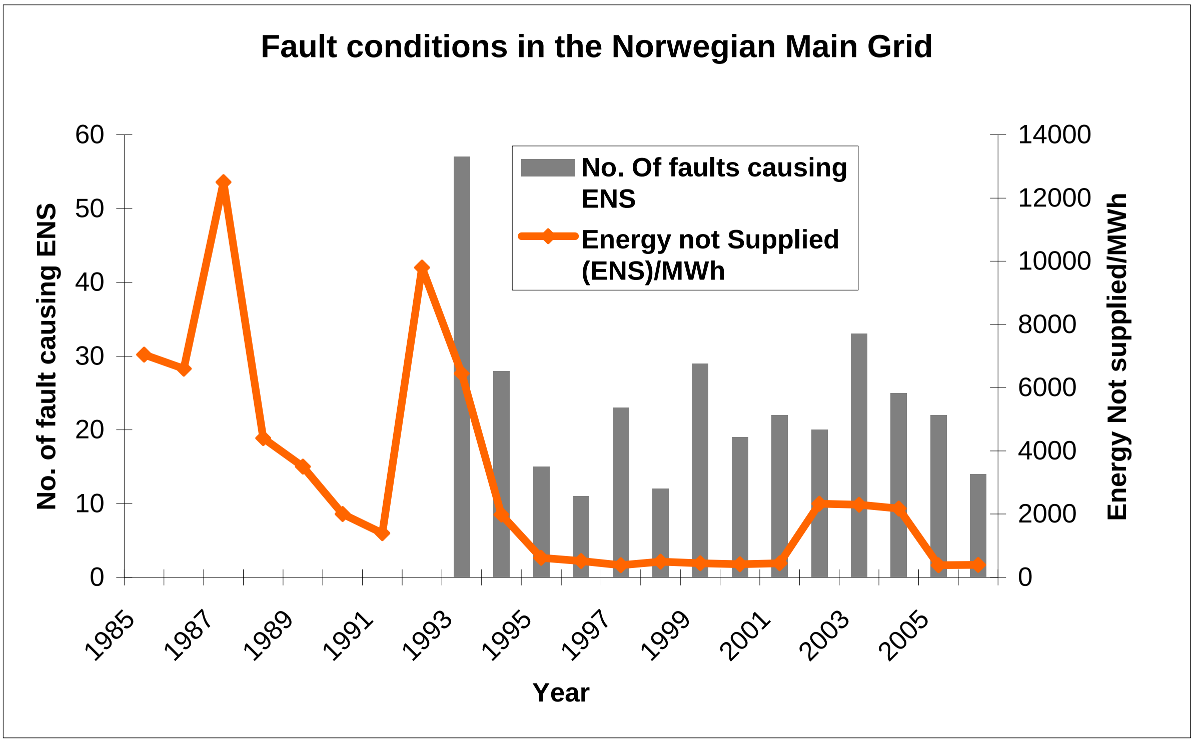

Figure 2: Development of the number of fault conditions 1993-2006

However, figure 2 shows no significant correlation between the lower investment level and the development in energy not supplied. The experience so far hence proves that the resources could be better utilised while maintaining a high degree of quality of supply. Reinvestment has throughout the period been on a stable level based on long-term planning for maintenance and reinvestment.

Transmission investment issues in Norway - conclusions and references

The Norwegian experience might indicate that there is no significant correlation between unbundling and investment, but obviously discrimination in terms of access and fair treatments for new users can be improved. Statnett has however through its strategic operation managed to be regarded as a neutral facilitator and added credibility and more functionality to the power market.

To phase in investment in order to optimize the total development of the power system is however a complicated issue and bundling or neutrality may not be the main triggers.

In the editorial of Economic Forum (issue 1, 2007), Professor Einar Hope and director of applied science Torstein Bye underlined:

> "Until now the Nordic market has benefited from the overcapacity created before the reform and worked quite well. The big challenge will be how the new investment needed can be optimized in a socio-economic way. This is a very complicated issue and a lot of research work remains."

In a working paper[69] professor Finn R. Førsund tries to reduce TSO risk caused by the uncertainty created by the location of generation. The use of concessions and other options for strengthening control of generation investment, including location, may be a proper tool and still ensure independence of generation investors.

