Creating New Electricity Markets in Europe to Meet Energy Policy Challenges

Explaining the Electricity Market Reform Landscape

Third Generation
Environmentalism (E3G)

GE imagination at work

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Executive Summary

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Creating new electricity markets will be vital to the EU at an important time for consumers, industry and EU competitiveness. Liberalised electricity markets have existed around the world for over two decades and have delivered many benefits to consumers. In some regions, however, we are now witnessing calls for reform of these markets. Such calls are due in part to the fact that recent experiences have afforded regulators and market operators with valuable lessons that can be incorporated into current market designs to improve operations. At the same time however these calls are also being driven by a growing recognition that existing market designs may not be able to effectively cope with three energy policy challenges – security of supply, climate change and affordability.

Electricity market reform (EMR) is a complicated and multi-faceted topic. The objective of this paper is to frame the EMR landscape in simple terms and promote a dialogue amongst policy-makers and other stakeholders charged with implementing changes to electricity markets.

Four key issues comprise the EMR landscape. They include:

1. **Low carbon generation**: Attracting sufficient, efficiently financed[1] investment to support the policy objectives of decarbonisation and security of supply.
2. **System balancing**: Ensuring that system operators can maintain grid reliability with increasing volumes of intermittent renewable generation.
3. **Energy sales**: Ensuring that retail electricity markets are competitive and customers who are facing increasing electricity prices can be confident that they are receiving a good deal from their supplier.
4. **Energy services**: Enabling cost-effective investments in the demand side of the market to reduce overall demand and provide balancing services.

Although these issues are applicable to all electricity markets, they represent particular challenges for the EU as policy-makers attempt to establish a single, integrated European energy market. In some cases, member states may have unique policy objectives that require different market arrangements. Indeed, some member states have already initiated market reform efforts independent of broader EU objectives.

The EMR agenda is frequently characterised as 're-regulation,' which leads some free-market proponents to view the subject with scepticism. Yet this characterisation is overly simplistic. The looming investment challenge does indeed demand a re-balancing of risk between investors and customers, and regulatory reform may be the most appropriate means for achieving this balance, while at the same time creating more reliable wholesale markets and dynamic retail markets are equally important.

GE and E3G have joined forces to promote a discussion that we hope will make a valuable contribution at an important time for the energy sector.

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[1] 'Efficiently financed' means that investments are financed at the lowest appropriate costs of capital and, therefore, that there are no unnecessary costs for consumers arising from risks that investors are unable to manage efficiently.

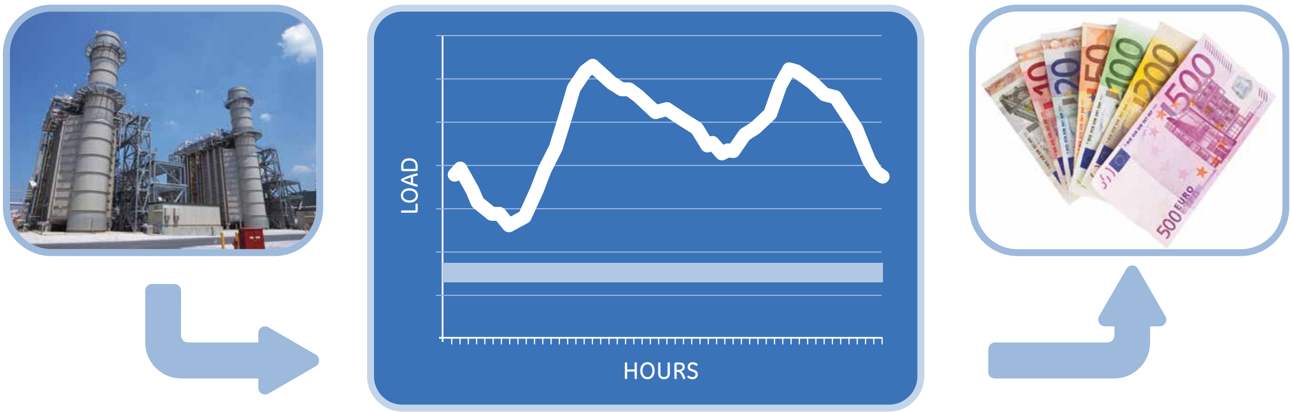
2 Liberalised Electricity Markets

The process of electricity market liberalisation is now well established in Europe. Over the past few decades, large state owned entities have been re-structured and often sold into private ownership. New market rules have been devised and implemented to allow electricity to be bought and sold whilst enabling a system operator to maintain reliable power supplies. End consumers have been allowed to choose from a number of competing electricity providers. These extensive changes have delivered many benefits, including significant improvements in generation efficiency and the attraction of private sector investment into the power sector (see *Figure 1* for an explanation of the principles underpinning generation investments). However, other potentially important benefits have proven more elusive. In particular, dynamic, customer-facing markets in electricity products and services have not developed and, in consequence, a responsive and efficient demand side to the market has not materialised. These customer-facing markets tend to remain highly concentrated with little evidence of significant new entrants or the emergence of business models built around innovative new products and services.

