Power System Economics Institutions

Master Energy – Master 2

December 11th, 2018

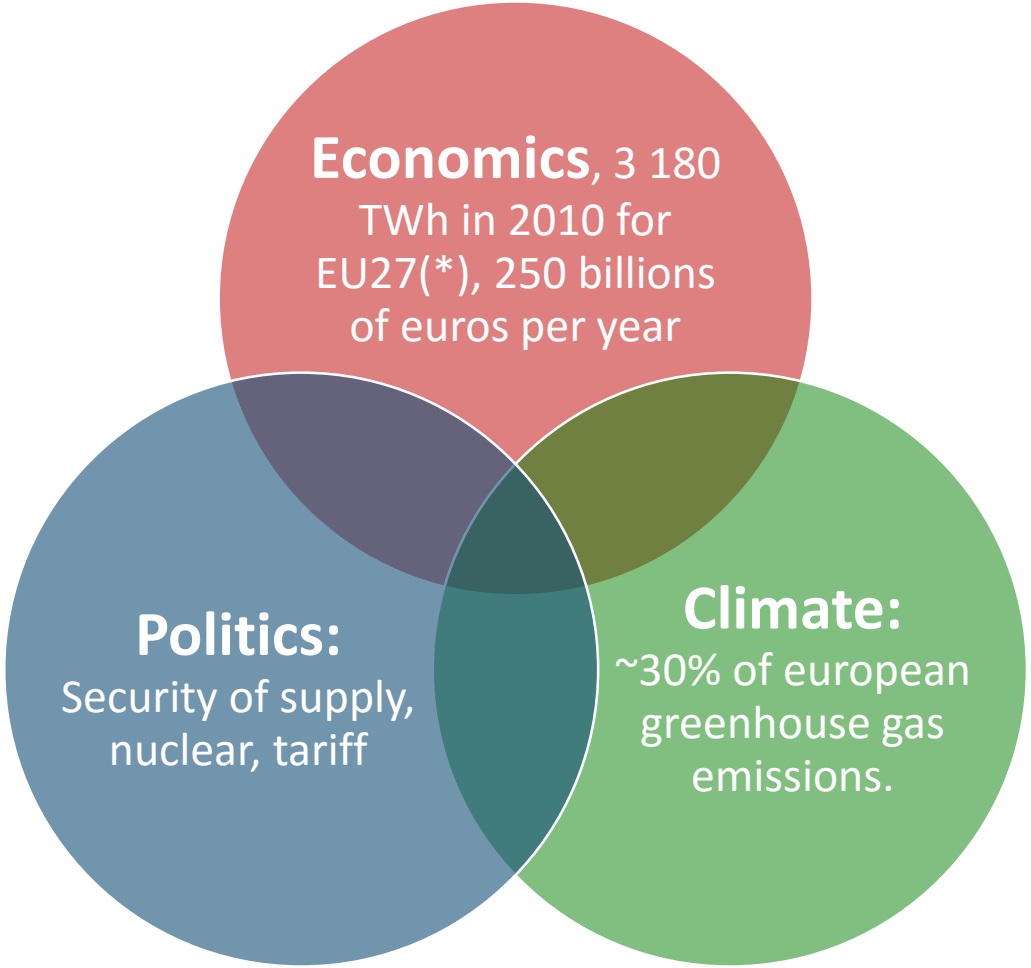
Nicolas Omont

nicolas.omont@rte-france.com

The views expressed are personal and do not necessarily represent the views of RTE