In most countries the TSO is regulated and some incentives are included so investment will be handled according to basic economic criteria. However Argentina introduced in the early 1990s a successful reform similar to UK and Norway. One part of this restructuring deserves special attention. Major expansion of transmission was no longer decided by the TSO owner but left to the users of the transmission system. A Public Contest method required users to propose and vote on major expansions. All users within a defined area would share the cost on the basis of their actual usage over an agreed amortization period. The method was adopted in order to avoid inefficiencies and over-expansion as in the previous state–owned era. This system has worked quite well and has shown that it is feasible to transfer decision–making powers from the TSO and regulators to users and put proposed investments out to competitive tender. This experience from Argentina[70] has shown that that there may be scope for enabling market participants rather than regulators to make decisions on grid investments.

In theory prices, or more correctly the discounted value of prices, will be one of the main parameter for calculating the net present value of a given transmission and generation expansion project. The theory of spot pricing suggests that energy spot markets will provide sufficient incentives in generation and necessary grid expansion. Volatile spot markets, as the highly hydro-based market in Norway, may limit predictability of future electricity prices and induce companies to rely more on current prices in their investment plans. This may result in investment cycles as indicated in the Statnett case.[71]

Most TSO investments are capital intensive and depend on other decisions as the location of generators and development of load which create uncertainty for future parameters affecting profits. When new TSO investments are decided, possible alternative investment in transmission and generation may be locked or even 'killed'. Power lines are not reversible and all opportunities should be investigated to maximize efficiency before investment decisions are made. In this way investment can be managed as a *financial call option*.[72] If granted a concession, the TSO has a right, but not the obligation, to invest. Carrying out an irreversible investment is similar to exercising a call option because it entails giving up the value of waiting for new information, which may affect the investment itself, or its timing. The lost option value is an opportunity cost that must be included as part of the investment cost. When this 'lost option value' approach is used, the net present value formula must be modified. Instead of simply being marginally positive, the present value must exceed the cost of the project by an amount equal to the value of keeping the investment option alive. If this theory is applied, uncertainty is far more important and fundamental, and small increases in risk may lead TSO managers to delay investment.

In *Economic Forum* (issue 1, 2007), Frode Kjærland at the Business School of Norway tries to find explanations for the low investment level in the Norwegian power sector. According to classical economic theory, price increases should attract new generation and transmission capacity. Traditional Net Present Value calculations show a clear positive value. Kjærsland makes a simple study mapping

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69 Working Paper No. 34/07 Bergen, November 207, ISSN 1503-2140.

70 Experiences from outside Europe and N. America can be hard to find but Stephen Littlechild has written some interesting papers, such as *Beyond Regulation* (February 2006, CWPE 0616 and EPRG 0516).

71 Such arguments have been emphasised in different research papers and used to support the introduction of capacity market, something which has little or no support in Norway. However, investment cycles will remain inevitable in the electricity sector due to price risk.

72 Dixit and Pindyk, "The Options Approach to Capital Investments", *Harvard Business Review*, May-June 1995. A call option is an agreement enabling the holder to buy or sell a security at a designated price for a specified period of time, unaffected by movements in the market during the periods (Britannica Online Encyclopaedia).

possible barriers but very quickly underlines that this type of investment is irreversible. He makes reference here to the work of Dixit & Pindyk. His article is a sort of test of the limitation of the NPV method which does not take into account the incremental value of new information to investment. In his article he tries to estimate the option value as an alternative cost and the calculation shows that the necessary price level to invest is far higher than what has been observed in the relevant time frame. The analysis also shows that the volatility of the forward price is the main component to calculate the value of the option. The analysis indicates that an increase in volatility is due to green certificates, carbon quotas and that increased demand not always will be compensated by supply in the short term. His conclusion is that the relevance of including option theory in investment analyses is underestimated.

This theory can fit into Statnett's efforts to better utilize the existing grid. Statnett managed until now to be very careful and cautious about grid expansion and the current policy to better exploit current investment seems to be very successful. It is important to underline that new hydro capacity in this period was limited and that no major hydropower development took place.

In January 2007 a revised income cap regulation came into force and one of the objectives was to promote efficiency and better incentives for investment. Interviews with network companies indicated that the new regulation in itself did not boost investment as the rewards were still considered too low to offset risks. These were rather the penalties for energy not delivered (for instance because of wire failure) or quality default which seemed to better explain network expansion plans. The outcome of these interviews supports the idea that grid investment is complex and yields different kinds of risk. More information, following the call option theory, may contribute to increase investment. Incentive regulation may contribute less than its advocates claim.

