

- A traditional model of power market design, and how it remunerates efficient generation investment
- Problems with this model caused by interventions by government and the changing technology mix
- Reforms to improve the efficiency of this traditional model by extending it to better value flexibility

Why can't the market for electricity be more like the market for apples?

- Markets are “complete” and “competitive”:
 - There is a well-defined product that growers produce and consumers want (apples)
 - Property rights are fully allocated (to growers) so trade between buyers and sellers is possible
 - There are many growers so competition is also possible
 - The same is true in the distribution and supply of apples



Source: Richard Herman, blogspot.co.uk



Source: <https://commons.wikimedia.org>



The market for electricity relies on effective regulation to deliver efficient outcomes

Supply/ demand fluctuate in real time and the commodity cannot be stored

⇒ Effective competition requires regulation to define a tradable product that reflects physical supply/demand conditions on the system reasonably closely



Source: <https://www.elisashittam.com>

Electricity has some “public good” characteristics, and is often highly politicised

⇒ Regulation is often used to protect vulnerable consumers



Source: <http://www.telegraph.co.uk>



Source: <http://buildipedia.com>

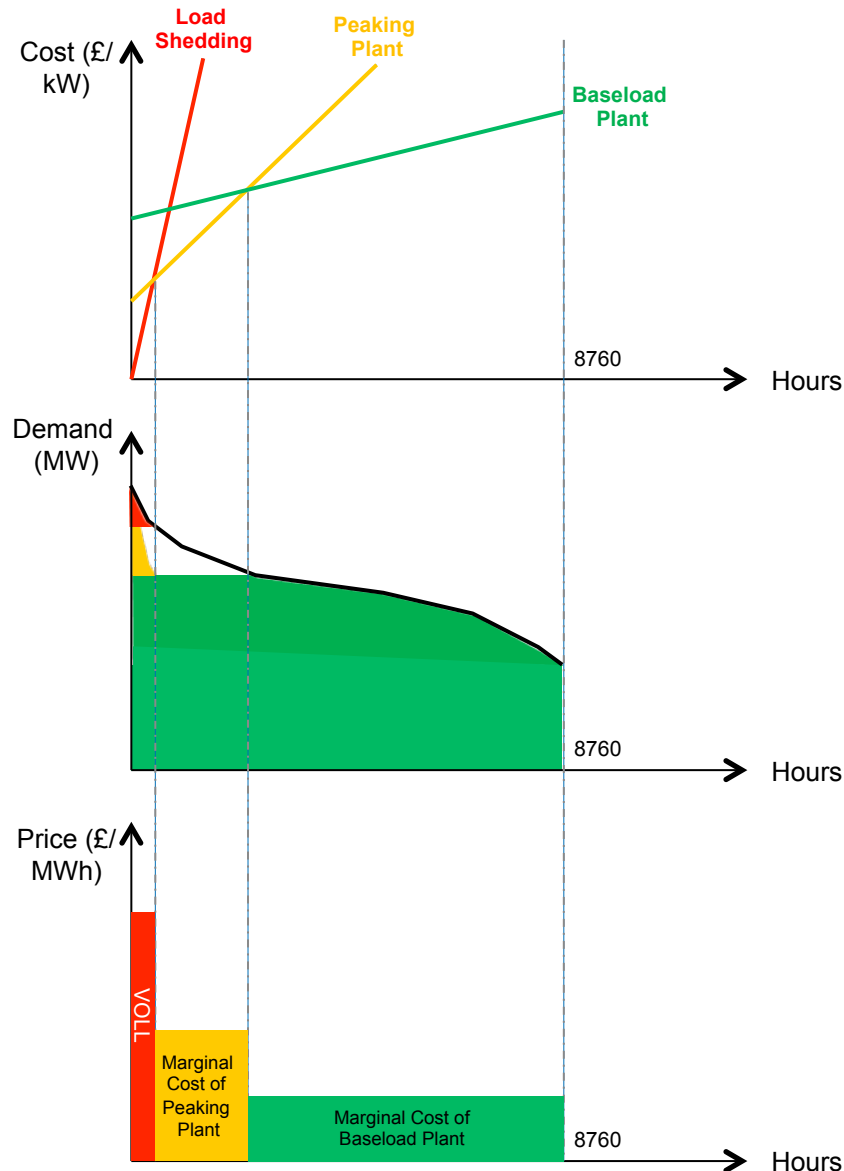


Transport is only economic via natural monopoly networks, preventing competition

⇒ Regulation is required to constrain the pricing of grid companies and set access terms