There is, therefore, much to learn about the design of liberalised electricity markets from the experience of the past few decades. Moreover, the policy and technological evolution of electricity markets has also moved significantly. They can no longer be viewed merely as a means to secure supplies at the least possible cost. Decarbonisation of the electricity sector is now considered to be the critical first step in the decarbonisation of the wider economy, presenting credible technology pathways for early reductions in greenhouse gas emissions and, thereby, presenting options for the subsequent decarbonisation of other sectors through electrification. In addition, the separate national markets across Europe are progressively converging, both physically and with respect to their regulatory frameworks, creating a new paradigm in the governance of electricity markets.

The twin desire to learn from the experience of operating electricity markets and to support the decarbonisation of the sector going forward has given rise to various market reform initiatives. These have ranged from incremental 'tinkering' with existing frameworks to fundamental overhauls of the key design elements. This paper sets out the electricity market reform landscape and identifies the most important changes that need to be pursued to meet future policy challenges. In particular, this analysis illustrates that market reform should not be characterised as an exercise in re-regulation. Rather, it is a necessary step to remove the barriers that have prevented competition and innovation from reaching all areas of the market to deliver maximum benefits to consumers and society at large.

Figure 1. Principles underpinning investment in generation in liberalised electricity markets.



New power plants will be more efficient and therefore able to operate at a lower cost than older plants. This efficiency advantage will enable them to operate at, or near, base load, and throughout the day earn market prices set by older and higher cost plants. Moreover, the technology of fossil-fired power plants is relatively mature. Investors can confidently expect that a construction project will be completed on time and within budget and the power station will, thereafter, work reliably. The new power plant could be expected therefore to continually earn an operating profit, or 'energy credit', in order to recoup financing costs and deliver project returns.

The founding principle of liberalisation was to transfer earnings risk from the consumer to the investor, however the extent to which investors were expected to bear the full earnings risk differed across Europe. Whilst this paradigm previously underpinned generation investment, the following sections explain why it is no longer sufficient to support the necessary investment.

3 The Electricity Market Reform Landscape

Electricity markets are subject to constant review and revision in order to respond and adapt to evolving circumstances. Changes can often be managed through detailed, technical measures by market participants and regulators. However, a number of major challenges have emerged over recent years that exceed the boundaries of technical responses and have commanded high level political attention. These can be grouped as follows:

1. **Low carbon generation**: Attracting sufficient, efficiently financed investment to replace and enhance the existing infrastructure consistent with decarbonisation and security of supply objectives.
2. **System balancing**: Ensuring that the move towards more intermittent forms of generation will not compromise system reliability while enabling deployment of sufficient flexible resources to allow system operators to balance supply and demand.
3. **Energy sales**: Creating retail electricity markets that are genuinely competitive and that command the trust of customers who are facing increasing electricity prices.
4. **Energy services**: Maximising the potential for cost-effective investments in the demand side of the market to reduce overall demand and provide balancing services.

These four challenges represent the critical issues that now need to be addressed by electricity market designers. They comprise the electricity market reform (EMR) landscape and are illustrated in *Figure 2*.

All countries and regions will want to tackle these issues at their own pace and according to their own priorities in coming years, largely as a result of differences in their current asset bases and the extent of their power sector decarbonisation ambitions. However it is likely that each of these issues will need to be addressed within a European framework at some stage if electricity markets are going to be able to support of the long term EU energy policy objectives.

The following sections explain the deficiencies in existing market designs that have given rise to this reform agenda and set out some of the potential reform solutions that are emerging.

