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## EUROPEAN ELECTRICITY MARKETS ALIGNING CONSUMER AND CLIMATE OBJECTIVES

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Electricity market reform has become a hot political topic. This is largely due to the role high energy prices are playing in the cost-of-living crisis. Various approaches are under consideration for reducing impacts on consumers, especially those who are vulnerable.

Beyond these immediate issues, there are also questions over the consistency of the current market design with a decarbonised system which will involve a high proportion of variable renewable electricity.

These are both crucial questions that cannot be treated in isolation. Measures that reduce impacts on consumers now but do not help decarbonise the system are detrimental to the long-term interests of consumers. Similarly, idealised models for a decarbonised system that do not manage consumer impacts will never be realised due to political pressures.

This paper sets out a framework for aligning these two debates. The framework includes:



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- A distinction between core market design elements that match demand and supply and non-core, temporary elements that affect investment or affordability.
  - A mechanism or process to continuously update and evolve the core market design to account for technological advances and reap the benefits of digitalisation.
  - Principles that ensure that non-core market elements do not distort the demand and supply balance in the core market by changing incentives for efficiency and demand side response.

The preferred model will vary over time and from place to place. However, a new dynamic approach to market design is necessary to take advantage of opportunities from emerging digital technologies and artificial intelligence to engage consumers at local levels. The EU will need to ensure Member States follow shared principles to maintain the speed towards decarbonisation as well retain a coherent EU-wide market and ensure consumer consent.

## Context

The design of electricity markets has been the subject of constant debate since they were first established over three decades ago. However, this discussion has rarely entered the political domain and has generally been left to economists and engineers to resolve. The situation now is very different and barely a meeting of the European Union Council passes without member states locking horns over the need or otherwise for change.

The ongoing nature of the market reform debate suggests that there is no obvious 'right' design. Instead, market rules are part of a system that is seeking to achieve a set of political and economic outcomes. As the context evolves and the desired outcomes change then market design needs to adapt.



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The current context is extremely challenging. The price of gas has escalated, and this has led directly to a hike in electricity prices. In combination with inflationary pressures affecting all goods and service, citizens across Europe are experiencing a severe cost of living crisis and pressure is mounting on politicians to act. The reason that electricity market design sits in the eye of this political storm is that significant effort has been devoted to decarbonising the electricity system, largely through the deployment of renewable energy sources such as wind and solar. These are relatively cheap, and production costs are unaffected by gas prices. It is, therefore, reasonable to ask why the price of electricity is tied so closely to gas prices. The answer lies in the ‘marginal pricing’ basis for electricity market design – all electricity used is charged at the cost of the most expensive source of production and this is often gas turbines, regardless of how much of overall supply is provided by renewables.

Whilst this debate has escalated over recent months, a separate discussion has been brewing in the background for several years. Increasing proportions of variable renewable electricity are radically changing the nature of electricity system operation. As these changes continue to intensify, many commentators from industry and academia have questioned whether the current market design will remain fit for purpose. These concerns relate to the extent to which a marginal pricing system can provide the right incentives to invest and how the range of new services required by system operators to guarantee affordable, zero-emissions energy should be procured.

These parallel discussions have, so far, failed to converge with the focus varying between countries. Box 1 summarises the intensely political issues that have arisen in Spain, whilst Box 2 explains the reform process underway in the UK where the issue has remained below the political parapet. Both sides of the market reform discussion are important and cannot be ignored. Politically sustainable solutions are required to address both issues.

### **Box 1: The market reform discussion in Spain**

Spain has been in the vanguard of EU efforts to deploy renewable electricity and, by 2020, 44% of national electricity generation was from renewable resources. Conversely, gas and coal generation have been declining fast (27% and 2%). However, as gas prices began to increase, the current market design meant that progress in deploying renewables has not insulated electricity consumers from corresponding price hikes. Indeed, prices have risen (see chart at the foot of this box). This has created a major political



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debate, challenging the benefits of Spain taking a leading role in the decarbonisation process. With elections due in 2023, it has become a political priority for the Spanish government to act. It has received permission to curb electricity prices as a temporary derogation from the Clean Energy Package, but it is also proposing structural changes to the electricity market design. This involves running a dual auction that will insulate domestic consumers from the impact of high gas prices.