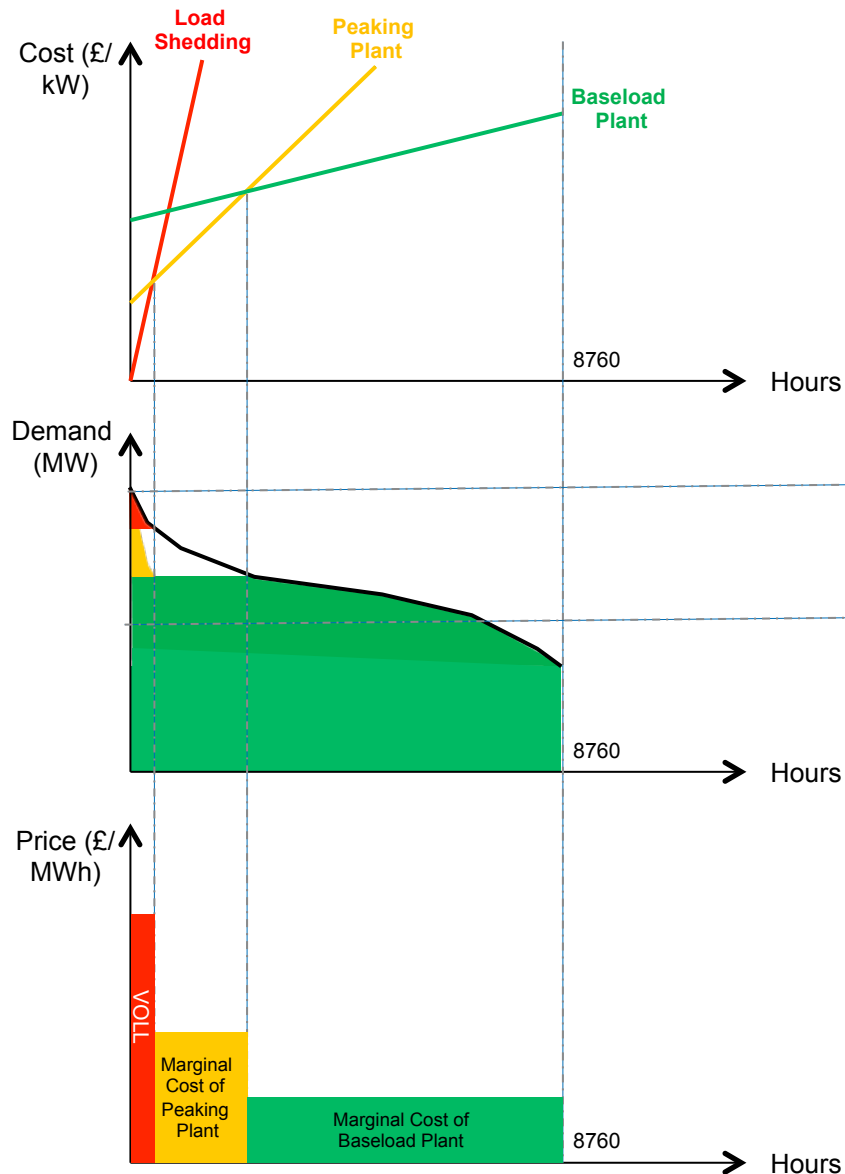
Key Challenge: Ensuring the regulation required to create effective markets keeps track with changing technology

In theory, traditional “energy-only” power markets can remunerate investment in generation through price spikes



- Traditionally, the challenge of planning an electricity system required an optimal mix of technologies to meet demand
- Then, the prices to emerge in a competitive power market (= system marginal cost) would remunerate efficient investment
- Essentially, generation capacity is remunerated through “spikes” in the price of energy

Example: Growing supply of low carbon generation can still be supported (in theory) through an energy only market structure



