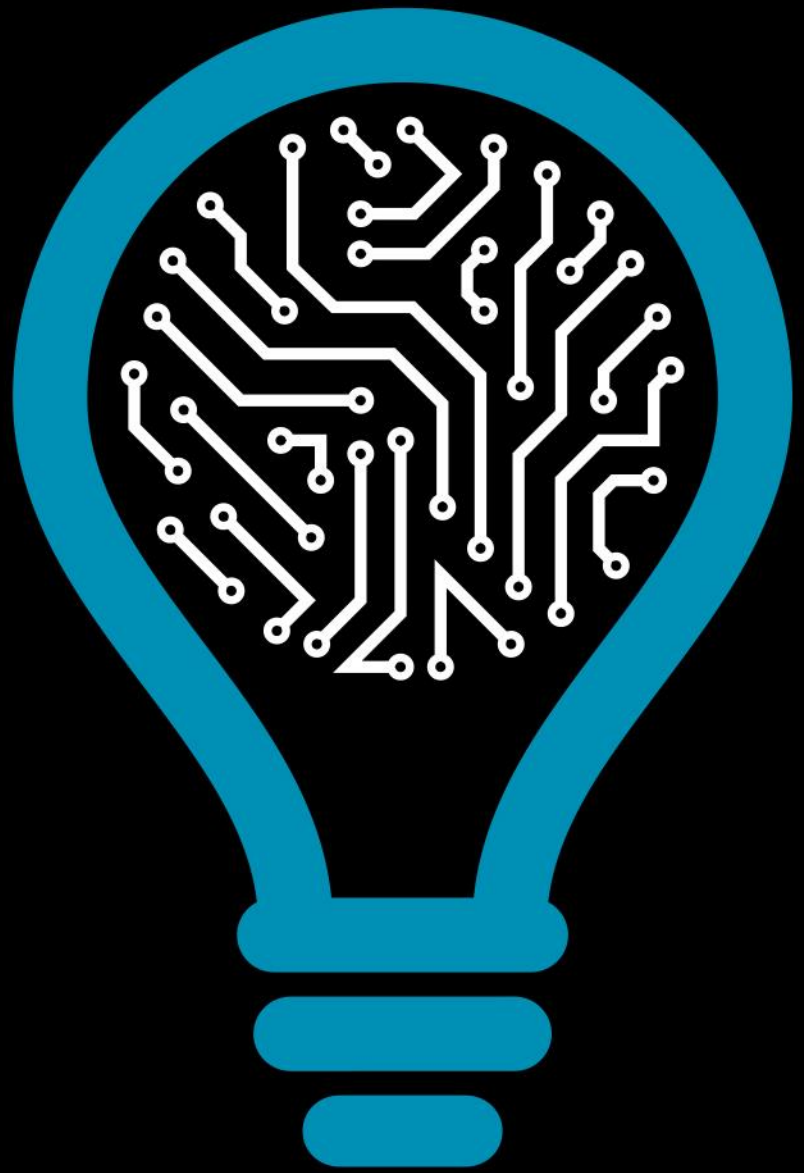
REDES ELÉTRICAS INTELIGENTES COMO CONDIÇÃO DE SUCESSO NA CONTENÇÃO DAS ALTERAÇÕES CLIMÁTICAS



