Réseau de transport d'électricité

Overview on electricity systems and renewables integration

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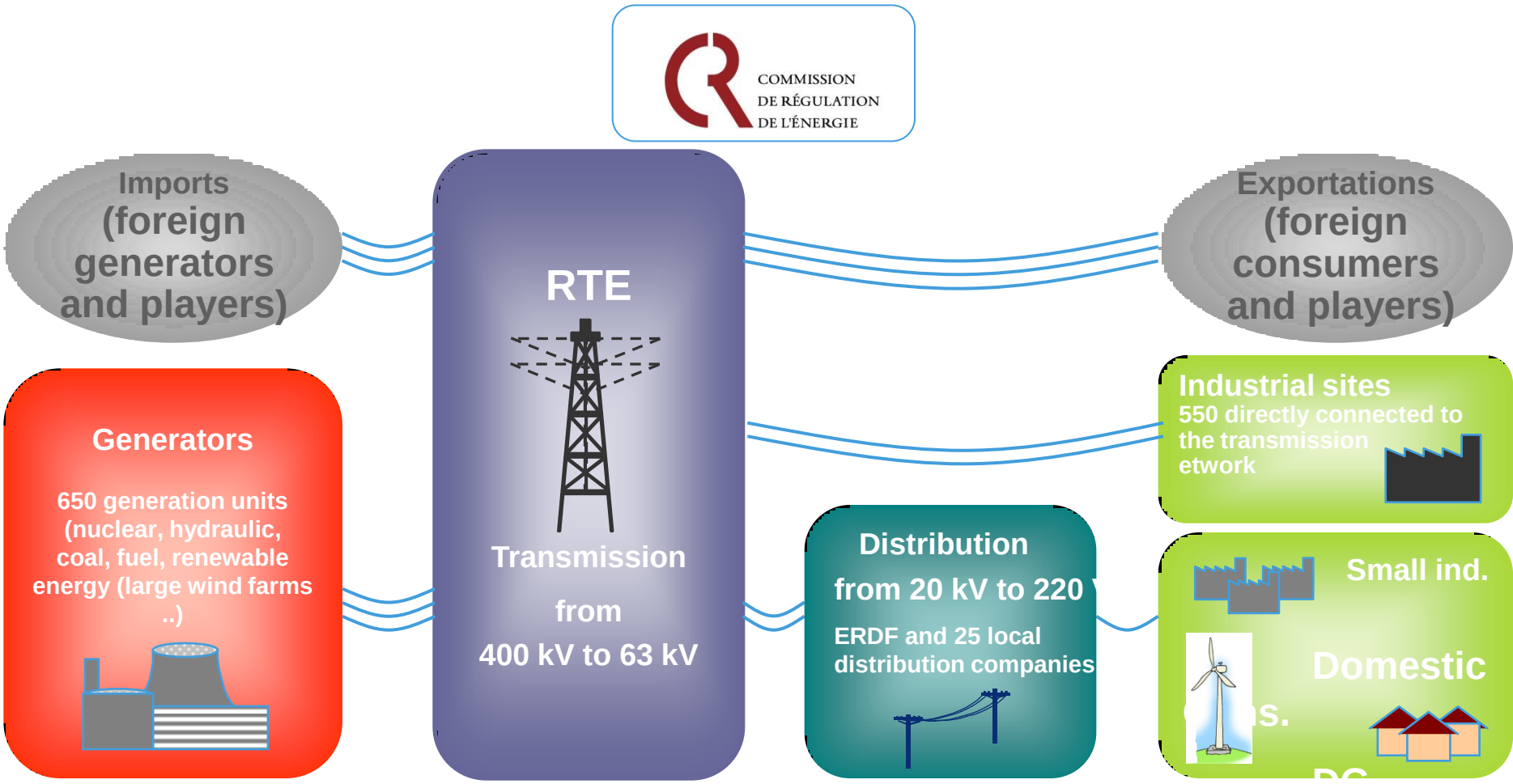
Outline

1. Introduction
2. Weather and European power system
3. Near Future
4. Conclusion

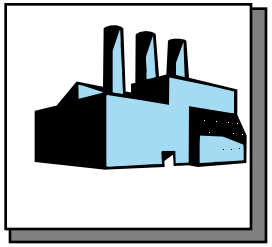
INTRODUCTION

French electricity system



Competing electricity suppliers / consumers free to choose their supplier

Roles and liabilities

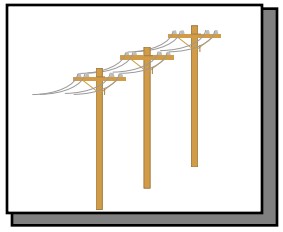


Producers

- required to dispatch their units in order to provide the energy volume sold to their counterparts
- required to provide margins to handle the outages on their units
- required to offer on the BM the total of the remaining power technically available on each unit (French law)

Suppliers

- required to satisfy the contracts of electricity delivery with their customers
- required to be covered against the risk on the level of consumption of their customers



TSO

- required to provide a non discriminatory network access to all users
- operational responsibility to maintain load-generation balance and system security by calling for the reserves submitted by the market participants on the BM, according to their merit order

