



# **Is the nodal design adapted to the European energy transition : *A practical point of view of the French TSO***

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# Is the nodal design adapted to the European energy transition ?

- 1. A MARKET FOR WHICH POWER SYSTEM ?**
- 2. NODAL MARKET DESIGN: A SOLUTION OF THE PAST OR THE FUTURE ?**
- 3. CHALLENGES OF THE NODAL MARKET DESIGN**
  - Uncertainties will impact power management and markets
  - European grid management and impacts
  - Investment coordination of grid and flexibilities
- 4. DECARBONATION IS THE PRIORITY**

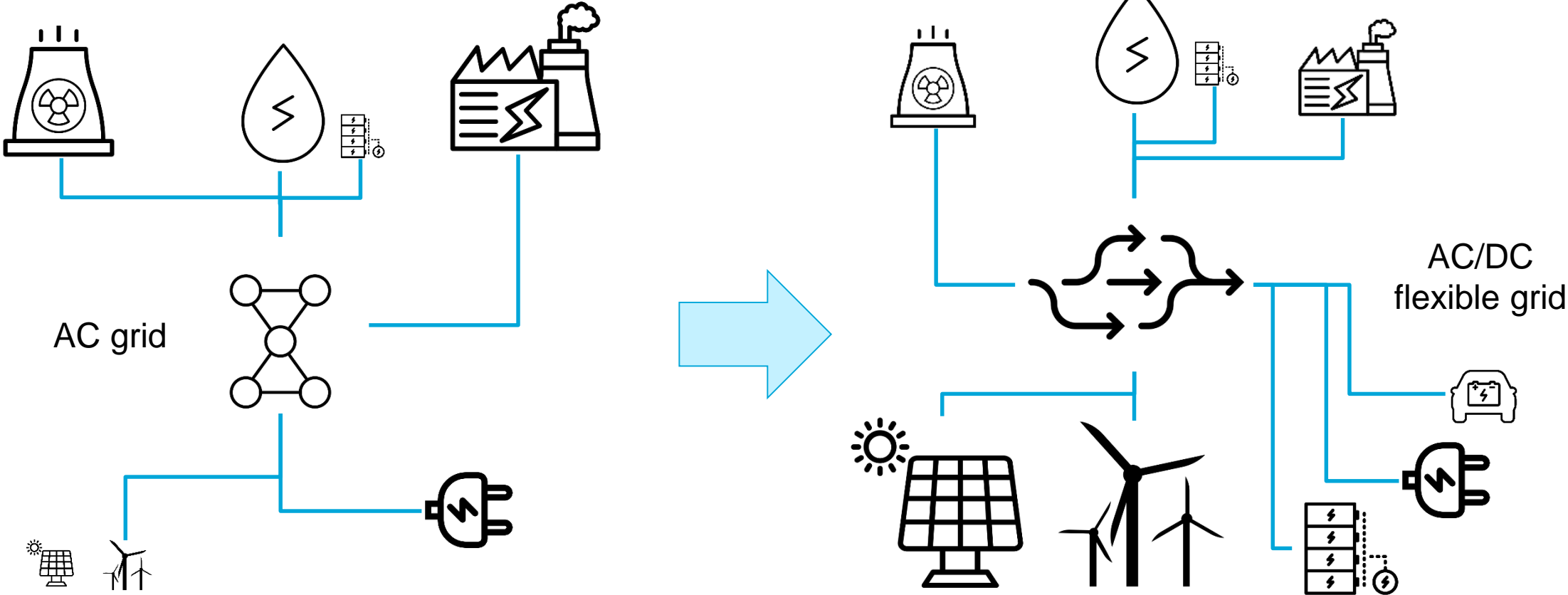


**A market for which power system ?**





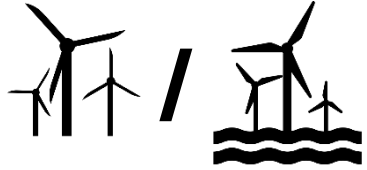
# Renewables, decentralisation, European integration, digitalisation are the key drivers of the European power system



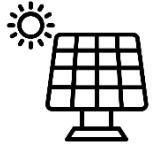


# How it could look like in France

**2015**



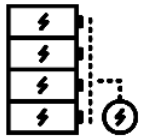
**9 GW**



**5 GW**

**TSO / DSO**  
(% MW)

**80 / 20**



**5 GW**

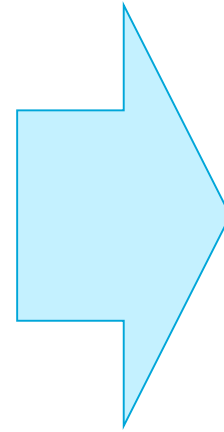
**2028** (PPE\* scenario)

