Wholesale power market design – Key issues and principles for an efficient decarbonisation

IX Electricity Security Advisory Panel Workshop

WHAT IS NEXT FOR OUR ELECTRICITY MARKETS? TOWARDS A NEW MARKET AND REGULATORY FRAMEWORK

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Agenda

- **A changing context in Europe: which implications for wholesale power market design?**
- **Principles for an efficient market design with high level of variable renewable energies**
  - Efficient market design requires further coordination of policies on key issues
- **The need for real time price signals to integrate variable renewables**
  - US and Europe market design differences revisited in the light of the growth of VRE
  - Coordination of networks and generation : the of debate on nodal versus zonal pricing
- **The need for an investment and security of supply framework**
  - An historical perspective of power investments in Europe shows role of state and contracts
  - If policy interventions are here to stay to drive investment and decarbonize, ‘competition in two steps’ will become the new model
- **Conclusions**

A changing context in Europe: which implications for wholesale power market design?

Context of the 1990s and early 2000s

- Policy : Focus on competition and market integration in Europe
- Market: Focus on day ahead wholesale market integration
- Technology: dominance of variable costs technologies ('dash for gas')
- Consumers: passive in absence of enabling decentralised technologies (decentralised generation, storage, DSR, etc.)
- Networks: focus on optimisation of the use of existing infrastructure

Current context

- Policy : focus on decarbonization and security of supply
- Market: focus turning to intra day and real time markets to integrate variable renewables
- Technology: dominance of fixed costs (CAPEX) / decentralised technologies
- Consumers: rise of prosumers require rethink of articulation of retail and wholesale markets
- Networks: Need to reinvest to adapt / upgrade grid to decentralised generation and growth of RES in some locations

- **Current EU wholesale 'Target Model' was designed in a different policy, market and technology context …**
  … and needs to evolve to provide adequate price signals for the power system decarbonization

The main challenges of variable renewable energies to market design

Capital intensity

- **Cost recovery: investment incentives**
  - Adequate investment signals
  - Implications for the design of energy markets, capacity markets, support schemes
- **Cost of capital: optimal risk allocation**
  - Exposure to risk, including policy risk, is a fundamental factor determining total system costs if the system is capital-intensive
  - Trade-off between policy flexibility and regulatory risk

Limited predictability and variability

- **Price volatility**
  - More volatile prices
  - Product definition (e.g., peak/off-peak) looses relevance
- **Spot market design**
  - Reduced gate closure
  - Higher frequency
  - Both day-ahead and intra-day
- **Assurance of system stability**
  - Need for new ancillary services products, e.g. providing system inertia
  - Redesign ancillary services to allow VRE participation

Decentralized and scattered generation

- **Coordination between generation and grids**
  - Increased investment demand requires new approach to TSO and DSO regulation
  - Locational price signals for centralised & decentralised generators needed
- **Prosumers**
  - Retail prices becomes investment signal
  - Base for taxes and grid fee erodes
  - Many small producers need access to wholesale markets

Principles for an efficient market design with high level of variable renewable energies

Ultimate goal

Maximise economic welfare
(subject to meeting the policy objectives and operational constraints)

High-level criteria	Efficient **dispatch**	Efficient **investment**	Appropriate **risk allocation**	Appropriate **rent allocation**	Pricing **externalities**
Specific criteria	Dispatch signals	Investment signals	Appropriate risk allocation	Robust to market power	Carbon externality
	Ancillary services	Coherence short/long-term	Minimizing financing costs	Stranded assets management	Health externalities
	Geographical co-ordination	RES support schemes	Reducing policy risk	Avoid windfall profits	Nuclear externalities
		Locational signals			Power system externalities
		Innovation incentives			

