New Perspectives on Electricity Market Design

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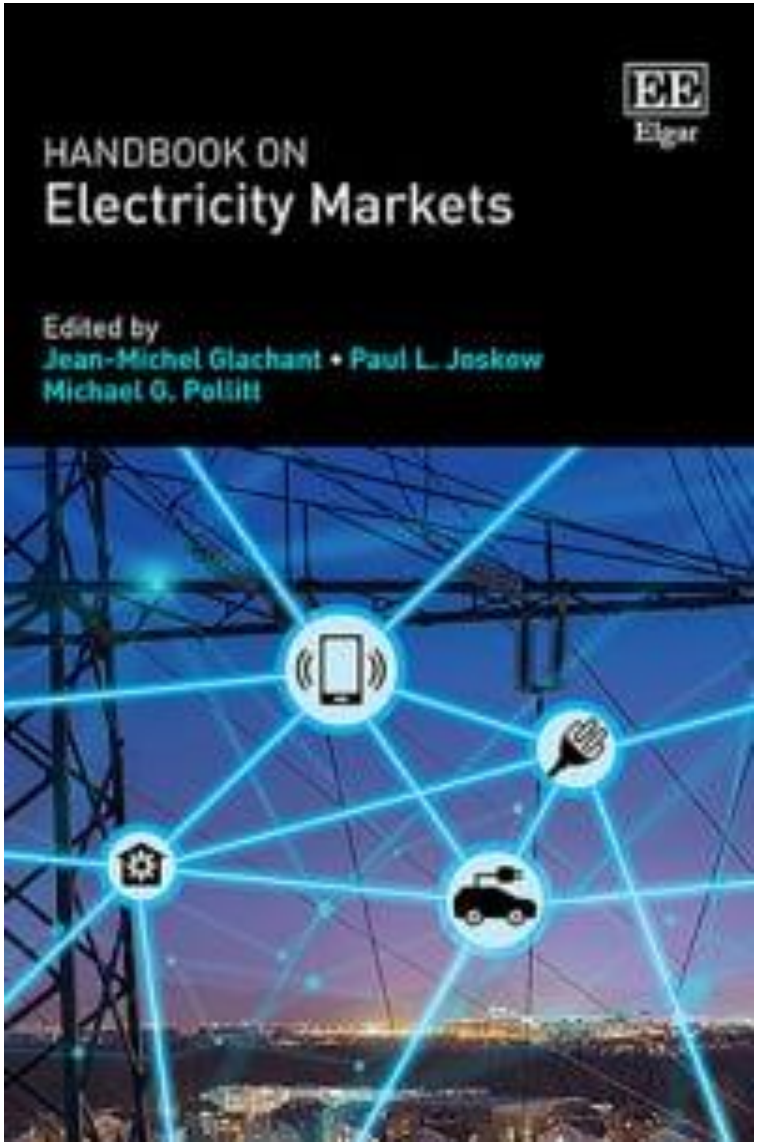
1st March 2022

Handbook on Electricity Markets



Edited Volume on current and future electricity markets, published in 2021. Available online.

With thanks to Jean-Michel and Paul!

22 Chapters by global experts

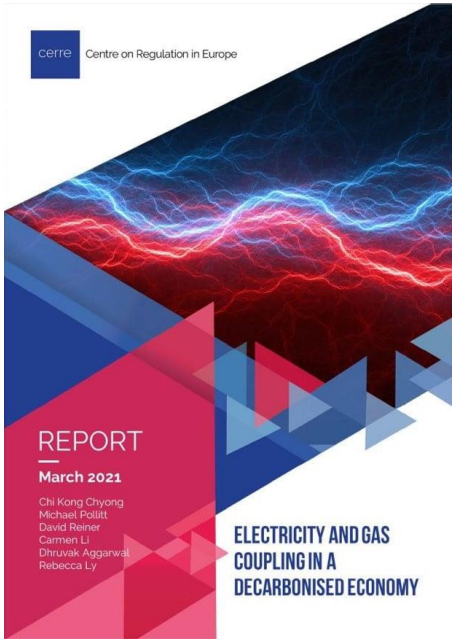
10 chapters on
'Taking Stock: The Legacy'

11 chapters on
'Adapting to New Technologies and New Policy Priorities'

For example:
'The Future of Electricity Market Design'
(Chapter 16 by M.G.Pollitt)

Previous CERRE reports on market design

Modelling to 2025



Modelling of 2050

Role of carbon pricing

Local markets

Opening thoughts on current crisis

- Low prices in electricity markets appear to be yesterday's problem.
- Higher marginal unit prices are necessary in the long run to get to net zero.
- Market design needs to address issues of seasonal and annual variability of renewables output, which will be a more acute in the future than it is now.
- Consumers (of all types) need some form of protection from high and volatile prices through business model regulation.
- Geo-politicisation of gas is a long-term concern, which may have implications for green vs blue hydrogen in net zero.