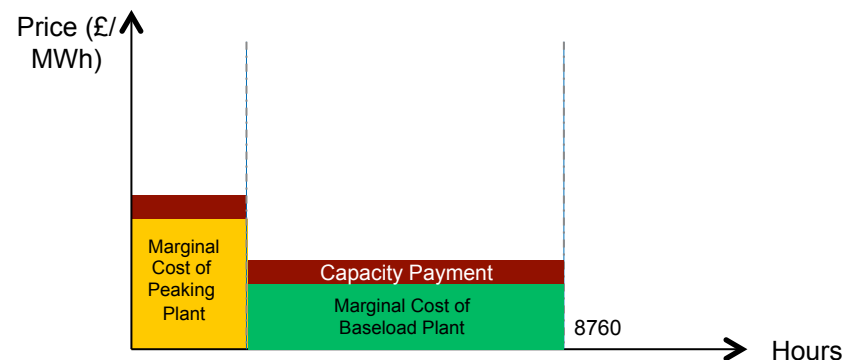
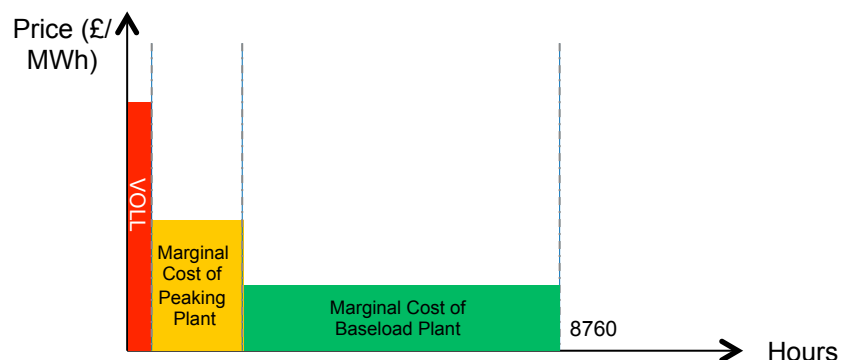
- Growth in low carbon technologies reduces the net demand to be served by other technologies



- The efficient balance between peaking and baseload technologies changes as a result



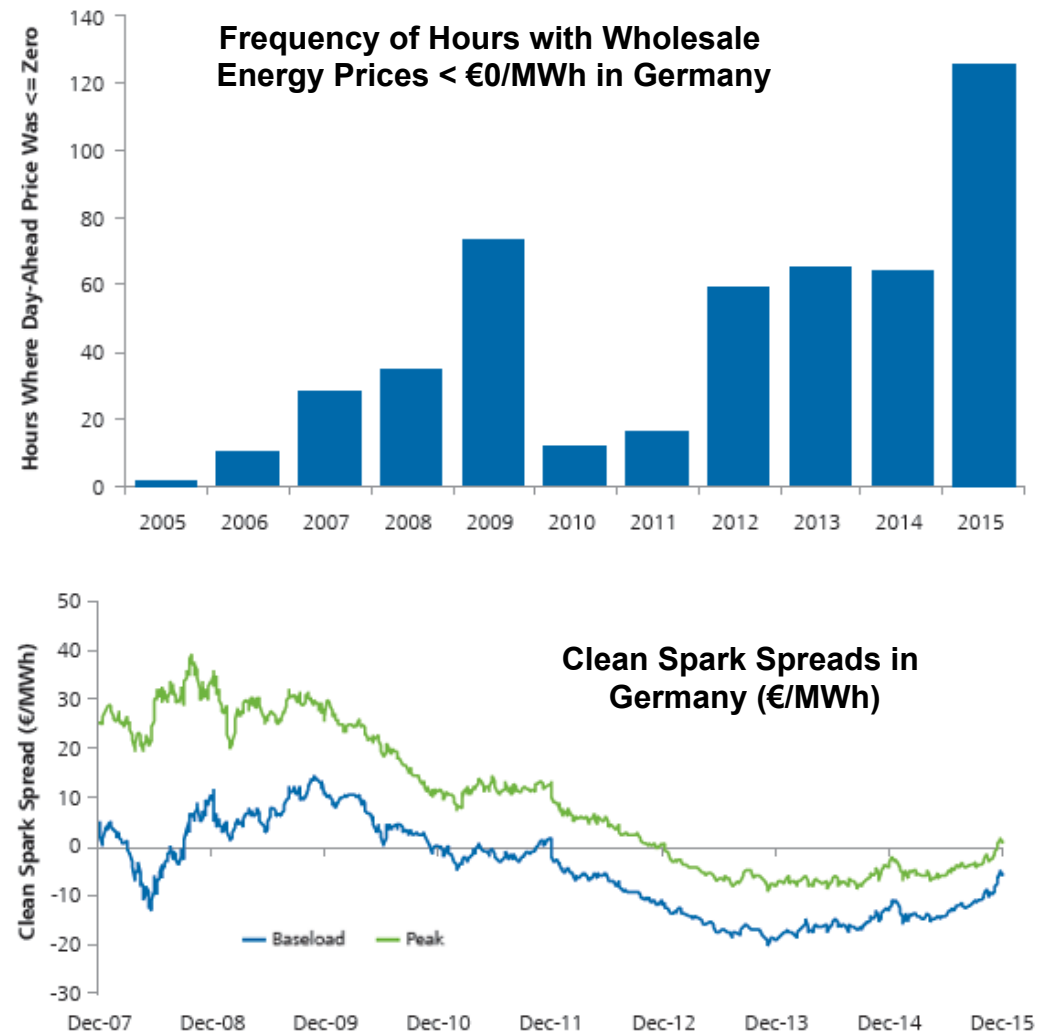
Capacity payments can be used to reduce the need to rely on price spikes, mitigating the risk of government intervention



