

Market Design

Hans-Arild Bredesen

Profile – Hans-Arild Bredesen

Hans-Arild has 25+ years of experience from international projects in the energy sector

Consultant

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Education and Experience

- BSc in Computer Science from Høgskolen I Østfold, Norway
- Involved in the electricity deregulation process since 1992.
- Technical project manager for the market systems at Nord Pool
- Former CEO of Nord Pool Consulting
- Product manager for wholesale energy market participant systems for the Nordic market.
- Wide international experience from key roles in the development of strategies for trading, scheduling and settlement systems for PXs and TSOs in Nordics, EU, California, Ireland, China, India, Central and Southeast Asia, Southern and Eastern Africa plus South-east Europe (both regional and Vietnam and Philippines).
- Board member of NODES – the European marketplace for local flexibility.
- Author of the book “Power to the People”

Selected Project References

- **Southern African national market reforms**
 - South Africa:** development of a Market Code, market structure
 - Namibia:** Supporting Nampower developing the MSB
 - Zambia:** Market structure, design and rules for the Open Access
- **Southern African Power Pool (SAPP)**

Supporting SAPP since 2006 with market rules and regulations, design and implementation of their regional market.
- **Eastern African Power Pool (EAPP)**

Responsible for the recommended market design and capacity building as well as regulatory development.
- **Implementing a Wholesale Market Opening for SEE (South-East Europe)**

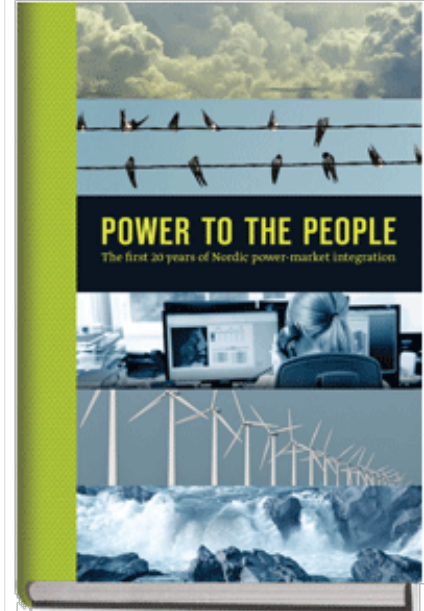
Creating a regional market design, develop an action plan and support in the implementation of a wholesale market in SEE.

Various market design and implementation projects for **Romania, Turkey, Albania, Bulgaria, Croatia, Georgia, Moldova and Ukraine**
- **Setting up a national power exchange for India (2006)**

Development of market rules and regulations, design of the market concept for a national Power Exchange in India.
- **Designing the Chinese national market**

Supporting NEA with market design and market rules for a national market in China including a lot of capacity building
- **ASEAN/GMS regional market initiatives**

Supporting ADB and UN ESCAP in various initiatives for development of a regional market (incl IEA report)



A market reform is a process and not a project

.... And it needs to be agile – support common market reform as well as individual strategies

National market reform (what is it?)

Politics



Regulator

System Operator



Market Operator

Transmission

Distribution

Generation

Retail

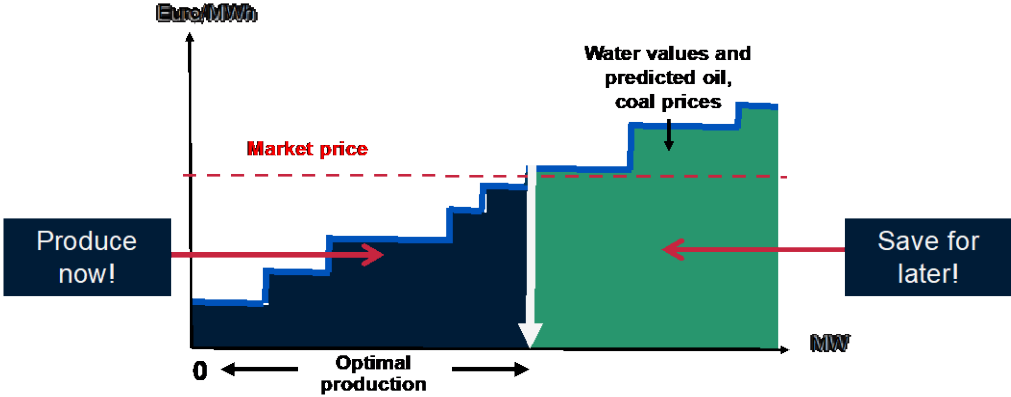


Bilateral trading (unregulated...)

In a competitive wholesale market – What are we trying to achieve?

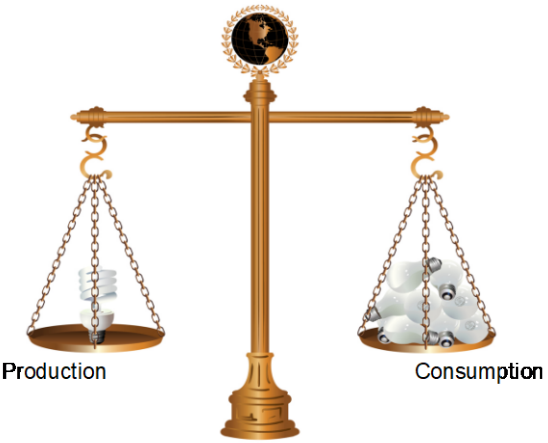
At a high level it is easy...

To Produce or not to Produce



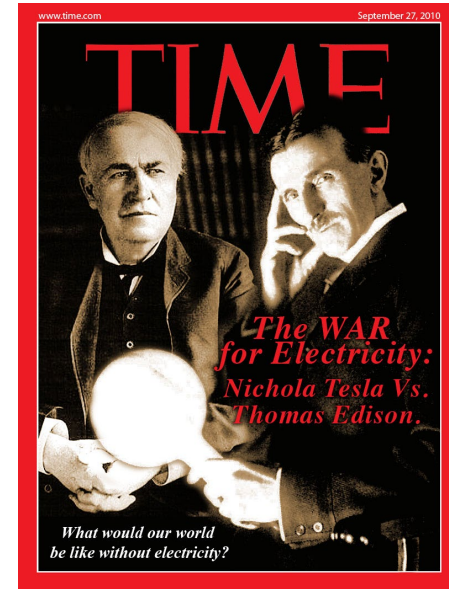
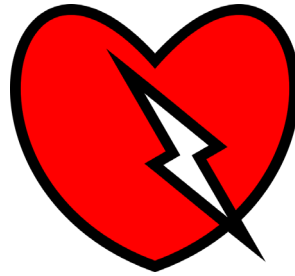
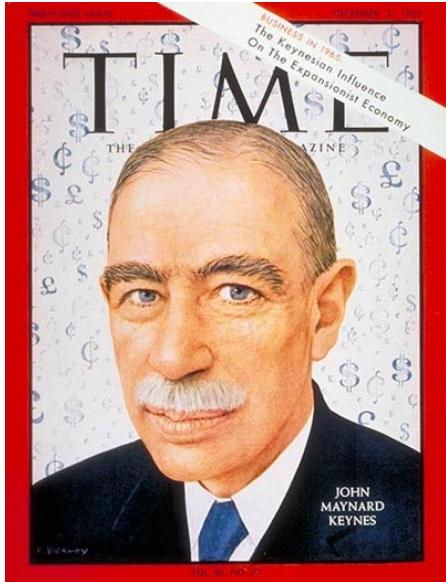
The fuel value is the opportunity cost of producing now compared with producing in the future?

Market Principle



Price

The power market: A happy marriage between economists and engineers



There is always a balance to be found....

...between competitive market with few limitations and a constrained real-time operation of the power system

The economist wants:

- Liquid markets
- Large trading area with no/few physical constraints
- Standardised products
- Large number of competing buyers and sellers
- No differentiation between the different buyers and sellers

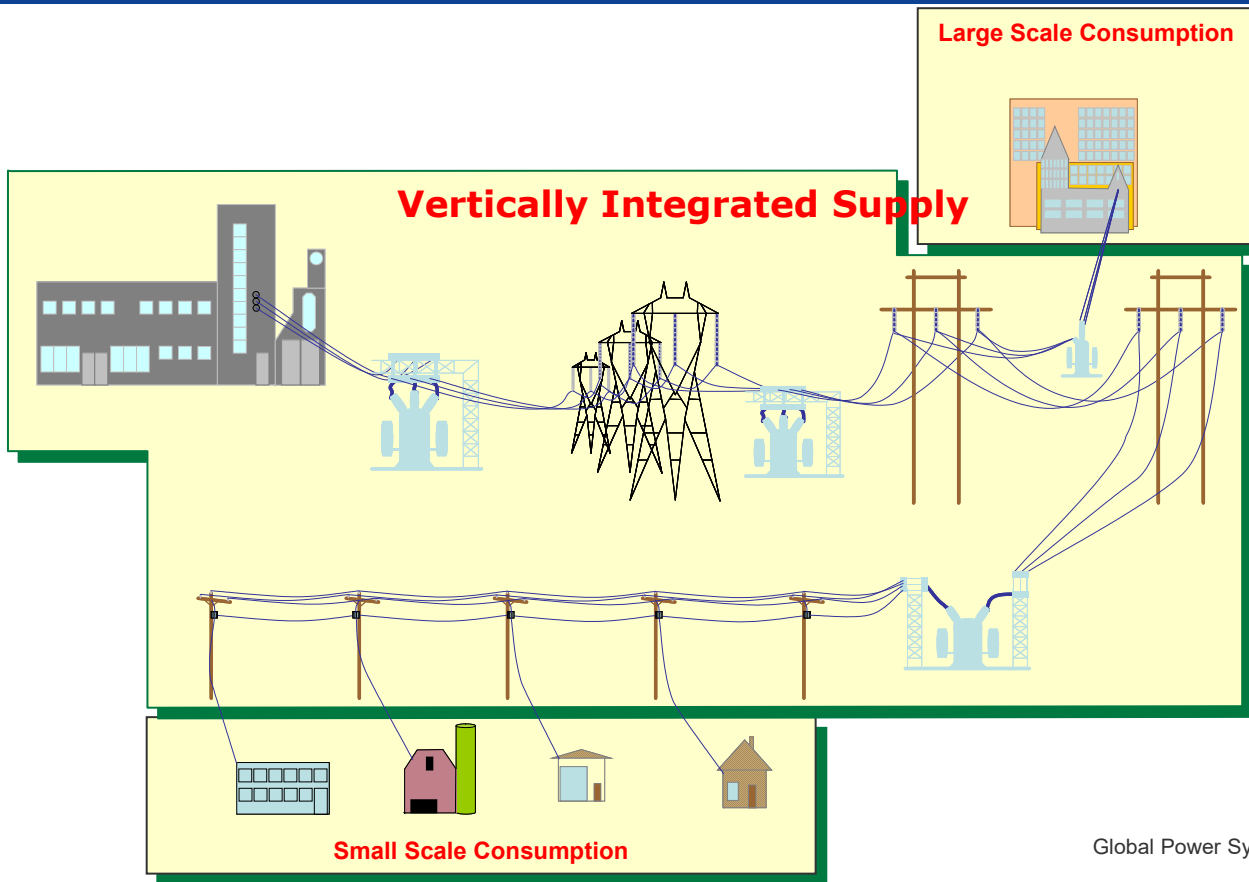


The engineers wants:

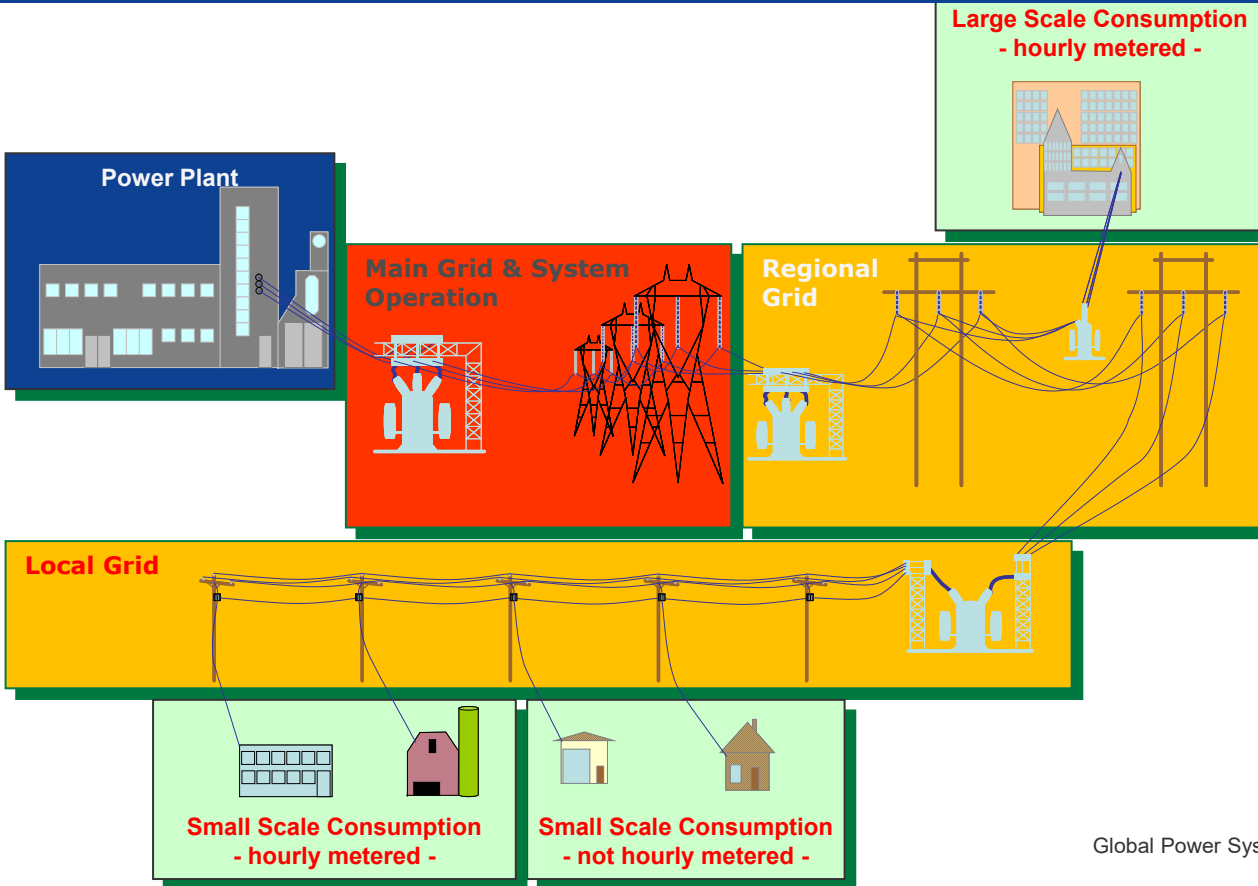
- Market representation of the underlying physical power system
- Representative trading areas with physical constraints
- Customized products for the physical needs
- Deep knowledge of the sellers and buyers capabilities

The power market concept needs to take this in account in all market timeframes

An Electricity Supply Reform - Vertically Integrated Supply and Monopoly



An Electricity Supply Reform - Competition and Natural Monopoly



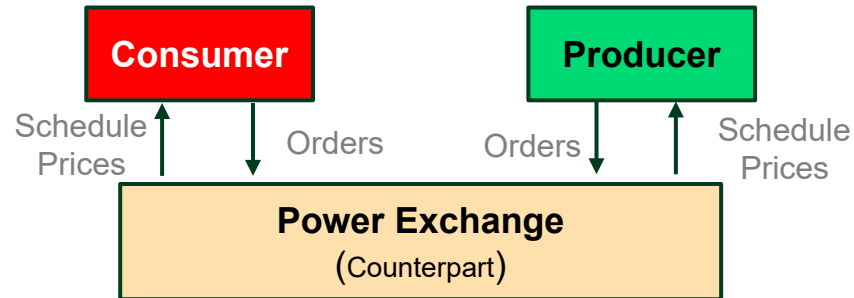
Trading of Power - Traditionally

- Traditionally customers have purchased all their power needs from a single supplier that provides all the required services on a fixed price tariff where:
 - The customer takes all the risks by complex price tariffs.
 - The customer have the advantage in simplicity, but with a disadvantages in cost, market transparency, flexibility and price setting.
 - The supplier takes the risk in many relations among other as future prices, inefficient operation and balancing service

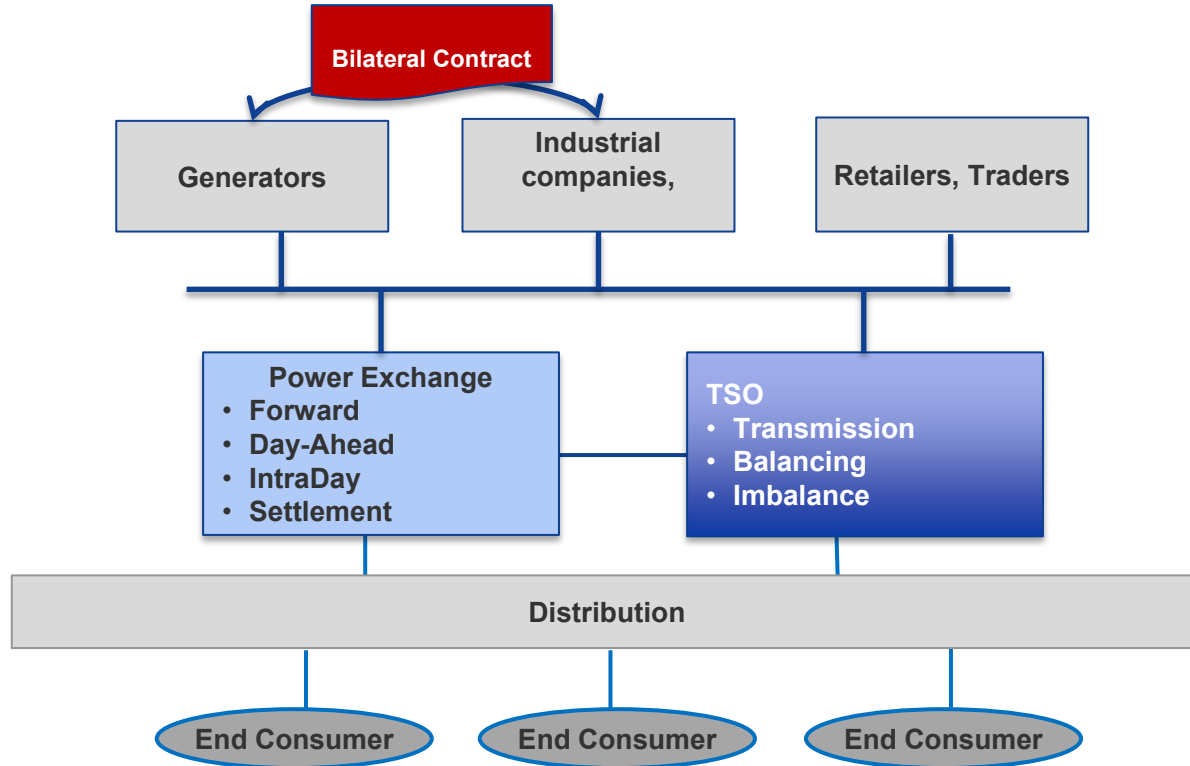


Trading of Power in a Open Market

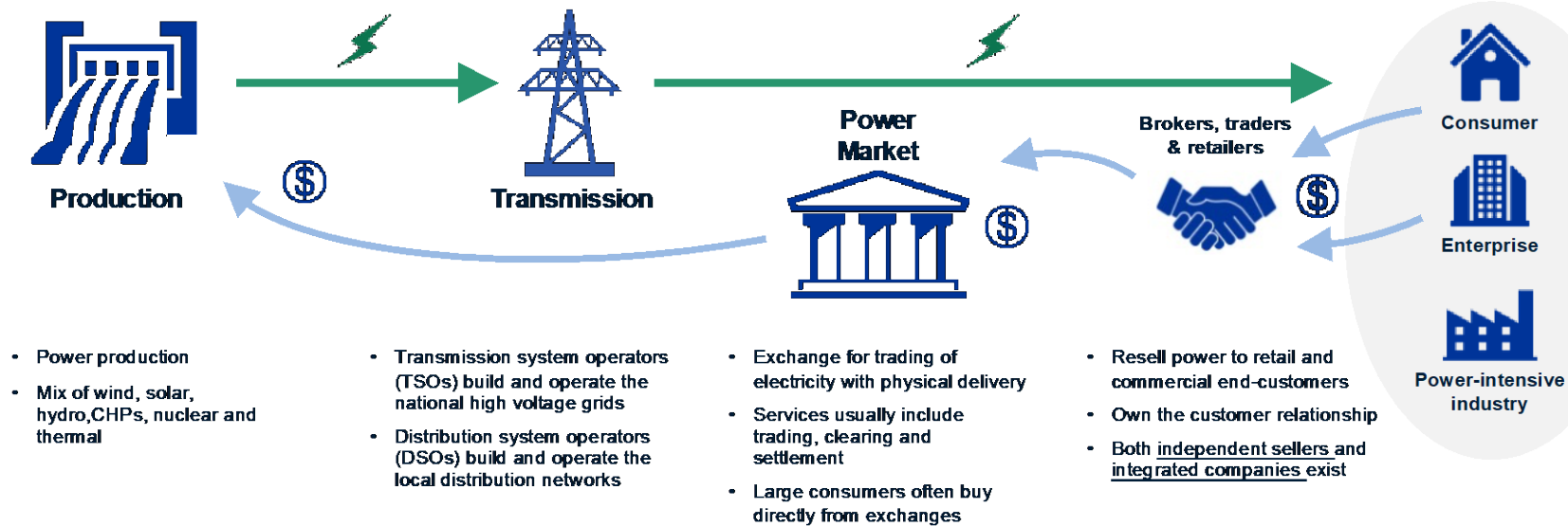
- In a market environment the supplier must:
 - Both supplier and consumer predict the load for the next day
 - Supplier will among many variables value the different production assets marginal prices,
 - Predict market prices (Power Exchange)
 - Prepare and submit orders for the short-term market
 - Report the schedule to the TSO for the country (area)
 - Manage the total portfolio on an hourly basis and void the balancing market