Does retail need to be regulated with respect to volatility and hedging contracts?

- **Obviously, yes.**

- Energy prices are a major part of household budgets, inflation and the political debate. We have NRAs for energy for this reason.
- The political system is exposed to energy price risk, some of which can be mitigated by hedging and high taxes.
- Historically, with VI we did not need to worry about volatility and hedging because of physically hedging and implicit long-term contracting.

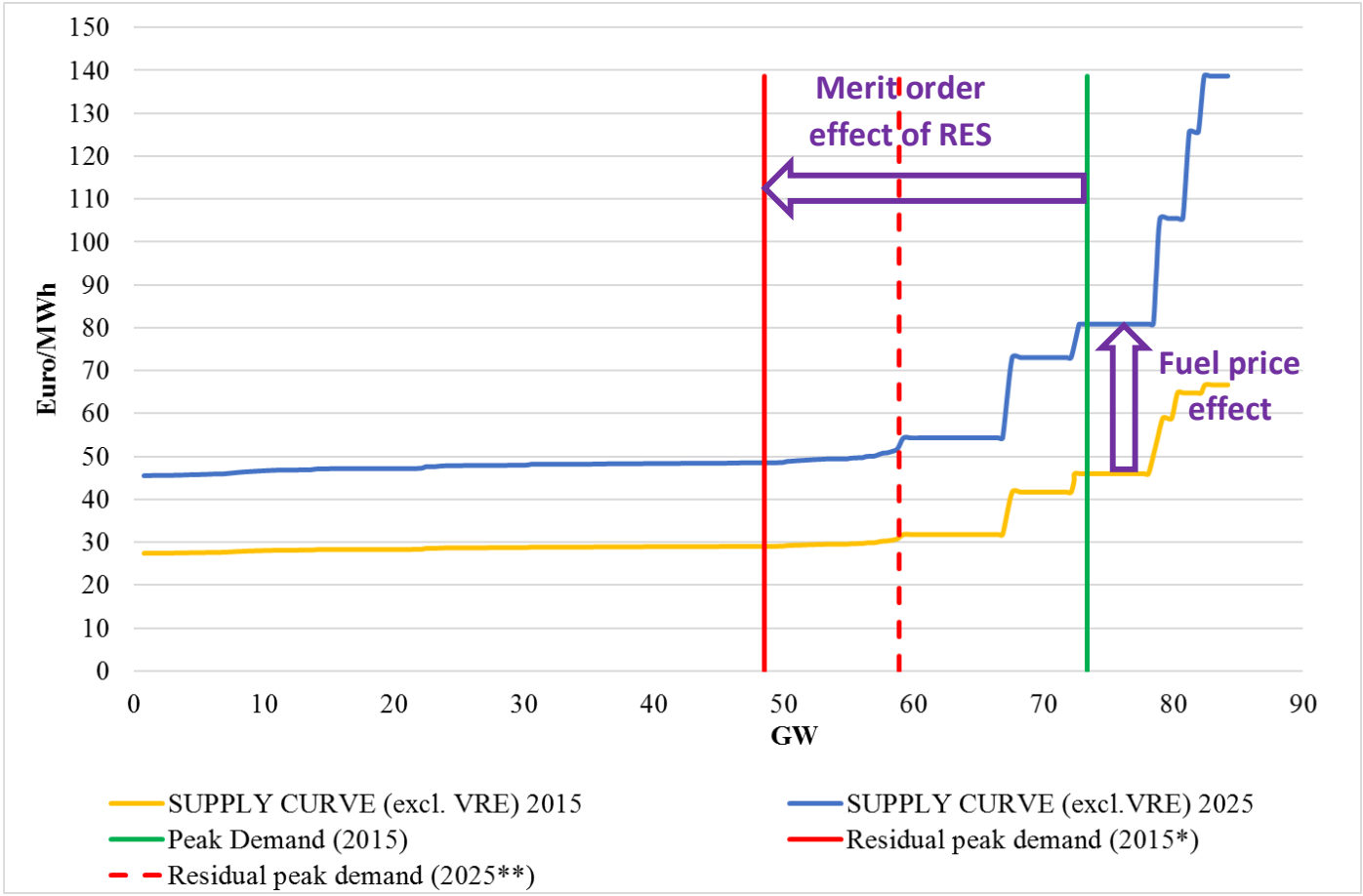
- What the current crisis has revealed is the capacity for unhedged retailers to expose the system to overall risk and cost.
- Household and SME customers cannot be expected to know about or care about the soundness of their retailers.
- As the political risk is national and the tolerance for risk is also national it is right that the exact nature of hedging should be set nationally, not at the EU level.

