

# *Market design in a world of energy transformation*



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## *The roundtable*

Senior executives and experts from 12 countries and four continents gathered for a PwC roundtable on market design in Brussels. The event brought together leading players with substantial experience from both the regulatory and corporate spheres to discuss how market design can best evolve to meet the challenges of new energy systems.

*Dr Peter Davis, Board Member, The Australian Energy Market Operator*

*Dr Florian Ermacora, Head of Internal Market Energy Unit in DG Energy, EU Commission*

*Mark Coughlin, Global Market Design Leader, PwC Australia*

*David Etheridge, Global Power & Utilities Advisory Leader, PwC US*

*Alain Janssens, Director Regulatory Oversight & Market Design, Corporate Strategy Department, Engie*

*Rodolfo Martinez Campillo, Head of Infrastructure Regulation, Iberdrola*

*Tony Meehan, Executive Manager Regulation, TransGrid.*

*Ekin Niksarli, Business Development Director, Europe and Asia SBU, The AES Corporation*

*Paul Nillesen, Partner, Strategy & Energy Practice, PwC Netherlands*

*John D. Quackenbush, President, JQ Resources, LLC*

*Massimo Ricci, Energy Markets and Sustainability Director of the Italian Regulatory Authority for Electricity Gas and Water*

*Andrea Villa, Head of European Regulation, ENEL*

*Graham Weale, Honorary Professor for Energy Economics and Policy, University of Bochum, former chief economist at RWE AG*

# Introduction

*Power market design varies considerably in different jurisdictions around the world but everywhere market design faces common challenges. In a changing energy world, power systems are becoming more decentralised and, with that, comes volatility. The need to balance energy resilience with flexibility is adding a new tension to the central trilemma of reliability, affordability and sustainability.*

*The contrast between the similarity of the challenges and the difference in market design approaches offers a great opportunity. What was evident from the roundtable discussion is that there should be no need to invent market design solutions from scratch. Different parts of the world have followed different evolutionary paths and have adopted different policy frameworks. There are things that are done well and things that are done badly everywhere and we can learn from them.*

At the heart of the challenges faced, there is the central theme of restriking the balance between profitability and the ongoing 'license to operate' for energy companies. It is the major tension as a number of governments and regulators look to intervene or re-regulate liberalised markets and it is also central to markets that have taken a more moderated approach to liberalisation.

As the title of the closing chapter in this discussion paper states, there are worldwide questions but also worldwide answers. The major pressures emerging in different markets around the world are often related to how well regulators, policy makers and companies have combined to create energy market outcomes. Deregulated markets can learn from more regulated markets and vice versa. More than ever, with power coming from multiple sources and energy systems moving from linear to decentralised structures, we should reject the old orthodoxy that there is only one direction of travel.



A stylized, handwritten signature in black ink, appearing to read 'Mark Coughlin'.

**Mark Coughlin**  
Global Market Design Leader and Partner,  
PwC Australia

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# Market design and future energy market outcomes

*A new world of decentralised and often intermittent energy sources is putting a strain on how well regulators, policy makers and companies are able to combine to create good energy market outcomes. Energy systems need to deliver flexibility whilst also ensuring reliability. The age-old trilemma of security, affordability and sustainability is as central as ever.*

The roundtable kicked off with a discussion of the new European electricity market design being proposed by the EU Commission. Introduced in late 2016, the proposals are currently under consideration by the European Council and the European Parliament. The reforms are part of a comprehensive legislative package as the EU moves to achieve its 2030 and 2050 targets on CO2 reduction, renewable energy and energy efficiency.

Dr Florian Ermacora, Head of Internal Market Energy Unit in DG Energy, EU Commission, stressed the need to achieve a market solution that is cost efficient: “When we developed these proposals we had the consumer in mind. So above all it’s about getting these goals of energy efficiency, renewables and decarbonisation at the least cost.”

## **A market for renewables**

A key issue is moving away from the era of subsidies for renewables: “We need to make sure that renewables are able to make their money in the market,” commented Ermacora. “There are a

number of barriers to the participation of renewables, among them the timeframes of markets. If you want to have sun and wind participate in the market you need to shorten trading periods dramatically down to intra-day hours. The market needs to become more flexible in terms of trading possibilities and there is a need to open up new markets such as for balancing and ancillary services.”

Developing the flexibility theme, Ermacora stressed the need to open the door to encouraging demand flexibility: “Customers need to have an incentive to consume electricity at the time where it is quite cheap because of a lot of wind and sun in the system and to feel that the price is higher when there is less electricity in the market. The consumers should also be able to produce electricity themselves but there are a number of regulatory questions of how to deal with such diversification of supply. New products from companies to respond to these issues are part of the new energy landscape which we are promoting.”