PSL RESEARCH UNIVERSITY PARIS

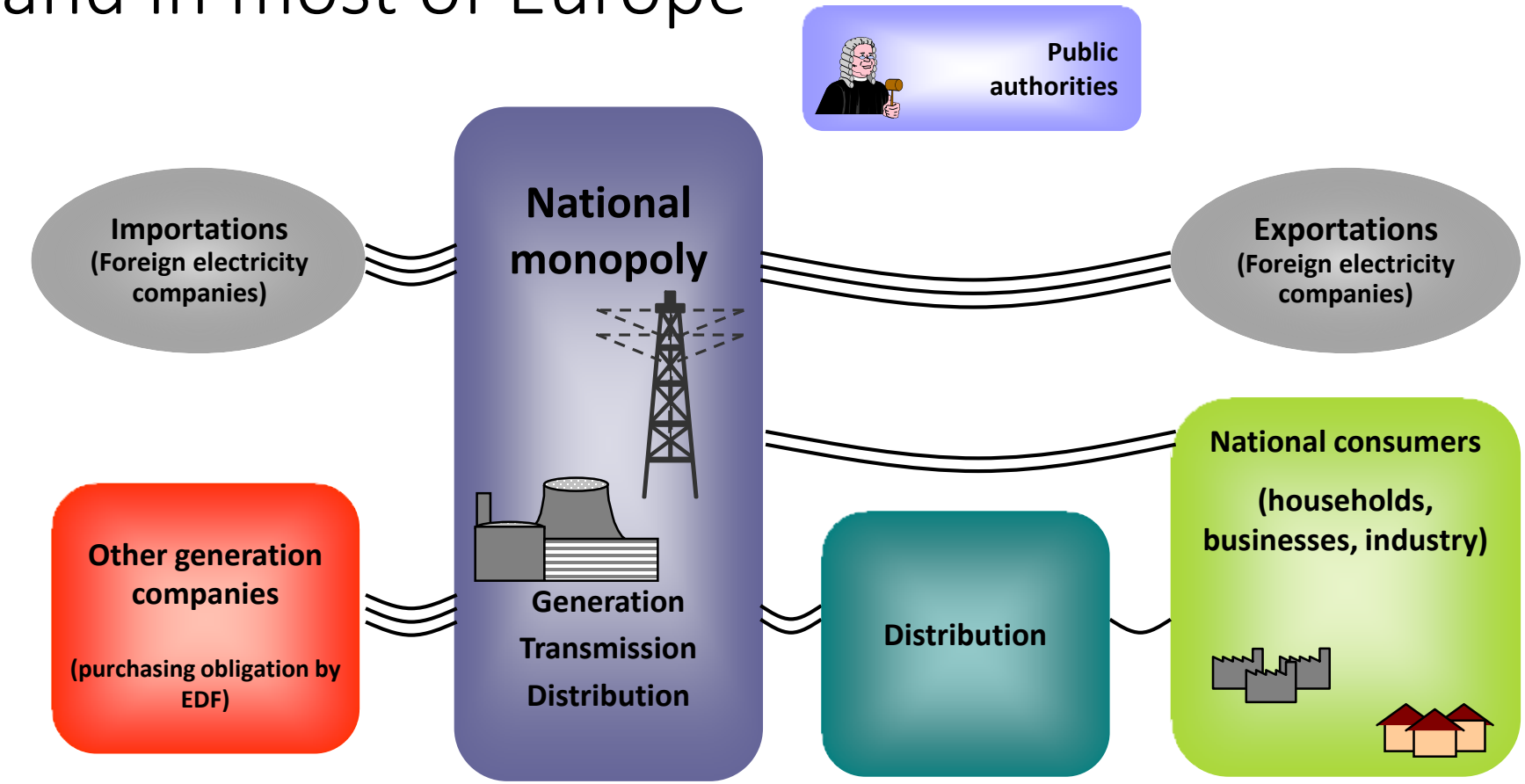
II- Economic analysis: the stakes



(*)Source: Eurostat 2012

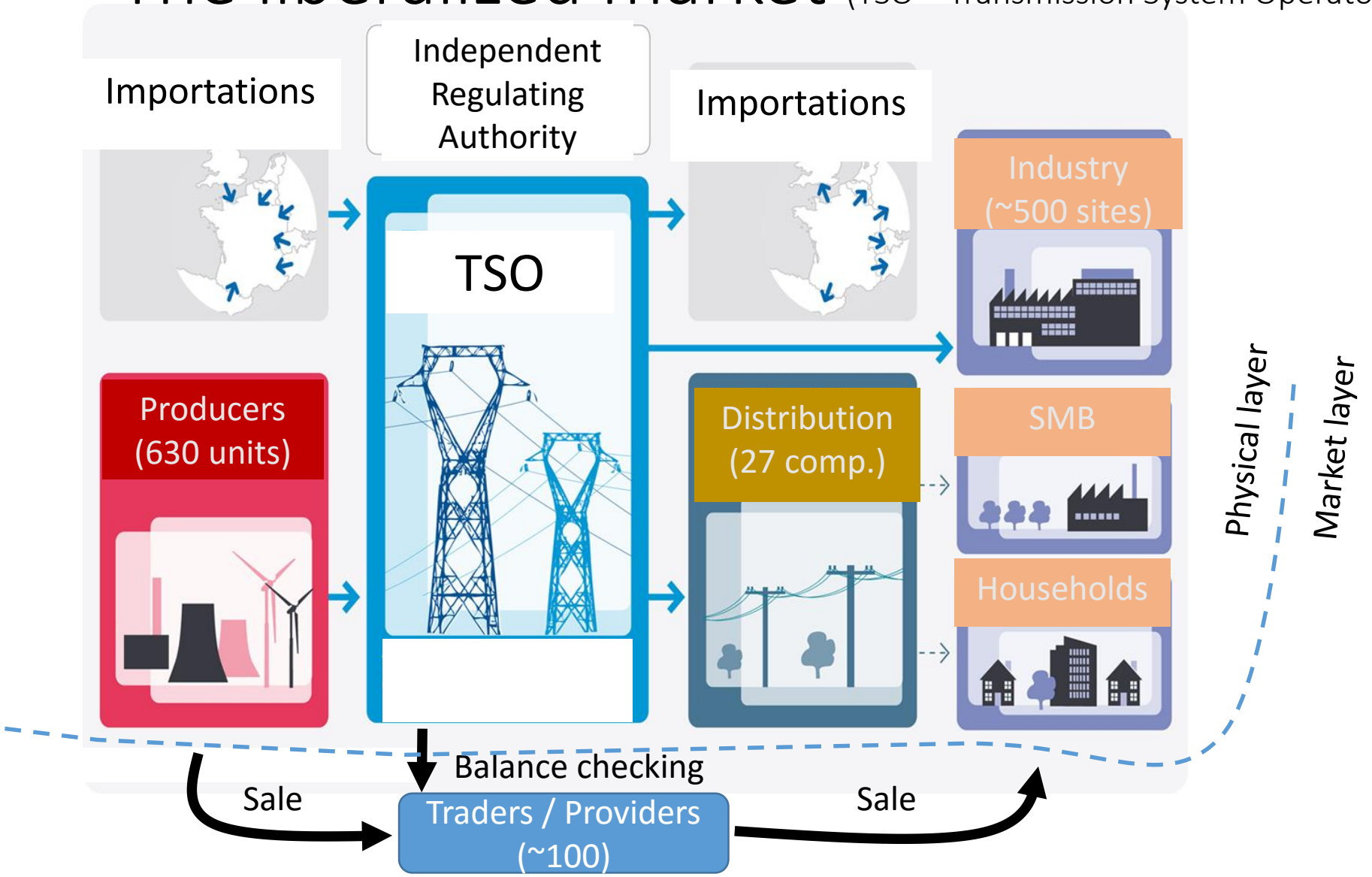
PSL RESEARCH UNIVERSITY PARIS

Before 1999, a national monopoly in France and in most of Europe

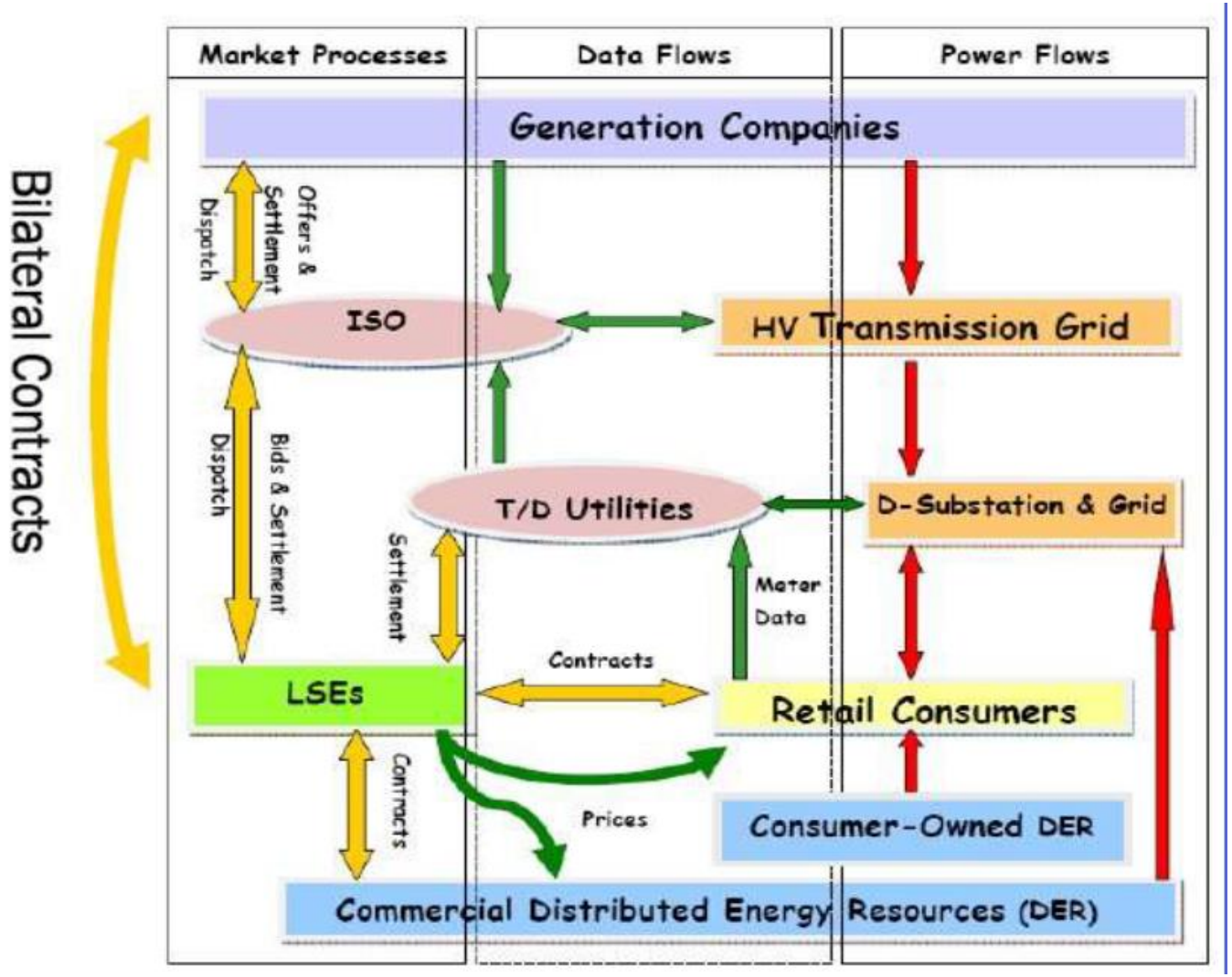


PSL RESEARCH UNIVERSITY PARIS

The liberalized market (TSO = Transmission System Operator)



American example with retail competition: ERCOT (Texas)



LSE=Load serving entity

PSL RESEARCH UNIVERSITY PARIS

The European liberalization process

- ~~Deregulation~~ → many more laws than before.
- It was pushed ahead by the European Commision (Only GB had some experience before):

- *European commission press release (July 12th , 1989)*

- "There are **regions** of the Community **where generating capacity can hardly satisfy demand** - and then with **high marginal costs**. In other **regions**, however, **highly competitive excess capacity is underused**. Yet intra-Community trade accounts for less than 4% of total consumption. Clearly, therefore, there are many obstacles to trade in electricity within the Community and full competition is lacking. The results of studies on the **"cost of non-Europe" in the electricity industry** show that full rationalization of the system could generate the following annual savings: (ECU thousand million)

1992	2000	2010
1.3	2.3-5.3	6-13

In the light of these findings, the Commission is proposing a step-by-step approach, in three sections, in order to liberalize transfrontier trade in electricity and thereby increase competition to the advantage of the consumer."

http://europa.eu/rapid/pressReleasesAction.do?reference=P/89/38&format=HTML&aged=1&language=EN&guiLanguage=en

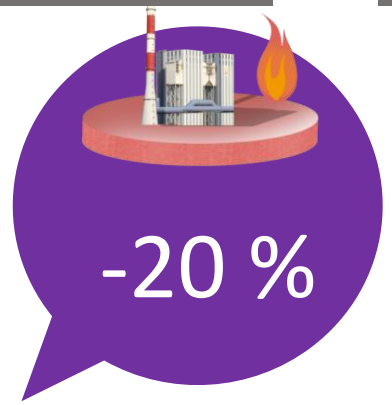
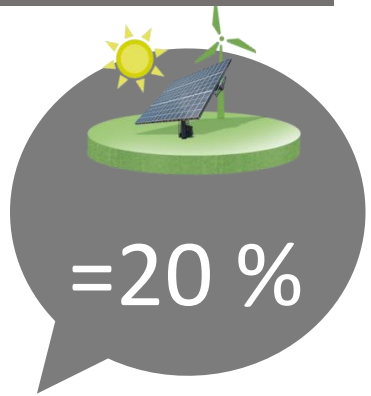
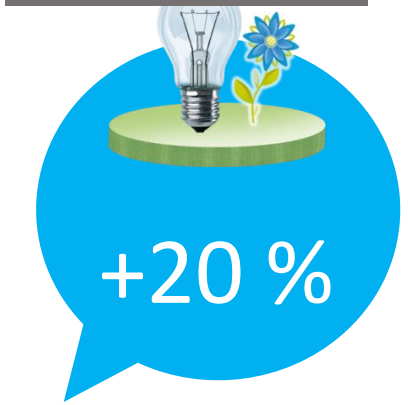
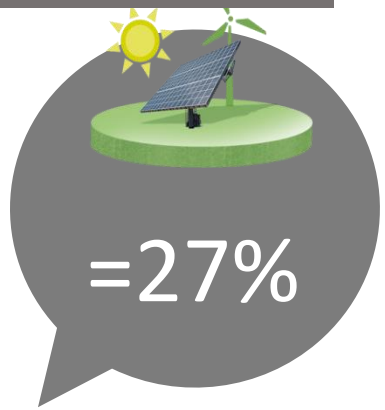
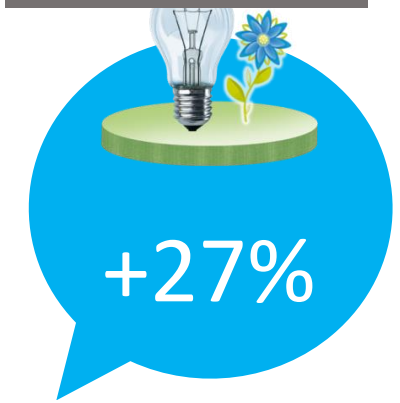
PSL RESEARCH UNIVERSITY PARIS

The European liberalization process

1996	2003	2008	2009	2014
1st directive Opening of the european market to competition Grid access, Choice of provider…	**2nd directive** Juridical separation of TSOs Independant regulator Competition opening calendar (2004 and then 2007)	**2020 energy and climate package** **Objectives: 20-20-20**	**3rd energy package** Patrimonial separation of TSOs Single European Market Creation of ENTSO-E and ACER	**2030 energy and climate package** **Objectives 40-27-27**
Law of Feb. 10, 2000 Creation of RTE	Law of Aug. 9, 2004 RTE as a subsidiary of EDF		NOME Law 2010 ARENH Capacity mechanism	Energy Transition law 2015 50% nuclear Renewable subsides

PSL RESEARCH UNIVERSITY PARIS

Decided at the European level

	Binding / national	Binding / national	Indicative / Europe
2020	 -20 % CO2 emissions compared to 1990	 =20 % Of renewable in final energy	 +20 % Energy efficiency
2030	 -40 % CO2 emissions compared to 1990	 =27% Of renewable in final energy	 +27% Energy efficiency

PSL RESEARCH UNIVERSITY PARIS

Strong relationships with the regulator and the government…

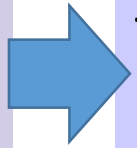
- The regulator (Energy Regulation Commission)
- Approves RTE's budget and accounts
- Approves the investment plan
- Arbitrate disagreements with grid users
- Proposes to the minister the grid access tariff

- The minister of energy
- Sets the grid access tariff
- Approves the development plan
- Defines the mission specifications (quality level…)

PSL RESEARCH UNIVERSITY PARIS

…within a complex decisional and institutional framework:

- European directives
- Orientations of European regulators **(ACER)**
- TSOs initiatives (**ENTSO-E)**



- Transposition into the French law
- Orientation and deliberations of the French regulator (**CRE)**
- Market rules proposed by the French TSO (**RTE)**

The missions of RTE

- Balancing consumption and generation
- Guaranteeing the safety of the network (24/24 7/7 continuous delivery of power)
- Maintain and develop the grid
  - Generation connection
  - Distribution grid connection
  - Large consumer connection
  - Interconnection with neighbours
- Guarantee fair access to the network
  - guarantee the confidentiality of commercially sensitive data)
- Integrate assets into the environment and guarantee the safety of persons and goods.
- At the best cost…