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Junh0 2018

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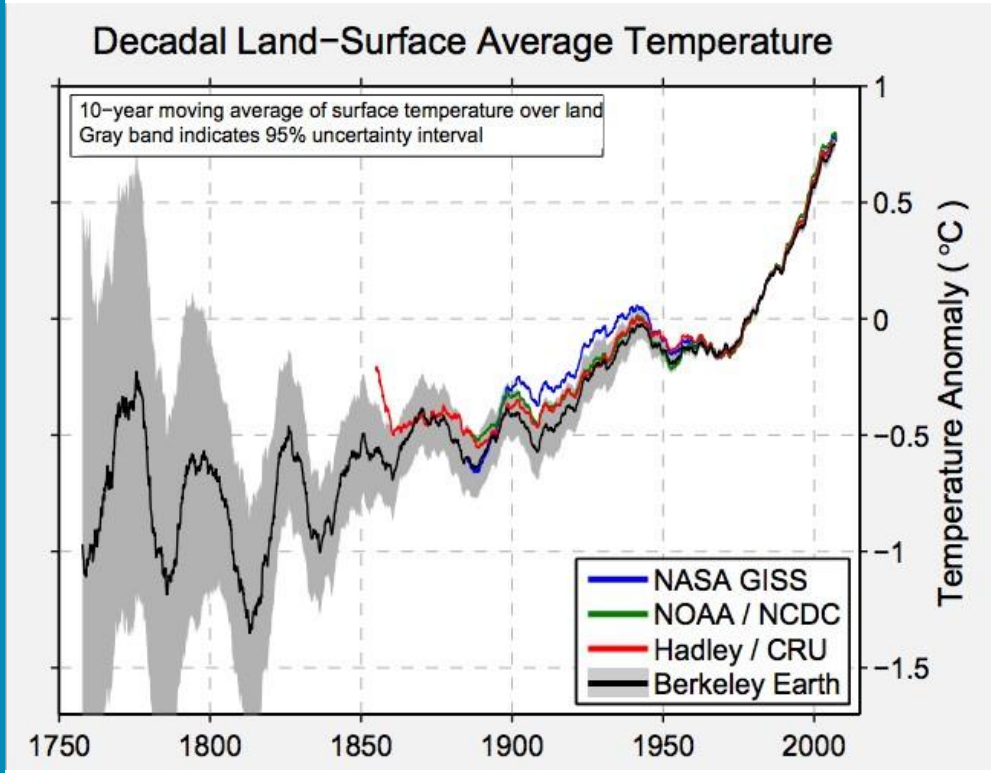
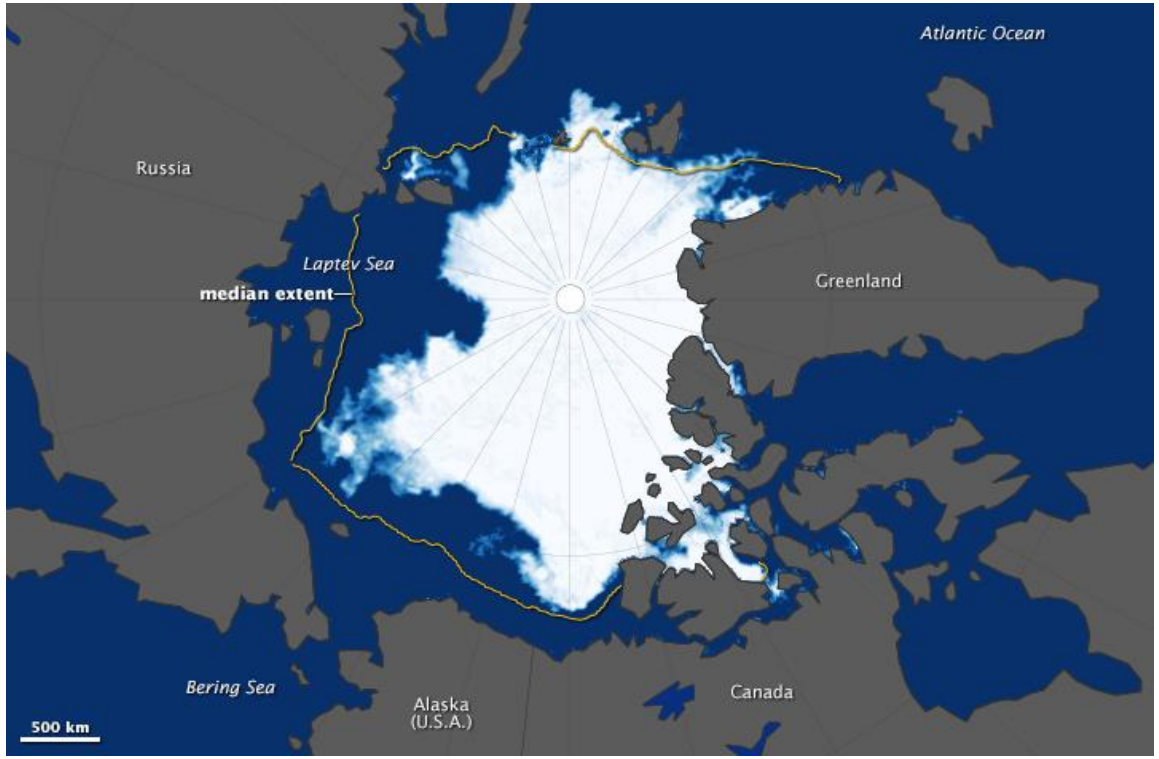
Climatic Changes

Global land temperatures have increased by 1.5 degrees Celsius over the past 250 years





Sea ice acts as an air conditioner for the planet, reflecting energy from the sun.