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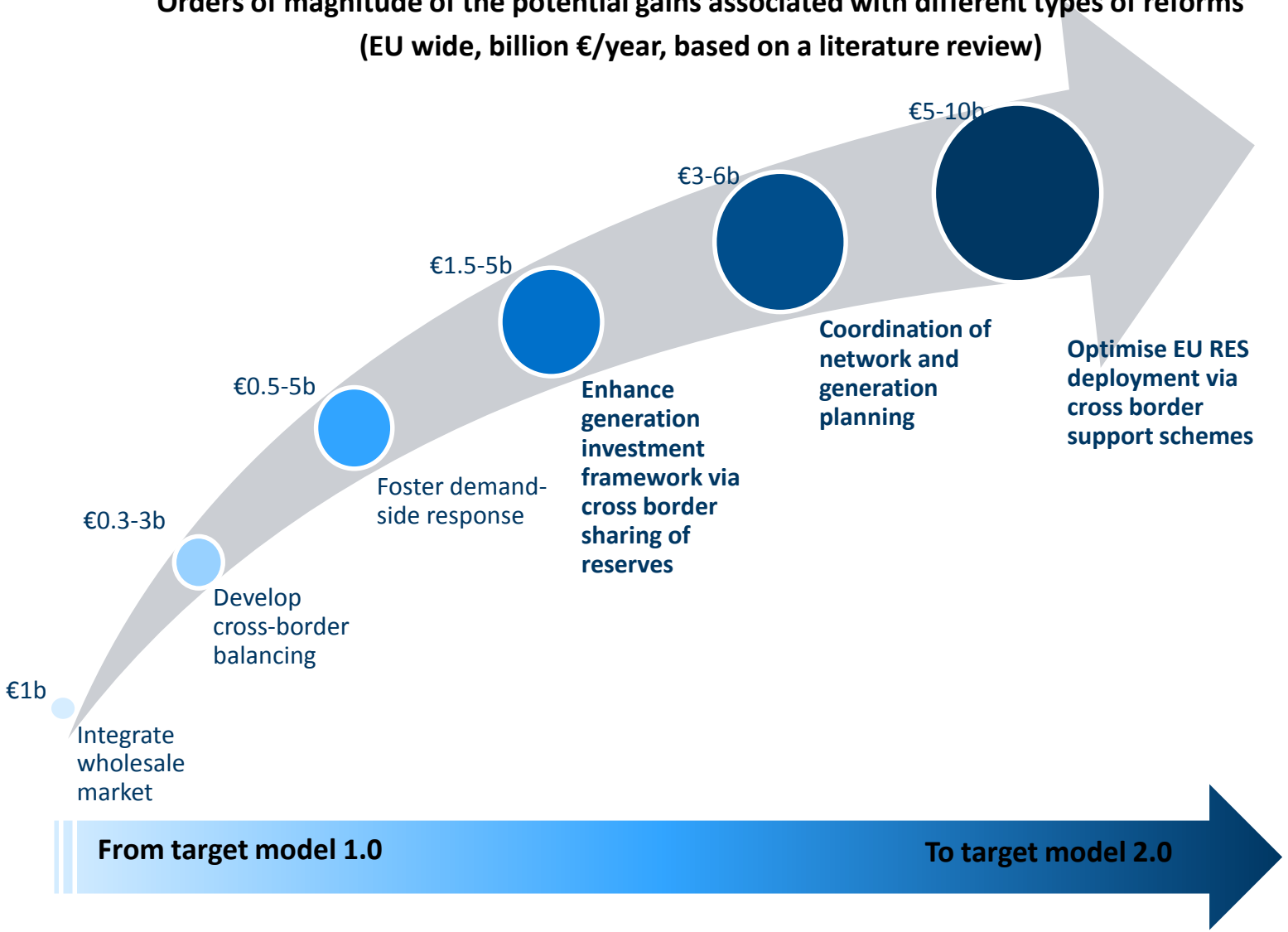
Efficient market design at EU level requires further coordination of policies on key issues

Orders of magnitude of the potential gains associated with different types of reforms (EU wide, billion €/year, based on a literature review)