**35 GW / 5 GW**

**40 GW**

**50 / 50**

**+ 5 millions**



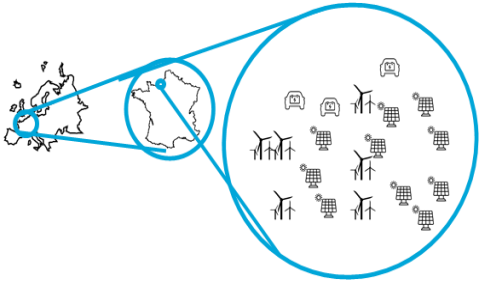
\*: Programmation Pluriannuelle des Energies Project

**Nodal markets, a solution of the past or the future ?**

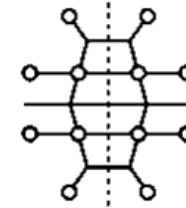




# The efficient centralised approach of nodal markets were designed in a world with a few big thermal dispatchable generators

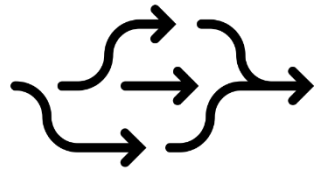


To organize tens of thousand stakeholders with **portfolio bidding, aggregators, hydro valley, self-dispatch units, dsm and storage**



Future assets will mainly be located on the DSO grid

**But is nodal market designed for Europe and its future?**



To maintain and enhance the **use of topological actions** in Europe valuating its highly meshed nature



Political desire to **aggregate prices for demand** (Italian PUN...) Distort bidding incentives for prosumers

# Challenges of the nodal market design

*Uncertainties will impact power management and markets*

*European grid management and impacts*

*Investment coordination of grid and flexibilities*





# Challenges of the nodal market design

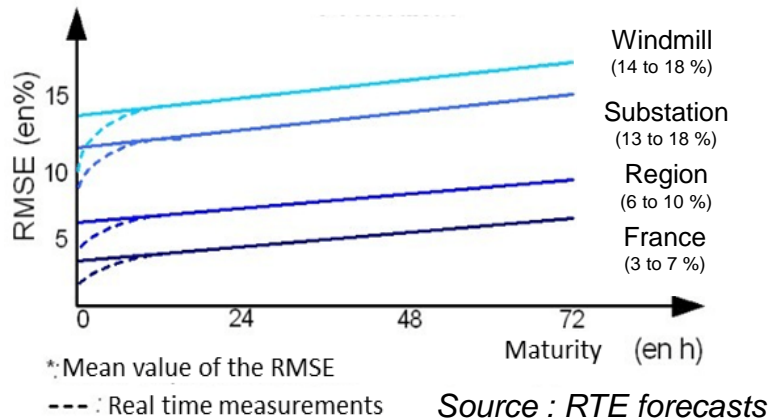
*Uncertainties will impact power management and markets*



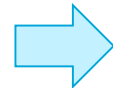


# Short term uncertainties will be one the key features of the European power system

Forecast\* error following the maturity

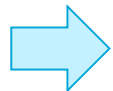


- Forecast uncertainties increase with the spatial resolution making congestions complex to anticipate for market players and TSO



Day-ahead price for congestion **seems to be a poor signal of system constraints** (cf. fig 2)

- Forecast uncertainties of intermittent productions decrease quickly in the last hours close to real-time

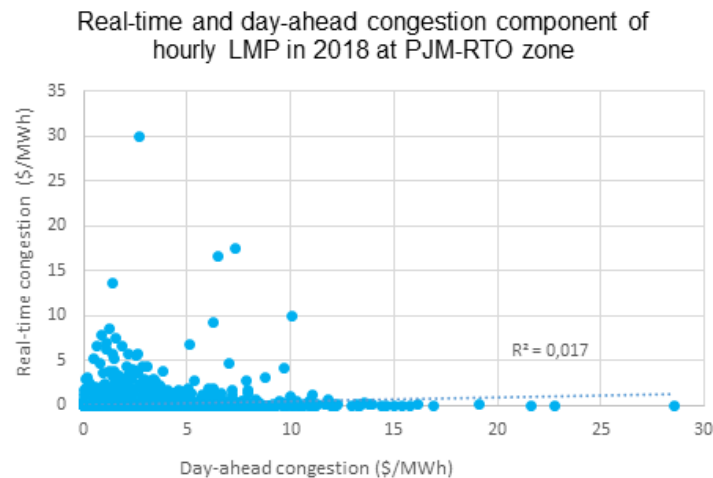


A strong **intraday market** will be required to efficiently manage the uncertainties of intermittent generation and the two settlement process of nodal design would need to be adapted [1]