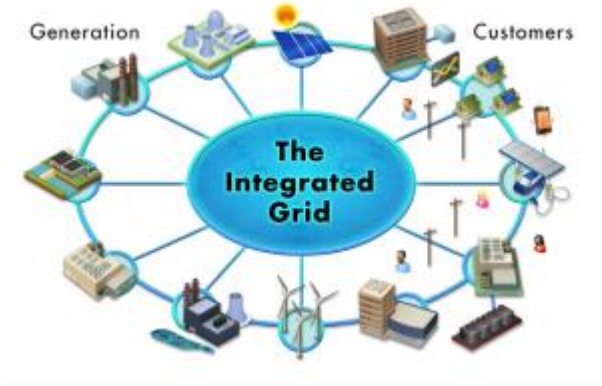
On September 17, the Arctic sea ice reached its minimum extent for 2014.

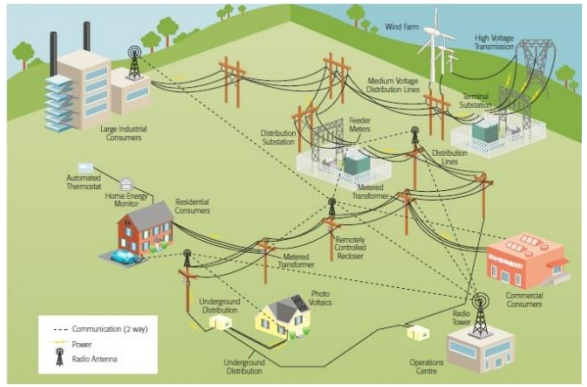
Introduction - Drivers

- **Climatic Changes → Large Electrification of the Economy (most efficient way)**

- **Driving forces for the future development of the electric energy industry:**
  - 1) **Environmental issues**: meet the PARIS Climate Agreement targets
  - **2) The mobility problem → Electric mobility**
  - **3) Replacement of old infrastructures** (generation and grid)
  - **4) Security of Supply**
  - **5) Increase quality of service** (more automation and remote control)
  - **6) Electricity market liberalization** (energy and services)
  - **7) Consumer empowerment**
  - **8) Availability of non-expensive ICT solutions**