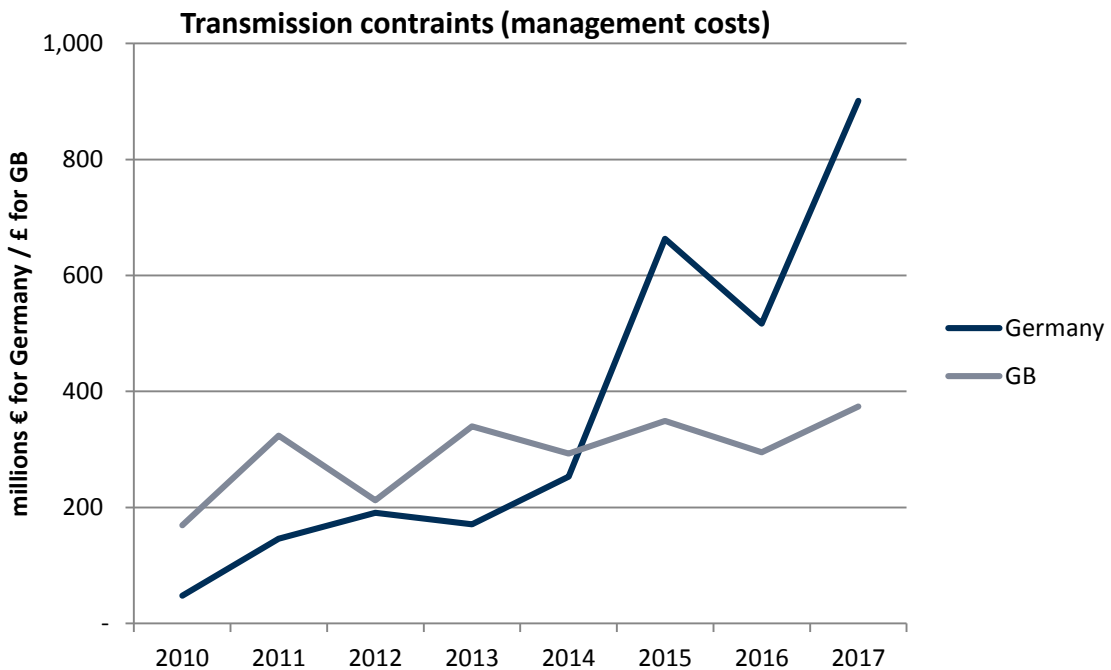
The need for real time price signals to integrate variable renewables: The US and Europe market design differences revisited

Day-ahead market	
■ **Unit-specific bids containing economic and technical parameters** centrally collected by RTOs/ISOs to run the DAM optimisation ■ Schedules financially binding at the unit level at DAM price	■ DAM cleared by PXs based on the bids representing each player's position net of load obligations ■ Generators **self-schedule units based on their portfolio-based position**
Real-time markets and balancing responsibility	
■ **RTOs/ISOs have balancing responsibility** ■ **Deviations** from DA schedule (for both load and generation) settled at the RTM price ■ DAM to RTM arbitrage encouraged by **virtual bidding**	■ **BRPs incentivised to self-balance** with SO's balancing role meant to be residual. ■ **A number of real-time prices signals** exist, reducing the possibility of arbitrage between real-time and day-ahead.
Operating reserves	
■ Procurement of several types of operating reserves **centrally co-optimised with energy in the DAM and RTM**	■ **Reserve capacity procurement and energy markets run sequentially by different entities** – TSOs and PXs respectively
Congestion management	
■ **Transmission congestion management** fully integrated with the clearing of energy markets through **nodal pricing**	■ Congestion management treated through **market coupling** and **ad-hoc re-dispatch actions** performed by TSOs.
Market power mitigation	
■ **Ex-ante screening tests and bids regulation implemented by RTOs/ISOs** to detect abuse of market power	■ **Investigations by NRAs performed ex-post** upon receiving specific signals or complaints.

Note: DAM: Day-ahead market, RTM: Real-time market, SO: System operation, BRP: Balance Responsible Party, PX: Power exchange, NRA: National regulatory authority

Coordination of investment in networks and generation is becoming a critical issue in Europe

Growth of renewables has been a factor in the increase in congestion costs in GB and Germany