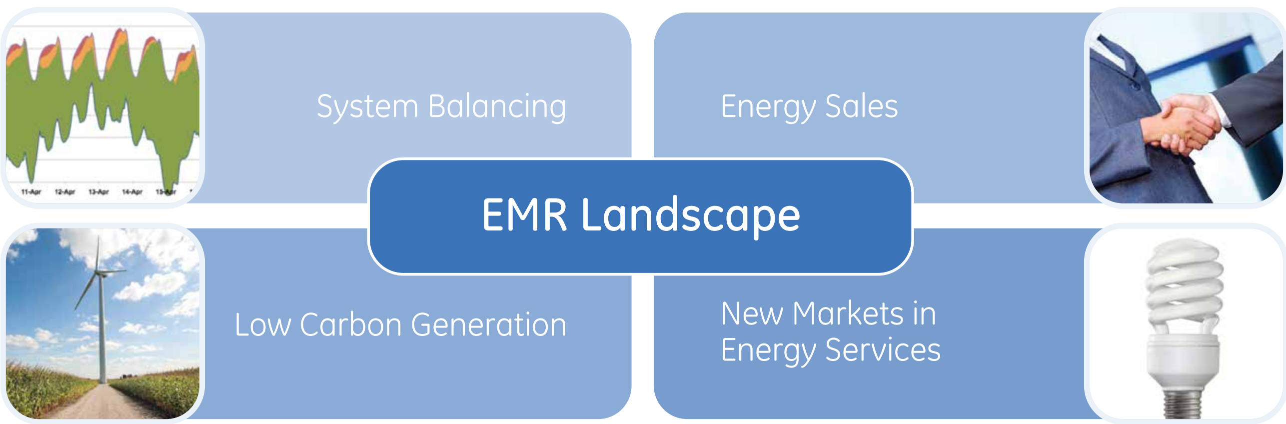


Figure 2. The EMR Landscape.

Low Carbon Generation

The decarbonisation agenda presents new challenges for generation investment. Significant reductions in the carbon intensity of electricity will require some combination of renewables, nuclear and fossil-fired plant fitted with carbon capture and storage (CCS) technology. These technologies tend to have greater construction and performance risks than conventional alternatives and are often considerably more expensive. The existing principles underpinning generation investment (see *Figure 1*) will, therefore, no longer apply and new administered mechanisms are required to deliver project returns for investors.

Part of the solution involves establishing a cost of carbon, either through taxation or a cap-and-trade scheme. This has the effect of increasing the operating costs of high carbon emitting plants, and thereby the power price, to the level where low carbon emitting plants can earn sufficient energy credit to recover capital costs and deliver a project return. Carbon pricing has proved effective in reducing the output from higher carbon emitting plants in favour of lower carbon alternatives that have already been built. This process will remain central to achieving decarbonisation targets in countries that expect to retain significant coal-fired capacity. However, carbon pricing in itself is not sufficient in driving significant levels of investment in new low carbon assets necessary to achieve long-term emission reduction targets. This is for a number of reasons:

1. Carbon prices are administered by politicians and, therefore, subject to on-going adjustment as political circumstances dictate. Investors require a high level of confidence in the future of these prices over many years and, sometimes, over several decades since they are vital in delivering project returns for long lived assets. The long term value of the carbon therefore tends to be discounted in an investment appraisal as a result of the risk of future policy change.
2. Newer low carbon technologies, such as offshore wind or CCS, might ultimately be required in large amounts but would require an extremely high carbon price to deliver project returns today. Such carbon prices applied across the whole market would lead to significant increases in energy prices for consumers, as well as windfall profits for cheaper low carbon plants. Such outcomes are generally regarded as unsustainable from a political perspective.
3. As the power system progressively decarbonises, the proportion of the time in which carbon emitting plants will be operating will progressively decrease. This will, therefore, decrease the proportion of time in which carbon prices are affecting power prices and reduce the ability of low carbon plants to earn an energy credit. This process also has the potential to lead to extremely volatile prices over the long-term.

It is, therefore, necessary to introduce additional mechanisms to encourage investment in low carbon emitting plants. This usually involves establishing a fixed price, or fixed price premium, payment for such plant, or by establishing an obligation on electricity suppliers to purchase a proportion of their electricity from low carbon sources. These so-called feed-in-tariff or quota schemes are an increasingly important element of electricity market design. Their importance is likely to increase over the next few decades as more low carbon capacity is built. Key design questions facing policy-makers include:

1. Should these payments for low carbon generators be embodied within a market regulation, which may be changed and may not give sufficient certainty to investors? Or should they be established through a contract, which is likely to be difficult to define and implement?

2. How should policy-makers balance the need for long term technology targets that support the development of efficient supply chains against the need to adapt quickly and flexibly to new technology options?

3. What approach should be adopted to ensure that future reductions in technology costs will be passed through to consumers without introducing changes to the mechanism that undermine investment confidence?