European electricity today

34 INTERCONNECTED COUNTRIES

Interdependence

Mutualisation

Integration

4 SYNCHRONOUS ZONES

Continental Europe

Scandinavia

United Kingdom

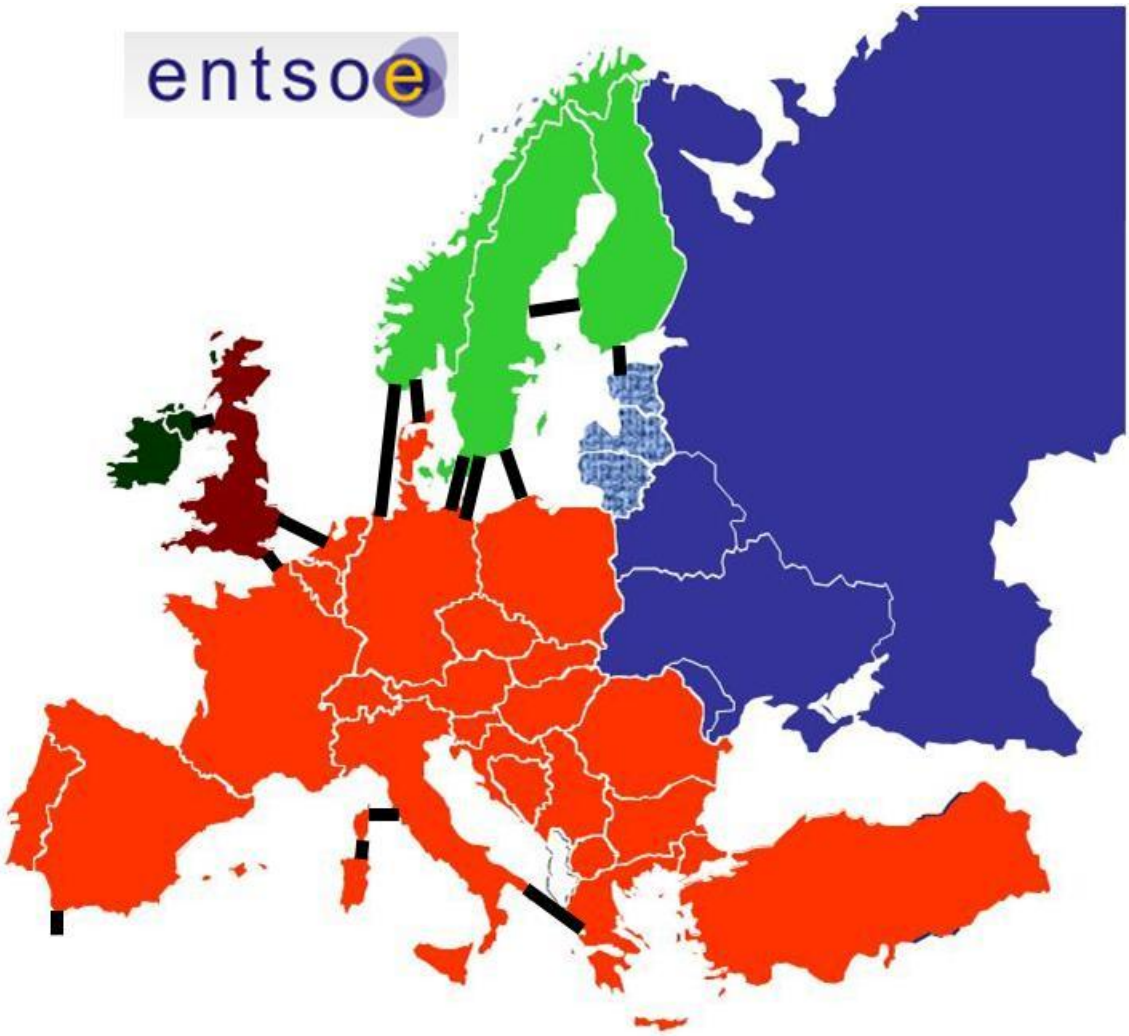
Ireland

KEY FIGURES

Installed capacity > 800 GW

Consumption > 3 300 TWh / year

Physical exchanges > 380 TWh / year

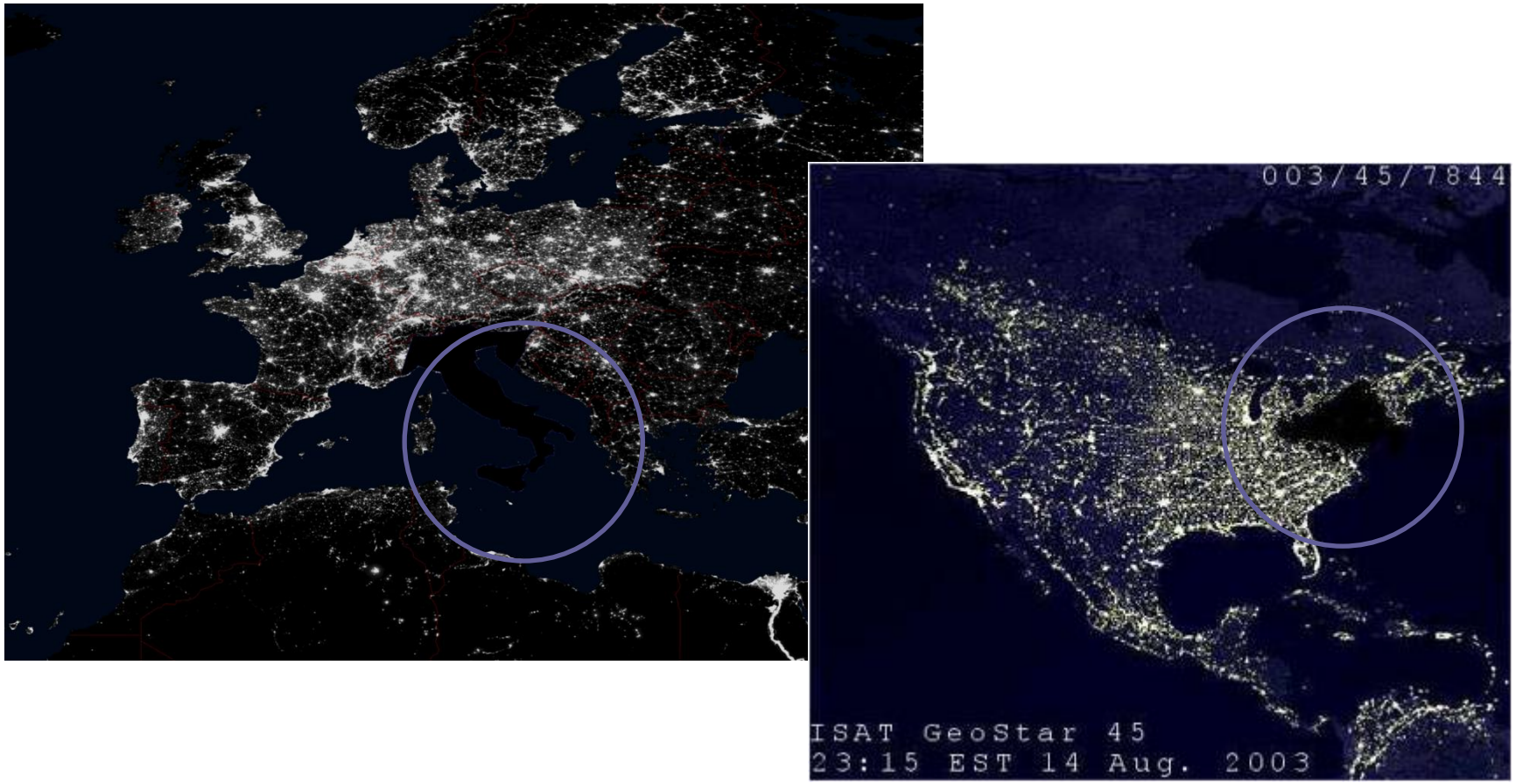


French TSO's missions

- **Balancing** electricity generation with consumption at all times (Electricity cannot be stored!)
- Guaranteeing the secure operation of the power system (carrying electricity 24 hours a day, 7 days a week)
- Maintaining and developing the network to allow generators, distribution networks and consumers to be connected, as well as **interconnection** with neighbouring countries
- Guaranteeing non-discriminatory access to the transmission network, whilst ensuring that commercially sensitive information remains confidential
- Integrating transmission installations into the environment and ensuring the security of people and property