PSL RESEARCH UNIVERSITY PARIS

PSL
RESEARCH UNIVERSITY PARIS

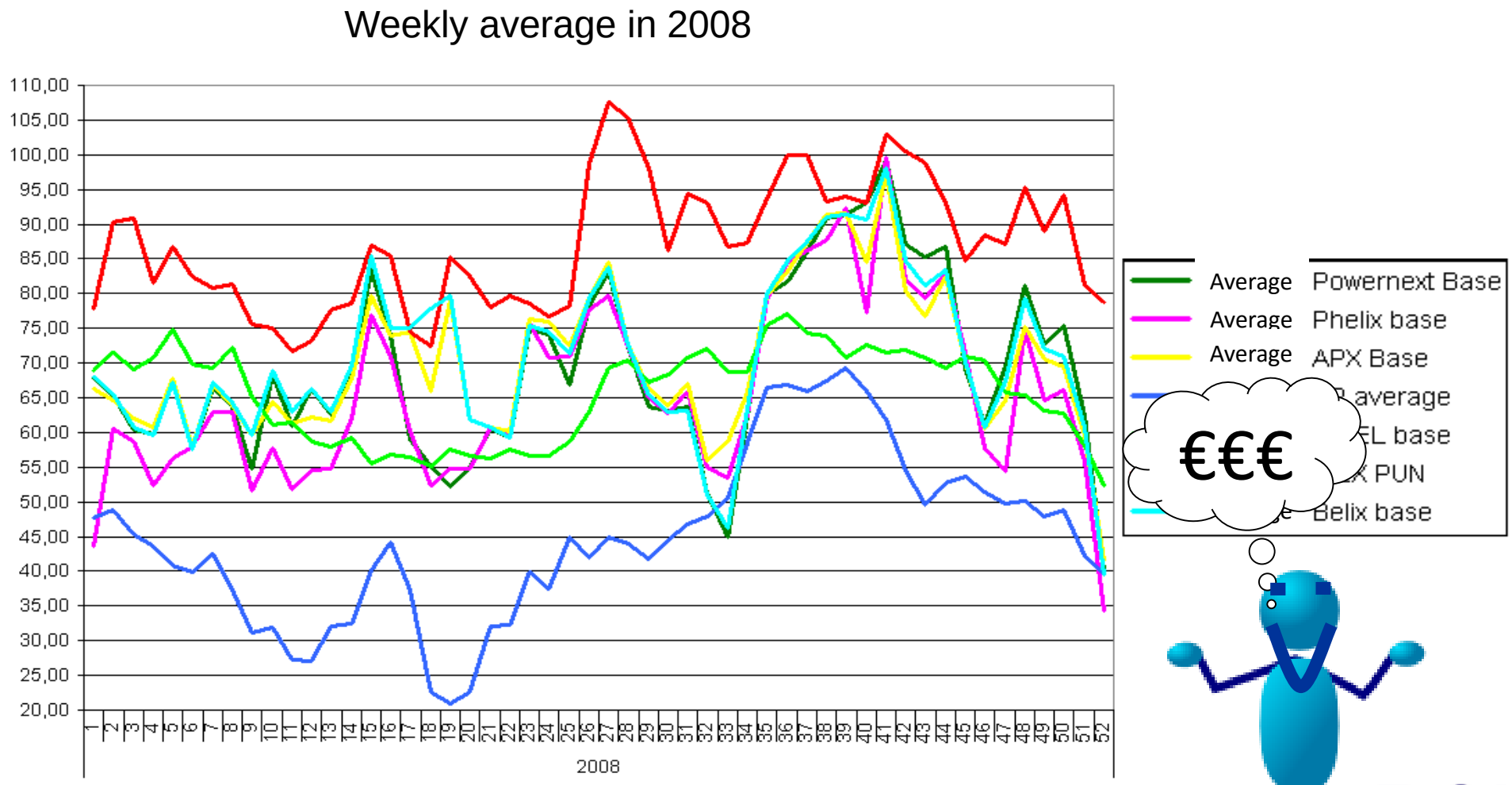
Implementations of exchanges

- Up to 2000: National monopolies exchanged power through bilateral agreement.
- 1999-2001: Creation of national day-ahead markets (Power exchanges).
- 2001-2002: Creation of long term to daily auctions to allocate cross-border transmission capacity.

$\Rightarrow$ Cross border trading was possible.

PSL RESEARCH UNIVERSITY PARIS

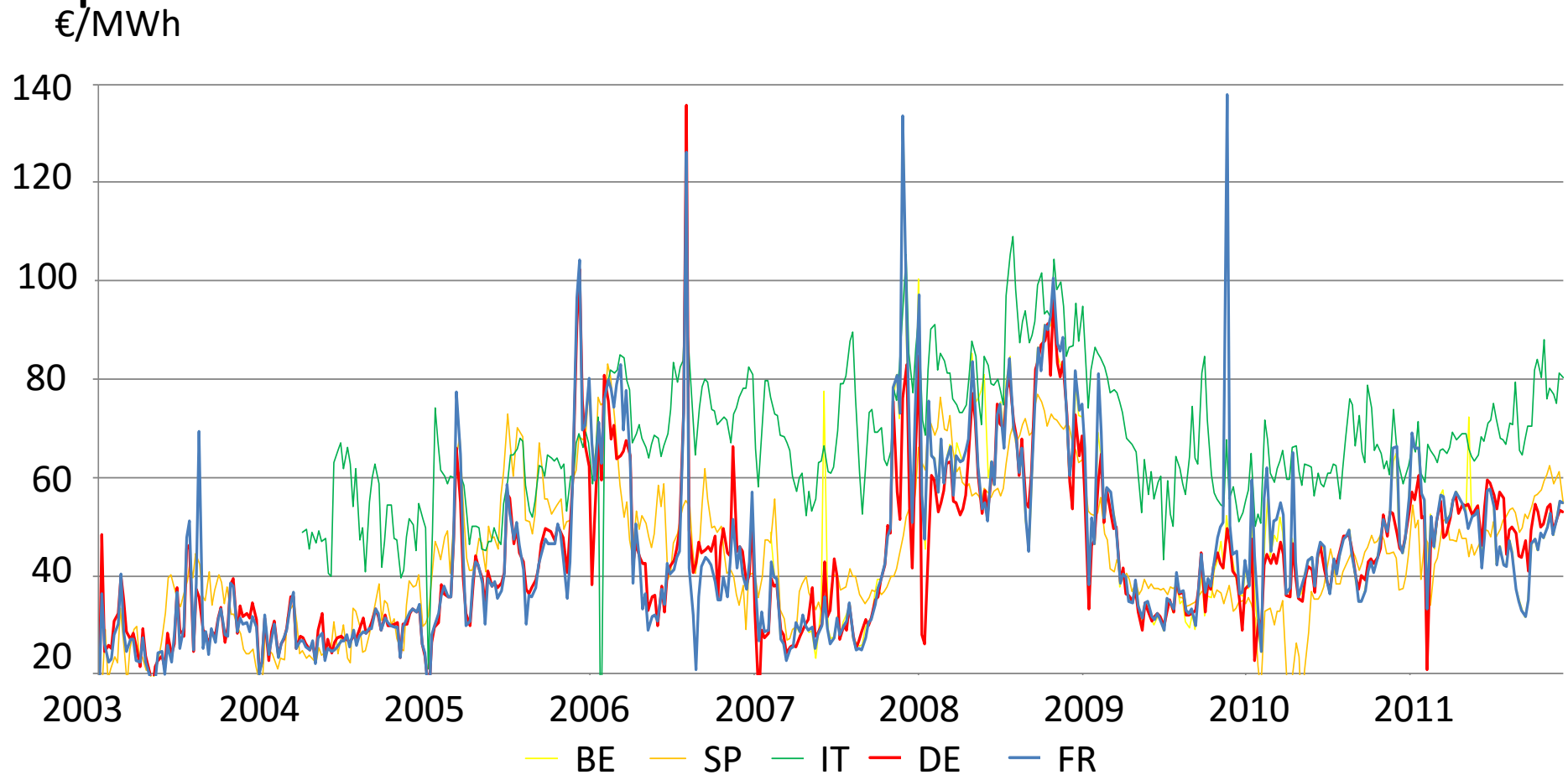
A trader's view on interconnections: European market prices



- For the trader: price differences = money to earn.

PSL RESEARCH UNIVERSITY PARIS

Compared evolution of market prices in some European countries



PSL RESEARCH UNIVERSITY PARIS

In practice: initially, explicit allocation of interconnection capacity

- A German company can produce 10 MW at 50 €/MWh
- Its trader wants to sell the production of the French Day-Ahead market because he/she expects a price of 60 €/MWh.
  - He/she bids for 10 MW of German to France cross-border capacity.
  - Let's assume the he/she obtains it for 5 €/MWh.
  - The trader nominates it so that he/she has to do the exchange
  - It offers 10 MW on the French market. The bid must be at the minimal price (-3000 €/MWh) so as to guarantee that the exchange will take place.
- If the French market clears at more than 55€/MWh, the transaction benefits to the company. If clears below, the company looses money because it must do the exchange.

- Not efficient: flows were often "against" the price differences.

  $\Rightarrow$ Implicit allocations through "market coupling" is being set up
  (started in 2006 with the "Tri-Lateral Coupling" between FR, BE and NL)

PSL RESEARCH UNIVERSITY PARIS

Interconnections: Market Coupling

The area in green, as well as the area in blue is fully coupled. Italy and Slovenia will do so soon.

In this area, when you bid in a given zones, you automatically benefit of the bids in the other zones (all prices are computed simultaneously while respecting the transmission capacities).