Power Market – Companies and Relations in a Market



Overview of the electricity value chain

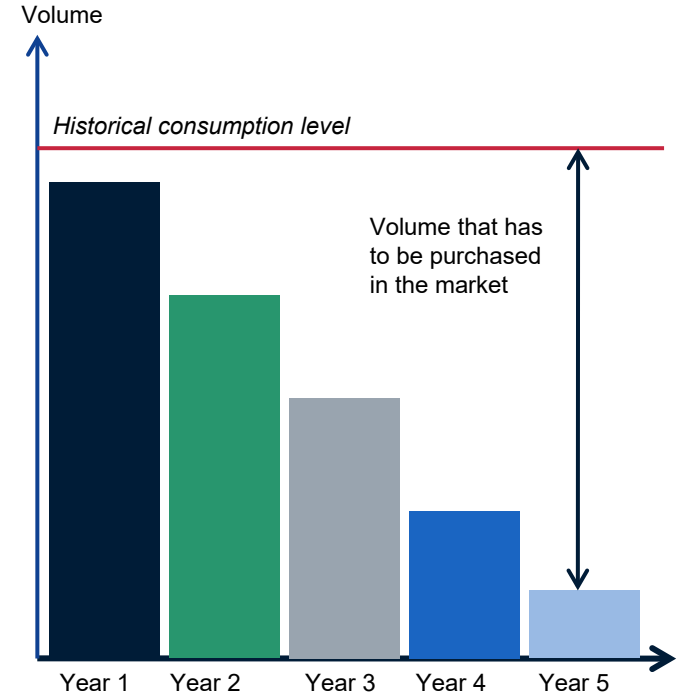


International best practices for a market reform

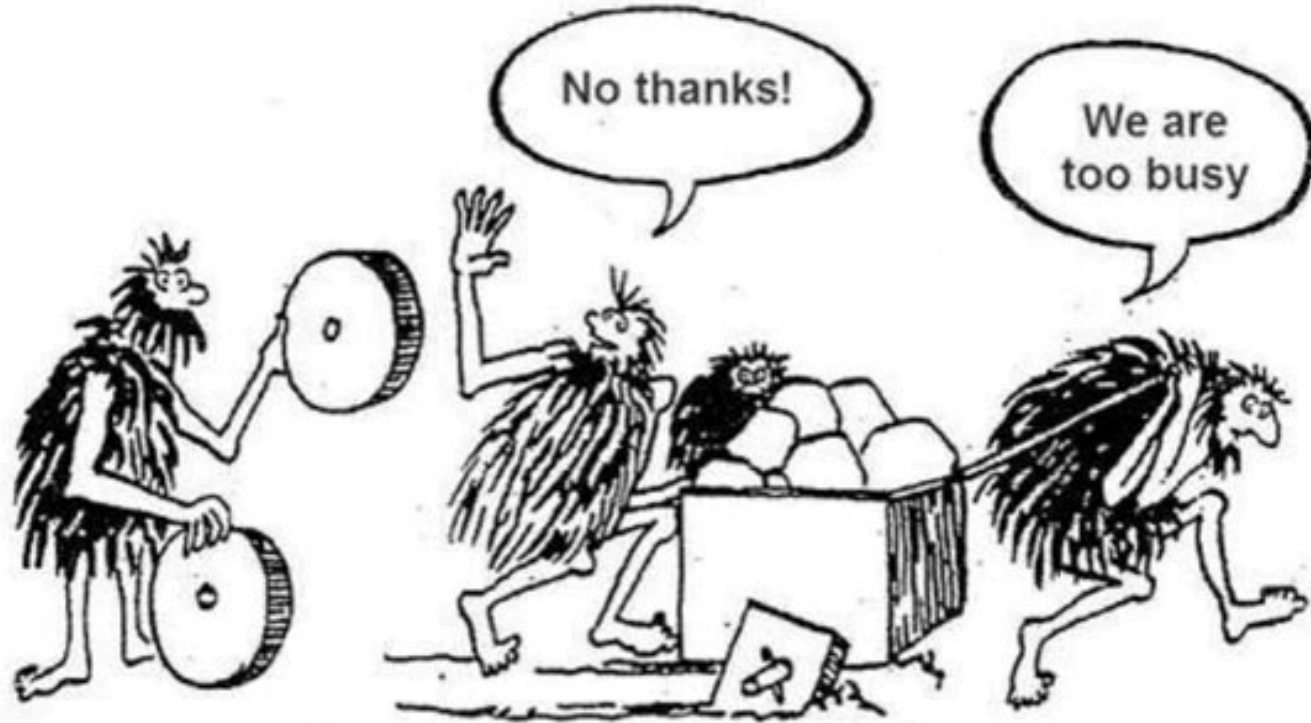
- **In all aspects of market reforms, stepwise is equally important:**
 - New market designs
 - Market restructuring
 - Market opening to new participants

 - ... we don't want to see California all over again

 - **What went wrong there?**
 - Nothing wrong with high-level design, but:
 - Big bang implementation
 - Nobody understood why, how and what
 - Mix of free and regulated market with really bad outcome



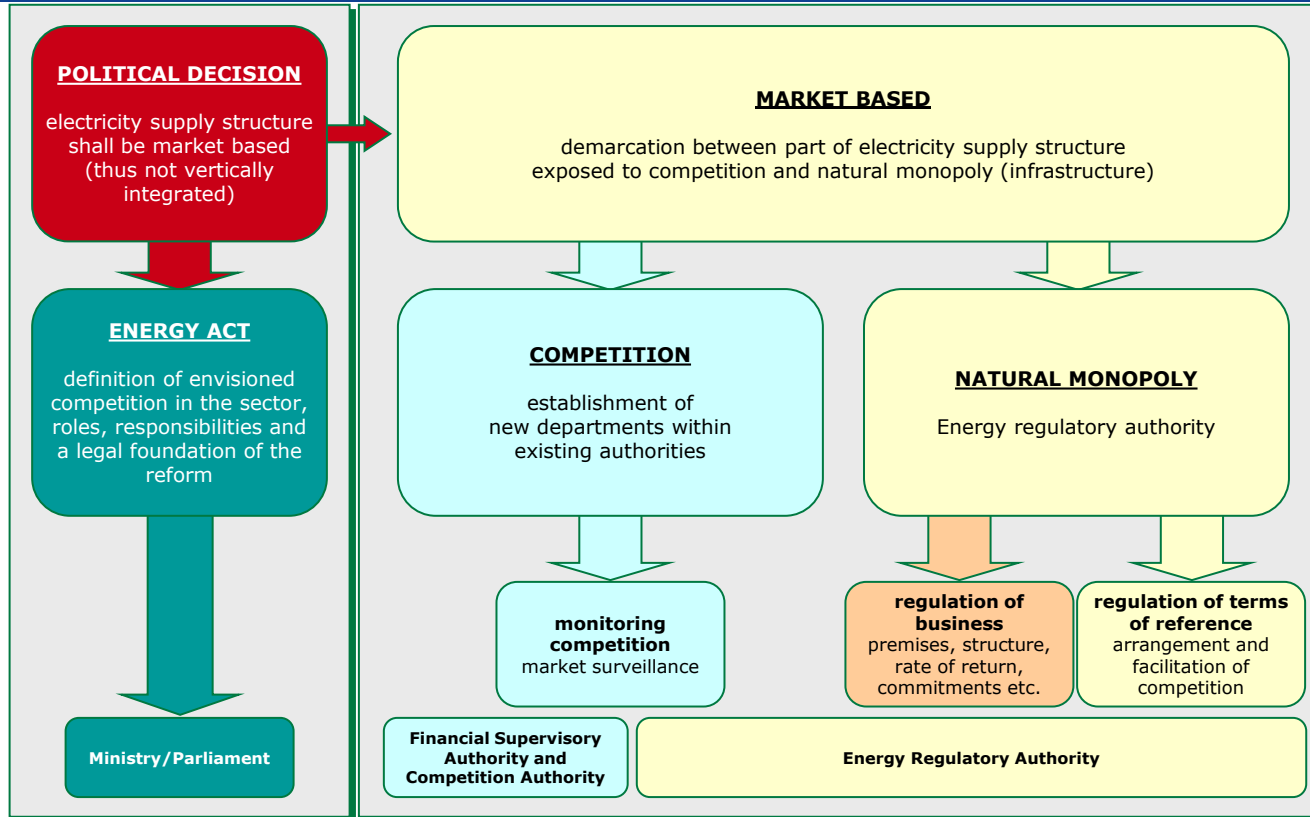
This is also true.... You have to take the time



A Market Driven by Planning

- The electricity market is driven by planning where the total assets and commitments must be balanced for every hour.
 - A buyer needs to estimate how much energy needed to meet customer demand for the next delivery day and the price to pay for this electricity volume.
 - The seller as the owner of power plants needs to decide how much he can deliver and at what price.
 - This has to be done based on the current market and electricity situation with a view to the company's short- and long-term strategy.