### **Electricity prices in the Iberian Electricity Market (MIBEL)** (€/MWh)



**Note:** \* The quarterly price forecasts from Q1 2022 onwards are drawn from the prices quoted for quarterly electricity futures contracts for the Iberian market as of 16 December 2021.

**Source:** CaixaBank Research, based on data from the Iberian Energy Market Operator (comprising Polo Español, or OMIE, and Pólo Português, or OMIP).

### **Box 2: The market reform discussion in the UK**

In the summer of 2021, the electricity system operator (National Grid ESO) initiated a project to consider the need for electricity market reform. This review was triggered by an escalation in the costs of balancing supply and demand as the proportion of renewable electricity increased. The current market design sets a single wholesale price for the entire country. However, the nature of the transmission system is such that electricity cannot always be transported to meet demand and the system operator must buy and sell electricity to resolve this mismatch. It is the cost of these trades that have



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increased and, with more renewables coming onto the system, this trend is expected to continue.

In April 2022, National Grid ESO recommended that electricity market design must change to enable a cost-effective decarbonisation of the electricity system<sup>1</sup>. They suggested that it was necessary to establish different prices for each point on the electricity system – so-called nodal pricing. However, they did not challenge the appropriateness of marginal pricing as the basis for setting prices.

Following this recommendation, the UK government and energy regulator Ofgem have initiated a formal process to review electricity market design. The Review of Electricity Market Arrangement (REMA) has a wide remit to consider all relevant issues and is likely to conclude during 2023.

## The Challenge

A fundamental requirement of electricity market design has always been to support efficient dispatch of resources<sup>2</sup>. Given the extent of the costs associated with deviating from efficient dispatch, this is likely to remain a core objective going forward. Liberalised markets assume that this is best achieved through a process of competitive bids and offers. Moreover, ensuring generators are paid, and consumers charged, the system marginal cost theoretically leads to efficient investment since projected earnings are based on expected future prices.

Over time, various complementary measures have emerged to drive investment overall (capacity mechanisms) or in specific technologies (feed-in-tariffs) and to reduce emissions (emissions performance standards, coal phase-out targets, carbon pricing). These measures reduce future revenue uncertainty and, thereby, the financing costs of investment. In consequence, short run prices now have a diluted impact on investment decisions. Much of the discussion relating to electricity market design has involved the need or otherwise for these complementary measures given their significance in driving market outcomes. It is, therefore, important to define the key outcomes that electricity markets must deliver going forward before identifying the set of complementary measures that will be required (see Figure 1).

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<sup>1</sup> See National Grid ESO [presentation](#)

<sup>2</sup> This involves both the provision of energy and non-energy services such as reserves that are required to maintain a stable system.



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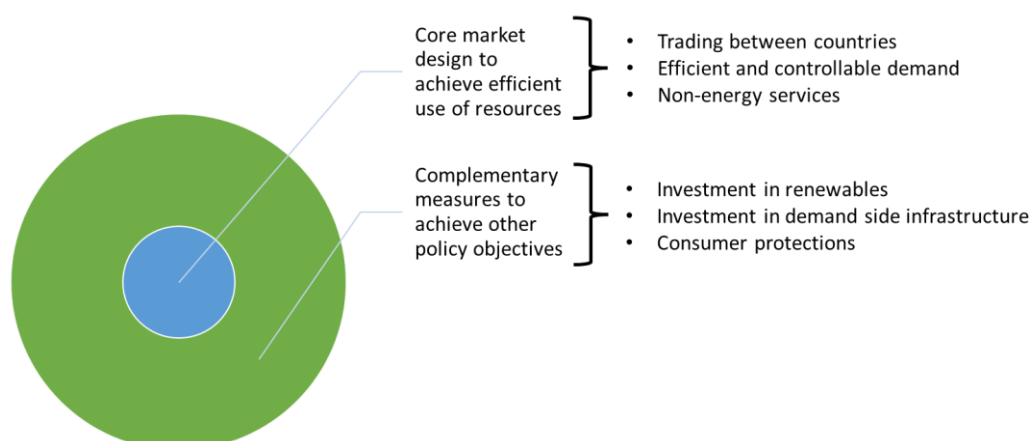