The goal is to have a unique price coupling zone in Europe.

http://www.acer.europa.eu/Media/News/Pages/ACER-welcomes-the-day-ahead-market-coupling-in-15-countries-and-publishes-its-latest-Status-Review-Report-on-Regional-initi.aspx

PSL RESEARCH UNIVERSITY PARIS

Interconnections mechanisms

Mechanism	
Explicit allocation	Capacity auctions (annually, monthly, daily)
Implicit allocation	Market Coupling (one day-ahead)
	Continuous market (intra-day)

PSL RESEARCH UNIVERSITY PARIS

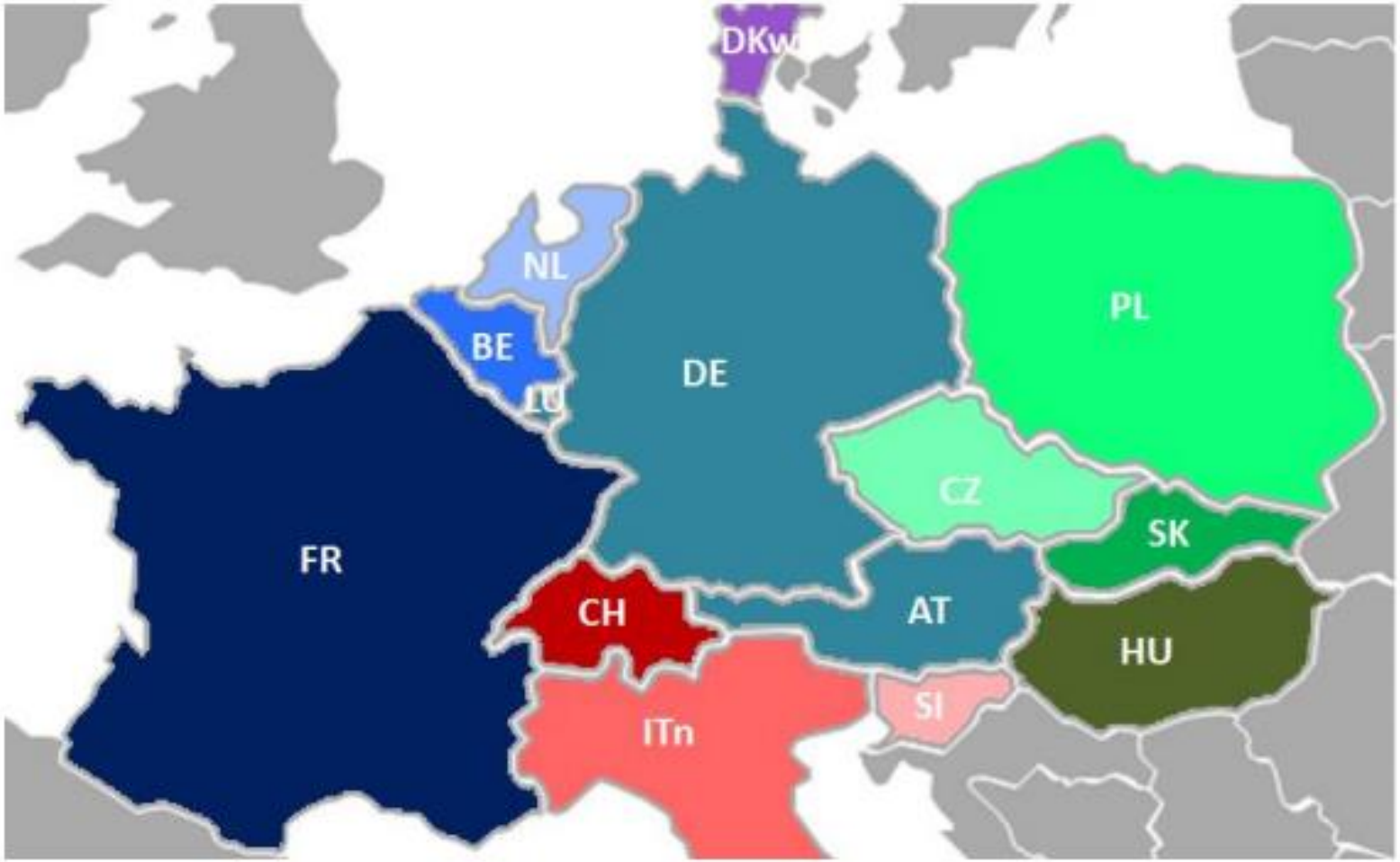
In practice

- In Europe: zonal pricing. 2 examples:
  - Central Western Europe + Central Eastern Europe + Central South Europe
  - Scandinavia
- In the USA: nodal pricing. 1 exemple:
  - MISO (Midcontinent Independent System Operator)

PSL RESEARCH UNIVERSITY PARIS

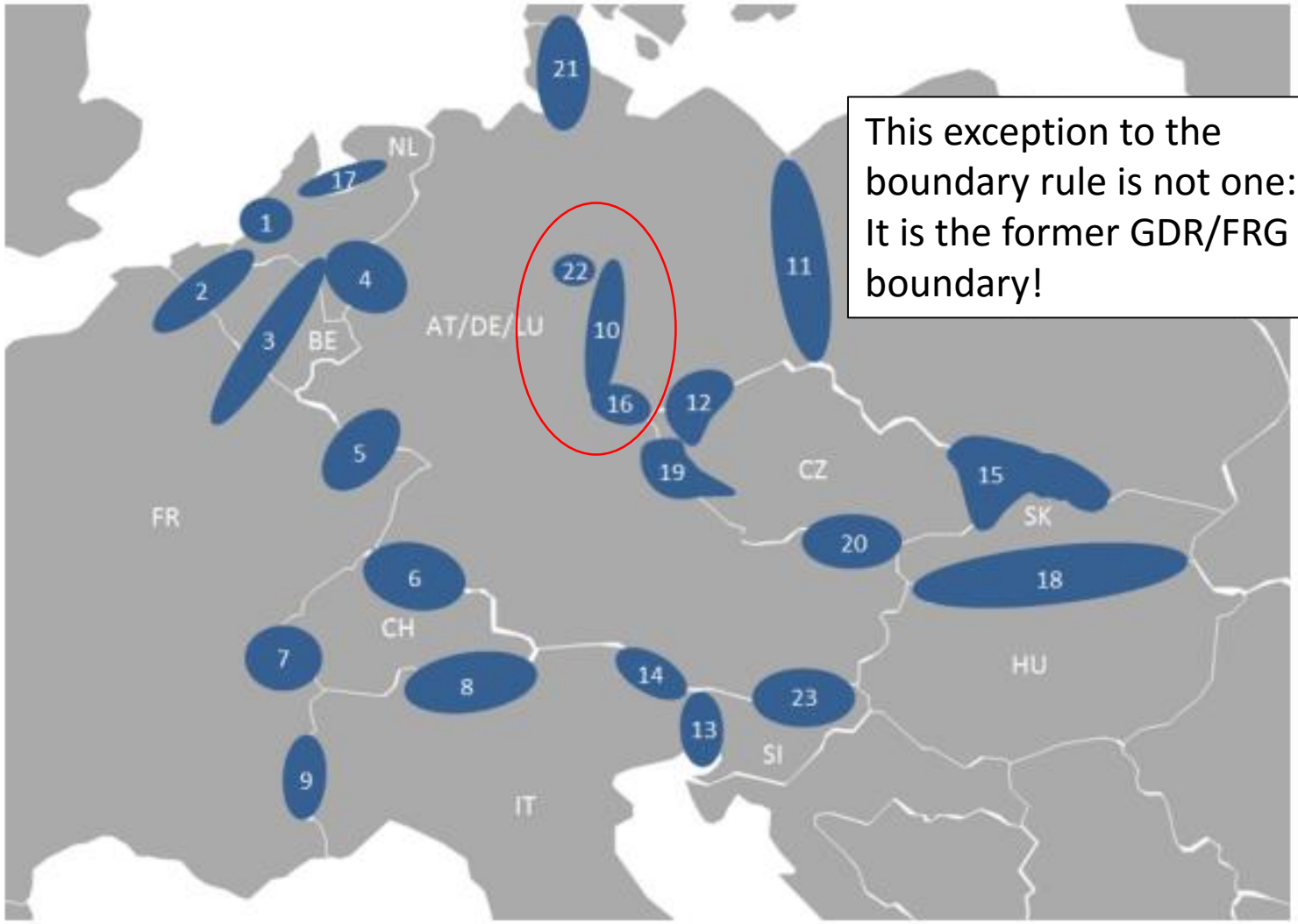
https://www.entsoe.eu/Documents/MC%20documents/140123_Technical_Report_-_Bidding_Zones_Review__Process.pdf

Continental Europe bidding zones:



Zones often match political boundaries. Besides political reasons, the grid is also weaker there.

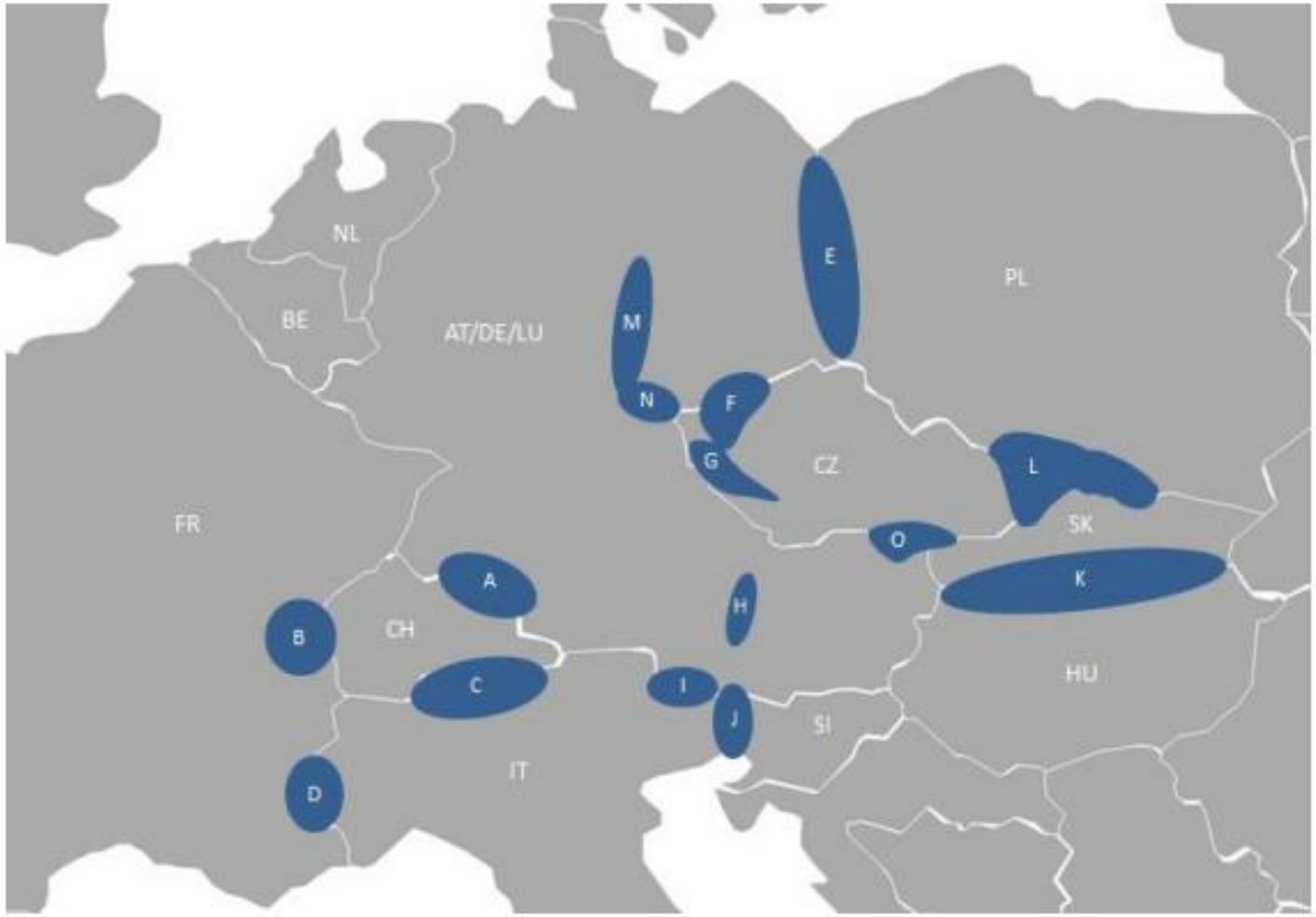
Continental Europe bidding zones: most forecasted constraints are indeed on the boundaries



This exception to the boundary rule is not one: It is the former GDR/FRG boundary!