If new legal tools are introduced, such as an obligation to invest, incentives created by existing regulatory mechanisms may become flowed. These tools should be considered as 'last resort' options to be used only when security of supply is at stake.

The European electricity market reform and why the Nordic market has worked so well?

Under this subtitle it may be possible to link several of the papers by Lars Bergmann,[73] Stockholm School of Economics, who has contributed to the Nordic reform, Market Design and evaluation. The most important of these papers is an early version[74] of the much-quoted paper "Why has the Nordic electricity market worked so well?"

Bergmann distinguishes between developing a market as an organic process, i.e. that agents realise that there are potential gains from trade, institutions and e.g. trading rules, which all tend to reduce transaction costs; and developing a market by discretionary decisions to create institutions through legislation and regulation.

These alternatives will have different dynamics of change as the organic process will be contestable and may only survive until better alternatives become available. To the opposite, markets created by discretionary decisions are not (fully) contestable and may survive even if better alternatives become available. In the European Union, electricity markets have been created by discretionary decisions and Market Design has become a vibrant field of economic research.

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73 Amundsen and Bergman, "Why has the Nordic electricity market worked so well?" 14(3) *Utilities Policy* (2006), 148–167. This paper is currently the most updated version of his communication to the EPRI conference "A Search for Alternative Pathways" in San Francisco, California.

74 In the version published in *Utilities Policy*, Bergmann has added the California case, which brings more focus to the US than to the EU development.

The European power industry can be divided into four 'islands': UK, the Nordic countries, the Iberian Peninsula and Central Europe, which are dominated by a few 'giants' as EDF, RWE, E.ON and ENEL.

The Nordic Market has a quite different structure:

> "A well integrated regional market, a common power exchange and similar transmission pricing models. Production and consumption are a good mix of hydro and nuclear represented by a few major but many small generators."

The indicators of a good functioning of competitive markets are: market clearing at prices which maximizes traded volumes; market prices reflecting the relevant marginal cost and investment in least cost capacities added when demand grows. The price level should also reflect the degree of competition, as well as marginal costs of generation, transmission and distribution. The notional level of charges and taxes must be transparent.

According to Bergmann the key questions to asses the success of a particular electricity market reform are:

- Will security of supply be maintained when central dispatch and planning are replaced by market-based decisions? Will the degree of competition be sufficient, or will market power prevent the potential benefits of competition from being realised?
- Will competition bring about efficiency increases to the benefit of consumers?

Some of the critical challenges are:

- As generation and load have to be balanced in real time, pivotal generators have a very significant potential market power,
- Pivotal generators need not to be big,
- But big generators are pivotal more often than small generators,
- Thus there is a positive relation between concentration and potential market power in wholesale electricity markets.

As a case study, Bergmann uses the Nordic 2002/03 supply shock which reflected an extremely dry autumn in 2002 and led to the lowest[75] water reserves in several decades. As described earlier in this paper, without caps or political intervention the price of electricity reached unprecedented levels but the supply-demand balance was maintained.

The test for the Nordic Market Design could be described as follows: Was the price increasing as a result of increased scarcity of hydropower, or did the major generators exercise market power? The analytical tool Bergmann used was the PoMo model.[76] This is a dynamic optimisation model designed to simulate weekly spot market pricing based on the assumption that the market is competitive and agents are risk-neutral (i.e. act on the basis of the expected value of stochastic variables such as water inflow and nuclear output).

The PoMo model will for instance reach the conclusion that generators exercising market power would produce less than they would under perfect competition, and prices would be higher than under perfect competition. It follows that if market power is exercised then actual spot market prices would systematically exceed the (simulated) PoMO prices. If real world generators are risk-averse, then actual spot market prices would rise earlier, but also fall earlier, than (simulated) PoMO prices in a 'dry' year.

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75 In the early autumn of 2002, the hydro situation appeared quite normal in Norway but Sweden faced early signals of below-average water levels. This initiated a net export from Norway. This situation was not so uncommon and hence did not raise any concern. However, the dramatic shock which severely affected the hydro situation occurred later.