4. Is it sensible to entirely insulate low carbon generators from short term market price signals or should they retain some exposure such that they maximise their potential to respond to market need?

For instance, the UK Government is in the process of reforming its electricity market in light of the need to meet challenging carbon reduction targets. It is proposing to introduce a new mechanism to support low carbon investment based on long term contracts, primarily aimed at attracting sufficient levels of low cost finance to the sector, accompanied by significant changes to industry institutions and governance arrangements. These proposals represent a major overhaul of the existing market design framework and, despite the clear underpinning logic for the reforms, the complexity of the market arrangements is making implementation a prolonged and challenging process.

5 System Balancing

Integrated power systems require that supply and demand continuously balance to maintain a stable system frequency and reliable supply for system users. This continuous balance is achieved by ensuring that there are sufficient resources on the system to meet total demand (resource adequacy) and adjusting the output of these resources in line with real time changes in the level of demand (dispatch).

Historically, power systems have been operated on the basis that output from generation assets can be controlled to follow changes in consumer demand. Under these circumstances, if sufficient capacity is available from those generators to meet system peak demand, it is assumed that they can be dispatched to meet total demand at all times. Therefore, the resource adequacy challenge is met by delivering a total amount of firm capacity to the system sufficient to meet the relatively few hours of system peak demand. There has been continual debate since electricity markets were first introduced as to whether the energy price signal alone would be sufficient to deliver an appropriate level of firm capacity or whether an additional 'capacity mechanism' should be included. No consensus on this issue has been achieved and both approaches have been widely adopted.

However, the increase in the share of supply from intermittent renewable generation will change the nature of the system and the associated reliability challenges. The principle change is that it will no longer be possible to ensure that all generation resources will be readily dispatchable when needed. Moreover, these assets tend to have the lowest operating costs on the system and the least cost approach is to utilise as much as possible of the energy produced when these resources are available, before turning to supply resources with much higher production costs.

The challenge for the dispatchable resources on the system is, therefore, no longer to follow changes in overall consumer demand, but rather to follow changes in the residual 'net demand' not already served by intermittent renewable generation. The result of this change is illustrated in a recent National Renewable Energy Laboratory/GE report that modelled 35% energy penetration of wind, photovoltaics (PVs), and concentrated

solar power (CSP) on the power system operated by the WestConnect group of utilities in Arizona, Colorado, Nevada, New Mexico, and Wyoming[2]. The charts in *Figure 3* show a relatively unremarkable week, when the 'net' demand follows a repeatable pattern that is not dissimilar to the overall system demand, along with a more challenging week where the profile of net demand is much more volatile than overall demand and does not follow a repeatable pattern.

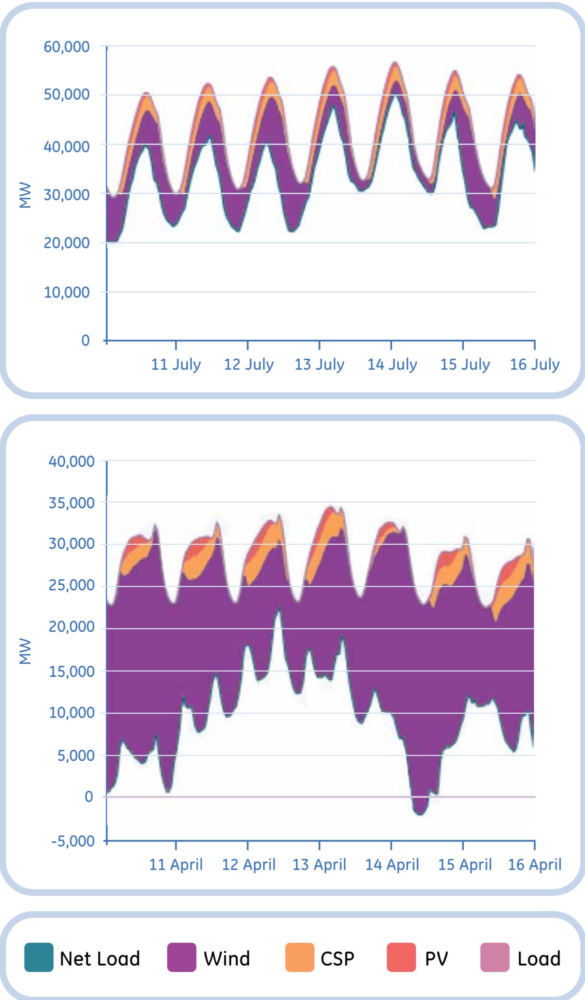


Figure 3. With 35% wind/solar, system operators must now balance generation against the net load (blue) line. This may be straightforward (top, July) or challenging (bottom, April).