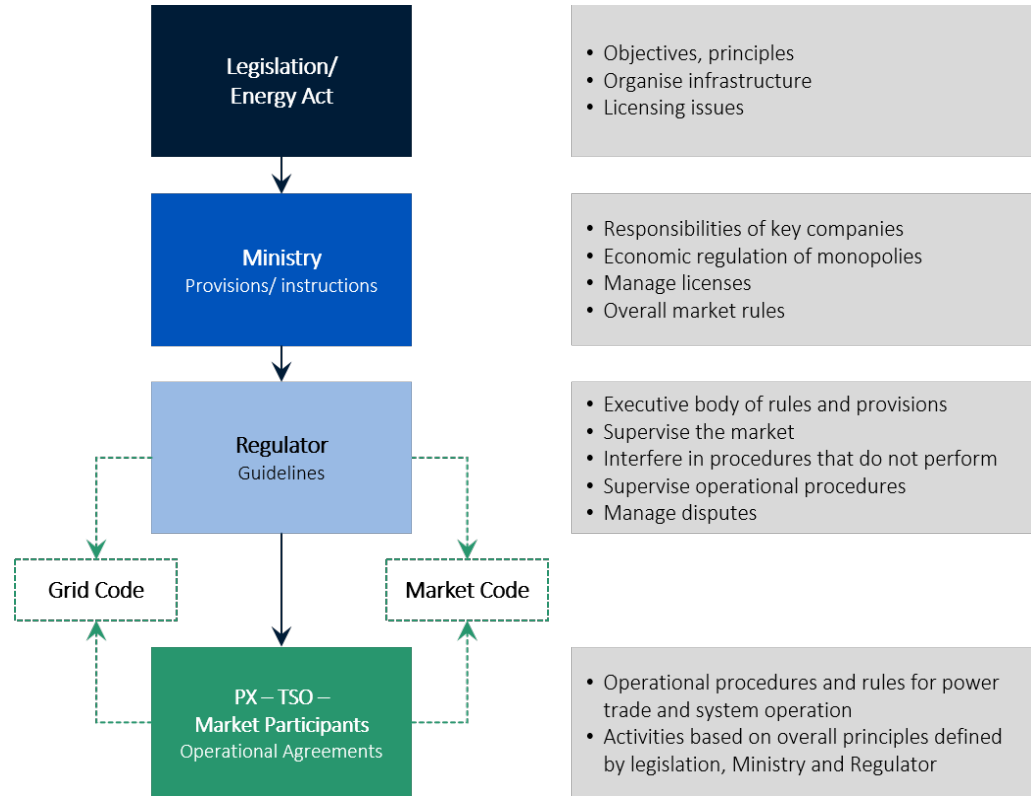
Legal and regulatory framework – Scope, laws provisions



A market reform needs Independent regulators and proper governance

- The question of «independent Regulators»

- Transmission System Operators **must be regulated** (not in competition on a given territory)
- As an example, in EU law asks for Regulators to be «independent from any other public or private entity»
- Necessary in Europe because of many state-owned utilities (conflict of interest for several governments)
- Could argue the same for many other markets



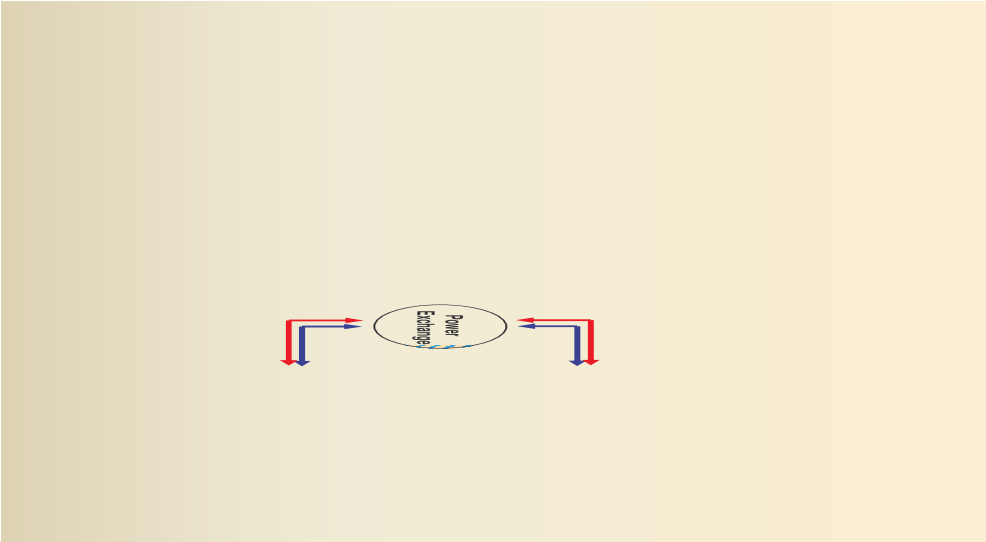
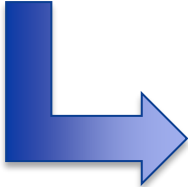
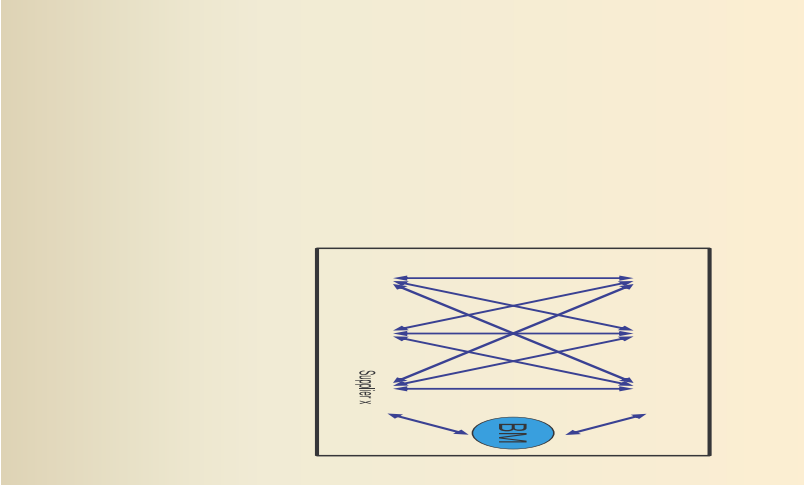
How to meet the new market requirements

... But this is not the only path...

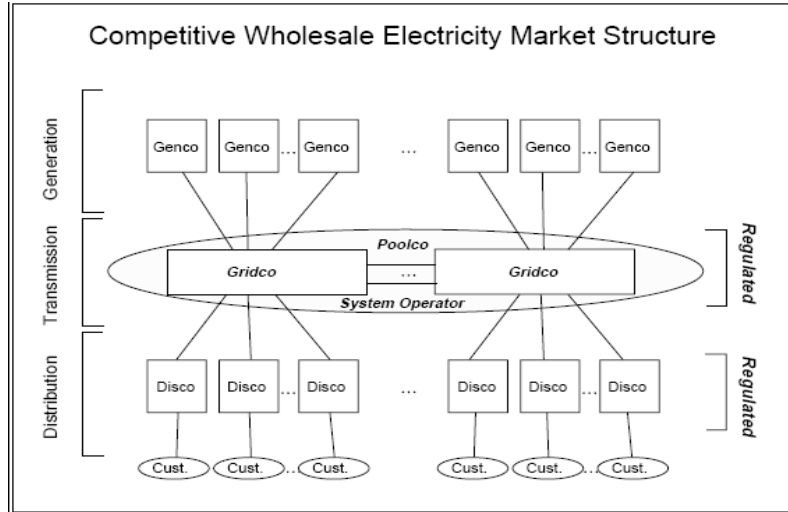
Characteristics	Monopoly	Single Buyer	Wholesale Competition	Retail Competition
Definition	Monopoly at all levels	Competition in Generation	Competition in Generation	Competition in Generation
Competing Generators	No	Yes	Yes	Yes
Choice for retailers	No	No	Yes	Yes
Choice for consumers	No	No	No	Yes

Increasing trend from monopoly towards fully competitive markets presents new requirements

Historical evolution of market models



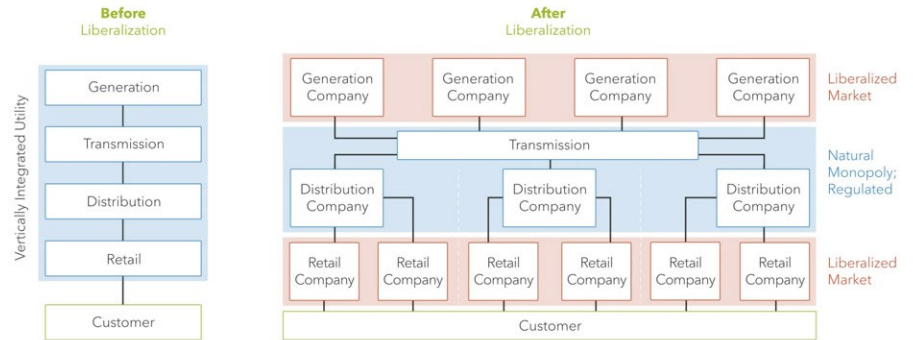
Generic best practice on Market Structure