## Capacity markets

Concerns about a lack of investment in electricity generation capacity to meet peak demand and the intermittency problems associated with renewables have prompted several EU Member States to introduce rewards for making capacity available, in the form of capacity mechanisms. Such mechanisms must conform to the EU guidelines on state aid for environmental protection and energy. However, capacity mechanisms are considered problematic because they risk distorting the internal electricity market.

“We acknowledge that for security of supply reasons there might be a case for such mechanisms,” said Ermacora. But he stressed it was not satisfactory to assess the case for them purely at a national level: “It is not good for the consumer if you leave the possibility to subsidise conventional energy producers at the national level without any conditions. That’s not our vision. We need to lift it out of a purely national context.”

Cooperation across borders may increase cost-effectiveness as spare capacity is pooled. Indeed, the European Commission’s final report from its sector enquiry on the impact of capacity mechanisms states that such mechanisms should be open to capacity providers in neighbouring member states in order to incentivise investment in domestic and foreign capacity and in interconnection, as well as to reduce system costs.<sup>1</sup> But an EU-wide capacity mechanism is not feasible as long as only limited amounts of electricity can flow across borders, due to limited interconnection capacities. Ermacora pointed out: “On average only 20-30% of the interconnection capacities in Europe are available for the market. The rest is not given to the market for technical reasons but we fear in some cases for reasons of national policy. We need to open this area and cannot accept anymore that all questions of system operation are purely national competence. We propose to have clusters of transmission system operators in Europe to bring transparency and efficiency into this.”

## At a glance: the proposed EU internal market for electricity

The proposed regulation is aimed at making the electricity market fit for more flexibility, decarbonisation and innovation, by providing for undistorted market signals.

It sets out rules for electricity trading within different time frames and clarifies the responsibilities of the market actors.

It defines principles for assessing capacity needs at regional and European level and proposes design principles for market-based capacity mechanisms with cross-border participation.

It introduces regional operational centres for handling-system operation and a European entity for distribution system operators.

*Source: Briefing, EU legislation in progress: the internal market for electricity, European Parliament, 2017.*

### The Italian experience

The question of whether to develop capacity markets and if they are the answer was taken up by Massimo Ricci, Energy Markets and Sustainability Director of the Italian Regulatory Authority for Electricity Gas and Water: “Markets can fail. Capacity markets can be at least part of the answer, provided that they are appropriate and proportionate and don’t distort competition.”

Ricci went on to outline the capacity market mechanism and contract structure being developed in Italy and currently under discussion with the EU Commission. It is an approach based on reliability options with the transmission service operator (TSO) responsible for defining a demand curve to comply with the adequacy target. The strike price in the contract structure is based on the variable costs of peaking production technology in order not to distort short term price signals. The mechanism plans ahead for a three year delivery period.

One key issue is what should be the strike price. “We took the approach of using the highest variable cost of the peaker power plants,” said Ricci. “It is designed so that the strike price will cover their variable costs and they will be able to cover their fixed costs with

the premium. The aim is to provide some hedging to ensure investment by the new entrant peaker power plant.”

Cross border flows of electricity from northern Europe are an important part of the electricity system in Italy, raising the issue of how they should be taken into account in the capacity mechanism. “You need coordination in establishing the adequacy target because you have to make an assumption about the imports. And whatever assumption I make, if the TSO on the other side makes a different assumption then we won’t get the adequacy for the European system. We need more coordination than is taking place. It’s part of the discussion that Europe should be doing.”

Ricci concluded by stressing that such mechanisms can guarantee capacity but not security of supply and they also risk being overtaken by technological developments: “You don’t know if that capacity has the flexibility to be available when needed so it is not a security guarantee. Also we are making commitments long-term when we don’t know what fast-moving developments in technology might produce.”

<sup>1</sup> Report from the Commission, Final Report of the Sector Inquiry on Capacity Mechanisms, European Commission, 30 November 2016.

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# Reforming power markets

*A blackout that left South Australia without power in September 2016 shows the fine line between accident and design when it comes to creating well-functioning power markets. The failure was the result of a chain of events triggered by tornadoes and, while the operational response was rapid with power restored to many customers within hours, the regulatory, political and media debate that ensued has been long and intense.*

Discussions around the electricity system in Australia had been gathering pace for some time before the South Australia black system event gave it added urgency. Retirements of more than 5,000MW of old baseload generation had led some voices to be raised about security of supply even though retirements have been more than matched by a mix of new gas-fired generation as well as new wind farms, a fast-growing contribution from new grid-connected solar and some new hydropower.