… all at the most economical cost possible

Avoiding blackouts



2003, 2006 (Europe), 2008 (US), 2011 (Japan), 2012 (India),…

Different time scales for forecasting

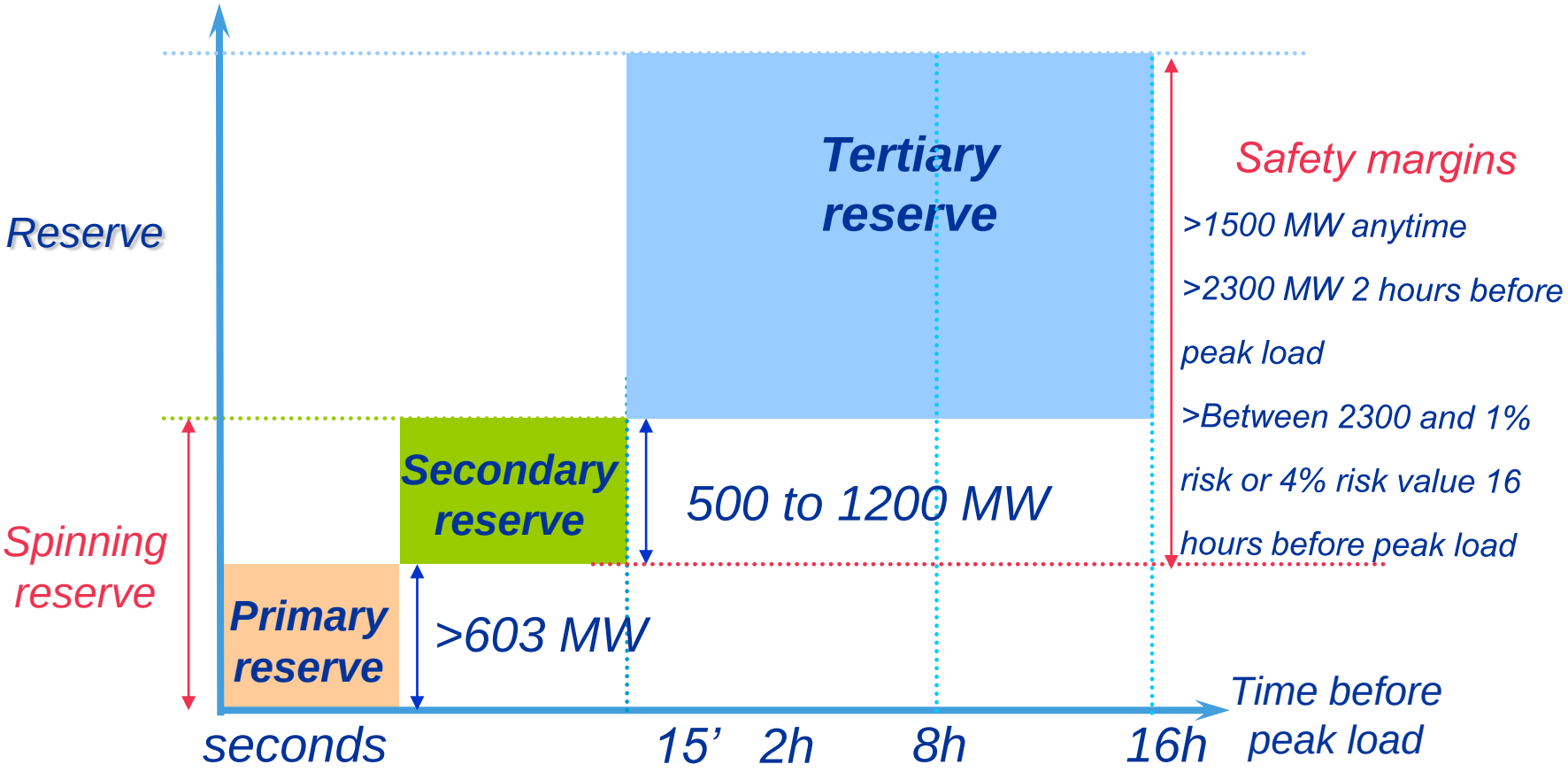
Long-term : investment

Mid-term : few months to few years
maintenance program

Short-term : few days to day-ahead
prepare dispatch program

Intraday and real-time : market + balancing mechanism

Generation-Demand balance in real-time



WEATHER INFLUENCE ON EUROPEAN POWER SYSTEMS