Source: Hogan, 1998


The starting point

Liberalization of Energy Markets



The best practice

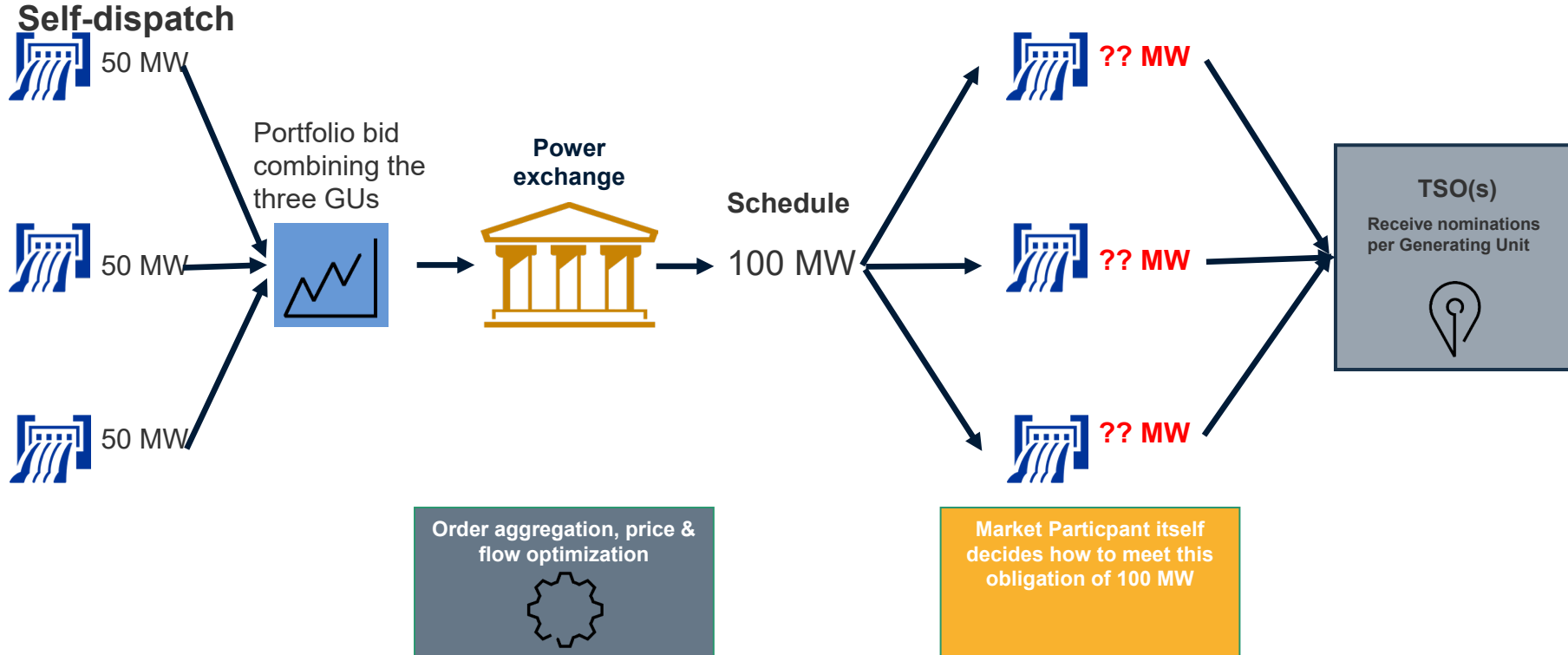
In allocating roles between central bodies and market participants,
market designs are often referred to as 'centralised' or 'de-centralised'

	Features associated with 'Centralisation'	Trend 	Features associated with 'De-Centralisation'
Physical	TSO constructs dispatch schedule and issues dispatch instructions to fulfil it	Central dispatch vs self dispatch	Parties self-dispatch, with TSO performing residual dispatch to adjust market positions
	TSO makes unit commitment decisions to turn plant on and off	Central commitment vs self commitment	Parties make own unit commitment (start/stop) decisions for their units
	Nodal pricing within an ISO area !!!	Locational vs non-locational	Zonal or national pricing over a very wide geographical area
Markets	Single marketplace option (for particular time frame)	Single vs multiple market (algorithm)	Multiple competing marketplace options (for particular time frame)
	Designated marketplaces are mandatory or exclusive marketplaces for physical trade	Exclusive vs non-exclusive	Flexibility to choose between different markets (most/all timeframes)
	Gross market (principally to settle positive volumes)	Gross or net market	Net (residual) market (principally to settle delta volumes)
	Designated trading windows with dead zones	Discrete vs continuous trading	Continuous trading opportunities without interruption
	Trades priced at common auction clearing price	Pay-as-clear vs pay-as-bid	Trade by trade specific pricing

Source: AFRY Management Consulting

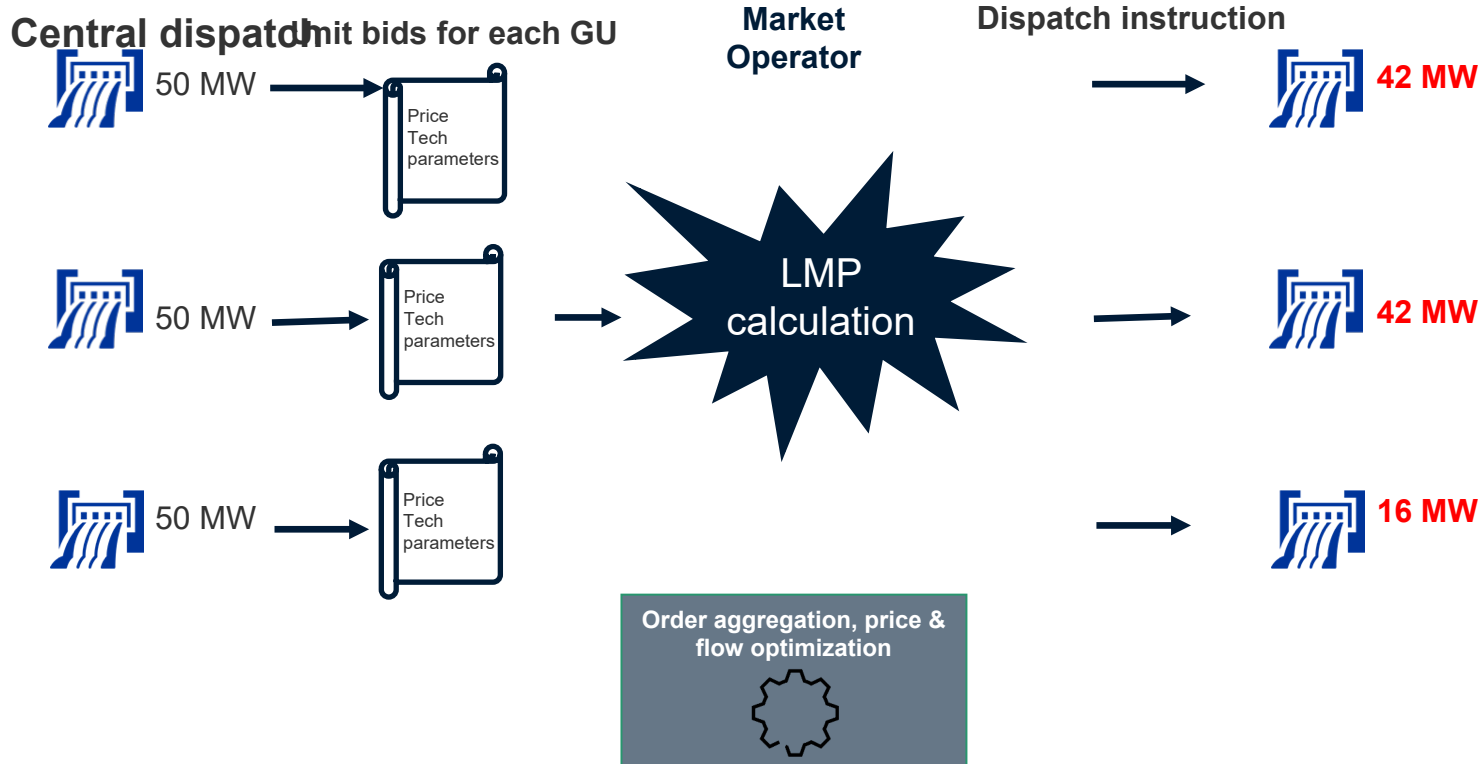
What does Self-dispatch mean? A simplified example

One market participant with three generators – all with 50 MW potential generation for the given hour



What does Central dispatch mean? A simplified example

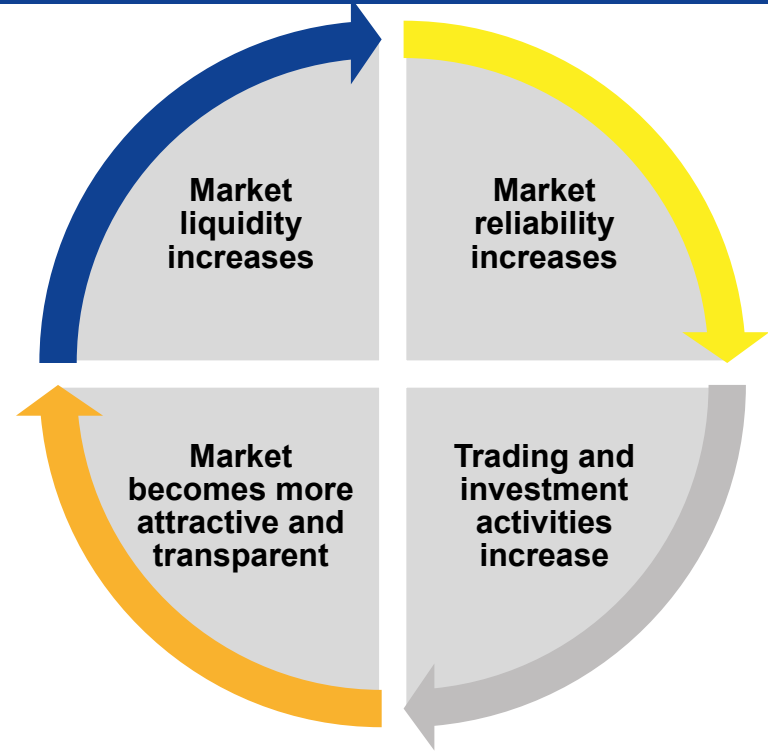
One market participant with three generators – all with 50 MW potential generation for the given hour



The stepwise market implementation

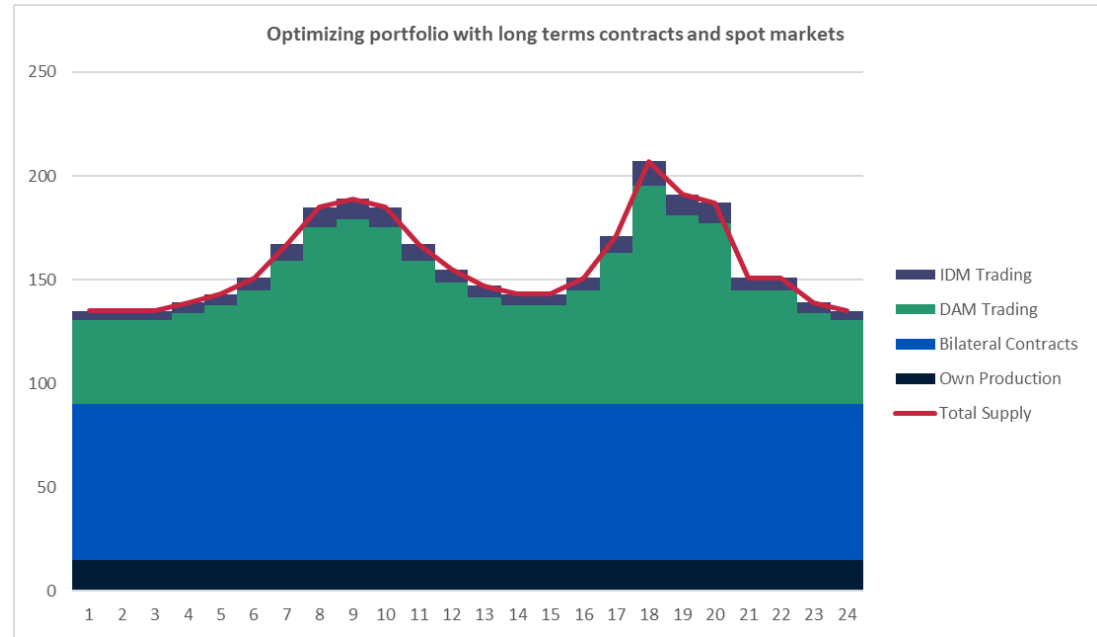
Main targets:

1. Economic-driven price signals
 2. Regain trust in the system
 3. Support the energy transition and the technology disruption
- moving towards ***unbundled, cost-reflective tariffs*** to better reflect electricity services
 - .. while increasing ***security of supply*** and ***reduce load shedding***



The BRPs are self-balancing the portfolio through the different market segments

- BRPs need to plan how to sell or cover their needs for electricity in the different market segments
- Own production and bilateral long-term contracts will provide a **baseline** of their planning
- DAM and IDM allow for **self-balancing** before physical delivery
- The BRPs need to forecast and execute the portfolio balancing activities as their daily routine & responsibility

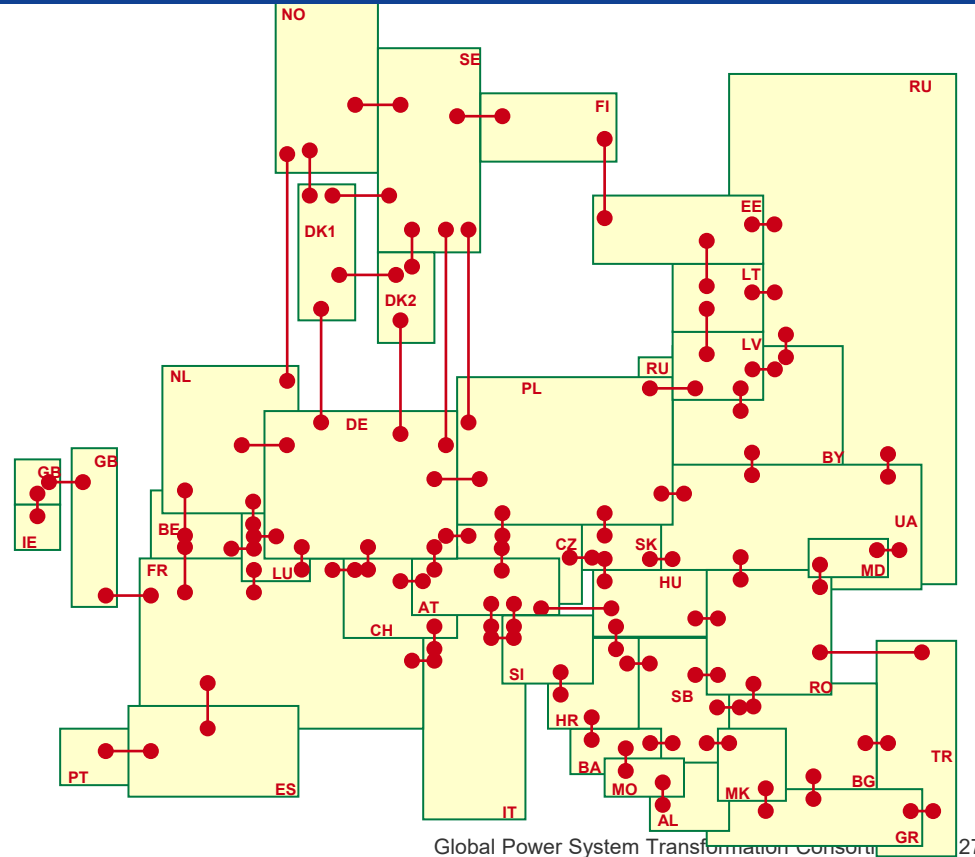


Selling the difference between long term contracts and estimated total supply to DAM/IDM = **self-balancing**

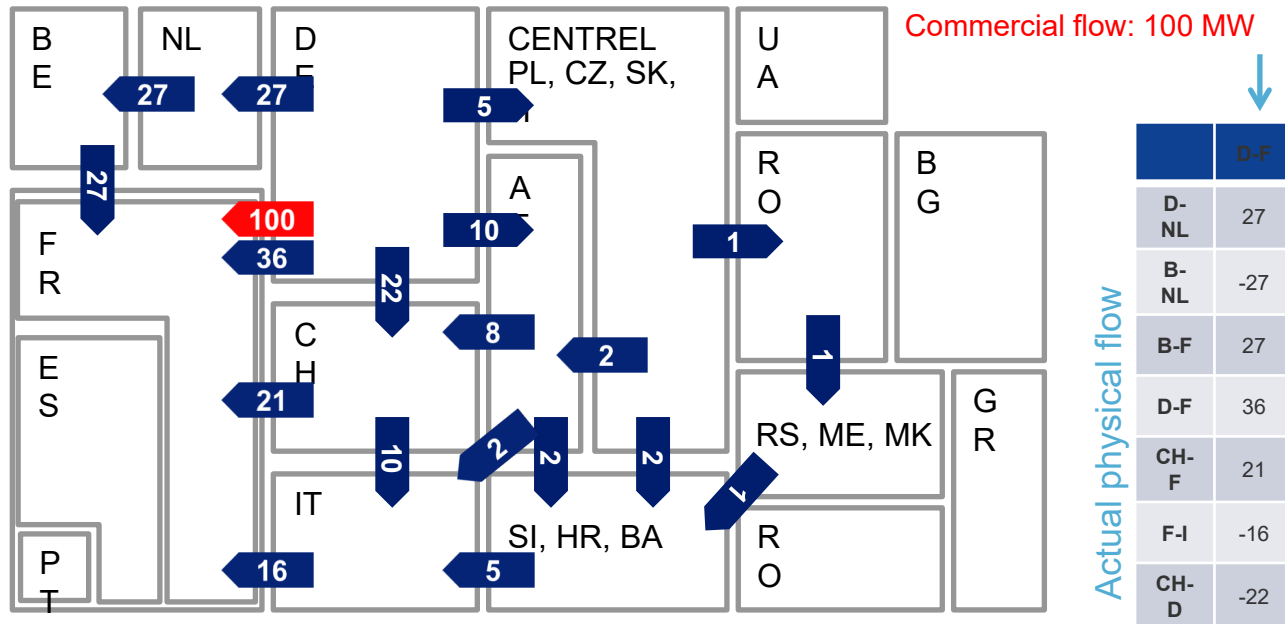
Regional markets

The European Challenge – Pre Target Model

- Europe had many interconnections, where different regimes are used to handle the exchange
 - implicit (Nordic)
 - explicit
 - market coupling
- How can we characterize the handling of interconnections in Europe when we today have to state that explicit handling of interconnections “produce” wrong flows in up to 25% of the operational hours (2008)?



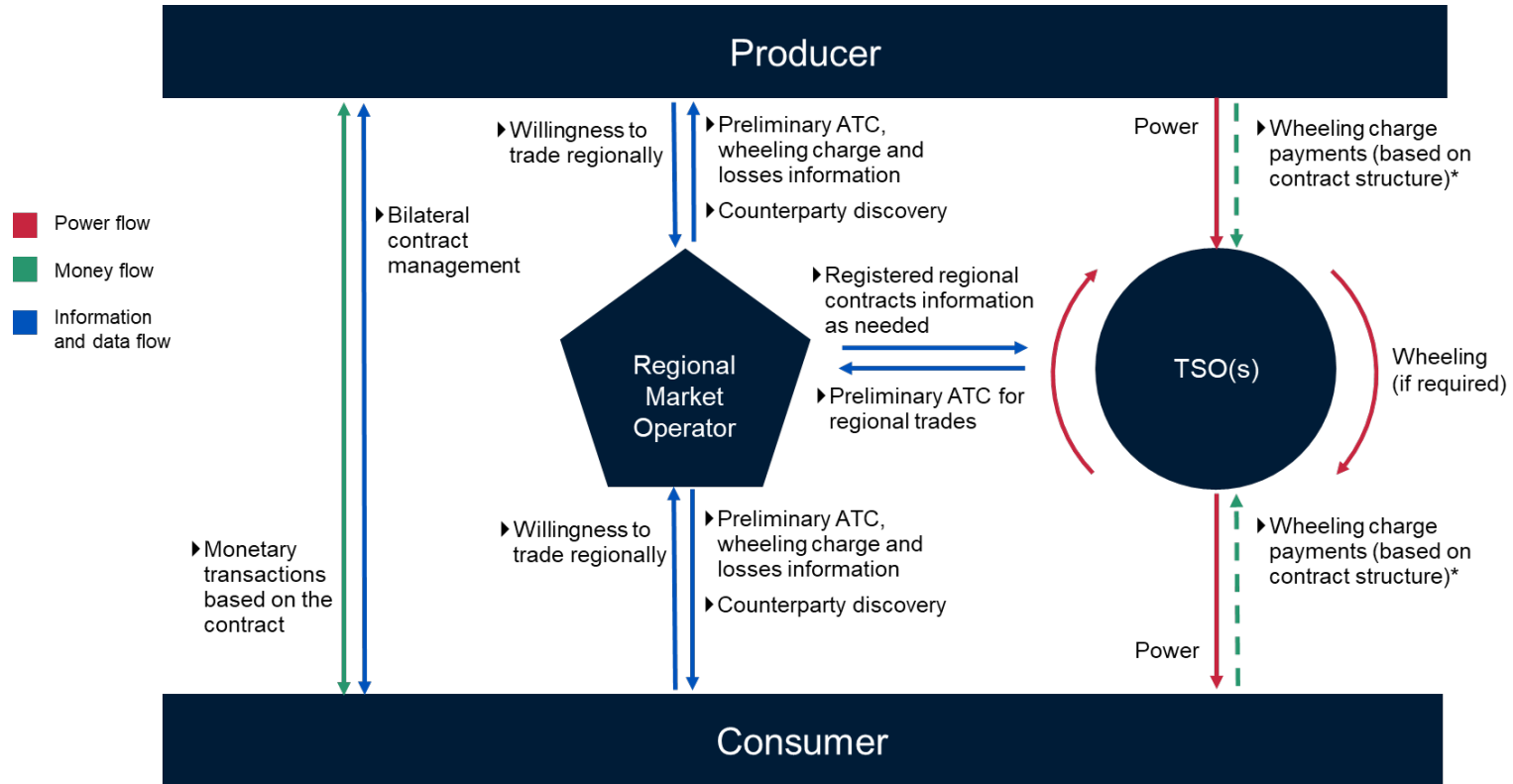
An Example



Based on a study from ENTSO-E

Different types of regional markets:

Multinational Standardized Regional Bilateral Trading



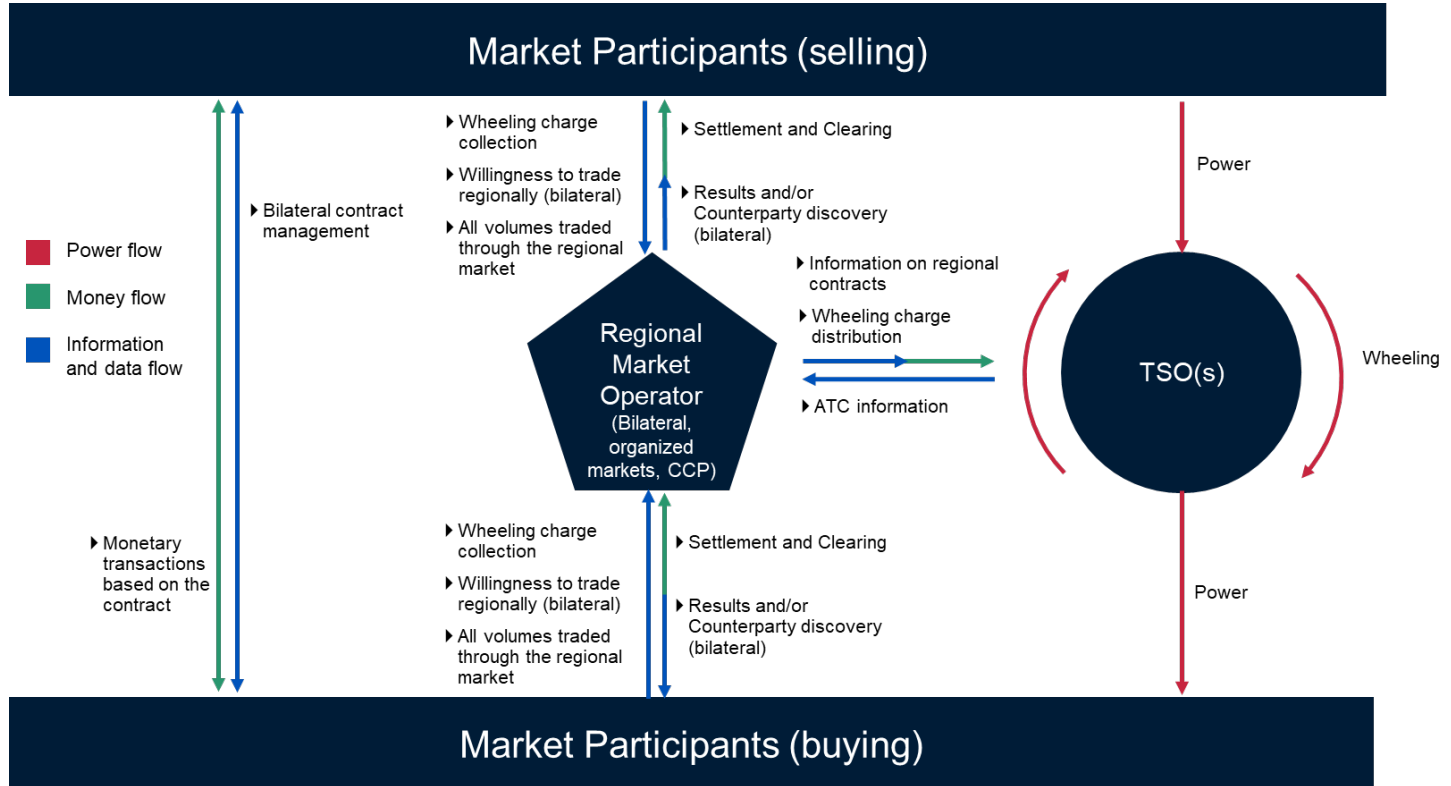
Different types of regional markets:

Multilateral regional market



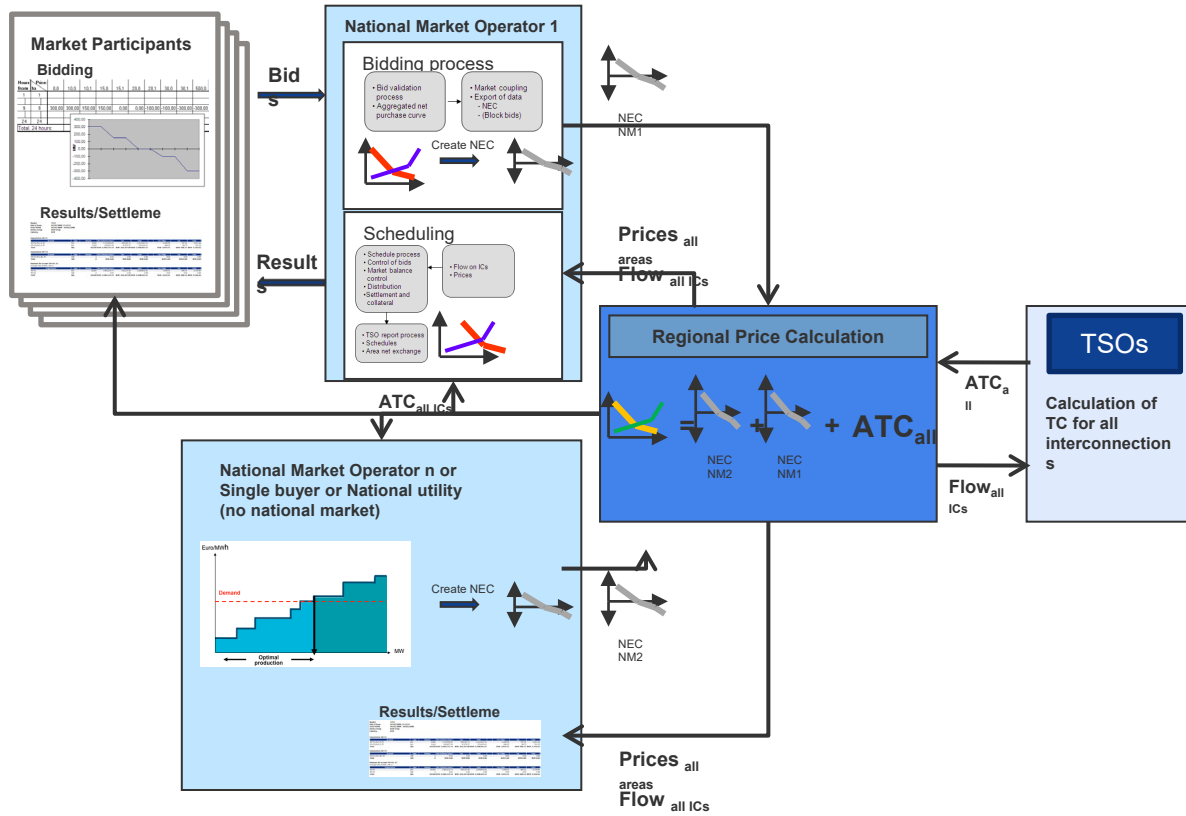
Different types of regional markets:

Fully integrated regional market



Regional markets – the need for a flexible approach

Allowing for regional cooperation, but maintaining national control of the assets



Flexibility is needed in:

- **Market design** – allowing future evolution of markets
- **Market Rules** – easy access to markets to new players
- **Market Platforms** – managing changes in the market framework
- **Legacy contracts** – respecting these
- **Market opening** – not a big bang where all join at the same time

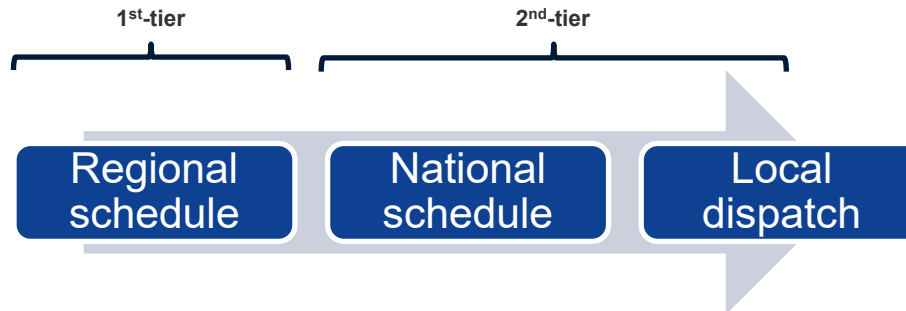


The regional market – two-tier dispatch

The primary purpose and criteria for the design of a regional power market is **optimal resource allocation and by this increase efficiency, enhance integration of renewable generation and reduce the overall cost of generation, including increasing the security of supply.**

To achieved this the concept is based on,

- Creating economic merit orders while taking transmission constraints into account
- Short-term optimizing of the power system and formation of a dispatch schedule from a regional perspective down to the local dispatch
- “Regional market”, connecting countries in a stepwise manner
- The regional trading provides (all or) parts of the interconnector flows between the countries
- The trades in the regional market is considered in the local dispatch together with the national schedule



Regional markets – will it provide affordable prices?

ACER has recently done an in-depth study of the impact of the EIM in light of the events the last period

Case: Cross-border trade delivers substantial benefits and mitigates price volatility

To estimate the benefits from cross-border electricity trading in Europe in 2021, ACER asked the European NEMOs to conduct an analysis for 2021. It compared actual 2021 market results ('historical' scenario) with a scenario where all cross-border capacities were set to zero (the 'zero scenario', implying no electricity trade across Member State borders)⁹. The difference in welfare benefit between the historical and the zero scenario (see Figure 11) is a proxy for the yearly welfare benefits currently obtained from cross-border trade in day-ahead markets. The benefits of cross-border electricity trading amounted to around 34 billion Euros in 2021 (source: ACER based on NEMOs). More than one third of these benefits correspond to the last quarter of 2021, when power prices were at their highest.

Figure 11: Estimated monthly welfare benefits (Billion EUR) from cross-border electricity trade in 2021



Source: ACER based on NEMOs' simulations.

In addition to the considerable savings associated with the current level of market integration, the analysis shows that this integration also reduces significantly price volatility. Figure 12 displays the differences in average price volatility between the two scenarios. It shows that price volatility would have been considerably higher (around seven times as high) if national markets were isolated.