## **Massive system change**

“What you’re seeing is a massive change and that has led to the security of the national electricity market being called into question,” Dr Peter Davis, Board Member, The Australian Energy Market Operator (AEMO), told the roundtable. “There’s always been a debate about balancing sustainability, security and affordability, the so called trilemma, but there’s no doubt that the questions of price and security are now front and central in the national debate.”

“Australia’s energy-only market design was suited for a time when we had excess capacity and large coal fired power stations providing the majority of supply but things can change so quickly that perhaps your market doesn’t actually keep up,” observed Davis. Since the black system event AEMO has been moving fast to understand system vulnerabilities and remedy them. A range of technical and operational changes have been made, particularly addressing the difficulties associated with non-synchronous and inverter-connected plant, more periods where the system is experiencing low inertia as well as frequency and voltage changes. The changes were put to a real-life test earlier this year and the system proved resilient.

## **Australian market reforms**

As well as technical changes, Davis stressed the importance of the wider market design changes outlined in AEMO’s final report<sup>2</sup> of its review of the black system event: “The technical challenges of the changing generation mix must be managed with the support of efficient and effective regulatory and market mechanisms, to ensure the most cost-effective measures are used in the long-term interest of consumers.”

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2 Black System South Australia 28 September 2016 – Final Report, AEMO, March 2017.

Supply adequacy is a concern with worries that there is insufficient incentive to both drive investment in new flexible, dispatchable resources and maintain existing such resources.

A centrepiece of the regulatory and political response was the announcement of proposed changes to the market. The government had already accepted 49 out of 50 recommendations from the chief scientist, Alan Finkel, and a panel of experts. But it rejected the fiftieth, a clean energy target, in favour of a new 'energy guarantee' which will impose new dual reliability and emissions reductions guarantees on energy retailers and large energy users.

The guarantee followed recommendations, announced just hours before the roundtable event, by the recently-formed Energy Security Board. If adopted by the government, the reliability guarantee will require retailers to hold forward contracts with dispatchable resources that cover a predetermined percentage of their forecast peak load. The amount and type contracted will be based on a system-wide reliability standard as determined by a new Reliability Panel constituted by the Australian Energy Market Commission. AEMO, in consultation with the panel, would then determine how the standard is translated into an operating requirement for each region.

### **Fundamental questions**

Graham Weale, Honorary Professor for Energy Economics and Policy, University of Bochum, former chief economist at RWE AG, posed fundamental questions about the very basis of the term 'power market'. Reviewing the features needed to have a well-functioning market, he claimed that electricity markets fail on five of seven key characteristics, including the effectiveness of price signals and the relationship of return on investment to the cost of capital.

Weale pointed out that the power market is very different from other commodity markets: "If you take many other commodity markets, such as for oil, coal, copper or zinc, they rely on the supply curve. The supply demand reaches a striking price and it's that price alone that determines how the market works. There aren't any externalities or support from elsewhere. The consequences of the non-storability of electricity and the high demand range required for supply security are absolutely key to understanding why the market is distinct."

He went on: "This is an important message that we really have to communicate to the regulators and to the politicians to help them understand more clearly why electricity is in a special category. You can't finance plants out of the wholesale market. I think it's important to recognise the limitations of the wholesale market. It's got an important job to do, but I've never seen it being sufficient to finance new power plants. I don't expect it to be so in the future."

"What the wholesale market does extremely well is optimal power plant dispatching," Weale explained. "But most customers have a single customer price for energy so their hourly decisions have nothing to do with the true hourly cost. Nor can it guide them on what their peak demand should be. In a nutshell, you've got a single price which is trying to do two jobs but doing neither of them correctly."

What's the solution? Weale favours a market where "consumers pay separately for the two services they want, peak supply availability and energy based on the hourly price. The change in the tariff structure will be challenging but is essential to minimise future investment costs and prepare for sector-coupling." And what if we don't move in that direction and continue to rely on the wholesale market to finance new power plants? Weale said: "For a few years we might get away with it but I would not commit my own savings to a power plant with a 20 year economic life which relies on the wholesale market."