Weather influence on the network

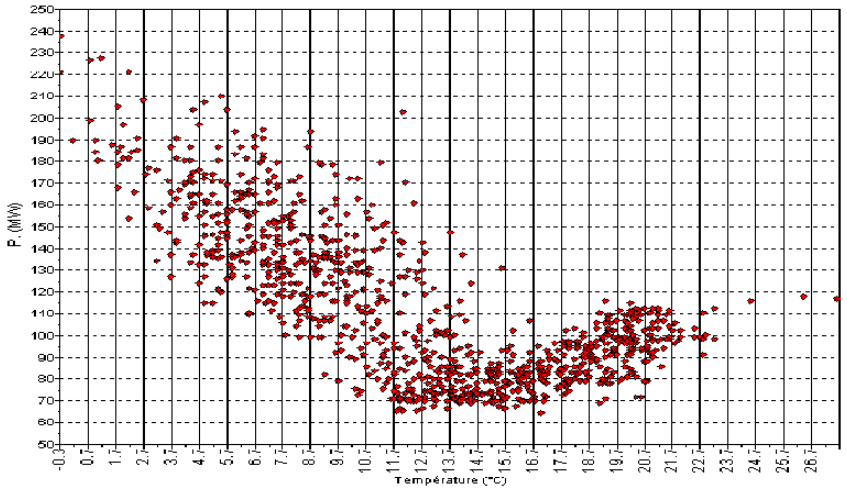
Wind storms

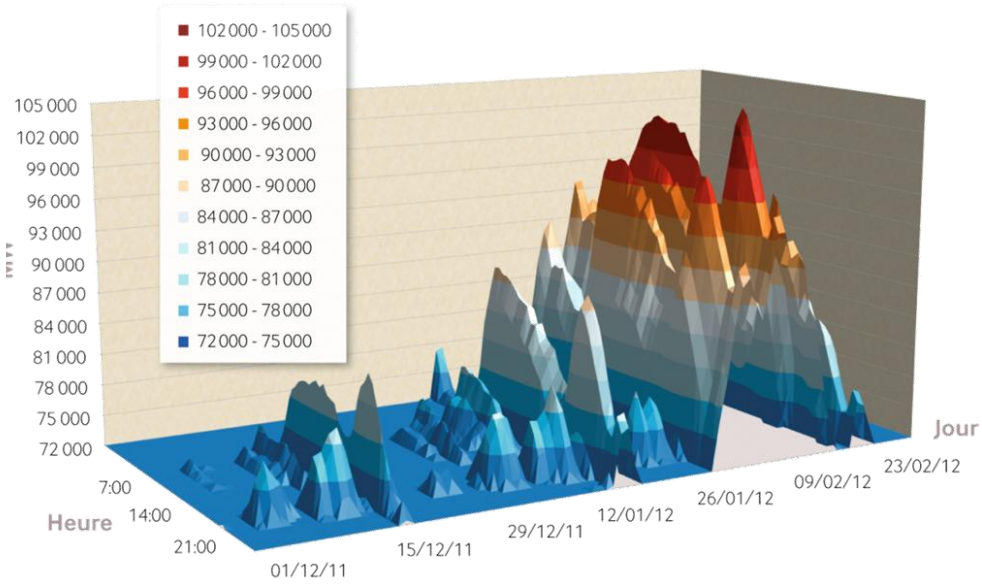
Ice, Snow

=> Local extremes forecasts

Weather influence on the balance

Electricity demand





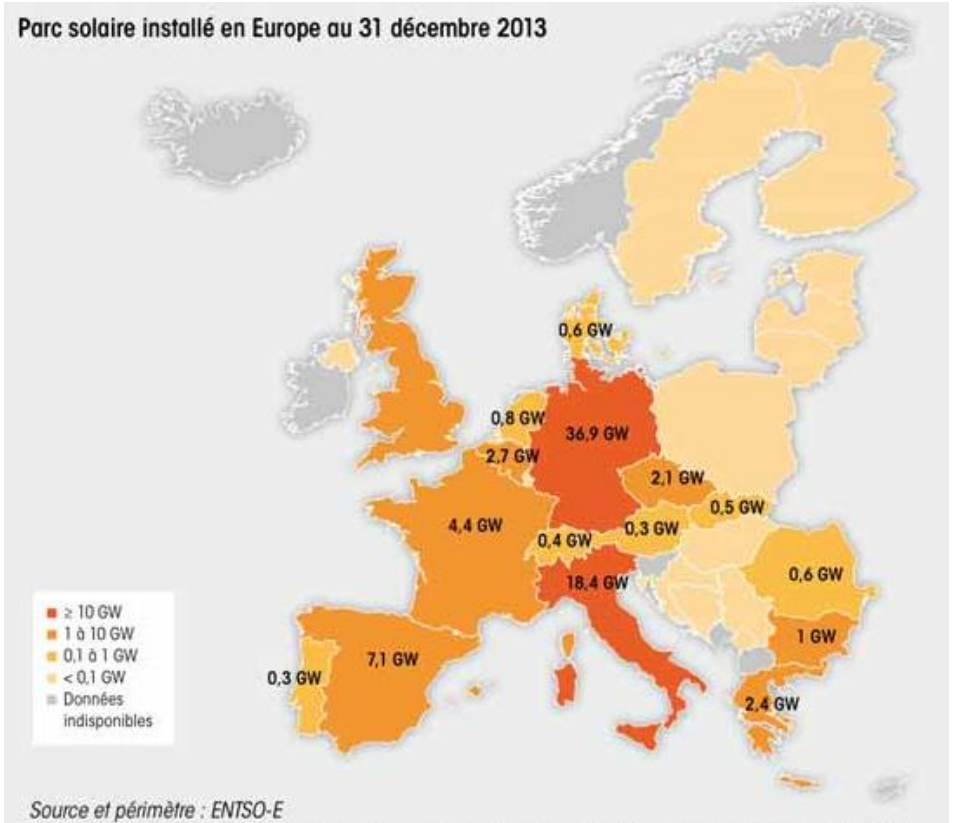
France : ~2400MW/Celsius Degree in winter
Consumption for cooling in summer is increasing
⇒ Accurate temperature forecasting is required (deterministic/probabilistic)

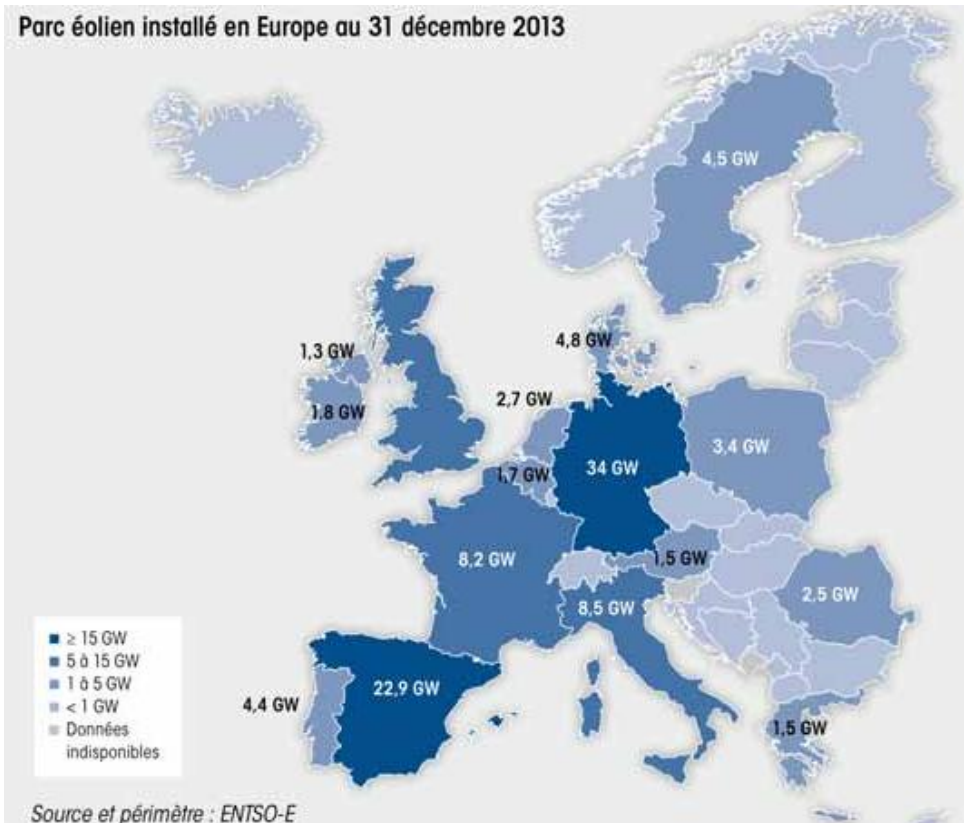
Other variables : cloud-cover, possibly wind