Figure 1: Structure of market design

Decarbonising the electricity system will involve major on-going investment in renewable electricity and this must proceed at pace. However, it is essential that energy security is retained throughout the transition by ensuring renewable generation is cost-effectively integrated onto the system. This will require a combination of:

- > Network reinforcement
- > Sharing resources across wide geographical areas
- > More power storage – especially long duration storage
- > Highly flexible demand.
- > New sources of non-energy services (e.g. voltage and frequency support) needed to balance the power system<sup>3</sup>.

These must be delivered by the market design within the broader regulatory framework including an upgraded approach to system operation. However, recent events have highlighted the importance of understanding and managing impacts on consumers. Indeed, building and maintaining consumer consent will be essential throughout the energy system transformation. The list of factors that will deliver what is needed in this regard is not understood as well as the technical issues associated with renewable system integration and is likely to vary significantly from place to place and time to time. However, the following issues will be important:

<sup>3</sup> Currently, these services tend to be procured via bi-lateral contracts between providers and system operators. These markets can be difficult for demand side providers to access, and competition is, therefore, limited. The development of these markets must be considered as part of the overall design.



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- > Consumers should benefit financially from using electricity efficiently and flexibly
  - > Retail innovators should not be inhibited from meeting the evolving needs of consumers by the constraints or complexities of market rules
  - > The benefits available to communities living close to the location of cheap renewable sources of energy should more than outweigh any detriment to local amenity
  - > The benefits of the energy system transformation should be shared evenly across society and not limited to those who are wealthy or well-informed.

A successful market design must, therefore, deliver efficient dispatch, support investment in renewables, support to cost-effective integration on renewables onto the system, and maintain consumer and societal consent throughout the energy system transition. It is necessary to understand the extent to which the core liberalisation model achieves these objectives and the need for complementary measures to address any deficiencies. Any measures introduced to address immediate concerns over energy prices should be viewed in the context of this overall set of requirements.

## Initial assessment

### Core market design

Current political challenges with energy prices should not be viewed as a one-off event but an enduring aspect of the electricity market – now driven by high gas prices but potentially driven by other causes in future. Solutions applied today should be assessed in terms of their longer-term applicability and consistency with the journey to a decarbonised electricity system. It is likely that new issues will emerge and disappear over time. It does not seem appropriate, therefore, that solutions should be embedded within the core market design but rather through complementary measures which can be applied when required.

The core market model has always represented a compromise compared to the theoretical ideal given practical limitations of metering and in the computation of settlement processes. Marginal prices as currently calculated are averaged over large geographical areas (often whole countries) and time periods of 15 or 30 minutes. Whilst these approximations are valid for well-connected systems with a passive demand and a small number of larger power stations, they are becoming increasingly inappropriate as assets (both supply and demand) become smaller, more decentralised, and operationally dynamic. It is this trend



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that has created challenges for the UK system operator who is having to centrally re-dispatch a large proportion of the system simply to balance supply and demand, without the tools that would ensure efficient use of resources.

The solution to deliver efficient dispatch would involve having the flexibility to balance supply and demand over various geographies and timescales, including small localities and for very short periods of time, along with the provision of the various non-energy services that are needed. Whilst this would have been inconceivable even a decade ago, the advent of digital technologies and the application of artificial intelligence makes this a realistic proposition. The size of the datasets involved no longer creates a barrier to change and delivering an efficient dispatch must be viewed through the lens of a highly digitalised energy system. However, this vision cannot be achieved through the traditional engineering approach of ‘design, procure, deliver’. Digital innovators have already established new norms whereby designs are constantly updated, and delivery involves regular updates of which users are largely unaware. Achieving an efficient dispatch therefore involves not so much a new market design, but a new approach to market design whereby a core system is constantly updated in line with latest technical opportunities and user requirements.