Critical/Congested network element clusters: Planning phase (D-1 and D-2 in 2011 and 2012)

Continental Europe bidding zones: most forecasted constraints are indeed on the boundaries



Congestion clusters: Operational phase (real ltime)

PSL RESEARCH UNIVERSITY PARIS

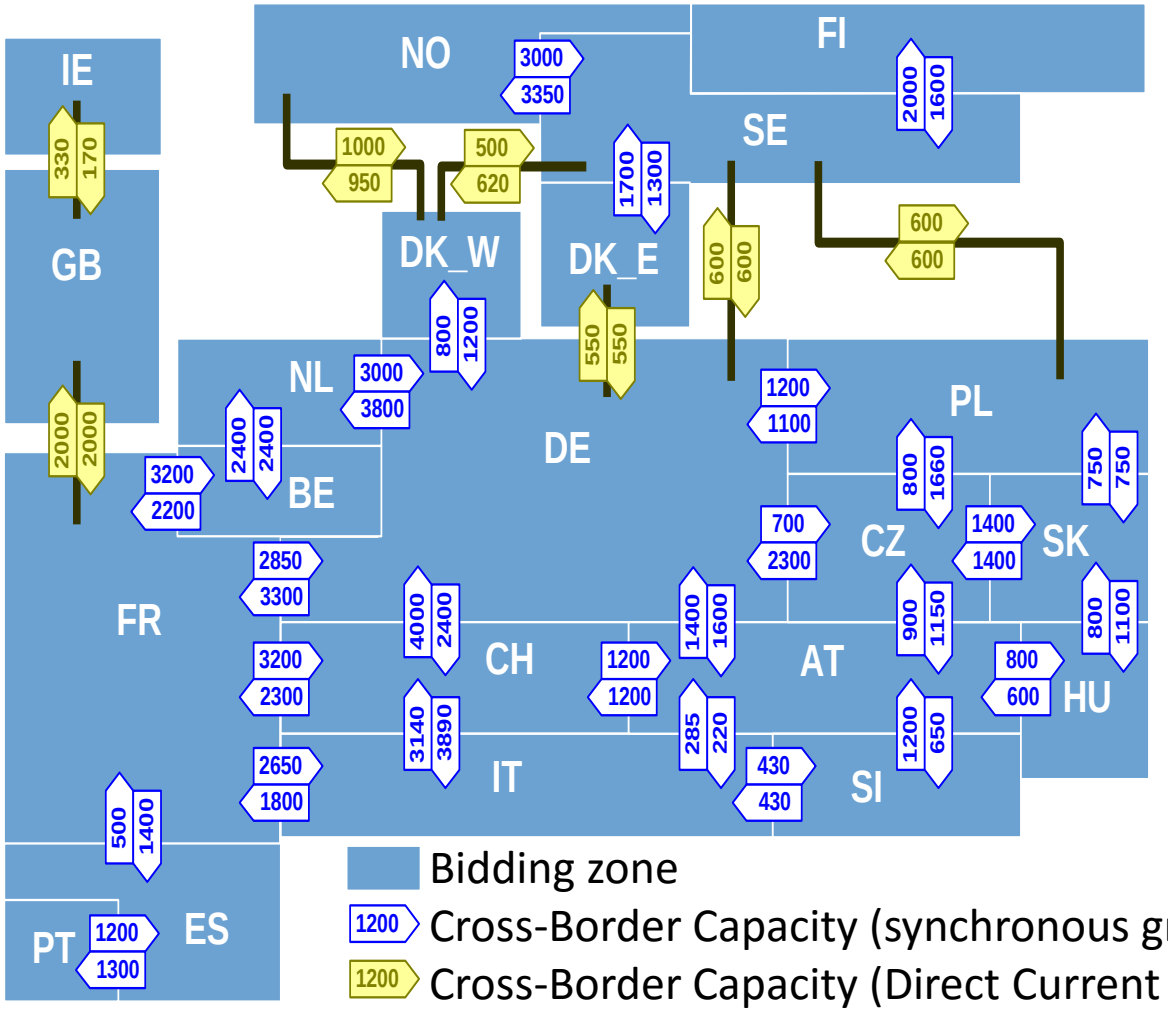
Reinforcement project for 2030 aim at relieving current congestions and anticipate on future renewable generation

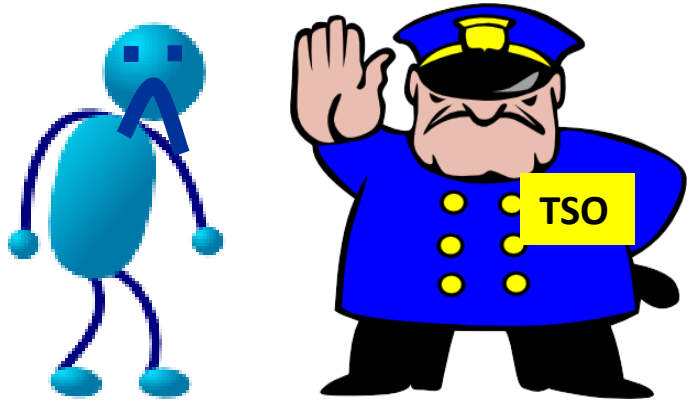
PSL RESEARCH UNIVERSITY PARIS

Capacity calculation

General principles:

- Within a price zone, no constraint for actors: free exchange of energy
- Between price zones, the “pipes” are limited.

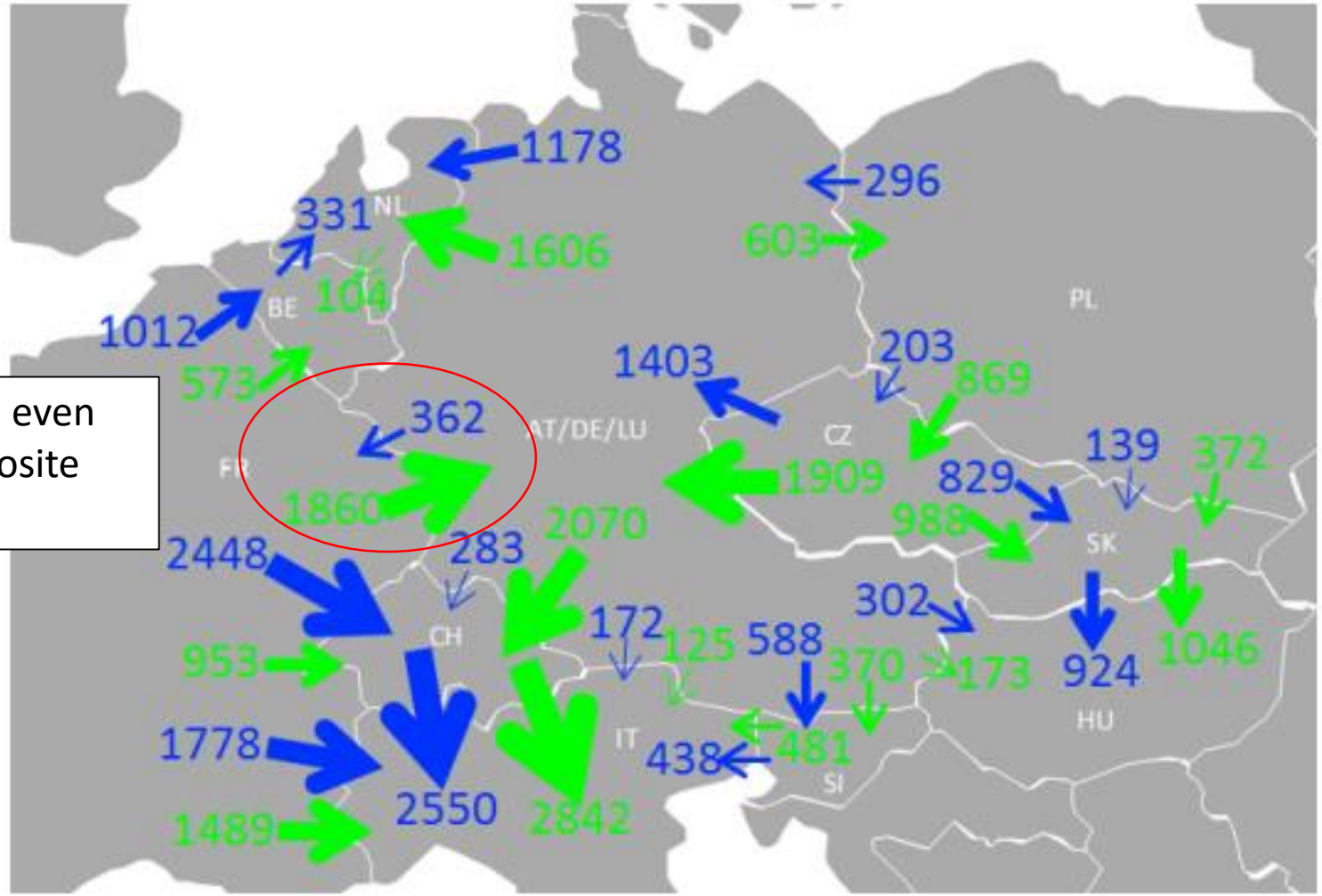




PSL RESEARCH UNIVERSITY PARIS

Commercial exchanges do not match physical flows! (ATC model)
Only both sums per country (net position) match.

Flows can even be in opposite direction!