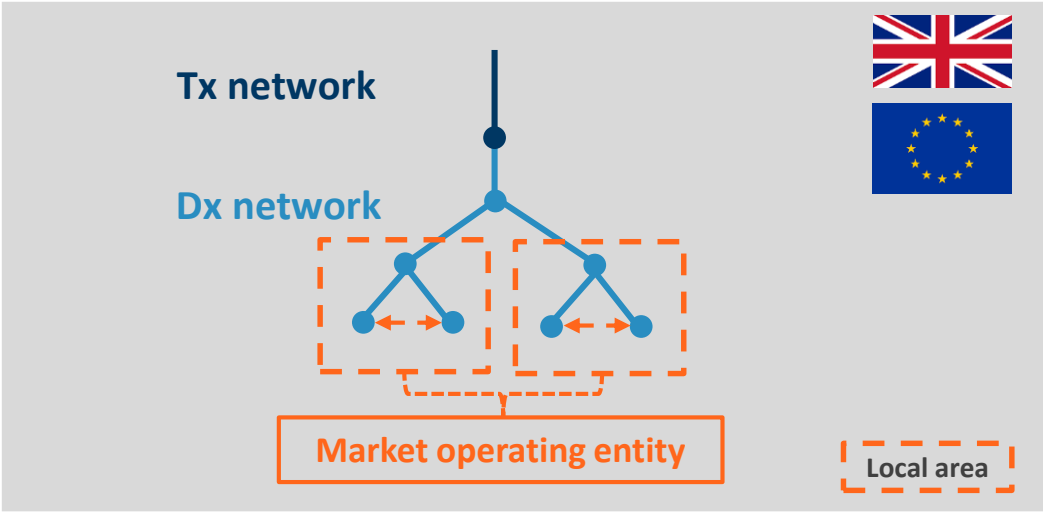
Source: FTI-CL Energy , based on Bundesnetzagentur monitoring reports and National Grid system balancing reports

In the UK and Germany congestion costs have increased dramatically recently, which suggests that a new approach to coordinate networks and generation / demand response is needed.

Economic theory suggests two broad options to deal with congestion: the old debate about 'zonal versus nodal pricing'

Zonal pricing

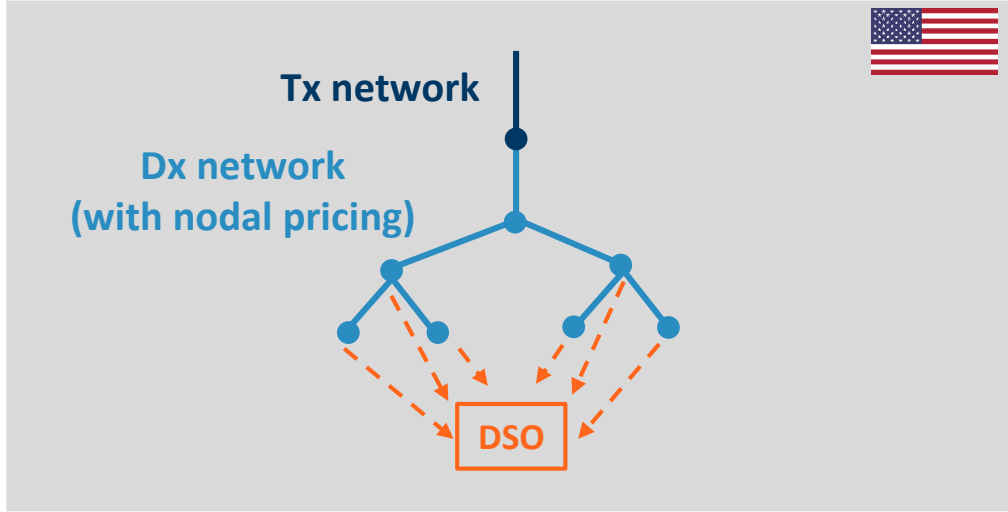
Transposition of the EU Target Model on the distribution level



- Akin to EU target model, the distribution network could be broken down into zones reflecting constraint boundaries
- Resources can trade with each other within zone on a bilateral basis (or through aggregator)
- Price per zone
- Trading between zones via centralised market (cf market coupling)
- Network operator can also contract for services to manage network issues (as per NG now)
- Could have locational network charges within zone…
- …could complement with a locational capacity mechanism
- Congestion within zone either compensated or curtailed