Weather influence on the balance

Intermittent renewables

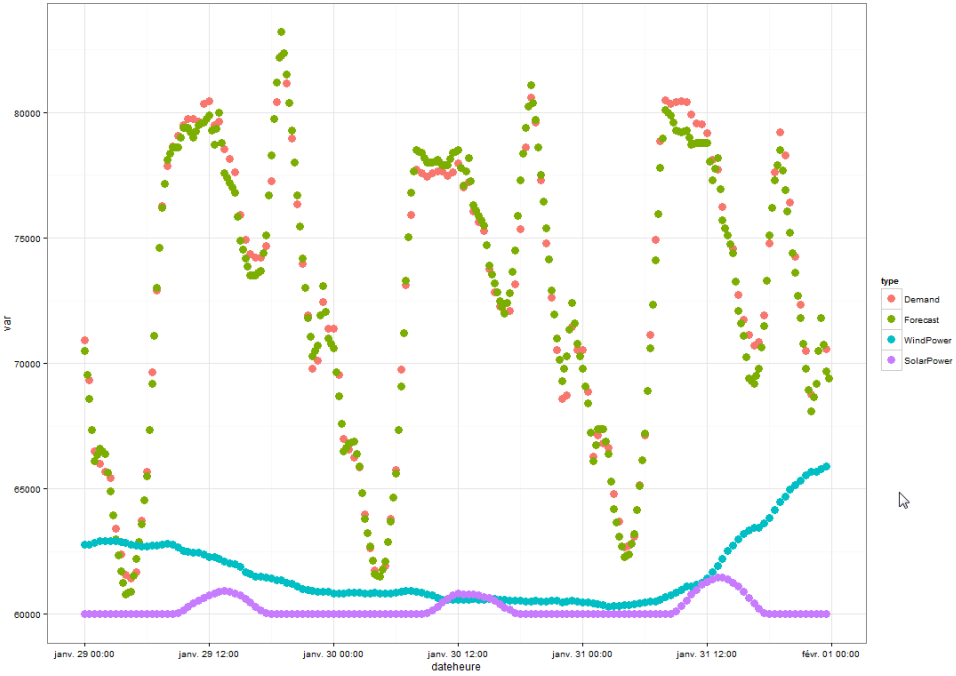
Do not forget hydro power (can be optimized by producers!)