76 This model was developed by K. A. Edina and EME Analysis, but not officially published.

The results of the PoMO simulations show the following: competition works. The 2002/03 price increase was essentially a result of increased scarcity of hydro power. Thus high prices do not to any significant degree seem to be a consequence of any insufficient market competition and yet high electricity prices cause real economic problems for electricity intensive industry[77] and households with electric heating.[78]

Bergman's main points are:

Simple but sound Market Design

- To a large extent made possible by the large share of hydro power in the Nordic system.
- No price regulation or regulations that increase transaction costs.

Successful dilution of marker power

- Far-reaching integration of the national markets made possible by significant inter-connection capacity,
- Distance-independent prices,
- Well-developed forward markets,
- Strong political support for a market-based electricity supply system,
- Possibility of an informal commitment to public service by the power industry.

The problems and solutions ahead – according to Bergmann – are the following: Due to environmental concerns and policies, the marginal cost of electricity has increased and is likely to remain high. The transition from low to high prices has not been widely anticipated and will include structural changes. The electricity market is signalling the increased cost of electricity. Redesigning the rules and regulations of the markets can only alter the signal, not the underlying reality (don't shoot the pianist!).

In the SESSA paper of 2006, *Refining Market Design,* David Newbery uses the Nordic market as an example of a successful design. The example of the supply shock of 2002/03 is used to evidence the robustness of the Nordic Market Design. Newbery raises the issue of whether the events of 2002/03 amounted to a warning, or indeed an outright proof, that the electricity market is flawed. Others consider the market performance during this period as evidence that it has reached maturity and are robust enough to withstand even quite extreme shocks. Most Nordic academics prefer the latter view. The supply shock brought to the surface a number of potential weaknesses which warrant careful analyses and which may eventually lead to further improvement in the regulatory framework.

The rapid price increase for end users, especially households,[79] became an issue and evidenced much higher price elasticity than previously predicted. By contrast, commercial and industrial consumers were less affected, due to longer-term contracts.

Although the NordPool spot price affects all Nordic countries, end use prices were not largely affected in Sweden and Finland. This is explained by the fact that retail markets differ in ways that make direct comparisons somewhat complicated. In Sweden the argument used was that their market is more robust to shocks and would be able to withstand the hydro shortage.

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[77] Interviews with the power-intensive industries reveal a strategy of both rationing and maximum use of reselling to NordPool. If Norway were to face serious actions of curtailment, the power industry may be an early target. High spot prices create high incentives to limit production and bid into NordPool. The power-intensive products can be bought in the international market and supply obligations could be met.

[78] Most households in single-family houses have a wood stove, and the use of firewood increased.

[79] The electricity bills increased by more than 50% for some segments of demand.

If one compares just Norway and Sweden, the retail markets perform rather differently. Average retail prices were considerably lower in Norway than they were in Sweden during the earlier period, and the explanation lies in the switching costs. Norway used profiles to determine bills, whereas Sweden required expensive interval meters[80] to switch.

Newbery still emphasises some residual concerns regarding price discrimination and market power in the Swedish retail market. The conclusion reached by Newbery is that the Nordic experience suggests that consumers can reduce demand appreciably in response to sustained increases in electricity prices, provided that the wholesale prices feed through into retail prices and are not distorted by market power supported by high switching costs. When the reasons for the high prices are clear and well understood (low reservoir levels), there seems to be no need for regulatory intervention.

Adding the fact that most households in Norway have got tariffs where the NordPool spot prices is a major component, the scarcity signal will pass through rather quickly. This characteristic feature is well organised and implemented in the Norwegian Market Design.

Summary and conclusions from the selected papers

It is important to assess and implement Market Designs which facilitate efficient, adequate and timely investment, both to prevent capacity scarcity and minimise regulatory and other risks, and ultimately lower financing costs. However at this stage, most academics are not convinced that ROs or other capacity mechanisms are necessary for most European countries, at least given their present level of market concentration.

The Cambridge report also shares the view that certain Market Designs still create market failures which could undermine sufficient and timely generation investment in the appropriate technologies. In particular, the failure of balancing markets to convey scarcity signals, the difficulties generation companies face in finding counter-parties for long-term contracts and options with customers or retail companies, as well as the ambiguity of TSOs' obligations and incentives for ensuring generation adequacy in some markets, are all sources of concern.