Nodal pricing

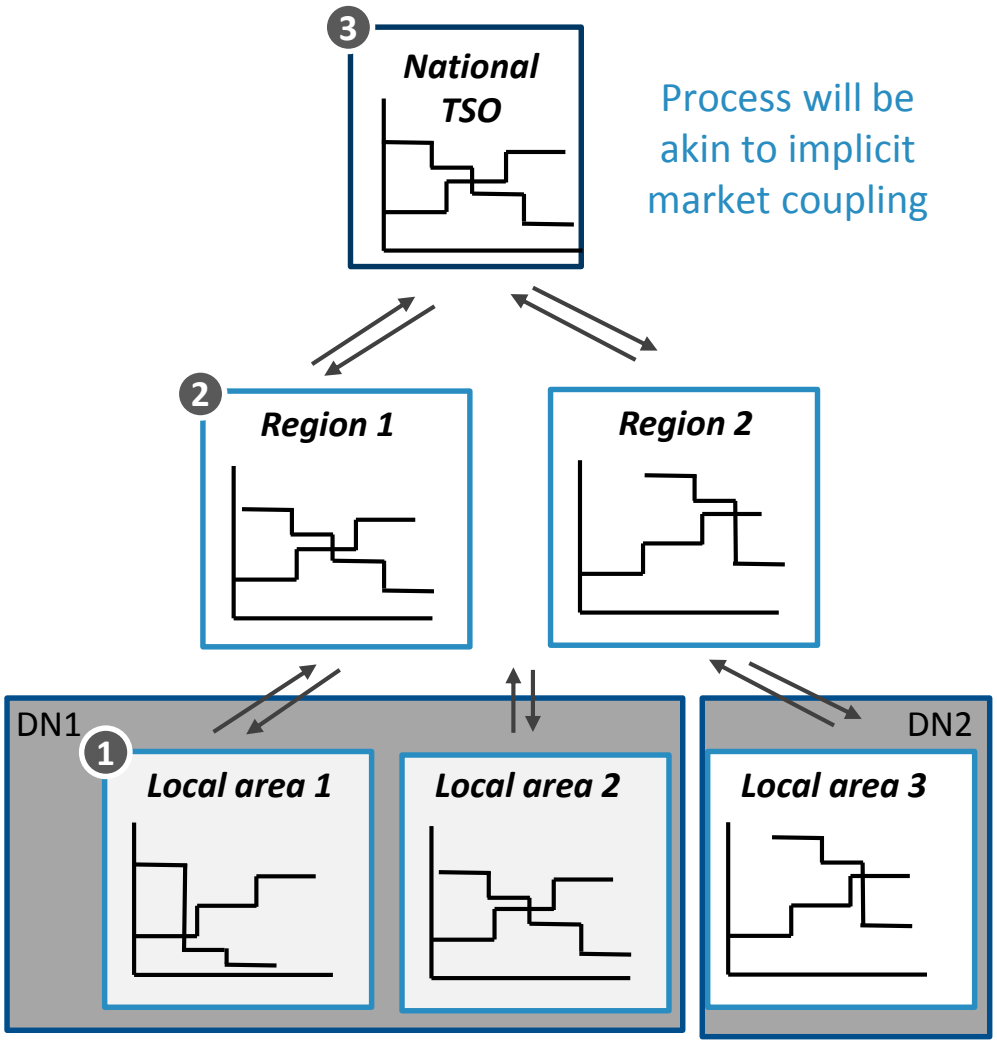
Extension of the US-style nodal pricing on the distribution level



- Akin to US model, the DSO co-optimises reserve and energy, albeit for local area only
- Participant bids / costs either submitted or assumed (standing bids)
- Nodal prices could provide price signals at granular level (at cost of computational complexity)
- Ex ante scheduling time needs to take account of trade off between forecast uncertainty and computational time…
- …and need slick "intra day" updating processes
- No "physical" trading between peers other than via the distribution system operator…
- …but financial peer-to-peer trading might be possible.
- Postage stamp network charge to recover residual d costs

In practice in Europe local flexibility markets are a promising way forward round the practical issues that affect nodal pricing

Example of a potential model of "co-optimised" local flexibility markets with national markets



Example of the mechanics of the coupling of local flexibility markets and national markets