Which hedging instruments?

- **This is problem is not new.**
- Many markets (e.g. in South America) across the world have introduced competitive wholesale markets and partially deregulated retail markets while protecting domestic/smaller customers with long run regulated tariffs, set on the basis of competitively procured long run generation contracts.
- Indeed, default tariffs for retail should require matching with forward contracts which cover all demand until retail tariff is reset at a minimum. Often, these regulated further and require rolling 18-month contracts (e.g. in Italy?).

- In theory, could have a requirement that a retailer has to on average match the maturity of all of its retail contracts on the generation side, which would maintain full customer driven competition.
- Exact contract matching is difficult, but could have a target level of matching (e.g. 95%+, depending on demand forecast accuracy).

Is a new market design really necessary? Might not be.



1. Reminded recently that fuel price effect is still strong
2. An empirical question requiring some modelling
3. Depends on fossil fuel/carbon prices, VRE capacity in a generation mix

View 1: Schweppian (e.g.Hogan)

- Fred Schweppe – a hero to power engineers…
- We need / will have more markets and more differentiated prices in the electricity market.
- The arrival of DERs increases the value of such pricing.
- This particularly applies to ancillary services products.
- Schweppe, F.C., Caramanis, M.C., Tabors, R.D. and Bohn, R.E. (1988), *Spot Pricing of Electricity*. Springer.

View 2: Coasian
When to use markets to procure?

- Ronald Coase - Nobel Laureate in Economics 1991.

- Coase (1937) on *The Theory of the Firm*. The decision of a firm to go to the market to procure inputs to its production is a choice. Vertical integrated firms such as EdF can be optimal ways to organise private production.
- Williamson (1975) formally suggested that the decision to produce in-house production is a decision which trades off the production cost advantages of outsourcing in terms of increased scale with the transaction costs disadvantages of having to assure the external quality of bought-in inputs.
- Richardson (1972) pointed out that outsourcing itself can be closer to in-house production if it takes the form of an exclusive long-term contract or closer a pure decentralised market if inputs are acquired via spot market trading.

The choice

- Future market design rests on whether the future electricity system will favour more or less formal use of markets and the nature of the markets that it might favour.

- (Spot) Markets work best when the product being procured via the market is standardized and provided competitively.

- Large firms work best in dealing with complex multi-level optimisation problems which are actually quite difficult to write down (think of how difficult it would be to write down Apple's optimisation problem over the years ex post, let alone ex ante).

- A key idea in Coase (1937) is that the capitalist firm is a planned system and that ebb and flow of market shares and vertical integration within the market is a reflection of the changing nature of the optimal scope of planning versus market competition.

How markets work

- Markets have to be formal and follow well publicised rules. This is especially true of the organized markets run by system operators in the US and in Europe.
- Thus, though these market arrangements are potentially very competitive they are also difficult to change.
- In-house arrangements to manage voltage and local constraints in the distribution system may be more efficient because they are flexible and do not require formal recourse to the market.
- Local energy markets are even more problematic because of the largely arbitrary boundaries that they would introduce and the fact that once introduced they become difficult to change, even though some might be successful and some would not prove viable.

More markets (or more prices)?

- A move to self-consumption with own storage is a move towards in-house production, while more use of wide area markets with nodal pricing would be a move towards more use of markets.

- Engineers often see the future of the power system as being about more use of market prices which are explicitly communicated to all consumers and all generators (Schweppe et al. 1988; Burger et al. 2019).
- Indeed, some views of the internet of energy foresee pricing to devices, not just customers (this is an extreme version of the transactive energy future as exemplified by the Pacific Northwest Demonstration project in the US).

More markets/prices?

- It is important for economists to point out just **how extreme** a view of the use of a spot market in either of the above ways would be.
- Most products are subject to simple pricing and customers expect the providers of the products to manage their own internal costs of provision to different customers.
- Only certain types of price discrimination are acceptable and worth doing in conditions where simple advertising messages, corporate trust and perceived fairness in pricing are important considerations for corporate pricing policy.
- That is not to say that some providers of services to the electricity system cannot be exposed to time and space varying prices, but that ability to expose **all parties** to these sorts of prices is limited.