- Capacity markets substitute for spikes in energy prices as a means of remunerating investment
- They smooth out volatility, and act as a hedge against government intervening to constrain peak prices
- Hence, the traditional model has a solution to the problems caused by government intervention to constrain peak energy prices

In reality, capacity payments are also seen as a means of offsetting reductions in energy margins

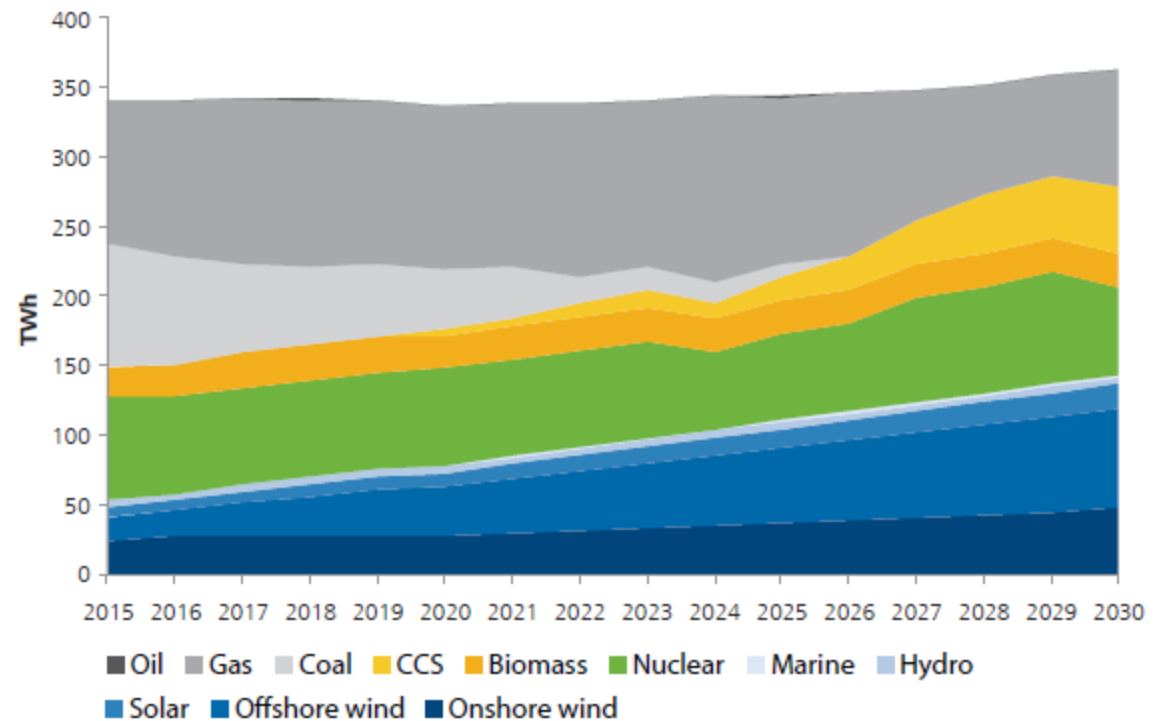
- Lately, capacity markets have also been used in Europe to provide investors with long-term contracts that provide a hedge against government interventions to adjust the generation mix, eg. due to low carbon policies
- They have also provided some compensation to investors in traditional plant, which have seen diminishing earnings from the energy market due to large volumes of low carbon generation being forced onto the system