1. Participants / aggregators submit day-ahead / intraday offers (which could be standing or assumed)
2. DSO and/or local market operators optimises local schedules both within, and across each local area
   - DSOs submit (network constraint) compliant increment and decrement bids to the TSO
3. TSO optimises these schedules at day-ahead / intraday (and may direct each DSO and/or local market operator on adjustments needed)…
   - …in concert with transmission connected units (e.g offshore wind, interconnectors etc)
4. Will need to update frequently as real time approaches given RES and Demand uncertainty

Emerging technology offers potential for consumers to engage in local trading nearly effortlessly

Users simply set preferences through devices - no need for "super-engaged" consumer

- Set expected time at home / away at home
- Set preferred time to charge / use EV
- Battery storage to optimise time-of-use
- Device informs (or locks-in) expected costs of the different options
- Or in-built machine-learning algorithm to optimise preferences

Instead, supported by suppliers, aggregators or other third parties, the "Internet of Things" will engage on consumers behalf

Millions of separate payment flows will be facilitated through a decentralised platform

- ✓ Potential role for blockchain technology as a distributed, secure "ledger" - holds millions of transaction records (in each time period) securely
- ✓ Records actions privately and independently of a centralised operator
- ✓ Platform could then be used to make or aggregate any forecasts of unscheduled demand / resources
- ✗ Blockchain technology still in nascent stages (e.g. potentially requires lots of energy to process)
- ? Unclear to what degree consumers will (or should) be exposed to price fluctuations/imbalances (but perhaps choose)

In practice, different platforms to monetize local flexibility emerge across Europe, including

- A joint venture between Agder Energi & Nord pool.
- Established at the beginning of 2018 and active in two pilots : One is Norway with DSO Agder Energi Nett and an other one in the TSO area of 50Hertz with the DSO Mitnetz Strom.

- Piclo Flex is a Peer-to-peer Energy matching platform gathering 6 DSO's in UK.
- Launched in June 2018, the first calls for tenders were launched in March 2019 for 2019/2020 & 2020/2021. On the 15/05/2019 the second tender launched contracted 18.2 MW of power from 6 companies in 8 different locations for a total value of £ 450,000.

- Coordinated platform within the SINTEG project, coordinated by EPEX, EWE, EWE NETZ, Avacon NETZ and TenneT, focusing on the northern area of Germany.
- Project launched in 2018 with two years of demonstration phase in 2019 & 2020 with the first transaction made on February 6th on the platform.

- Dutch platform launched by 1 TSO & 4 DSO.
- This is not a market platform but rather a link with offers posted on the ETPA intraday platform.