These new power system characteristics represent a significant change from the paradigm set out in *Figure 1* and there has recently been much debate as to whether or not these changes increase the need for a separate capacity mechanism or not. However, an analysis of net demand highlights that, whilst having sufficient firm capacity to meet peak system demand remains necessary, it is no longer sufficient to deliver reliability at least cost. Therefore, the quantity of firm capacity no longer constitutes the sole basis upon which resource adequacy should be determined. The most challenging threat to reliability is not the overall level of peak system demand. Instead, the biggest challenge arises when consumer demand and the availability of intermittent renewable generation are moving in opposite directions, something that can happen any day, every day, at any time during the day, and even several times a day. It will occur to the greatest extent in two situations:

1. When demand is increasing to system peak whilst the availability of partially dispatchable renewables is reducing to a minimum, and

2. When demand is falling to system minimum levels whilst the availability of partially dispatchable renewables is increasing to a maximum.

This highlights that the ability of resources to respond to a rapidly changing level of net demand will be as important as the overall quantity of firm capacity in delivering system reliability.

Advanced generating technologies, such as gas-fired generation, can provide generator maneuverability and response capability with faster starts and ramp rates and deeper turndown capability. In addition, higher part-load fuel efficiency, reduced emissions and tighter frequency control can help to support the evolving power grid. Advanced heavy-duty gas turbines (in open cycle, and increasingly in modern combined cycle configurations), aeroderivative gas turbines and gas reciprocating engines can provide fast start operating reserves. Combining many

[2] Lew et al., 2010: How Do High Levels of Wind and Solar Impact the Grid? The Western Wind and Solar Integration Study, NREL/TP-5500-50057, December 2010.

of these smaller units as one large plant provides the owner with a wide range of operating conditions and the opportunity to dispatch the entire plant at a high efficiency throughout the entire operating range, while avoiding eventual additional costs associated with starts and stops. Combined-cycle gas turbines can provide automatic generator control (AGC, or secondary control) to move within the operating constraints of the unit to provide load following capability for the grid. Combined-cycle units can provide this type of grid support at significantly lower emissions than coal generation units.

The evolution towards increased system flexibility will be critical to the successful integration of high penetrations of wind and other renewable resources. Manufacturers of advanced gas turbine technologies are continuing to invest in flexibility attributes in order to drive additional value to generators and to the power system of the future[3].

Policy-makers are only now beginning to consider whether new mechanisms might be required to encourage investment in resources that are sufficiently flexible to meet the future system balancing challenge.

6 Energy Sales

A key initial objective of electricity market liberalisation was to reduce price by introducing consumer choice and allowing a variety of supply companies to purchase power from the wholesale markets for onward sales to customers. This has generally worked well with many markets exhibiting relatively high rates of supplier switching. However, liberalisation has not necessarily led to lower prices. In addition, some markets still retain regulated tariffs and, in other markets where prices are unregulated, there have been on-going concerns about the extent of competition between suppliers and whether consumers really do have a meaningful choice. A major source of concern is the absence of new entrants to the market that have emerged into significant competitors to incumbent suppliers. These concerns are exacerbated by the perceived similarity in the prices and products offered by the few existing players.

Apart from the political impulse to control retail electricity prices and retain regulated tariffs, there are two key challenges that have constrained the development of competition in retail electricity markets:

1. Legacy billing and metering infrastructures
2. Wholesale market price risks

The first of these has presented a particular challenge for established brands that may wish to enter the energy retail markets. It has proved notoriously difficult to produce accurate and reliable bills and provide high standards of customer service using legacy metering infrastructure. This creates a significant risk of brand damage, which acts as a deterrent to major retailers wishing to enter the market.

The second challenge is the most significant and affects all players in the retail electricity markets. Prices in forward electricity markets are often highly volatile and suppliers need to decide when to purchase the power they need to sell to customers. Significant fluctuations in these costs have the potential to lead to some suppliers having a substantial cost advantage or disadvantage compared with other suppliers. Although this presents the opportunity for lower cost suppliers to increase market share, such moves are unsustainable as price fluctuation favours different suppliers over time. This has led to suppliers adopting very similar hedging strategies to avoid significant swings in market share. These concerns can be reduced to some extent where wholesale markets are highly liquid, since this allows suppliers to avoid major wholesale price exposures by backing energy sales with

[3] "An examination of grid planning and the contribution from flexible energy resources for various economic and renewable energy scenarios", GE for Power-Gen Europe, 2011, Milan, Italy

immediate purchases. This is particularly important for smaller suppliers who are not able to sustain significant financial exposures. However, liquidity is often relatively low, particularly where a high degree of vertical integration exists. Indeed, the inherent riskiness of the wholesale markets creates drivers for consolidation, both vertical and horizontal, as suppliers try to manage the risks through diversification and scale—thereby reducing the liquidity required by smaller and independent suppliers.