Average realized schedule exchanges (blue) & Measured physical flows (green) for the year 2011 and 2012 (in MW)

PSL RESEARCH UNIVERSITY PARIS

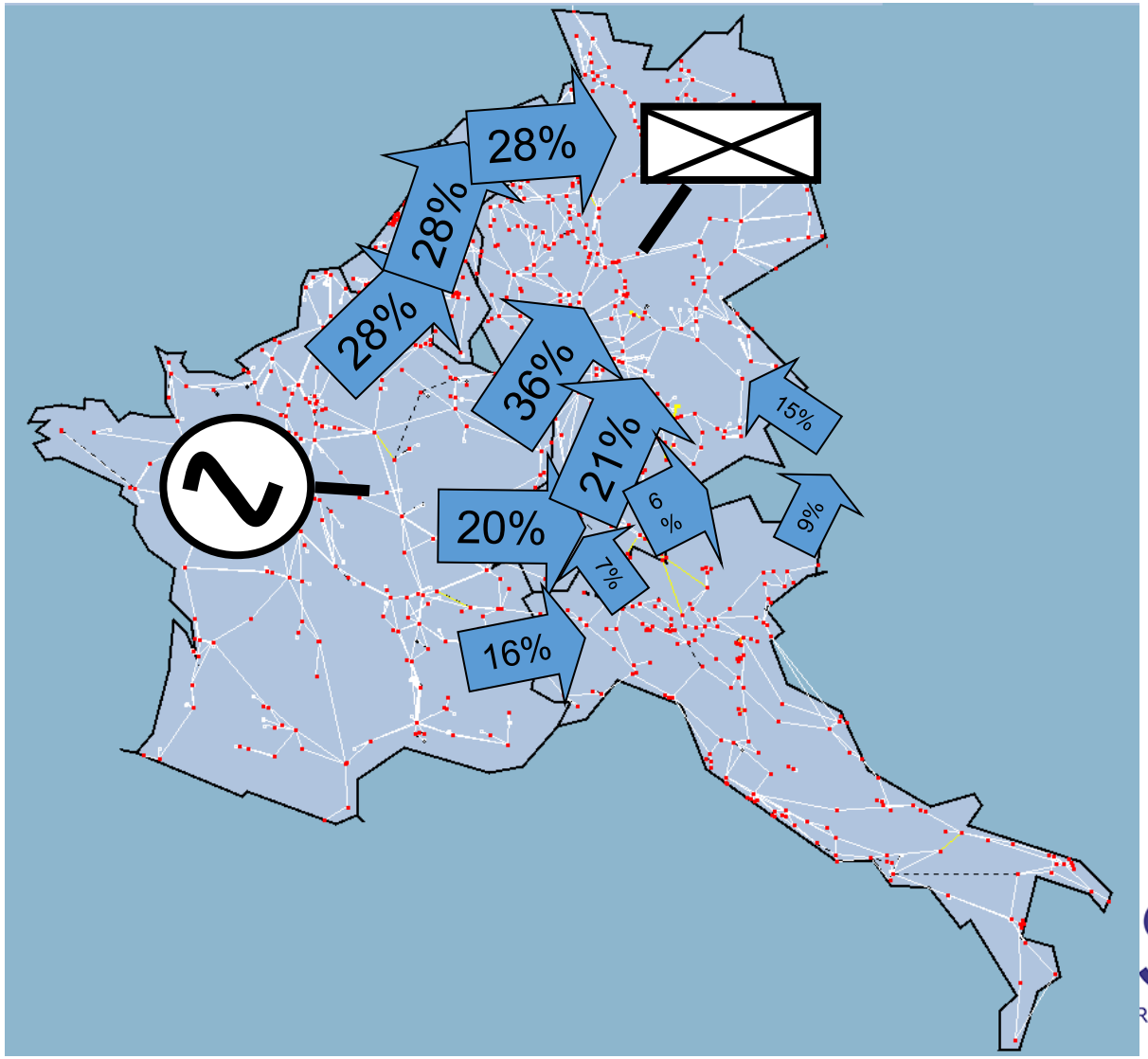
But, things are more complex…

Exchanges ≠ Physical flows…

Physical flows generated by a an exchange FR⇒DE

Only one-third of the flow goes through the French-German boundary. The other flows are called “loop flows”

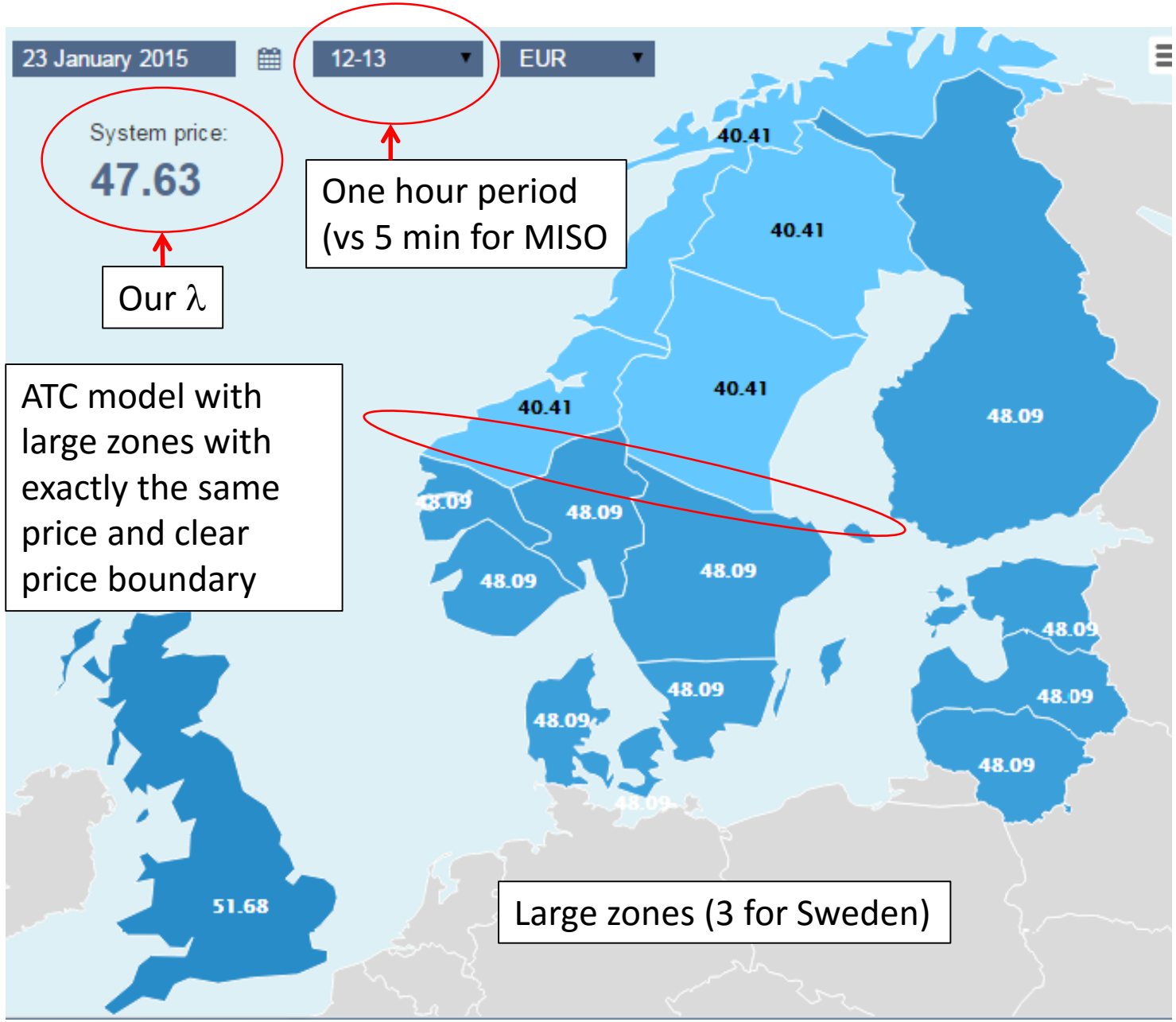
Only the **net export position** of each country is actually meaningful (sum of exchanges = sum of physical flows)