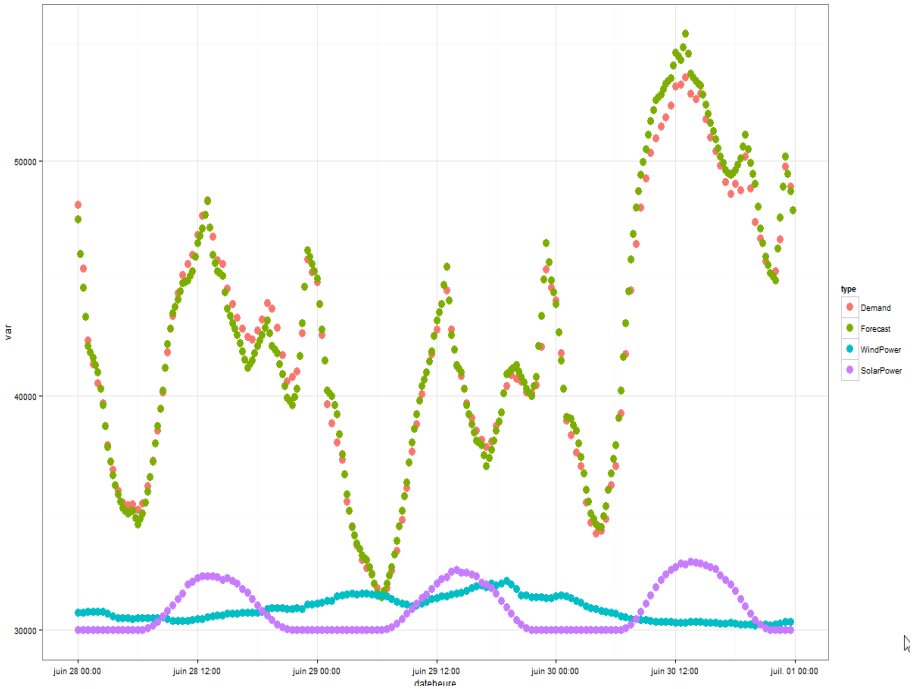


Residual demand

End of January 2014



End of June 2014



Data

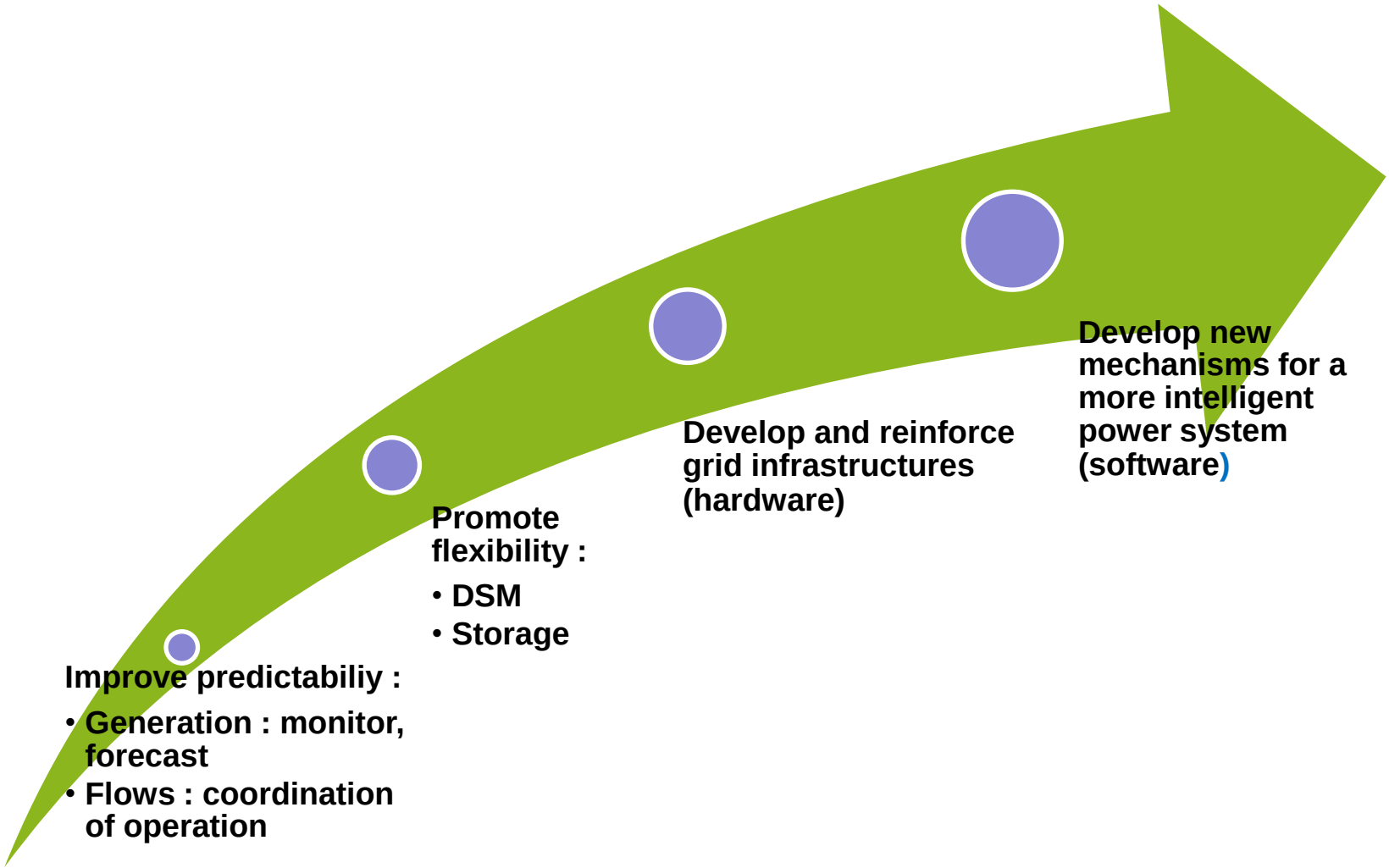
Short-term : operational forecasts from ARPEGE Model (Météo France)

Mid/Long-term : scenarios from ARPEGE-CLIMAT consistent with ERA-Interim

Variables : temperature, wind –U,V-, solar irradiation, cloud-couver)