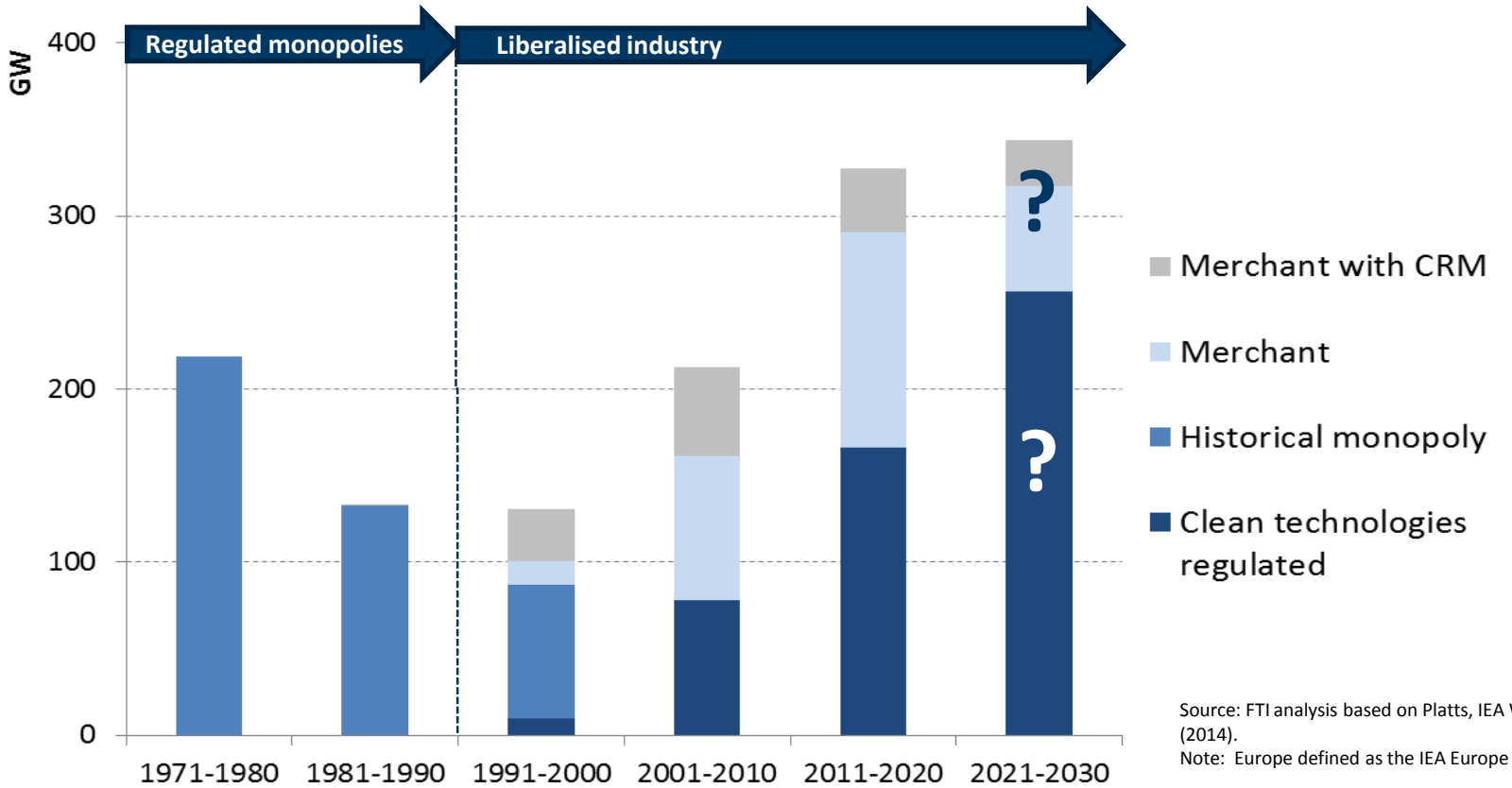
Key issues in the design of local flexibility platforms include:

- **The existing flexibility platform experiments differ in the way they manage the different steps of flexibility procurement:**
  - **Prequalification** : Who decides / prequalifies among the assets which want to participate in this market?
  - **Reservation** : Will there be a capacity reservation and who will take care of it ?
  - **Activation** : Once the offers have been selected, which actor will send the signal to activate the energy block chosen and in what will b the form of this signal?
  - **Measurement, control of the realized and penalties**: Once the order has been placed, who will take care of the effective control that the service has been performed according to the defined characteristics, and will define the penalties in case of failure?
  - **Treatment of the perimeter of equilibrium** : Offer activation may cause an imbalance within the perimeter of balance responsible party: will there be compensation, who will do it and in which form (physical, financial ...)?

- **And how do the existing platforms fit with the current institutional and market organization?**
  - **Organization of TSO / DSO's coordination** : How will TSOs & DSOs communicate to avoid unappropriated activation which could cause additional constraints, and how do prioritize activation if both are interested by the same assets ?
  - **Creation of a market apart or extension of the current functioning of the market** : Should a separate order book be created besides the current national market or should the current market be adapted with some evolutions, e.g; by tagging orders based on their location ?

What drives investment? An historical perspective of power investments in Europe shows role of state and contracts

Capacity additions in Europe based on the regulatory framework when the decision was taken



Source: FTI analysis based on Platts, IEA World Energy Outlook (2014).
Note: Europe defined as the IEA Europe perimeter

- About ¾ of the thermal plants operating today in Europe were built prior to liberalization
- Based on the current regulatory framework, only 20% of total generation investments in the next decade will be merchant

If policy interventions are here to stay to drive investment and decarbonize, 'competition in two steps' will become the new model

Investment planning (years ahead) → **Operations planning (days /hours ahead)**

Competition "for" the market

- Tendering of long term capacity contracts
- Can be technology neutral or specific
- Puts competitive pressure where it matters: CAPEX
- Can be used to stimulate new entrants and development of competitive market
- Ensures coordinated system development

Competition "in" the market

- Well integrated and liquid forward, day ahead and intraday markets
- Optimizes short term dispatch and minimizes costs for consumers
- Level playing field with balancing obligation
- No distortions as subsidies not based on production

Alternatives to implement two step competition based on long term contracts :

1. Mandate an independent organization to define the type of contracts and to procure them through a centralized auction (e.g. capacity auction, CFDs, etc.), or
2. Implement a decentralized process with contracting obligations on suppliers (e.g. capacity obligation, renewables obligation, etc.)