SL
RCH UNIVERSITY PARIS

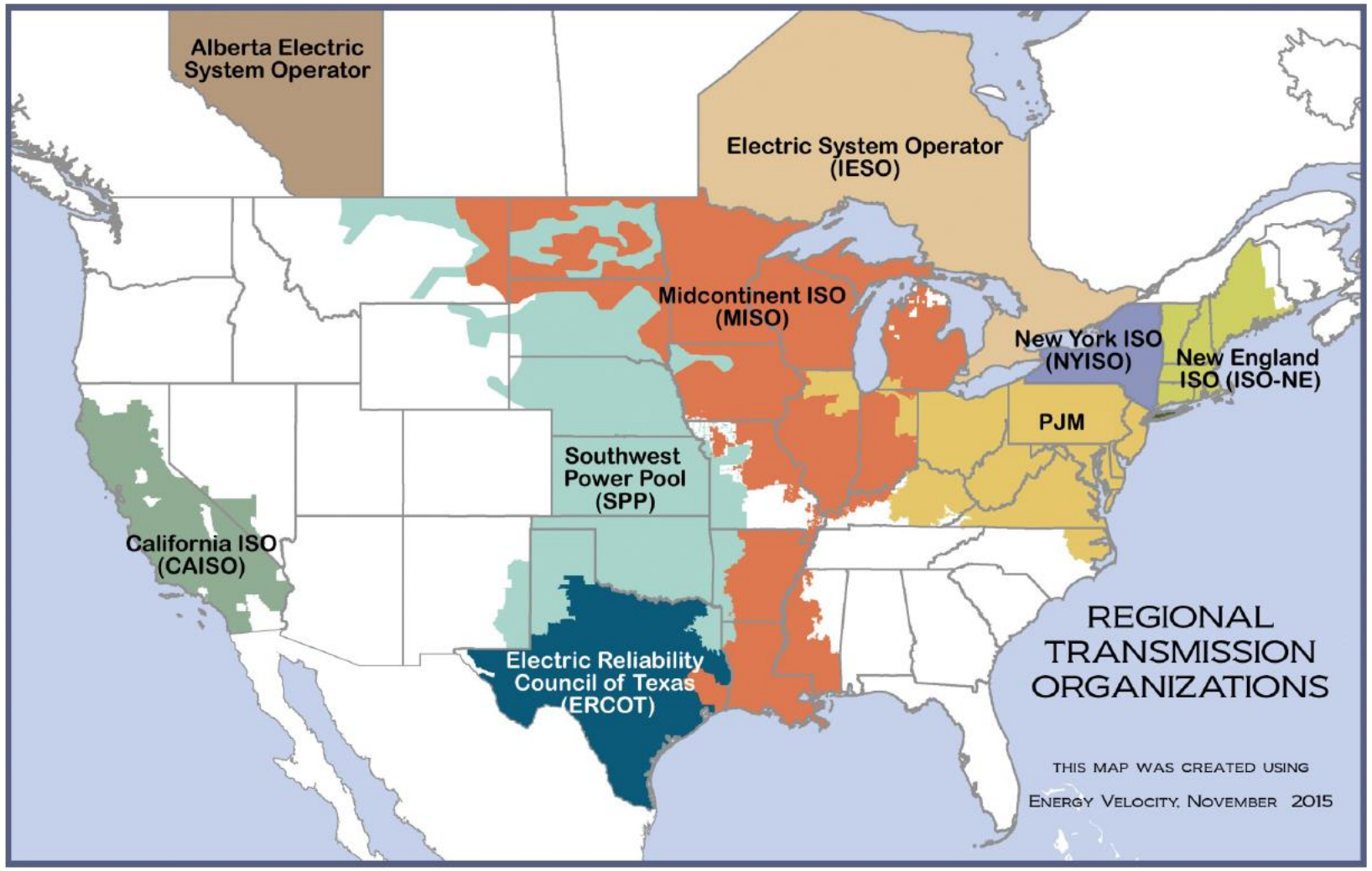
A European example: NordPool

http://www.nordpoolspot.com/#/nordic/map



PSL RESEARCH UNIVERSITY PARIS

USA Real Time Operator map

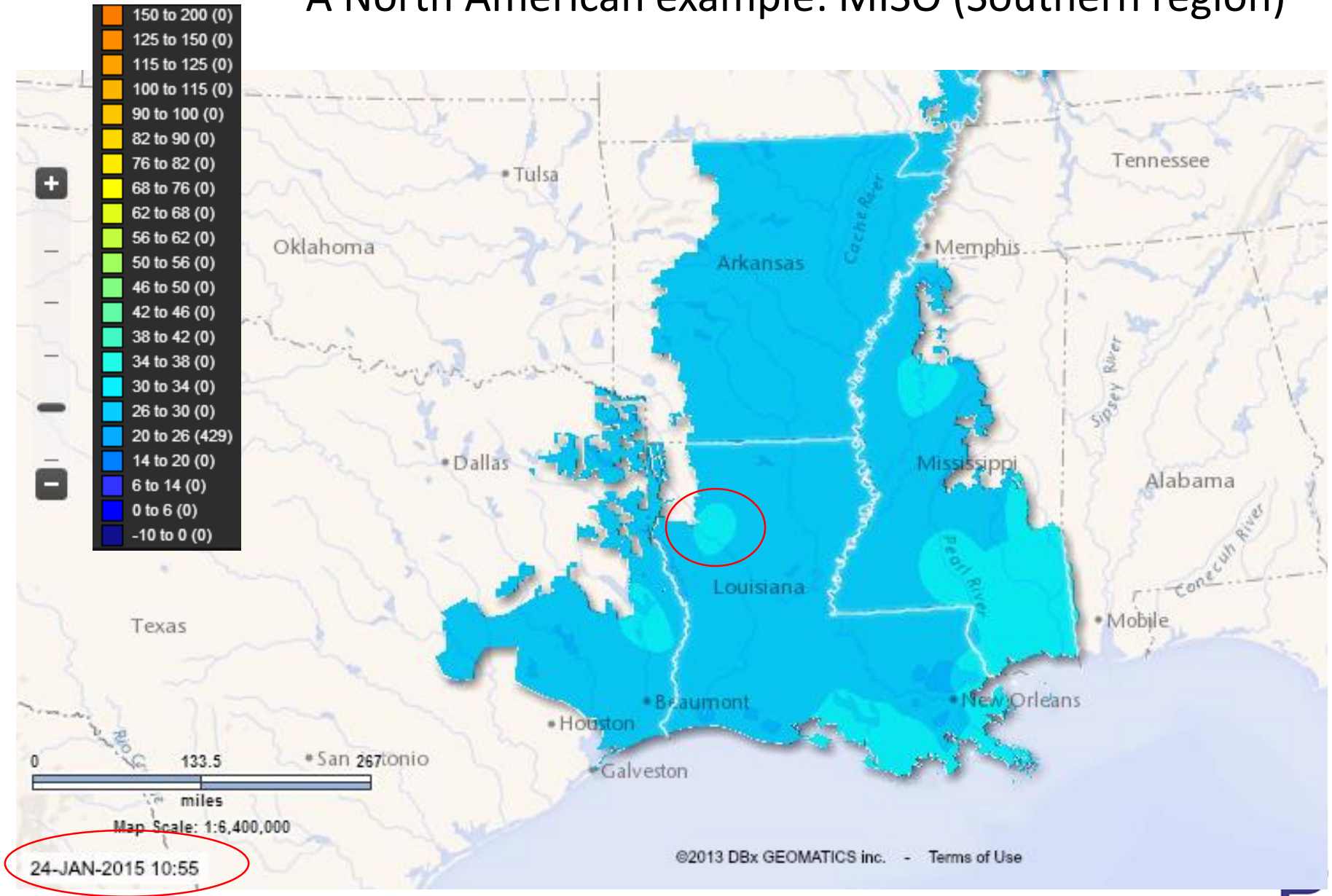


https://www.ferc.gov/industries/electric/indus-act/rto/elec-ovr-rto-map.pdf

PSL RESEARCH UNIVERSITY PARIS

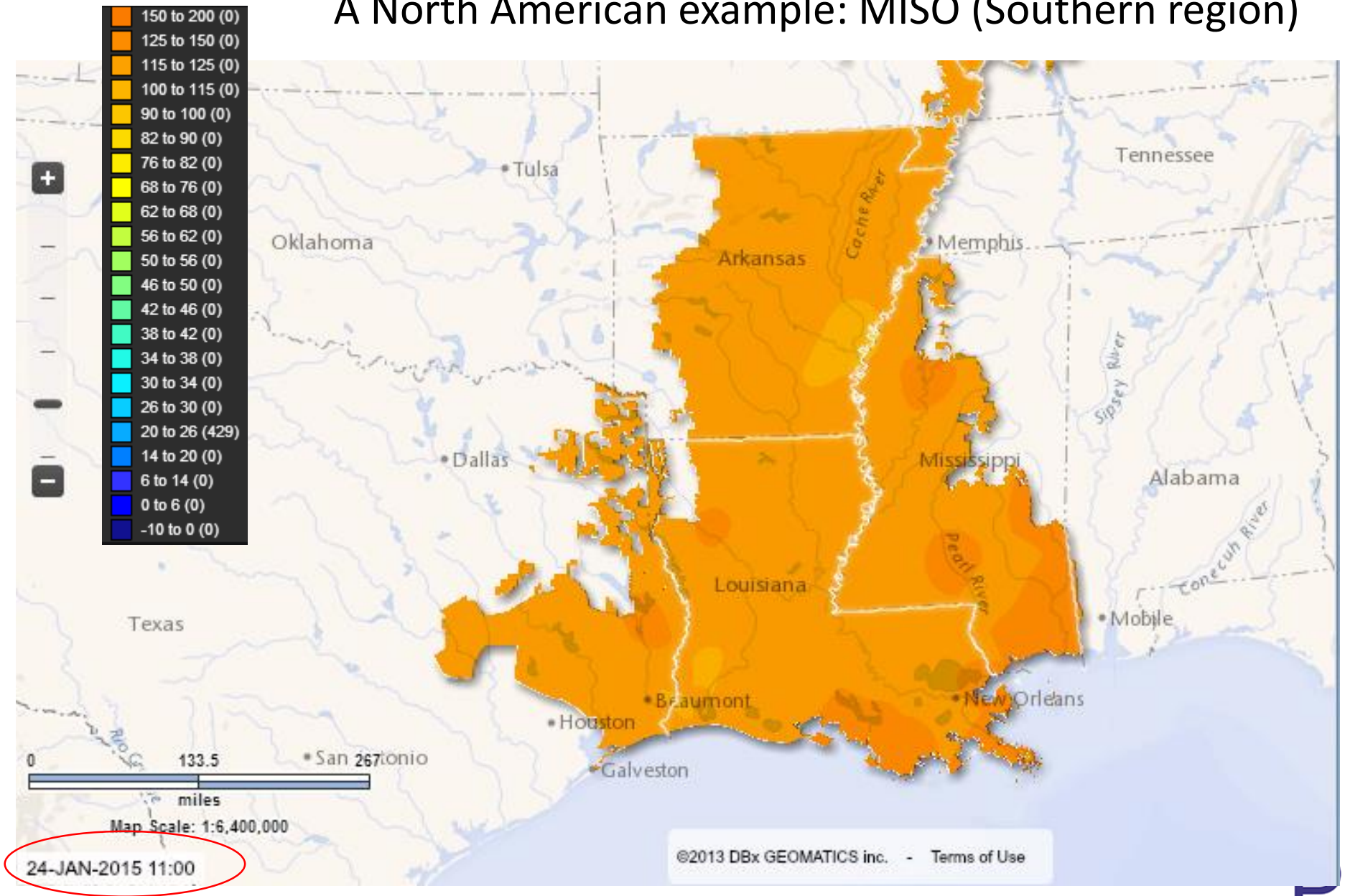
A North American example: MISO (Southern region)

https://www.misoenergy.org/LMPContourMap/MISO_All.html



Saturday, 10:55: the real time price map is quiet. Some fine grained differences (<30km) are visible