The situation in which a small number of suppliers serve the overwhelming majority of customers is now a common feature of electricity markets. Indeed, many Governments take advantage of this situation and use these suppliers as delivery agents for a range of social and environmental objectives (e.g., social tariffs, energy efficiency). The introduction of these so-called 'supplier obligations' further reinforces the drivers for consolidation by increasing the complexity and risk of supplier business models.

Nevertheless, the expectation amongst consumers for competition and choice in electricity supply is now widely established, often leading to frustration and concern with the reality that presents itself. In particular, in times of increasing energy prices, consumers are looking to politicians to provide assurance that prices are fair and are not the result of anti-competitive practices or market structures. These political pressures inevitably lead Governments into two responses:

1. Re-impose regulation over electricity prices—thereby reversing the fundamental component of liberalisation.
2. Introduce changes that attempt to promote new entry and competition in electricity supply.

The first approach is easier to implement and is likely to be the immediate reaction of many Governments. However, the second approach, although more challenging to pursue, has many long term advantages. This 'energy sales' element of EMR has three key components:

1. Eliminate or simplify supplier obligations such that they do not have an over-riding impact on the business model of electricity suppliers. This will tend to reduce drivers for consolidation but may require that delivery responsibility is transferred to some central authority.
2. Pursue replacement of legacy metering systems with new smart meters, along with the associated network infrastructure. This will introduce many attractions for major non-energy retailers to enter the market by improving the quality of customer service and providing a deeper customer relationship. The benefits of smart metering run beyond the impact on market entry as explained in the next section on energy services.
3. Focus on improvements to market liquidity. There are many options available to force generators to sell their output on the open market, including mandatory auctions or release programmes. However, liquidity in short term markets ultimately depends on well-designed imbalance settlement mechanisms that allow market participants to forecast, and therefore manage, future contractual imbalance.

While often not categorised as 'EMR', these issues represent a critical challenge for market designers and will have a huge impact on the nature of future electricity markets. It is not necessary to implement all these changes at once. A sequential process for introducing the necessary elements may be more appropriate. For example, additional regulations covering existing suppliers that improve the functioning of short term markets and promote tariff choice may be an important first step in ensuring that consumers perceive that they are paying a fair price for the energy they consume.

7 New Markets in Energy Services

Investment is also required in the demand-side of the market to reduce demand or provide balancing services. In many cases this will not only complement supply side alternatives, it is probably essential if energy policy challenges are to be met. However, existing electricity market designs have not proved successful in attracting such investment at scale. There are many reasons why a pure energy price signal has not proved successful in creating a market for investment to reduce usage and provide demand-side services, and a combination of remedies will inevitably be required if such a market is to emerge.

The value of potential investment in demand reduction or response will depend respectively on the avoided cost of future energy purchases and the short run value of balancing services. Both of these parameters are highly uncertain and difficult to predict, and this inevitably gives rise to a significant investment risk. Those businesses which have, or are capable of developing, new products to help consumers manage energy consumption, along with those that have the project delivery capability, are typically not experts in energy markets. They generally will require the customer to evaluate the investment return, yet small customers are likely to be wary of taking such risks. Even large, energy intensive industries may reject such investments unless the business case is overwhelming.

Policy-makers have therefore resorted to identifying and appointing 'delivery agents' to drive investment in the demand side and ensure any demand reduction or response targets are delivered. System operators are responsible for maintaining system balance at least cost and obligations are now commonly placed on electricity suppliers to promote demand reduction. However, both of these delivery routes have limitations that have constrained the development of demand side markets. Apart from the potential adverse implications for retail competition, supplier obligations drive a least cost compliance response and the bulk deployment of low cost measures (primarily insulation), often through large national contractors. Although this can be extremely useful in capturing the 'low hanging fruit' of efficiency improvement, it has not been successful in stimulating a dynamic market for products and services that harnesses the innovation potential of smaller providers. Similarly, the system operation function is extremely complicated and it has not proved easy to regulate or incentivise system operators to seek out innovative new ways to balance the system. They have, therefore, generally been able to rely on tried and tested approaches, usually employing power plants to provide balancing services.