- In a unpredictable power system, waiting before taking decisions has a value [2]



**The last time to decide** approach is used by RTE to alleviate congestions, minimizing false-positive actions.



Source : data PJM, graph RTE

**The European zonal design reduces uncertainties for energy market, develop strong ID to deal with it and increase options for the TSO to deal with congestions**

[1] Central-versus self dispatch in electricity markets, Ahlqvist, Hölmberg, Tangeras, 2019

[2] Smart, Flexible and responsive future electric power markets, O'Neill, 2011

# Challenges of the nodal market design

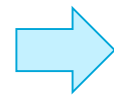
*European grid management and impacts*



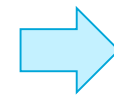
# European grid is highly meshed and topological actions are intensively used by TSO to manage congestions



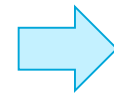
- Nodal market design focus on using generation capacities to manage congestion but **other actions can be used by the TSO.**



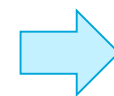
**Non-costly topological actions are intensively used** by RTE to manage its grid and congestions (~500 a day)



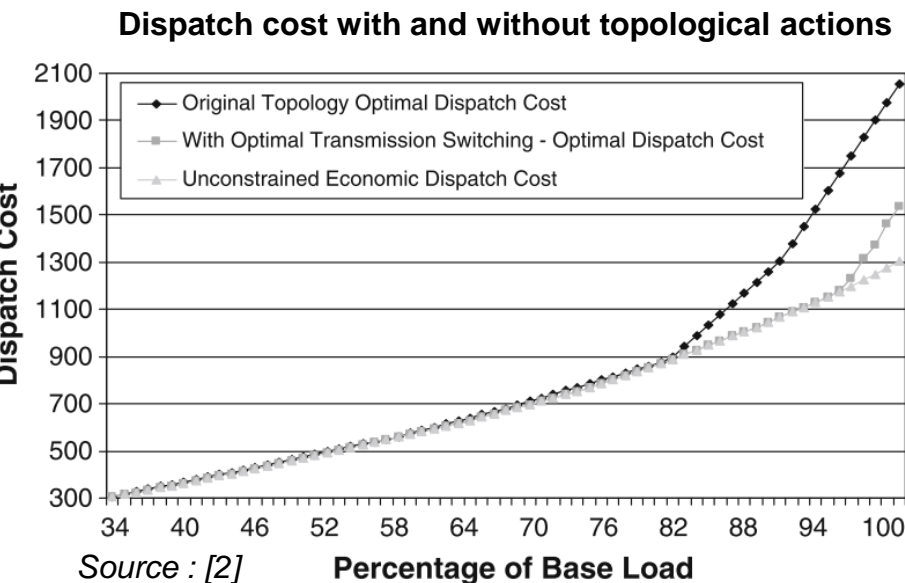
The value of **these flexibilities is high** (estimated to 3,5% of total costs with only limited topological actions) [1]



This flexibility is an integer variable with combinatory issues making it **very hard to implement in nodal design** regardless the impacts on market prices and revenue adequacy issues [2]



The **TSO model encourages to use those flexibilities compared to an ISO model.**



**As TSO are directly impacted by the cost of congestion, they look for the least cost options to alleviate them and use the full benefit of grid flexibilities**