Achieving efficient dispatch requires information on producer costs and the value consumers place on buying electricity. Liberalised markets obtain this information through competitive bids and offers. However, it is likely that the ‘true’ marginal costs this would reveal in a more granular market structure would be very volatile and vary from place to place. This would have political implications that need to be considered:

- > Is it acceptable for electricity prices to vary from place to place?
- > Is it fair that those who are engaged and able to afford the latest technology would have cheaper prices than those who do not?
- > Will cheaper prices be sufficient incentive to drive deployment of smart demand-side technology at the rate required to limit costs for all consumers?

There is a key policy issue that needs to be defined relating to the core system. Is it appropriate to expect consumers to define the value they place on using electrical assets at different times or should this be estimated through an administered process? Whilst allowing consumers to determine the value would be consistent with the liberalised model and is likely to be technically possible with relatively low burden on individuals, the benefits for dispatch efficiency





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would be limited if complementary measures result in significant changes to electricity costs. Indeed, if it is deemed politically necessary to cap consumer prices at levels below the value they place on electricity, then some degree of administration would be required to preserve efficient dispatch. The current energy cost issues highlight that this decision will be crucial to the development of electricity markets.

It is important to recognise that marginal electricity costs that vary by place and in time will be created by the process that delivers efficient dispatch. These marginal costs can be used as the basis for market prices but the extent to which they directly determine costs and revenues will be driven by the complementary measures that accompany the core system model.

### **Complementary measures**

Complementary measures are likely to be required to drive investment in the resources needed to cost-effectively decarbonise the electricity system and to ensure a politically acceptable impact on consumers. They will, therefore, represent critical elements of the overall market design.

Mechanisms to support investment in renewable electricity are now well-established. Best practise approaches recognise the importance of avoiding linking revenue enhancements to generation which would alter short-run costs and affect dispatch efficiency. It is likely that these mechanisms will remain an important part of market design for the foreseeable future. However, it will be important that such mechanisms not only drive investment in renewables but also in the technologies needed to cost-effectively integrate renewables onto the system, such as storage and demand response. Upgrading buildings with smart energy control systems will be vital and mechanisms to deliver such investment at the rate required and in a socially fair manner are a key missing element of current market designs.

The need, or otherwise, for capacity mechanisms (complementary measures designed to ensure sufficient firm capacity is available to meet a defined security standard) has been the subject of intense and continuous debate. It is unlikely that political positions on this issue will change significantly over the next few years. However, as more consumers can bid a value for the electricity they require, the need a centrally administered security standard will disappear along with capacity mechanisms in their current form. It is possible that they will be replaced by more explicit approaches to protect consumers from high prices at times when consumption is essential.



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Complementary measures to drive investment can generally be structured to avoid affecting dispatch efficiency. However, measures that directly reduce electricity costs for consumers cannot since they will incentivise higher consumption than would otherwise be the case. A modest reduction in efficiency may be a small price to pay for managing impacts of high energy costs. However, it is worth considering whether the same outcomes can be achieved through lump sum grants or rebates targeted directly on those affected. Indeed, such targeted approaches including investment programmes to upgrade the homes of those requiring support could help accelerate the transition to a decarbonised energy system.

## Way forward

This paper does not attempt to provide answers to the key market design questions. Instead, it is intended to provide a framework that will allow policy makers to consider the options in a way that addresses short term political imperatives at the same time as driving power system decarbonisation.

The current focus on electricity market design presents a timely opportunity to define an approach that accelerates the journey towards power system decarbonisation whilst focusing on delivering the needs of energy consumers throughout the transition. The various review processes underway must not lose focus on delivering against these twin objectives.

## About E3G

E3G is an independent climate change think tank with a global outlook. We work on the frontier of the climate landscape, tackling the barriers and advancing the solutions to a safe climate. Our goal is to translate climate politics, economics and policies into action.

E3G builds broad-based coalitions to deliver a safe climate, working closely with like-minded partners in government, politics, civil society, science, the media, public interest foundations and elsewhere to leverage change.

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