Another major obstacle to the development of a dynamic market in energy products and services is the absence of the necessary metering and network infrastructure to harness the potential of demand side resources. Distribution network operators respond to the regulatory requirements or incentives that are placed upon them, and thus far these have proved insufficient to drive deployment of advanced metering infrastructure. Accordingly, it is necessary to ensure that the regulatory framework is fully aligned with the objective of achieving a more active and engaged demand side of the market. This may involve the need to establish clear output targets on regulated businesses that drive the deployment of the necessary instrumentation and communication technology.

The objective of electricity market design should be to ensure that equal value is available for equivalent investments on both the supply and demand sides of the market. This is necessary for the power system to deliver the set of best-value investments for consumers. Many demand-side technology options are under-utilized but are not afforded the same level of support given to newer low carbon generation technologies. Renewable generation benefits from deployment targets and revenue support mechanisms that eliminate much of the future energy price risk. Policy-makers are beginning to consider if such approaches may be required to drive the development of demand side markets and flexible generation. If successful, this has the potential to trigger the most fundamental transformation of electricity markets of all the EMR initiatives, leading to the development of dynamic new markets that will provide real choice and benefits for electricity consumers.

European Energy Market

It has long been the ambition of European policy-makers to roll out the liberalised electricity market model across the EU to create a single internal energy market, where buyers and sellers of electricity can trade freely across national boundaries without the distortions of uncoordinated state subsidy and regulatory regimes. Most recently, a third package of internal energy market regulations has established a 'target model' for electricity trading along with rules for providing access to networks and governing cross border trade. Working alongside these market regulations, a climate and energy package of measures has been implemented with the aim of delivering carbon reduction, renewable deployment and energy efficiency targets by 2020.

The European Commission has undertaken scenario analysis exploring various technology pathways to 2050[4] and is now considering how the Climate and Energy Package might be extended to the 2030 time-horizon. The EMR issues outlined in the previous sections will be extremely significant to this process since they suggest that certain adaptations in the internal energy market principles may be needed to achieve the required outcomes.

The European energy market debate contains an important additional dimension relating to overall governance of market design and reform. In particular, it is necessary to establish the extent to which individual member states can pursue separate climate and energy policies and in what circumstances they should be constrained within an overall European framework.

There are a number of reasons why member states might have their own policy objectives relating to their electricity market:

1. Power system assets are capital intensive and long lived and different member states are at a different point on their asset replacement cycle. This creates differences between member states in the time that new investment is required and also, therefore, the rate at which the power sector can be decarbonised efficiently.
2. Member states will also differ in the carbon abatement potential in other sectors and this, in turn, may lead to differences in the rate at which the power sector could be decarbonised to achieve an efficient decarbonisation of the overall economy.
3. There are different levels of system reliability which may result in Governments attempting to implement different generation security standards through the introduction of national capacity (or capability) market regimes. This, in turn, may lead to a distortion in the incentives to invest in different locations or restrictions in trade across interconnectors as individual member states attempt to maintain a reserve of spare capacity.
4. Finally, individual member states may have particular resource security or industrial policy concerns arising from their particular resource availability. These member states might seek to change the primary fuel balance beyond the levels provided by the integrated single European energy market.

These national differences provide many challenges and opportunities for policy-makers at the EU level attempting to introduce a single internal energy market. In particular, it is necessary to identify where common EU approaches are required to improve the efficient achievement of decarbonisation and security of supply objectives.

1. **Decarbonisation**: The EU emissions trading scheme, and the underpinning carbon reduction targets, have proved extremely important in creating a unified pan-European decarbonisation ambition which has, in turn, increased the European influence in broader global climate diplomacy discussions. Looking ahead, there is likely to remain a critical role for a significant carbon price to drive operational efficiency in carbon abatement, particularly with regard to the timely retirement of existing carbon intensive power plants. EU level policy-makers have complemented the emissions trading scheme with technology specific deployment targets that have proved important in creating the