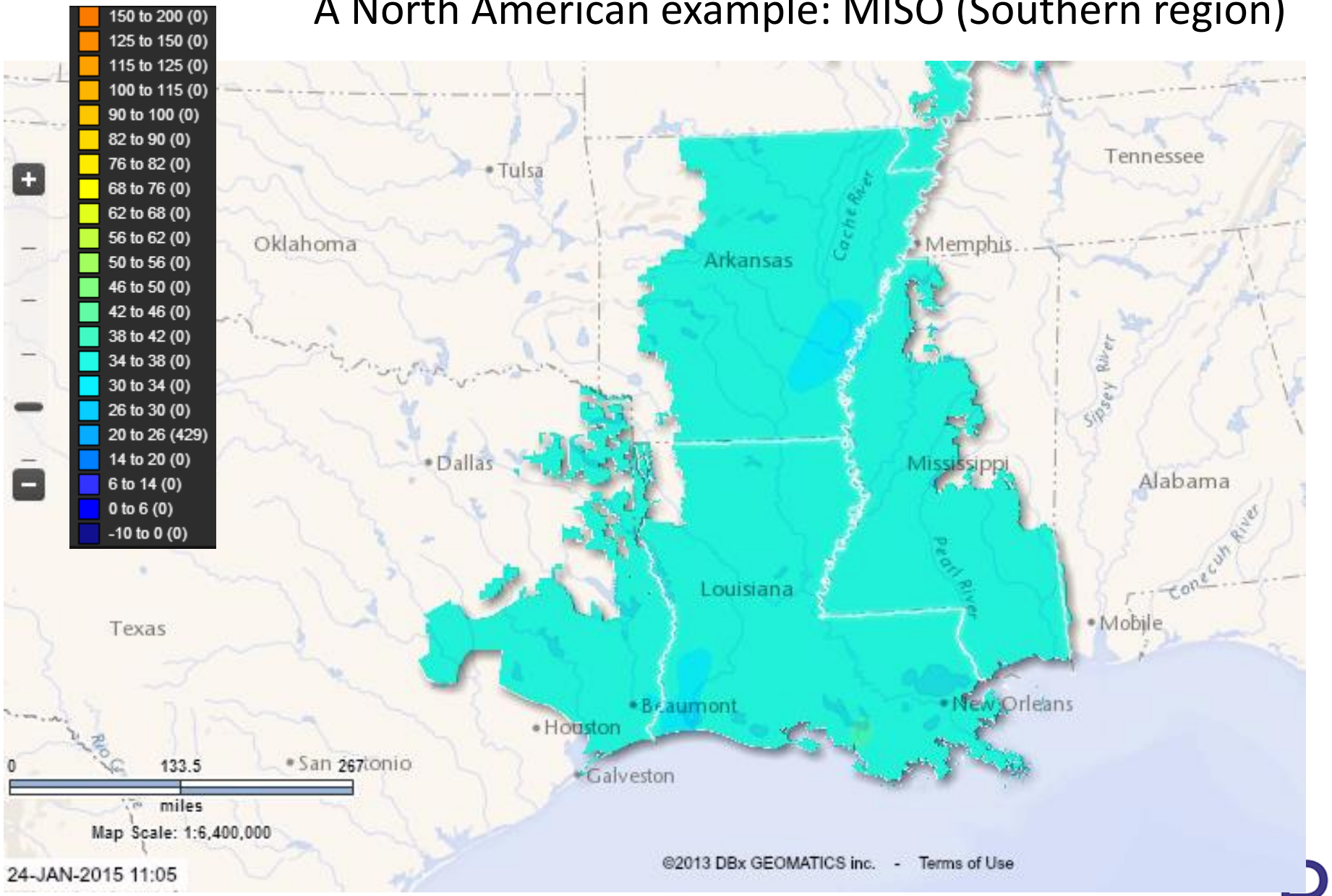
A North American example: MISO (Southern region)



5 minutes later: prices are up from 20 USD/MWh to more than 100 USD/MWh!

PSL RESEARCH UNIVERSITY PARIS

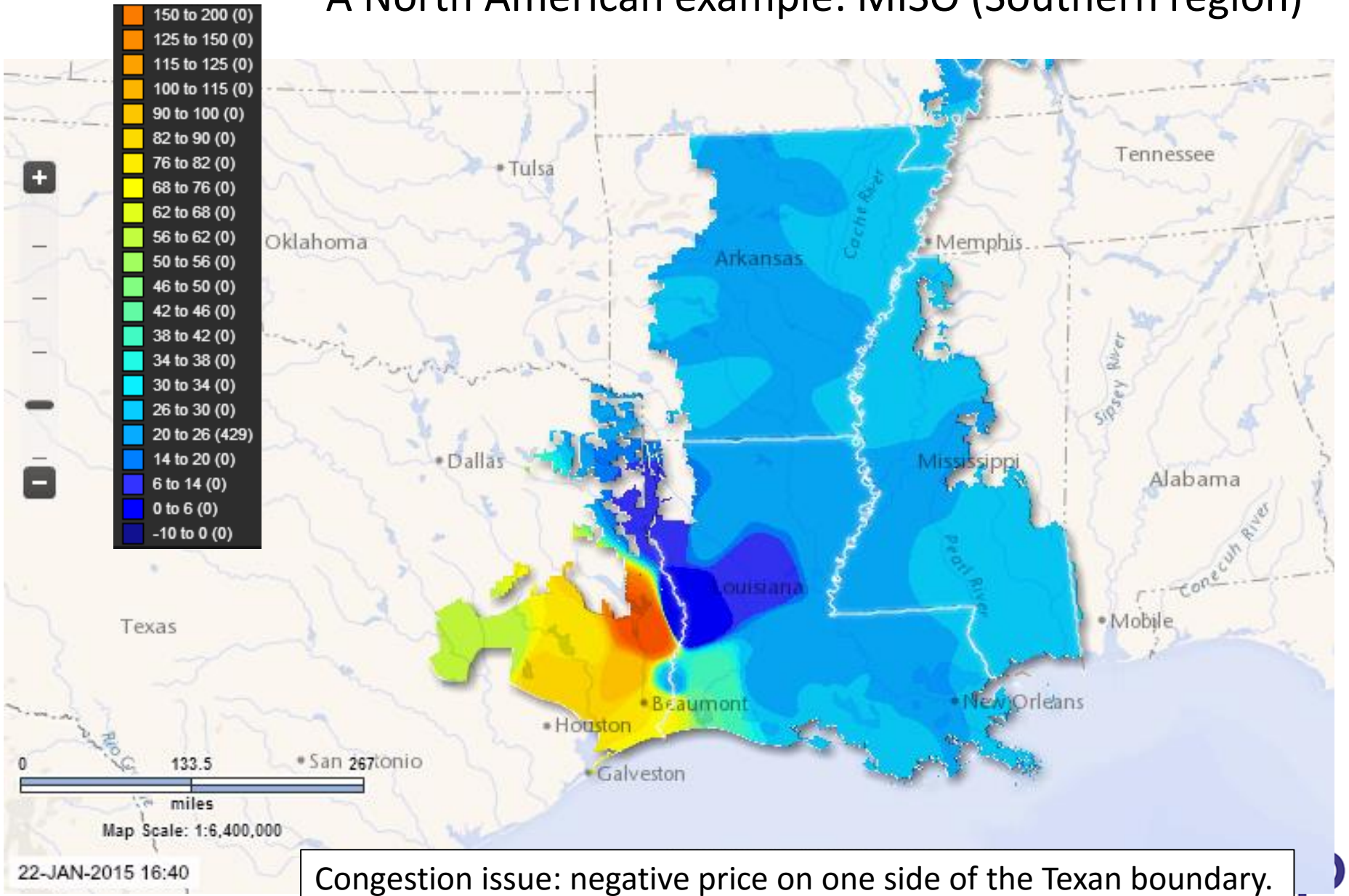
A North American example: MISO (Southern region)



10 minutes later: prices are down to 30 €/MWh…

PSL RESEARCH UNIVERSITY PARIS

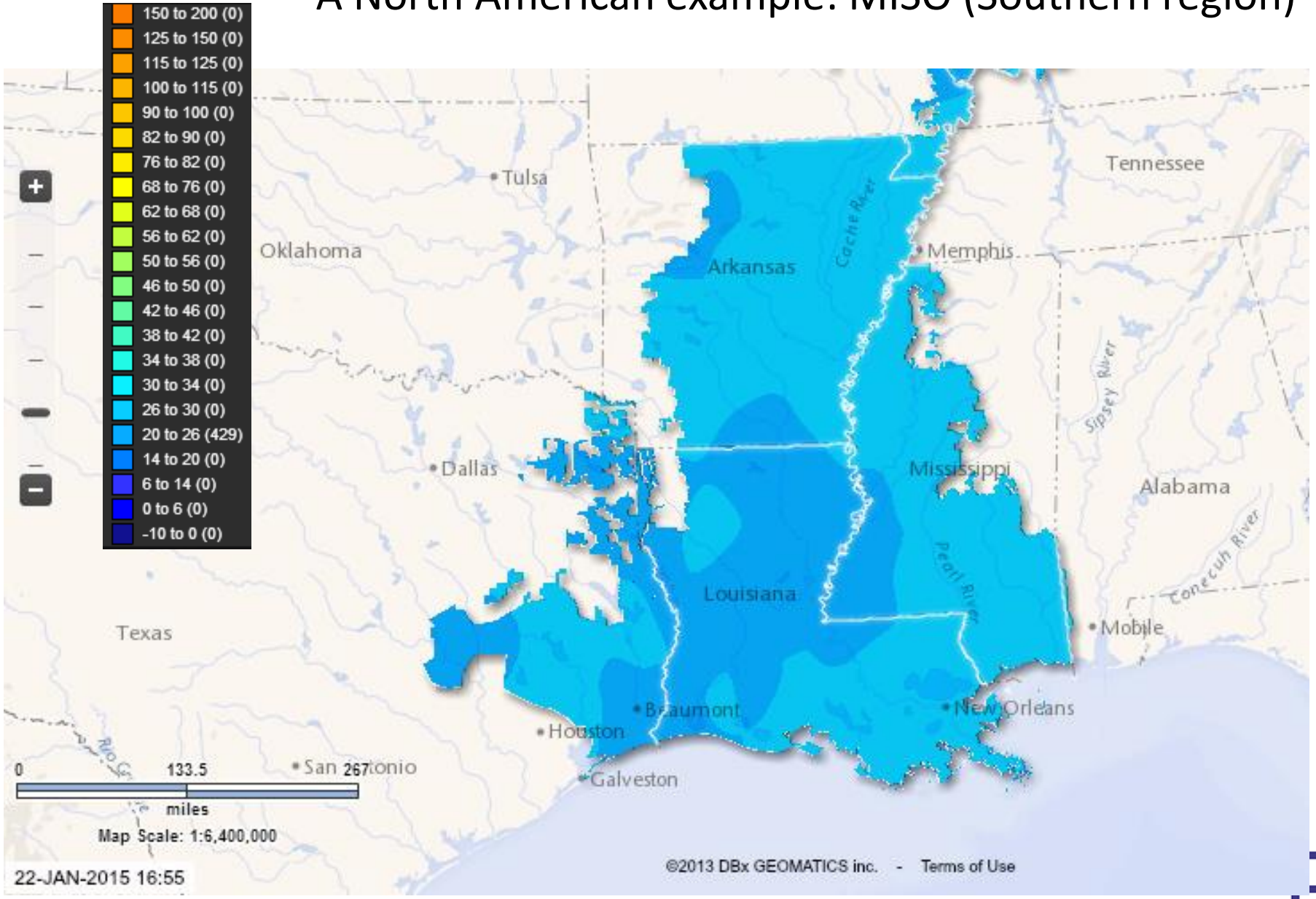
A North American example: MISO (Southern region)



Congestion issue: negative price on one side of the Texan boundary.
More than 160 USD/MWh of difference in virtually 0 km!

PSL RESEARCH UNIVERSITY PARIS

A North American example: MISO (Southern region)



10 minutes later: everything back to normal…

PSL RESEARCH UNIVERSITY PARIS