[1] Congestion management through topological action, Papavasiliou, 2014

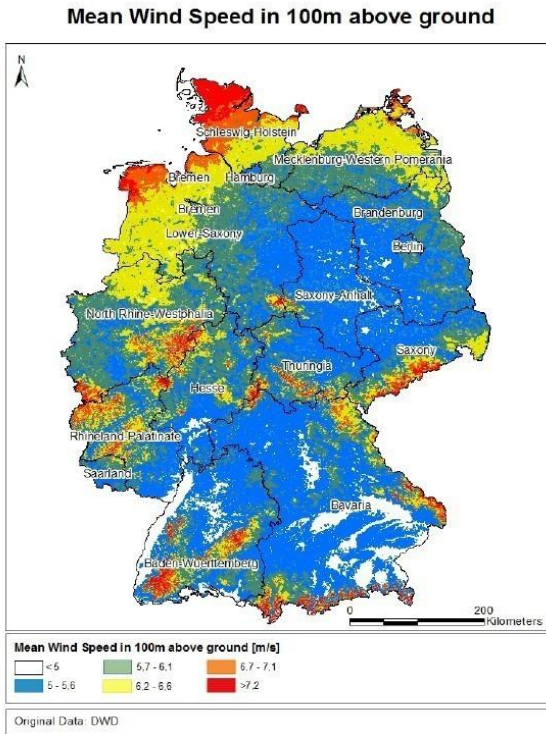
[2] Optimal transmission switching: economic efficiency and market implications, Hedman, Oren & O'Neill, 2011

# Challenges of the nodal market design

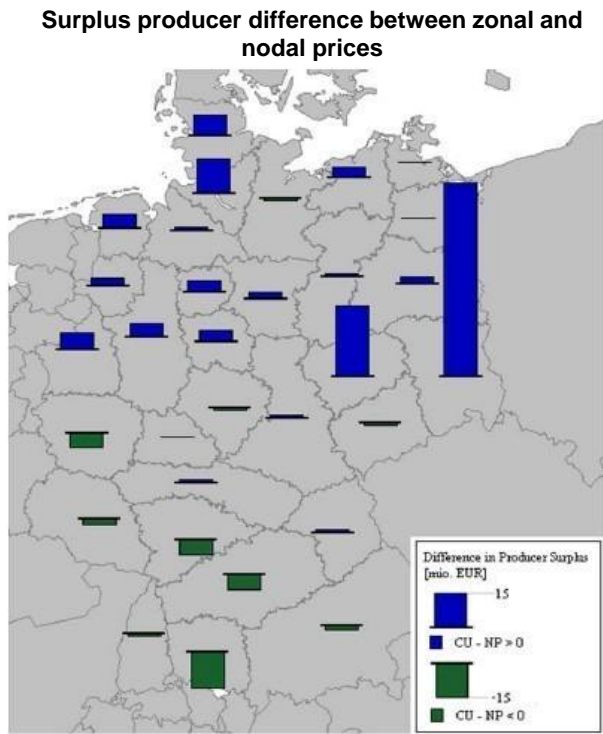
*Investment coordination of grid and flexibilities*



# Nodal markets for investment coordination raise challenges



Source: ISPRS Determination of Suitable Areas for the Generation of Wind Energy in Germany



Source: Essays of the Economics of Congestion Management, Burstedde, 2012

- Nodal designs focus on using gen/load flexibility to manage congestion but:

- Massive congestions like the German ones are economically solved by **grid development**
- Efficient flexible grid solutions like DLR\* are lagged because TSO/ISO are less exposed to the cost of congestion
- We shouldn't overstate their flexibility : GW of offshore wind capacity will be installed... offshore

- Alternative locational incentives** are used to coordinate grid and gen/load development [1]

- Connection charges, grid usage charges, locational capacity payments, RE support schemes...

**European zonal design stabilises prices and do not expose market parties to unpredictable congestion cost and internal grid development**

\* *Dynamic Line Rating*

[1] *Congestion Management : From physics to regulatory instruments, Hirth & Glismann, 2018*

**Decarbonation is the priority**





# In a limited resource environment, decarbonation should be the priority



- **Challenges**

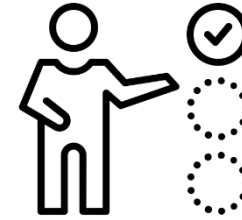
Nodal designs has still challenges to cope with future **European key features** mainly regarding distributed resources, uncertainties, grid flexibilities and coordinations between markets.

- **Grid development**

Congestion costs are relatively small compare to the overall cost of the power sector and **grid development is most of the time the cheaper way for massive congestions.**

- **Differences**

**EU are not the US** in term of governance, relations between national states, coordination capabilities and size : PJM serves 65 millions customers, CWE covers 215 millions people.



The transition toward nodal design would certainly be a **lengthly and costly process implying to rethinking many pillars of the power sectors** like power trading, market rules, governance, national security rules **providing uncertainties for RES investments.**

**This time and resources will not be used to decarbonize the power sector:** integrate more RES, manage DC equipments, solve inertia issues, connecting RES, develop internal and international network, adapt to self-consumption, ensure future adequacy, improve flow-based etc...





**Thank you**

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