[4] European Commission. (2011) Energy Roadmap 2050. COM (2011) 885/2. Available: http://ec.europa.eu/energy/energy2020/roadmap/doc/com_2011_8852_en.pdf

critical mass necessary to kick-start deployment of immature technologies, especially renewables. However, it is now necessary to understand the implications of a Europe in which member states aspire to decarbonise at different rates and achieve different technology mixes through the deployment of a mixture of fiscal measures including carbon taxes and targeted technology specific support schemes. It is, therefore, a key question for EU policy-makers to establish where pan-European targets and regulations are required and how they should be implemented. For example, the carbon price that results from the emissions trading scheme will depend critically on the success in the delivery of national measures outside the scheme and European policy-makers will require forward visibility of national policies and will need to take a view as to their likely success when setting carbon caps. Also, the European regulatory regime has traditionally regarded long term contracts as a problem since they potentially lock customers into high cost supplies. However, Governments may increasingly need to broker contracts that lock customers into costs. This is in the context of a philosophy that has encouraged customer participation to keep costs to a minimum. The role of the liberalised electricity market in imposing upstream cost discipline may, therefore, be reduced and it will be important to ensure that the single energy market agenda going forward focuses competition on those areas which can deliver real benefits to consumers.

2. **Security of supply**: An increasingly interconnected power system has many advantages in terms of system reliability since larger balancing areas have less need for, and greater access to, operational reserves and are less prone to systemic failures such as the dependence of renewable generation on weather conditions. However, individual member states retain control over national energy mixes and are likely to use this power to seek to enhance national interest, both in delivering increased resource security and to support industrial policy. For the benefits of an interconnected power market to be fully realized, it is necessary that common 'reliability products'[5] are defined such that they can be efficiently traded across borders in addition to the trading of bulk power. This, in turn, requires some harmonisation of market rules and regulations[6] which would constrain the ability of individual member states to implement a separate security standard or establish certain national objectives on the way system operators manage their power networks. The internal energy market rules must therefore consider the trade-off between delivering security of supply through increased interconnection or through the flexibility to impose bespoke national measures.

There is, however, a major opportunity for European policy-makers to support individual member states in re-focusing competition and integration in the electricity market such that it delivers significant and on-going benefits for consumers. The previous focus on creating markets that produce an efficient short-run wholesale price will deliver diminishing returns as the requirement shifts towards efficient investment in low carbon technologies. Instead, there is the opportunity to support the creation of dynamic new markets in customer-facing energy products and services. This will require that management of wholesale market risk, or delivery of supplier obligations, do not constitute over-riding business imperatives that restrict market access for businesses with new and innovative business models. This will become the key policy challenge for those wishing to create the new electricity market that will deliver the policy objectives in a decarbonised European energy market.

[5] 'Reliability products' are the range of products and services provided by system users to enable the System Operator to balance supply and demand.

[6] Apart from obvious and direct implications for balancing and capacity mechanisms regimes, it may even impose constraints on technology support measures such as feed-in-tariff design by specifying the extent to which individual market participants must be responsible for balancing forward contractual commitment with metered generation. This would change the nature of the traditional metered output feed-in-tariff.

Conclusion

A successful EU economy includes customers and industries that will depend on the choices posed by electricity market reform.

Electricity market liberalisation has delivered many benefits for consumers and market designs have continued to evolve in light of experience. However, existing designs have major limitations that are likely to require further reform if they are to be able to support challenging energy policy objectives going forward. The four areas discussed in this paper represent the key issues that will need to be tackled at some point in all liberalised markets. It would be a mistake to describe the thrust of this reform agenda as a 're-regulation' process that is stepping back from market principles. Indeed, it is a mistake to assume that existing market designs are giving rise to competitive and efficient outcomes. In particular, the inherent risks have led to consolidated market structures and the demand side of the market has failed to develop. Moreover, there is likely to be an increasing need for supplementary mechanisms to ensure that an appropriate mix of resources will be forthcoming to efficiently meet consumer demands for energy. The level of investment needed will require a rebalancing of risks between customers and investors and this, by definition, will involve an expanded regulatory regime. However, a well-designed package of reforms has the potential to increase the overall levels of competition and innovation through placing increased flexibility both on the supply and the demand side of the market at the centre of the reform agenda. This will involve the development of new dynamic markets in customer-facing products and services and ensuring wholesale markets promote efficient investment and the procurement of the range of resource capabilities that will maintain system reliability.

These changes present particular challenges for EU policy-makers who have spent two decades seeking to roll-out the liberalised market model and create a pan-European single energy market. Firstly, the new decarbonisation and security of supply challenges suggest that changes to the traditional liberalised energy model will be required. Secondly, the reform agenda will face the challenge of individual member states seeking particular outcomes that may require different market arrangements. The major opportunity for EU policy-makers is to align member state and EU-level interests. This can be done by re-focusing market developments on building the new demand-side markets underpinned by fit-for-purpose wholesale and capability markets that have the potential to deliver clear benefits to EU consumers, industry and the wider economy.

E3G

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