Market power and regulation

- Engineers also fail to take seriously the reality of market power and the linkages between markets.
- There is also no reason to assume that unregulated markets for related activities (energy, non-energy ancillary services and network investments) will cumulatively add up to a social optimum, according to the theory of the second best.

- As Joskow (1996, p. 381) argues the task of regulators of the electricity sector is to achieve 'a favourable trade off' between short-run and long-run costs and benefits in conditions where some co-ordination is necessary (at the level of short-run system operation and in lumpy transmission investments) and where the benefits of competition are often long-term.

Suggestions for improvements in existing markets

- Hogan (2005) proposed an improvement to the energy-only market design to address the lack of a market for reliability: to price scarce reserve at the opportunity cost of energy through a regulated operating reserve demand curve (ORDC).
- Joskow (2007) concludes that a forward capacity market is needed to ensure resource adequacy.
- Newbery (2016) noted that even if the revenue is potentially adequate to cover capital costs but is not perceived to be so by generators and/or their financiers then there is a "missing market" problem. Hence capacity markets.
- A fundamentally different approach would be to shift the focus of provision of adequate capacity away from the generators on to retailers. A related suggestion to this is that (see Bidwell, 2005), retailers should contract for reliability options with generators, where generators agree to provide reliability at fixed prices during stress events and effectively forego price spike revenues.
- The Single Electricity Market (SEM) in Ireland has implemented the DS3 (Delivering a Secure Sustainable Electricity System) - 14 ancillary service products, including a new frequency response product for delivery of frequency response within 0.15 seconds. In the first competitive auction to procure these new services, offerors will be required to submit a package bid for 5 ancillary services products (around frequency response and short term operating reserve), at a discount to maximum prices published by the system operators.

Future market design

- One issue for the future market design is whether rising distributed generation and flexible demand mean that markets are zonal, local or nodal, rather than national (or even regional), especially if overall demand is falling.
- It is highly likely that there will be more distributed energy resources (DER) participation within existing markets. Falling platform costs and increases in distributed generation and storage suggest that the trend to more DER participation in energy and non-energy ancillary service markets must increase.
- This will require minor, conceptually speaking, changes to existing markets to lower participation thresholds and allow greater roles for aggregators of small DERs.
- This is at the same time as there will be greater pressure to integrate markets over a wider area to manage intermittent energy resources with large negative correlations over long distances, as we have seen with the European single electricity market.

Which world: Schweppe or Coase?

- One suspects that a truly nodal or fully distributed pricing system is not sustainable in a smart world partly because of the computational complexity involved.
- Rather like the internet, the greater likelihood is that capacity should be expanded to reduce nodal (actual or virtual) price differences and that any 'rationing' that does occur should be on a non-price basis for residential and small non-residential users.
- This gives rise to a new potential market design which is based on non-price rationing of the available intermittent generation to loads in priority order.
- This would exploit the ability of smart meter enabled systems to communicate with individual devices to switch them on and off.

The internet of energy?

- A fully flexible system would have every device prioritized and supplied on the basis of customer specified priority.
- Customers might be able to override contracted priorities for a fee or choose more or less items in higher priorities for higher fees.
- This sort of market design whereby demand was rationed by priority order would move the emphasis from price flexibility to quantity flexibility.
- This is what happens with the internet, whereby users can pay for the size of their connection but packet speeds are reduced for everyone when the internet is congested at peak times, rather than rationed by price via charging more at the peak times to maintain packet speeds.
- This would be a true internet of energy, even though it would – no doubt – be complex to set up.

A hybrid design?

- Of course, the likelihood is that some sort of new hybrid market design might develop.
- This would make use of some price-based elements, particularly towards non-energy ancillary services, and of non-price quantity based rationing.
- One could imagine the default contracts being rationing contracts and these would exist on the basis of public desire for zero carbon energy systems.
- Retailers or energy communities (such as exist in California or the EU) might provide power on this basis to their own customers, acting as intermediaries between price-based charging and quantity-based rationing.
- Equally, we might imagine that households would have two contracts – one for basic service and one for EV charging.

Future market design for retail and wholesale markets?

- Retail energy markets will remain heavily regulated. Fully flexible *retail* prices for electricity and heating are detached from current political reality.
- What will be required is building a wholesale market that can cope with renewable volatility and where we do not ration short run output wholly on the basis on price.
- CfDs, long-term contracting requirements and high and stable carbon prices can reduce overall retail price volatility.
- In the future we will need deep demand flexibility and innovative retail models, which combine control and price-based elements in a politically acceptable way.
- Different countries and different types of consumer might be willing to accept different types of retail contract as their default contract.

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