NEAR FUTURE

Keys to enable an anergy transition

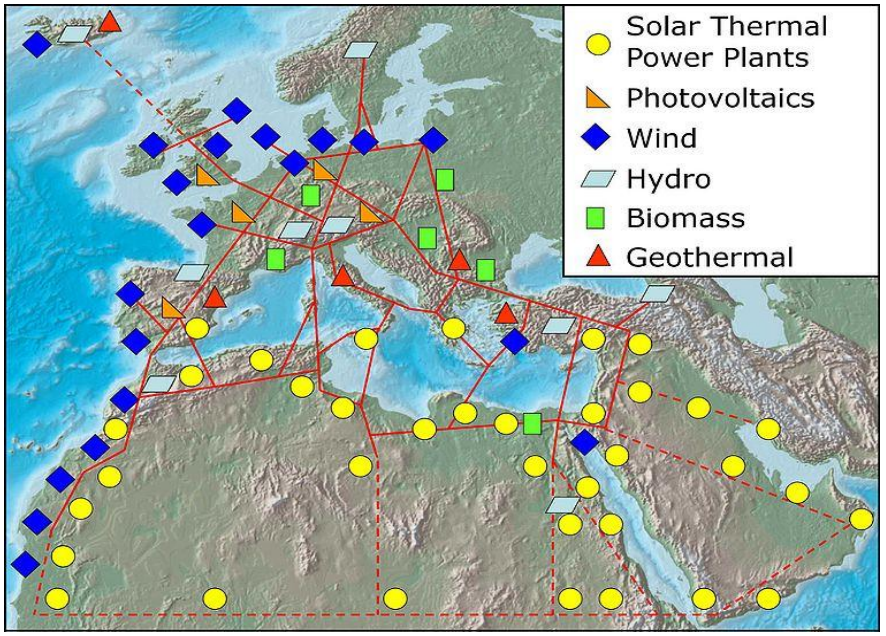


In the near future

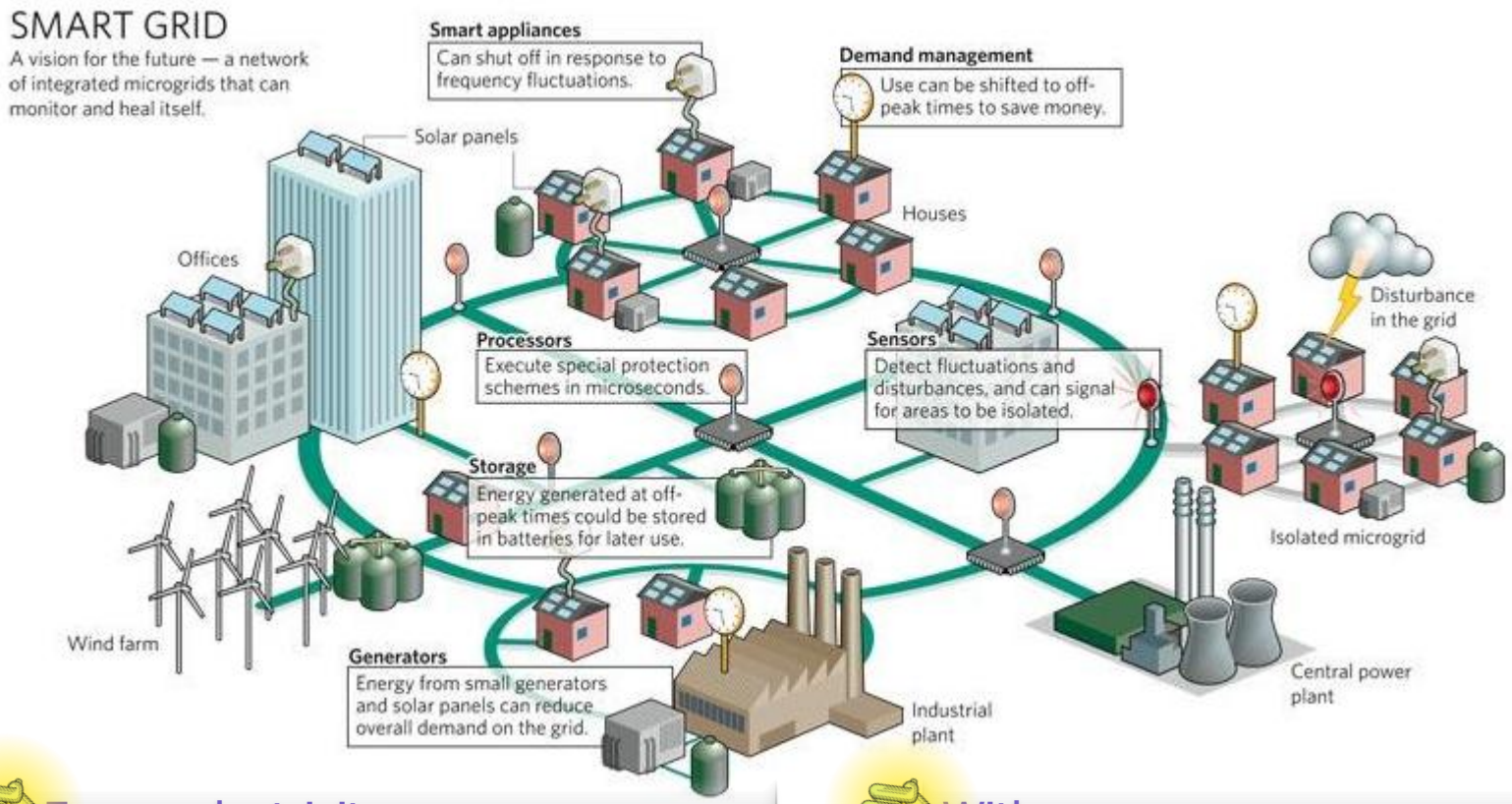
Smart grids

Greater integration of European (and beyond) markets

Storage



Smart grids



For an electricity :
- greener
- more flexible

With :
- new devices
- a more complex market design

CONCLUSION

To wrap up

Consistent dataset required

Fine geographical and time resolution

Probability of extremes