Conclusions: Key recommendations for wholesale market design

1. **Price signals need to reflect real time system conditions ("scarcity pricing")**
   - ⇒ Growth of renewables requires real time markets – develop intraday and balancing markets
   - ⇒ Key issue is development of new products / liquidity and price propagation across time frames

2. **Flexibility / reserves need to be adequately priced**
   - ⇒ Current ancillary services / reserve procurement approaches need to be revisited
   - ⇒ Key issue are product design to fit new system needs (e.g. new products for ramping needs) and co optimization with energy market

3. **Locational signals to coordinate network, centralised and decentralised generation**
   - ⇒ Possible approaches: locational prices, geographically differentiated network charges
   - ⇒ Local balancing / flexibility platforms likely to emerge and create new trading opportunities

4. **Price signals needed to support a sustainable investment framework for security of supply**
   - ⇒ Several approaches possible: energy only + strategic reserve / capacity markets
   - ⇒ Key issue is clear definition of product / obligation and interface between energy and capacity markets

5. **If policy interventions are here to stay to decarbonize the power mix, wholesale power markets are bound to be structured around 'competition in two steps'**
   - ⇒ Competition 'in the market' for long term contracts followed by 'competition in the market'
   - ⇒ Raises key issues on design of contracts, auctions, and interface with short term markets but helpful to coordinate investment, contain risks, and facilitate investment

Thank you for your attention

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Appendix: Our recent work on the ETS and RES policies

Wake Up! Reforming the EU ETS: Comparative Evaluation of the Different Options

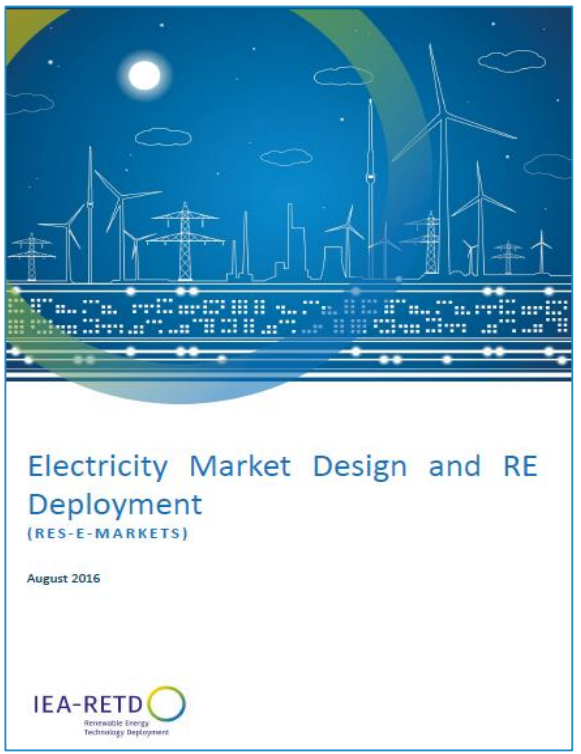
Web link

The new European Energy Union - Toward a consistent EU energy and climate policy?

Web link

Electricity Market Design for high shares of Renewables

Web link



Appendix: Our recent work on electricity market design

Toward the Target Model 2.0 –

Policy Recommendations for a sustainable market design

Web link

Publications on capacity mechanisms

- Market design for generation adequacy: healing causes rather than symptoms Web link
- Coordinating capacity mechanisms – which way forward? Web link
- European electricity market reforms: the "visible hand" of public coordination Web link

Publications on European electricity markets

- The new European Energy Union - Toward a consistent EU energy and climate policy? Web link
- European electricity markets in crisis: diagnostic and way forward Web link