The recommendation is an evaluation of alternative institutional and regulatory arrangements, from the least disruptive - such as giving a clear duty to the TSO to maintain a certain reliability level and incentivising the TSO to do so at least cost – to the more radical solution of retaining or reintroducing the domestic franchise with long-term contracts on behalf of their domestic customers.

The report agrees that ROs as suggested by Henney and Bidwell are a potentially attractive alternative that may be more compatible with retail competition. However, their implementation might prove complex in interconnected systems, and more research is required on issues such as market power at the time of signing the option contract, whether to allow third parties to trade the ROs and to address issues of capacity availability and requirements with substantial intermittent generation. The authors of the Cambridge report have some concerns that ROs might have unintended consequences on the development of contract markets and other options. Given the potential (but also the uncertainties) of ROs, it would clearly be desirable to conduct an experiment (after careful simulation and having tested alternative designs), and logically this should be in a country that has concerns over generation adequacy or needs to reform its Market Design. Spain might be such a case.

In the current Market Design of Norway, both the power exchange NordPool and the TSO Statnett have an important role in domestic issues and in the integrated Nordic Market. Nordel[81] is an important organization to coordinate operation and investment in the regional grid. Among key

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80 Later on Sweden moved to profiling and costs remained similar.

81 As a consequence of the establishment of ENSTO-E following the enactment of the 3rd package, NORDEL will be closed.

stakeholders, the debate on missing grid investment has been high on the agenda since the mid 80s. The chapter on the Norwegian TSO describes the historical development of investment and demand since 1963 and also includes future plans. By adding fault conditions, an improvement in utilization becomes noticeable. The figures also give an indication of Statnett business cycles, which appear to be somewhat longer than usually anticipated.

The policy of postponing irreversible investments in an optimal way is recognized both in the Cambridge paper and in the Statnett paper. References to several papers are quoted. Overall, Statnett investments seem robust and close to the optimum, and are an important part of the Market Design chosen in Norway.

3. The *Strategy Paper* - a List of Wishes or a Committed Program for the 'Success' of the 2003 Directive?

The *Strategy Paper* is the outcome of a request from the Florence Forum of October 2002. In the introductory comments, the Commission emphasises that there is a broad consensus within the industry regarding its content.

It could be interesting to take a closer look in a comparative perspective at the major strategies and challenges described in the paper, and to identify which topical issues remain to be tackled in the 3rd Package.

The Strategy Paper focuses strictly on competitive market for the enlarged EU, i.e. not only a market where customers have a choice of supplier, but also a market where all unnecessary impediments to cross-border exchange are removed.

Improved cross-border flows will increase the scope for real competition which will then enhance the economic efficiency of the sector, leading to benefits for customers both in the business sector and in the household sector, in terms of lower energy prices, improved services and products tailored to their needs.

Competitive electricity markets must deliver a secure, reasonably priced and continued service to final energy customers.

In the introductory remarks, the Commission underlines the following:

> "Considerable progress towards the objective of an internal market without barriers has already been achieved. From 2002, ETSO introduced a mechanism for cross border tariffs that has removed specific transmission charges associated with exchanging electricity across most of the internal borders of the EU."

Cross-border regulation is still debated and removing barriers is still at the top of the agenda in the 3rd Package.

On the TSO-level the Commission highlights the following:

> "It is expected that TSO will harmonize network security rules, grid codes and access and tariff methodologies such that trade within a region is as easy as trade within a country or TSO control area." This is a repetition of the points used to establish ENTSO[82] and ACER in accordance with the 3rd Package proposal.

[82] ENTSO is a new pan-European body grouping TSOs. The 3rd Package documents give an outline of tasks and responsibilities.

It also states:

> "Power Exchanges are also likely to have a key role in developing the Single European Electricity market by providing transparent, non-discriminatory access to electricity trading in the European Union, insuring proper functioning of electricity markets."

The Commission outlines major commitments to and responsibilities for power exchange but no regulatory or legislative needs are mentioned. Markets are created – they don't pop up over night!

The regional market challenges and the proactive statements from the Strategic Paper draft are all gone, and the mechanism to create this market is described as follows:

> "It is, indeed, expected that regional markets will develop "organically" through co-operation between institutions in neighbouring markets."

This miracle did not occur – the ERGEG regional initiative was a necessity and progress has been troublesome and slow. Lately some long-awaited progress has been made but further help and support from all stakeholders is still needed.

