UNIVERSITY OF CAMBRIDGE | Energy Policy Research Group

# What energy market model for a competitive decarbonisation?

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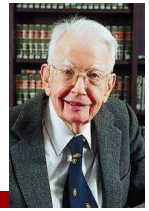
# The choice: Schweppe vs Coase



- 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.
- 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). This is Schweppe+ (1988). *Spot Pricing of Electricity*. Springer.

- (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 (e.g. Apple's optimisation problem).
- A key idea in Coase (1937) *The Nature of the Firm* 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 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.

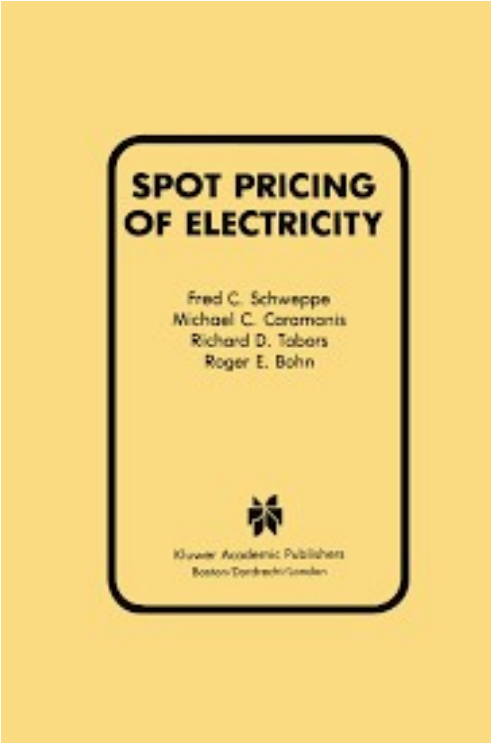
- In-house arrangements to manage voltage and local constraints in the distribution system may be more efficient because they are flexible and do not require formal recourse to the market.

- 'Local' energy markets are 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)?

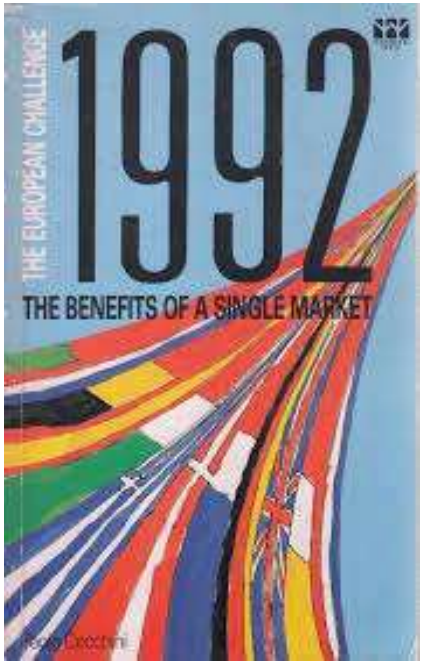
- A move to self-consumption with own storage is a move towards in-house production, while more use of wide area markets with locational marginal prices (LMPs) would be a move towards more use of markets.

- 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).



# More markets/prices?

- It is important for economists to point out just **how extreme** a view of the use of a spot market with excessively granular prices is.
- 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.



# Issues raised by nodal pricing (LMPs)

- What exactly is the problem being solved by nodal pricing?
  - constraint payments, interconnector and offshore wind landing points signals, local constraint management problems due to DG export, etc.?
- Calculating LMPs is the easy bit, knowing what they mean and what to do with them is not at all obvious.
- Which nodes? In theory it should be all nodes, otherwise not an inefficient nodal system.
- Why are they mostly ignored in other networks? Nodal prices exist in all networks (they are just marginal shadow values from a linear program).
- Who should be exposed to nodal prices? In theory this should be all loads and generators with potential to respond to them, otherwise inefficient.
- What is the behavioural value of nodal pricing? Fixed costs and charges still must be recovered and nodal price a small fraction of total delivered price.
- What is the net impact of nodal pricing in systems where they are implemented? In the presence of demand averaging, limited nodes, market power mitigation and financial transmission rights (FTRs) not clear the net impact not better achieved some other way.

# 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.

# 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 resource (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?

- 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/off behind the meter.

TABLE 2: APPLIANCE PRIORITY LIST USED TO DETERMINE LOAD SHIFTING

| Appliance type | Priority allocation |
|---|---|
| Vacuum cleaner | 1 |
| Water heating top up | 2 |
| Laptop | 3 |
| Freezer | 4 |
| Refrigerator | 5 |
| Electric iron | 6 |
| Play station | 7 |
| Video cassette recorder | 8 |
| Sound system (Hi-fi) | 9 |
| Television | 10 |
| Central heating | 11 |
| Electric Shower | 12 |
| Electric oven | 13 |

1: Highest Priority/least shiftable
Source: Infield et al., 2007, p.3.