Introduction – A vision of the future

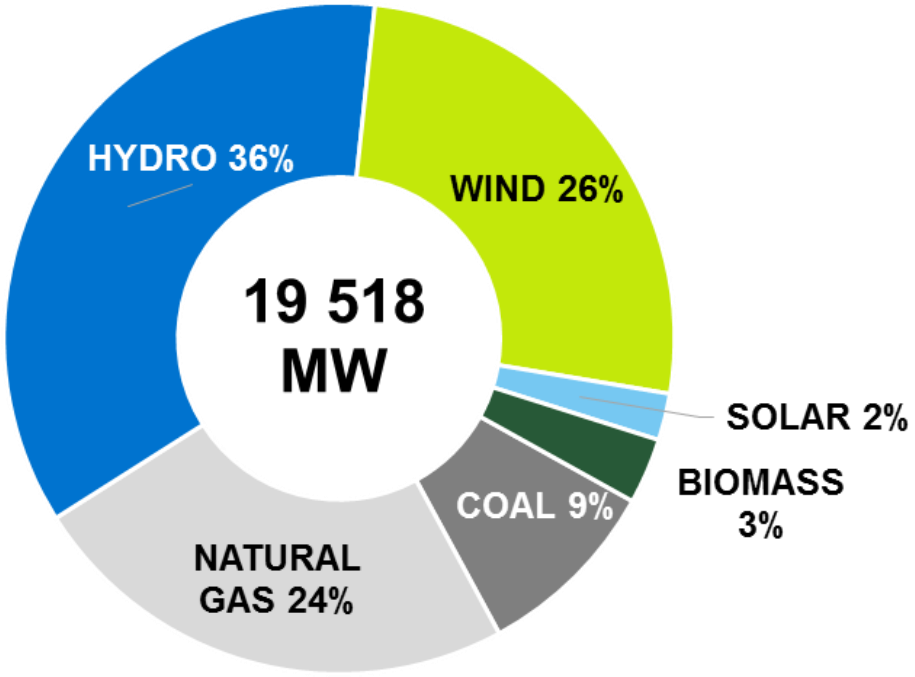




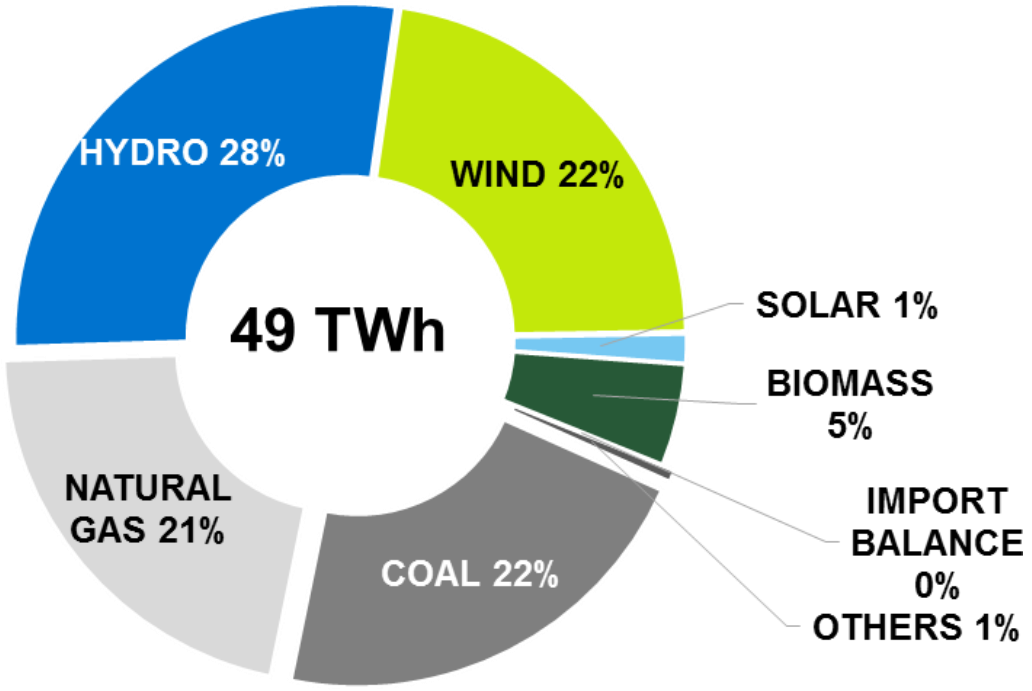
The Portuguese case

2016

INSTALLED CAPACITY