### **Cybersecurity and cloud computing**

From the US, John Quackenbush, President of JQ Resources, offered insight from his experience working for regulators and regulated entities. He took a step away from the trilemma of security, affordability and sustainability to highlight the challenges for regulators of cybersecurity and cloud computing. "Cybersecurity is a growing rate-making issue because, as expenditures on it grow, it becomes a more important part of the revenue requirement," he pointed out.

But it poses some real dilemmas for state regulatory commissions: "Security and confidentiality mean you don't want to be divulging things in public that would give clues to how cybersecurity protections can be attacked," Quackenbush observed. "So, commissions have tried to hire and retain staff that understand cybersecurity but there are skills shortages and cost issues associated with that. It's very difficult and the situation is compounded by the disclosure obligations on commissions of the Freedom of Information Act." His conclusion is that "we will see an evolving use of third party attestations whereby a third party who has cyber expertise will look at what a utility is doing and actually file an attestation. It's an important issue going forward."

When it comes to cloud computing, Quackenbush pointed out that: "Many utilities face a regulatory disincentive as, unlike major IT investment, cloud computing is typically treated as an operating cost not a capital cost by the regulator and so companies can't put it in their rate base." It has led to a resolution being passed by the National Association of Regulatory Utility Commissioners (NARUC) to encourage commissions to be flexible and consider capitalising cloud computing in order to level the playing field between cloud solutions and other types of IT investment.

# Worldwide questions, worldwide answers

*Market structures are very different around the world. In many countries, they remain vertically integrated and are relatively closed to competition. Even where they are liberalised, the balance between short-term and long-term price and investment signals varies widely. Concluding the roundtable, David Etheridge, Global Power & Utilities Advisory Leader, PwC US, observed: “With rapid technological change, there’s a recognition that we can and need to do something different. As we move to new models we need to learn from worldwide experience.”*

Alain Janssens, Director Regulatory Oversight and Market Design at Engie, reviewed market design and regulation in leading markets around the world and stressed the need to learn from different regions, not least those in South America which are often overlooked. “Markets in Latin America have a lot of features that are present in our more ambitiously restructured markets but they have taken a particular view on the level of liberalisation that they were going for, typically taking a more moderate approach to downstream liberalisation, but also towards the role of competitive wholesale markets.”

## **Chile and Brazil**

Janssens outlined some key market design features in Chile and Brazil (see snapshot) as well as highlighting Chile’s ambitious renewable energy plans which are targeting a total share for renewables (incl. hydro) in generation of 70% by 2050. Turning to Brazil he observed: “Generally speaking, Brazil has been very smart at attracting new investment to match the development of their demand and economic growth while managing to keep electricity affordable for a large population where there are huge inequalities.”

This has been achieved by conducting separate tenders for new and existing generation, thus yielding very different prices. “The issues they have in Brazil are nothing to do with the market model, it is more the increasing impact of the El Niño and La Niña phenomenon which has started to result in occasional water shortages for hydropower, resulting in a need for thermal generation and gas infrastructure, to provide back-up.”

## **Snapshot: Market design in Chile and Brazil**

### **Chile**

A market design combining capacity price and energy (marginal cost):

- administrative capacity prices set 2x/year based on rolling adequacy forecast (benchmark = 25-yr annuity for recovering investment in a CCGT).
- capacity term typically worth ~20% of total price.
- PPA’s are then priced combining both capacity and energy.

### **Brazil**

Main differences with the Chilean market design:

- central dispatch, but monthly imbalances settled with computed settlement price.
- no capacity based approach => energy based PPA’s, no nodal pricing.
- separate auctions for new and existing capacities yield very different prices.

*Source: Presentation by Alain Janssens, Director Regulatory Oversight & Market Design, Corporate Strategy, Engie.*

In the US, Janssens highlighted how gas prices, influenced by shale, have flattened the supply curve, drastically reducing infra-marginal rents. In the ERCOT market in Texas, for example, he pointed out that “gas generators don’t have hardly any margin to live on any more and so this shows you how simply the market value of a marginal fuel can ruin the business case of a merchant generation. I agree this is quite an extreme example, but it shows the type of things that can go wrong in an energy-only market.” Engie sold its US merchant plants, including six in Texas, in 2016 taking the view that market conditions would remain problematic for some time.

Janssens described the clean energy package in Europe as “an ambitious package on energy efficiency, renewables and customer empowerment, but with serious pitfalls on market design. In the end we will probably be talking about a very different value chain and probably a very different market design as well. One of the major differences will be that there will need to be much more interaction between consumer behaviour and price signals which will have to reach all the way up to investment and profitability of operations. In the meantime, we are in a transition phase and it’s about trying to fix the current model the best we can.”