Source: (Top Panel) European Power Exchange via Platt's PowerVision. (Bottom Panel) OTC via Platt's PowerVision and NERA Analysis⁶

Demand for flexibility will also increase as the generation mix changes

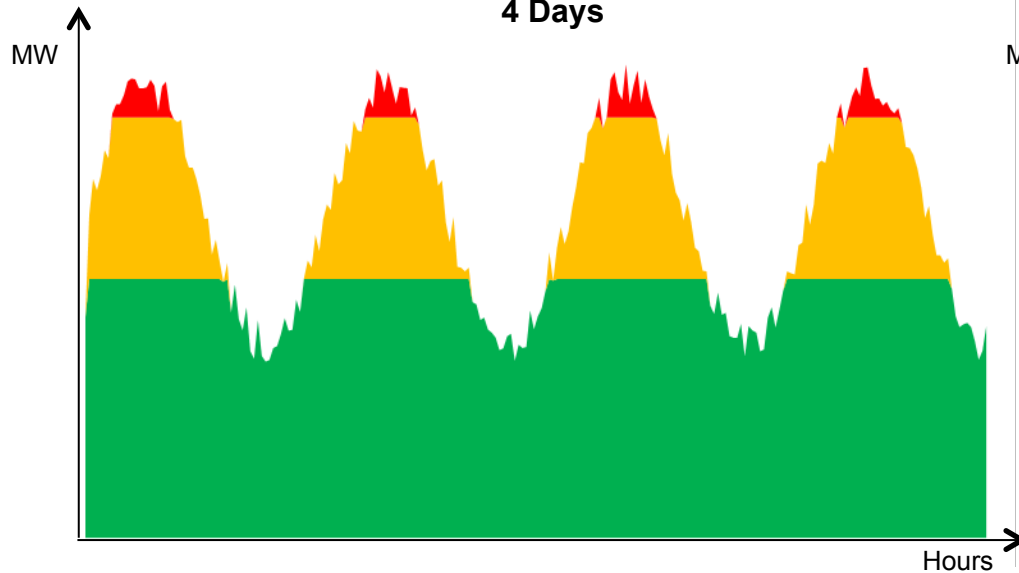
- A range of trends are eroding the market for energy and increasing the market for
 - Declining output from traditional generation means less “inertia” on the system.
 - A more volatile supply mix, with more wind and solar
 - New large nuclear units also increase reserve requirements
- **Result: more demand for “flexibility” services that are not reflected in the products most widely traded in competitive electricity markets**



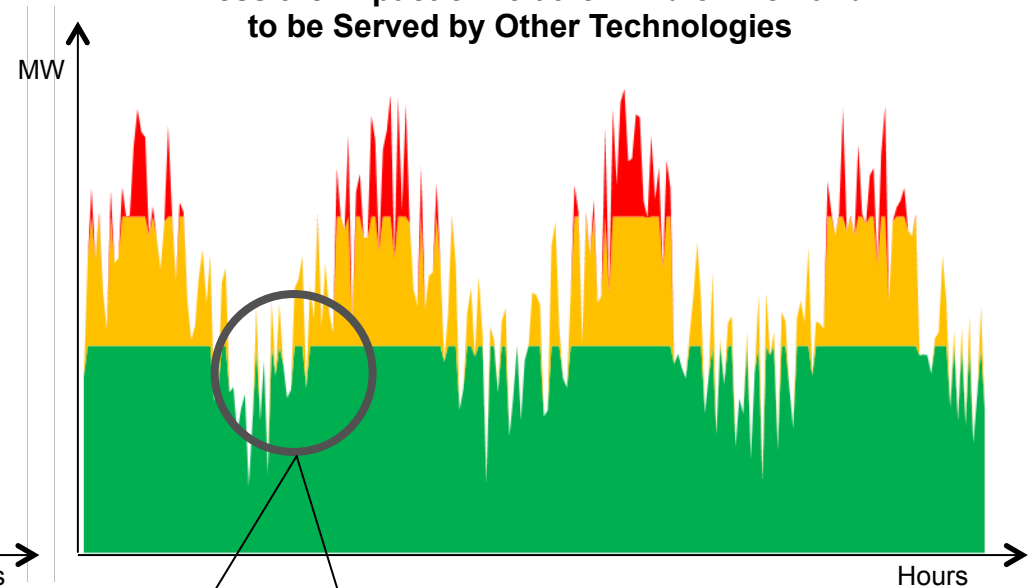
Source: CCC, Fifth Carbon Budget Dataset, Central Scenario