Figure 12: Price volatility (EUR/MWh) in integrated and isolated electricity markets in the EU in 2021



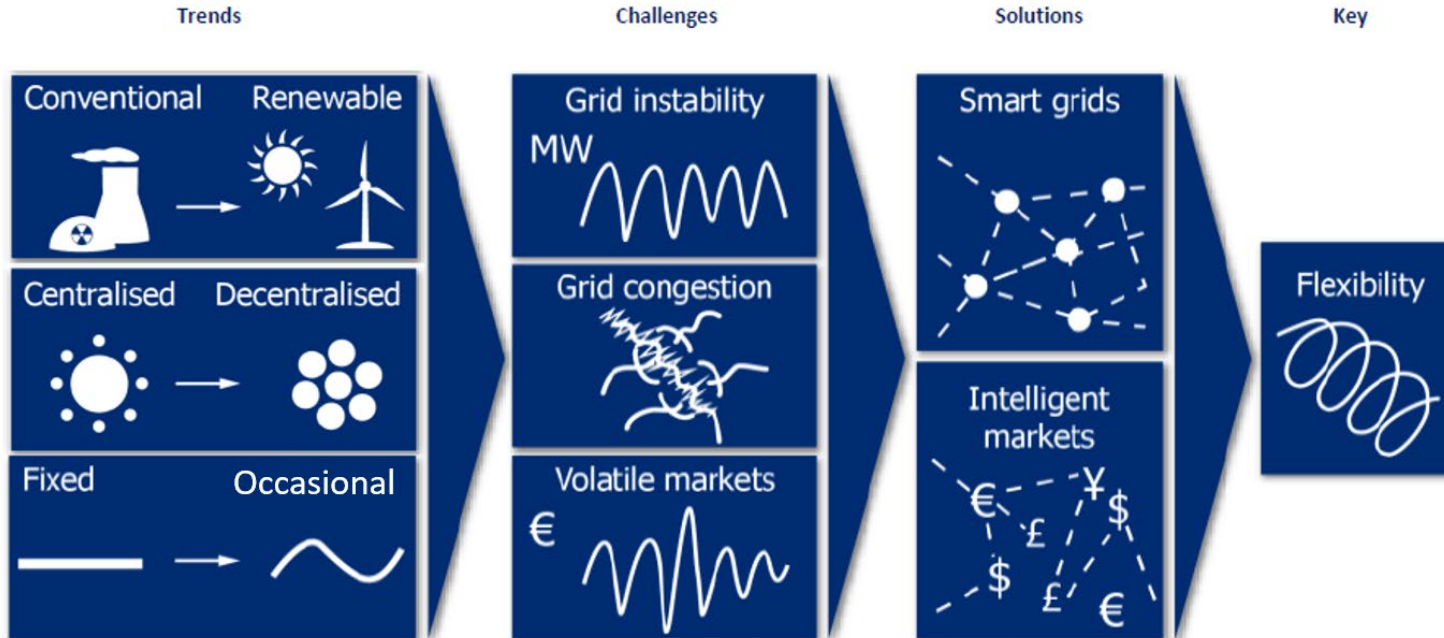
Source: ACER based on NEMOs simulations.

Volatility was estimated by using the standard deviation of day-ahead wholesale prices. The standard deviation was calculated per bidding zone for the whole year, then averaged out across the EU.

*“Overall, in 2021, cross-border trade delivered an estimated **34 billion Euros** of benefits while helping to smoothen price volatility.”*

... and if this is not hard enough –

Trends are challenging the traditional power systems



Global drivers for change

Climate Change



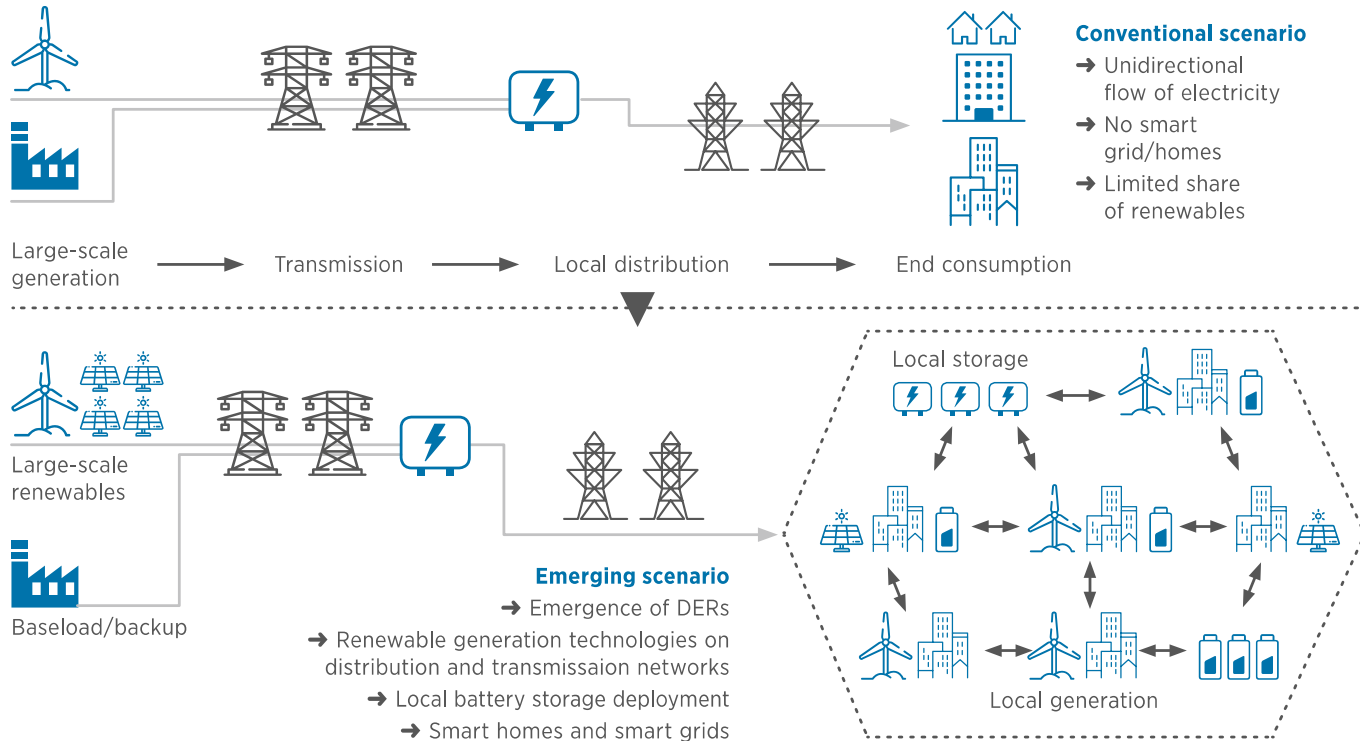
Technology



Consumption Patterns

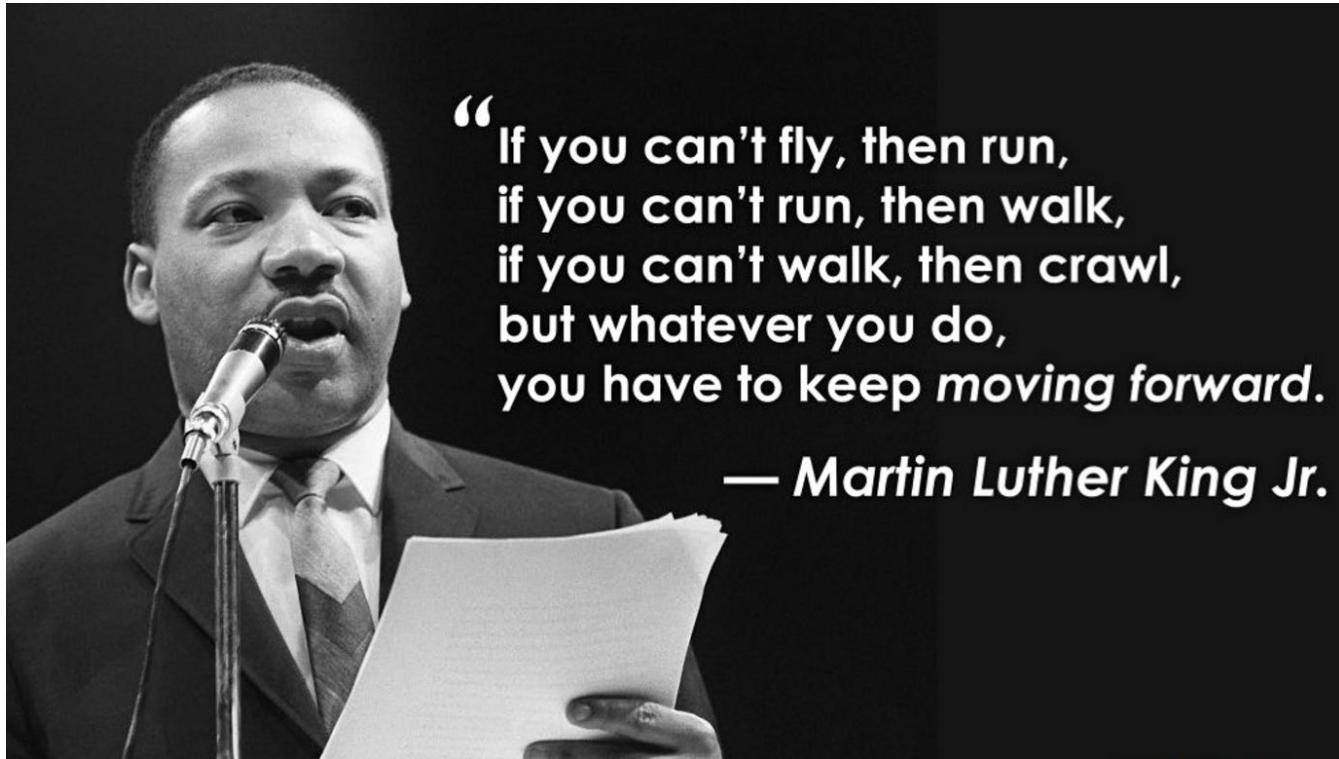


The changing role of the TSO and DSO in the future



Words of wisdom

(my favorite market reform quote):



**“If you can't fly, then run,
if you can't run, then walk,
if you can't walk, then crawl,
but whatever you do,
you have to keep *moving forward*.”**

— *Martin Luther King Jr.*

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Transforming ENERGY

IEEE
Advancing Technology
for Humanity

VTT

AEMO
AUSTRALIAN ENERGY MARKET OPERATOR

EPRI | ELECTRIC POWER
RESEARCH INSTITUTE

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