**“Countries in South America have developed clear long-term commitments and long-term contracts for investing in the system.”**

*Paul Nillesen, Partner, PwC Netherlands, in conversation with Rodolfo Martinez Campillo, Head of Infrastructure Regulation, Iberdrola; Tony Meehan, Executive Manager Regulation, TransGrid; Ekin Niksarli, Business Development Director, Europe and Asia SBU, The AES Corporation; and Andrea Villa, Head of European Regulation, ENEL*

**Nillesen: What countries do you think we should look to as pathfinders in terms of their current approach to regulation?**

**Meehan:** “The more I talk to people internationally, there doesn’t seem to be any silver bullets. I think the main impediment at the moment continues to be establishing a consensus around the transition away from carbon in energy. If we could get agreement as to what our market should look like in 2030 and 2040 then the industry can get on with market design and regulation. But with things changing month by month or week by week, the resulting instability makes it really difficult.”

**Villa:** “The example that we have to look to is South America. Countries there responded to the crisis of the 1970s and the 80s by developing clear long-term commitments and long-term contracts for investing in the system.”

**Campillo:** “I wouldn’t say that there is a single country to follow. Every country has different problems and as soon as they are faced with a problem they need to improve and do something to fix it. In the area of distribution, New York in the US is somewhere to follow because they were very much committed to overhaul the whole of the distribution business. In Brazil they have a good structure for regulation and some very good initiatives. They have other problems, including certain political problems, but it is a promising market. We also see very good regulations in Mexico as well in terms of the wholesale market and market definition. They are doing very bold and interesting things. Here in Europe, the clean energy markets also has some very interesting things. So there is no single country to follow but we need to select from what is good and also recognise what is bad.”

**Niksarli:** “Mexico, for example, has been introducing a very investor friendly environment for power and utilities. AES has been tripling capacity investments in that country, precisely because of their long term view on power markets. Europe is very challenging due to merchant exposure. If the European markets would allow bankable long term contracts to be remunerated on capacity and energy as well as the flexible solutions services that we can provide, then we would also be investing heavily in these markets.”

**Nillesen: Isn’t transmission the solution to some of the issues in the Australian market?**

**Meehan:** “Because of the surplus of generation we’ve had for decades, there’s been an undervalued view of the role of transmission. I think that is starting to change. The existing grid is built for coal. But that doesn’t necessarily mean the sun shines or the wind blows where we dug up coal. So, one of the recommendations from a review from chief scientist Alan Finkel is to develop a national transmission plan, identify

renewable energy resources and start to link both together. It’s very clear that with more interconnection South Australia wouldn’t have gone black last year.”

**Nillesen: What about the danger of stranded assets as new solutions come in given the pace of technological change we are seeing?**

**Campillo:** “Yes, the risk of the stranded assets is severe. The important thing is to have good regulation in terms of keeping the regimes stable. The problem would be not so much stranded assets, rather stranded regulation whereby you might have a regulation for a PPA or for some kind of feed-in tariff and then five or ten years later changes it and it is no longer profitable. That is one of the risks that renewables are facing and, of course, we have seen some cases in Spain, for example, in which those problems have appeared.”

**Nillesen: What needs to happen in the regulation of battery storage?**

**Niksarli:** “Batteries should be remunerated for the services that they deliver in terms of flexibility and speed. They provide you with the fastest ramp-up possible and can be placed right where the load is needed. In Long Beach California, AES is building a 200MWh battery storage facility. It’s double the size of Tesla’s Australia storage unit. It has no chimneys, no sound, no carbon emission. It’s a power plant in the middle of the city.”

**Nillesen: How does large-scale PV compare with rooftop solar and what does this mean for how we choose to move forward?**

**Campillo:** “In a world of limited economic resources and choices you have to look at overall cost. The cost of distributed PV is about twice as much as the cost of a large scale plant. In Spain for instance, we have enough barren land which can be used for solar PV. The cost is going to be half the cost of putting all the roofs in Spain with solar panels. Of course, it depends on the circumstances of a country. There are countries where you don’t have so much land available or where land is more expensive so the solution might be different.”

**Nillesen: Certainly in Europe we’ve gone through a long period of unbundling and separating parts of the sector. Is there a case for reintegrating some of these activities?**

**Villa:** “I don’t think that we need to integrate them but we do need to give them the right incentives. We need smart regulation, so each part of the sector - transmission, distribution, retail - has the right incentives to deliver. For example, in transmission the TSO does not need to be integrated with the DSO, but it does need the right incentive to build the right connection line.”

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