As demand and supply conditions become more variable, the definition of traded products may need to change to support effective competition

Illustrative Profile of Production Over 4 Days

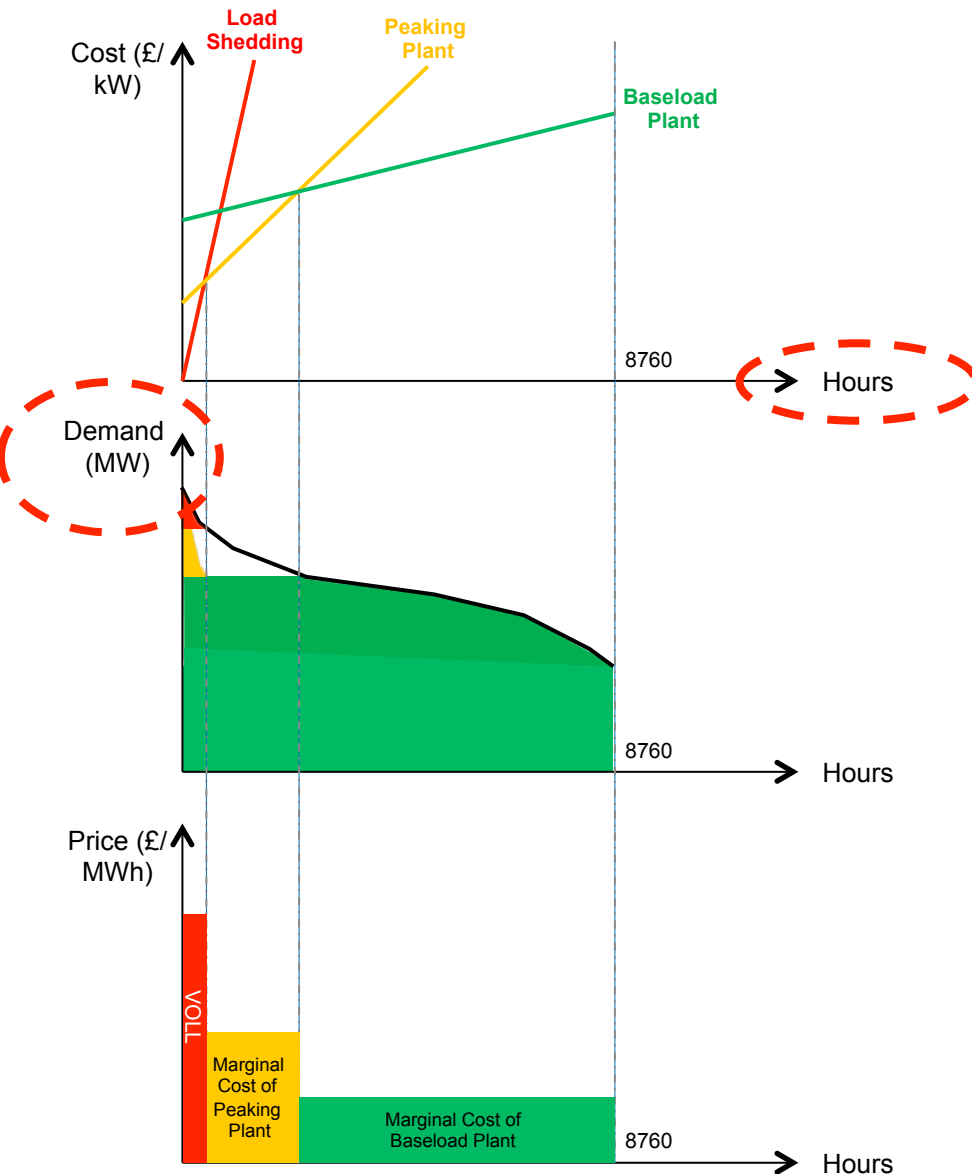


...Less the Impact of Volatile Wind on Demand to be Served by Other Technologies



Fluctuations in supply in real time, which increase due to intermittency, will not necessarily change the value of the traded energy product (hence prices), which usually reflects average conditions over circa 30 minutes, across a wide geographic area

The traditional market model does not recognise the value of flexibility, treating it as an “ancillary” service



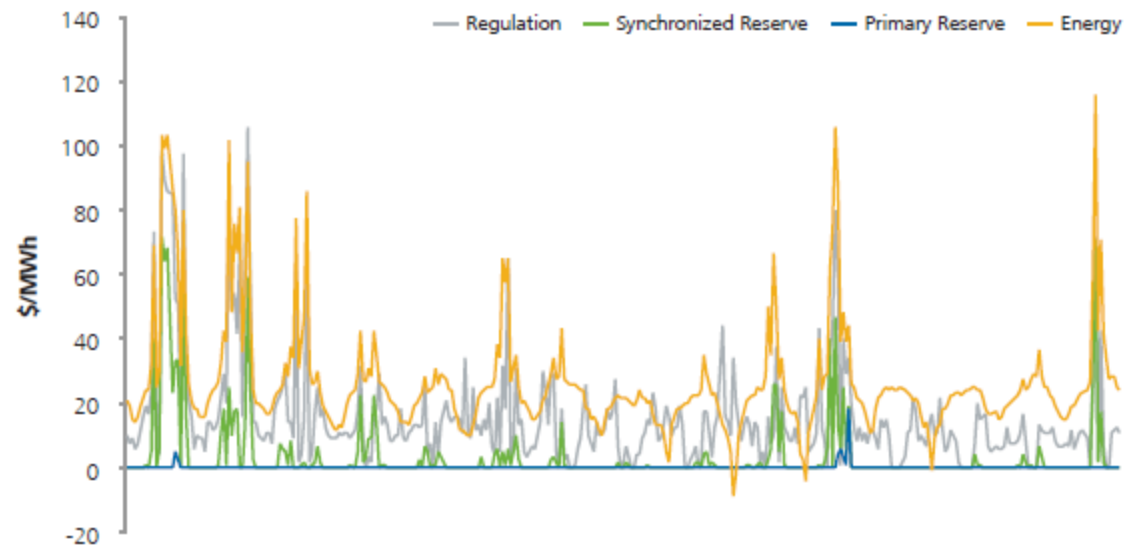
(1) This traditional market structure is usually set up to value power traded over a relatively long (eg. 30 minute) trading intervals, so market prices cannot reflect changing conditions over shorter horizons

(2) The market treats production within relatively wide regions (eg. the whole of GB) as substitutable, with relatively weak locational signals

Electricity market design should evolve to recognise the value of flexibility – they are an ever less “ancillary” service

- The solution to this problem under the traditional structure is to remunerate flexibility outside the market
 - ie. flexibility services are procured through bilateral contracts with TSOs, often through opaque, infrequent tenders with little price revelation.
- Making competition work in evolving electricity markets requires a change in the “product definition” used in the traditional market design to better align with the needs of the system:
 - **Energy traded over shorter time intervals**
 - **More granular locational signals**
 - **More potential for trade and price revelation in (no longer) “ancillary” service markets**

Example from PJM of Ancillary Services Traded Continuously and Aligned with the Energy Market