In 2005, ERGEG issued a report The Creation of Regional Electricity Markets as a discussion paper ready for consultation. The main topics covered are:

> "activities of transmission network operators (TSOs) and the wholesale energy trading market arrangements and discuss whether or not obstacles exist within these areas which may need to be overcome in order to establish an effectively functioning regional market."

The main focus is on TSOs' operations and technical rules for trade, but little attention has paid to Market Design[83] and to the need and role of power pools. The most interesting parts of the paper are the many annexes which describe arrangements and case studies from countries in progress. Those who want firm ERGEG recommendations must look elsewhere.

There is a long list of specific objectives which should be pursued in the context of the Regulation (1228/2003), and an indicative timetable. Almost none of these critical issues have been solved and the timetable has almost lapsed. Some required tools such as an agreed methodology of ITC (2005), market participants in all Member States to have access to a relevant functioning power exchange (2006) have not been implemented.

However, congestion management (2006), a single power market in South East Europe (2008) and the establishment of a Baltic market (2008) are some of the objectives which have not been met.

The list of regulatory updates or new legislations to be included in the 3rd Package is quite extensive. There is thus a strong pressure on legislators and politicians to make it a success and implement mechanism to accelerate the development of the single electricity market.

However, the starting point for the 2003 Directive was exotically the same. Although substantial progress was made, the regulatory gap was not closed and major barriers to protect incumbents are still in place.

An attempt to critically assess how regulatory inputs are processed into EU legislation

The optimism on a quick transposition of the 2003 Directive very early slowed down when the governments in member states started to show much reluctance. Delays were many and hopes for strong political commitments gradually weakened. Is the main reason 'Economic Patriotism' in

83 Key features of market design are just left to a paragraph on page 31 and the BETTA arrangements are the only example mentioned.

member states? In his EUI Working Paper on Electricity Market Design Convergence, Jens Weismann[84] outlined a theory which calls for attention.

He says:

> "regulatory convergence may be in conflict with national interests, especially when critical infrastructure services like electricity are concerned. The EU member states undergo cycles of pro European and anti–European rhetoric's. Even though the general interest is towards greater integration economic patriotism is powerful, populist counterforce to identification with the fairly abstract idea of a union that tries to overcome the last 200 years of successful ideological, cultural and linguistic national-building by creating a multi–faced demographic colossus with non–democratic and seemingly distant decision–making process."

Glachant and Leveque (2009)[85] write in respect to the internal energy market:

> "The EU national diversity is first and foremost a predictable result of the nature of the compromises between the Member States, formalized by the European Community in the first Directive of 1996. According to the insightful commentary of L. Hancher, this first Directive allowed nearly everything, except …an integrated internal market. The second Directive (2003) and its companion Regulations managed to reduce the scope of this diversity, but no eliminate it."
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> "As the momentum for the internal electricity market gathered pace on a European level, governments learned how to transform their strategy sets from initial opposition to a more subtle approach formally embracing the concept of liberalisation while pursuing an agenda to protect the values of the old system and the status of their utilities. The revised strategy was: to accept the regulation relating to competition, but act as little as possible to conserve to current situation."
>
> "The creation of a single market across member states is almost inevitably intertwined with convergence of regulatory regimes, because borderless trade is only facilitated by harmonization in rules and practices. The resistance of transfer of regulatory powers to super national bodies, while on the hands, the EU framework of rules to which member states regulatory regimes are subject does not fully match the functional need for uniform EU rules. The resulting regulatory gap is partly filled by new types of informal institutions, the trans-national regulatory networks."

An example from Jorge Vasconcelos is used as a confirmation of this regulatory gap:

> "The first Directive defined some rules to be applied by all Member States in order to open up their energy markets (….) However, the Directives provided little guidance as regard cross-border trade, development of regional markets, interactions with non-EU markets, development of interconnectors, supra – national integration of energy markets etc. Hence, a "regulatory gap" between national markets and the EU internal energy markets emerged."

He also underlined his tendency of establishing diverging regulatory regimes:

> "Looking at the way legislators and regulators started making use of the freedom to shape domestic markets, it was soon recognized that implementation of the common rules in Directives could lead to incompatible trading arrangements and block cross-border trade if nothing was done. In fact, parallel liberalisation of the 15 energy markets did not ensure capability – and even less convergence or integration - of these markets."