# The internet of energy?

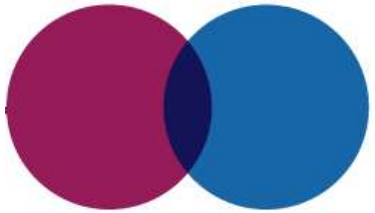
- A fully flexible system would have every device prioritized and supplied on the basis of customer specified priority.
- Customers might be able to override contracted priorities for a fee or choose more or less items in higher priorities for higher fees.
- This sort of market design whereby demand 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.


https://www.energyly.com/blog/internet-of-energy/

# A hybrid market 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.

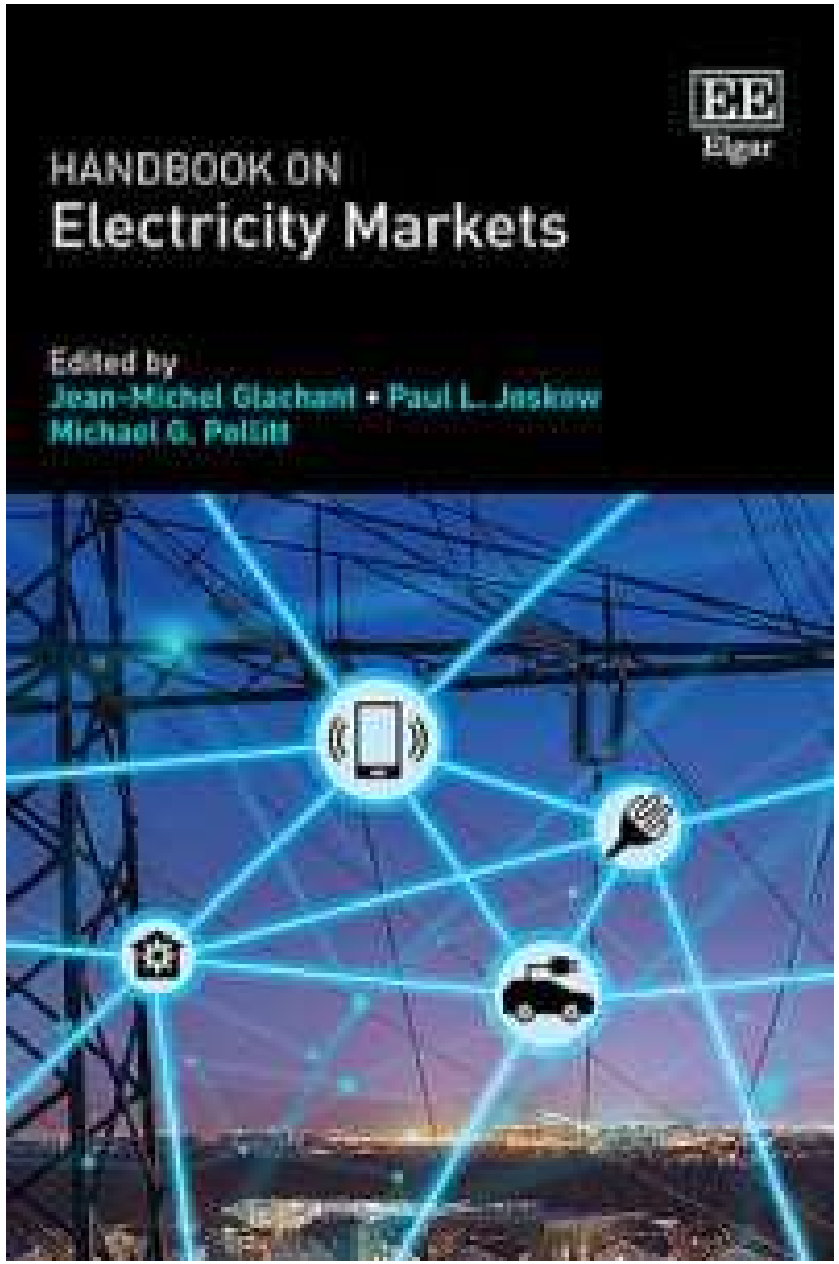
National Audit Office



The energy supplier market

The Department for Business, Energy & Industrial Strategy and Ofgem

# Handbook on Electricity Markets




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

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)

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