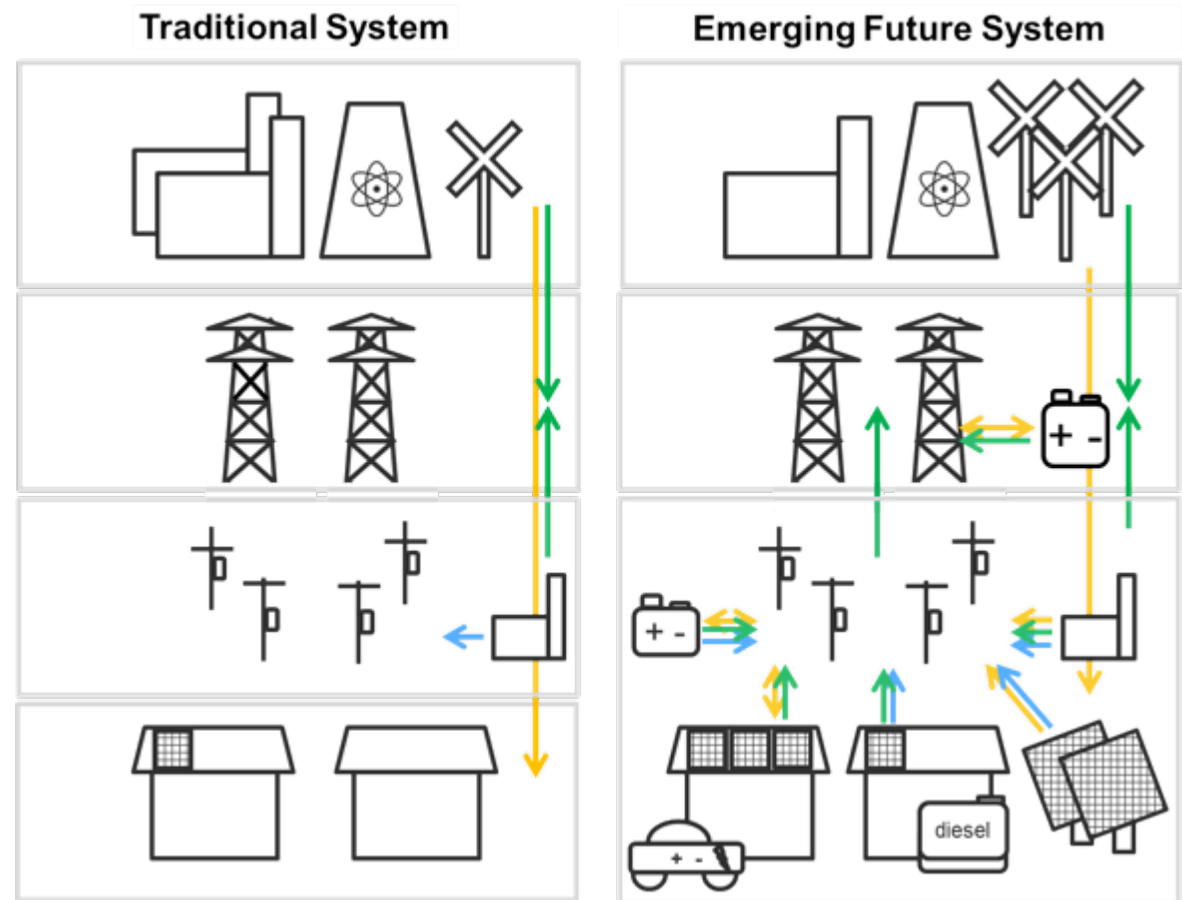


Source: Energy prices are real-time LMPs for the RTO downloaded from SNL Energy; Ancillary Services prices are from PJM's website.²⁴



Current market arrangements also have missing markets for local energy resources – distributors are key to creating them

- As well as sharper locational signals on transmission systems, there are also no market mechanisms that recognise the value of Distributed Energy Resources (DERs):
 - Helping avoid distribution capex
 - Efficient trade-offs between / layering of services
- Innovative mechanisms for aggregating DERs are emerging, but to promote deployment, a product market is needed into which these (aggregated) services can be sold.



- Trading in Energy
- Trading in Ancillary Services
- Helping Offset Network Capacity Requirements

- Making competition work in evolving electricity markets requires a change in the “product definition” used in the traditional market design to better align with the needs of the system:
 - Energy traded over shorter time intervals
 - More granular locational signals
 - More potential for trade and price revelation in (no longer) “ancillary” service markets
- This applies both at the national and local level. Promoting an efficient deployment of DERs will rely on effective product market from which distributors and others can buy services



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