The development of translational regulatory networks accelerated when the Florence Forum and later CEER and ERGEG were set up. But since then they got very limited power, the regulatory gap was not closed.

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[84] Weismann, "Agglomerative Magnets and Informal Regulatory Networks: Electricity Market Design Convergence in the USA and Continental Europe", RSCAS Working Paper 2007/15, page 6.

[85] Glachant and Lévêque, "Electricity Internal Market in the European Union: What to do Next?" in Glachant and Lévêque (eds.), E*lectricity Reform in Europe: Towards a Single Energy Market* (Edward Edgar, 2009).

Both the UK regulator and Norway could be the pioneers for years to come without any intervention. However, the development in the Nordic countries had a quite different development compared to the rest of EU. Norway benefited from a more robust wholesale market and Sweden could keep Vattenfall as one company without breaking it up. Unified incentives created consensus of a common Market Design, as Bergmann underlines. The "internal regulatory gap" in the Nordic area was insignificant.

The EU challenge is to fully close the regulatory gap and prevent member states from acting selfishly. A strong ACER with decision making powers and national regulators as local agencies will make sense.

Some Conclusions

Experiences show that the development of a single market has been slow and that the political commitment varies among member states, although regulations aim to achieve integration. The European industry can still be divided into the four islands which Bergman described. There is very often political support for this 'giant' structure, although Directives negotiated within the same political sphere promote a policy to foster full competition excluding marker power.

There has been a long-running debate not only on the concrete content but also on the degree of harmonisation which is necessary for the internal electricity market. As described in this paper, EU consultation, legislation and Directives have little focus on harmonisation of the Market Design issues, but detailed rules and regulations have received much attention. The 'repair boxes' approach still seems to be the preferred way forward, despite the fact that previous experiences suggest a different approach.

The 3rd package was initiated as a more coherent and coordinated strategy, but much of the momentum has been lost in the long bureaucratic and political process, and the large number of compromises on the political level has not improved consistency.

Papers which have focused on a sound Market Design have all been based on sound regulatory experiences, economic theory and success stories. They should be regarded as valuable and important input to the 3rd Package. However, none of these efforts has had any major effect on the intended regulatory structure of the 3rd package.

There seems to be common agreement regarding the main success factors emphasised by Bergmann but monitoring market developments and security of supply are conducted in a somewhat veiled way.

Environmental restrictions, CO2 taxes, fuel prices and political decisions all have an impact on electricity prices and rational consumer response, so obtaining the understanding of customers will be difficult to achieve.

Customer support and protection varies considerably among Member States. Households with regulated tariffs below cost have no incentives to support competition and switch suppliers. Without such discrimination and cross-subsidies, full market acceptance will never be met.[86]

Customer choice and transparent benefits must be easy to undertake and reach. Introducing new technology, such as smart meters, will contribute to such a development.

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[86] Commenting on the specific case of France, the *Utility Week* of 29 March 2009 in the "Single Markets Incomplete" article: "*If consumers who earlier left the regulated system want to return, they can ask for a special state–administrative return tariff (known as Tartam) below the market price. Because only a limited number of companies have benefited, the Commission fears it could be an illegal subsidy that breaks EU state aid rules."*

Public attention to electricity markets will always suffer from a general lack of a general understanding of the industry complexity, the effects of new regulatory tools, political promises and the volatility of fuel prices. Affordability and ensuring that ‘the light is on’ are the main concerns of customers. For this reason a direct link between success factor and customer response is hard to find and estimate.

The currently fragmented market structure in the Member States will be difficult to monitor without a firm point of reference. In this paper the arguments for a pool central dispatch Market Design as a baseline is quite obvious. There must be some consensus on basic structures before any detailed specific regulations are put on the agenda for discussion. Up until now the ‘consensus’ on a single market is set without a proper ‘road map’ – how do we really get there? The current outcome is: crossing border is easy in one area but impossible in another area. The ‘devil’ here does not lie only in the details. Introducing a more coherent Market Design is the only way to go forward in order to remove such fundamental structural barriers.

To get back on track the pan-European Regulatory Body ACER needs a design and power to set rules and regulations which will foster ‘full’ trade and competition. Unfortunately, the political trend is heading in the opposite direction. Some countries will benefit from the existence of regulatory gaps and will always try not to close them fully. Compromises will always be inevitable.

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