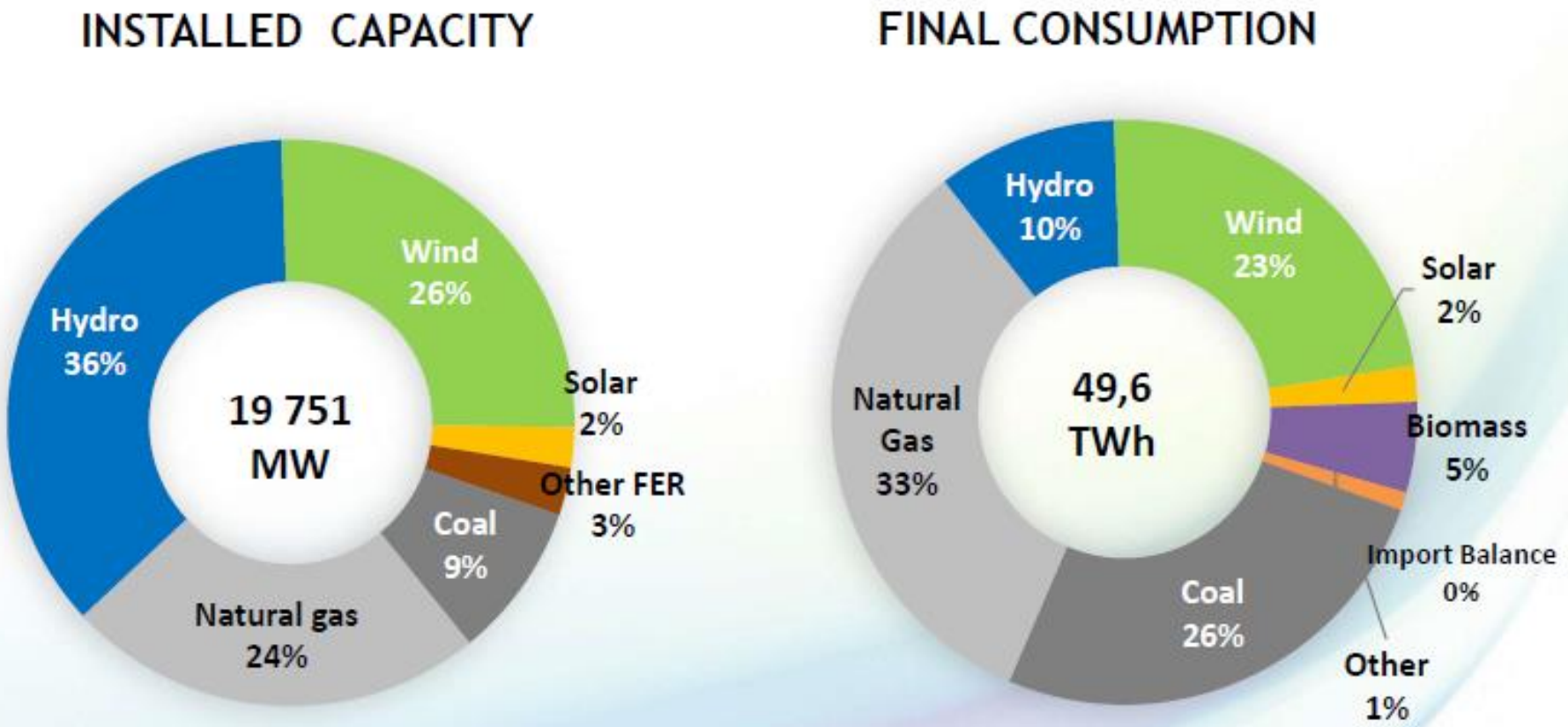


FINAL CONSUMPTION



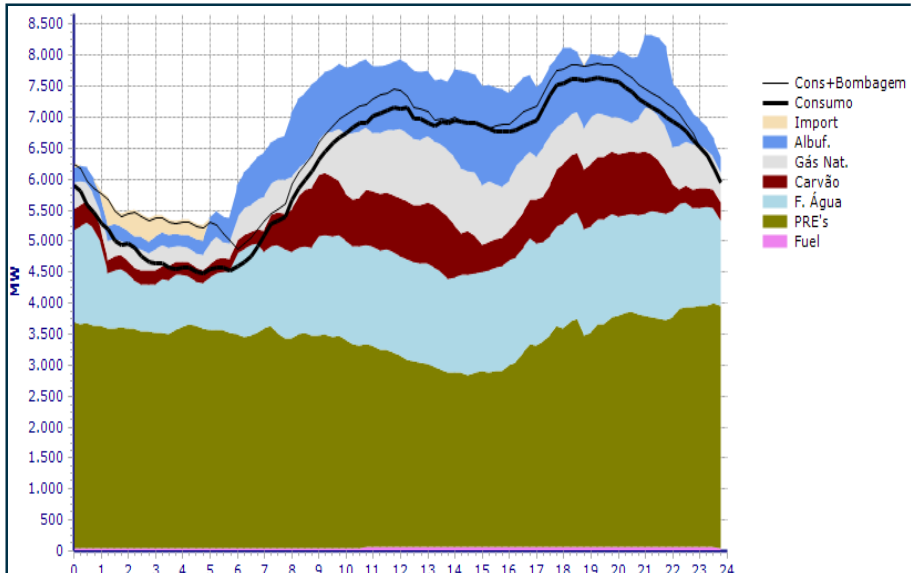
The Portuguese case

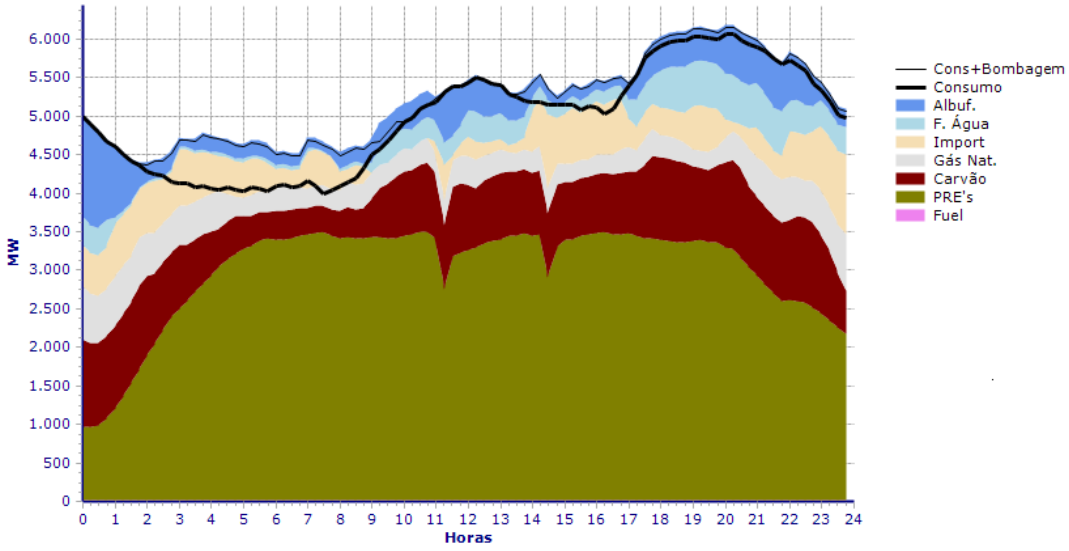
2017



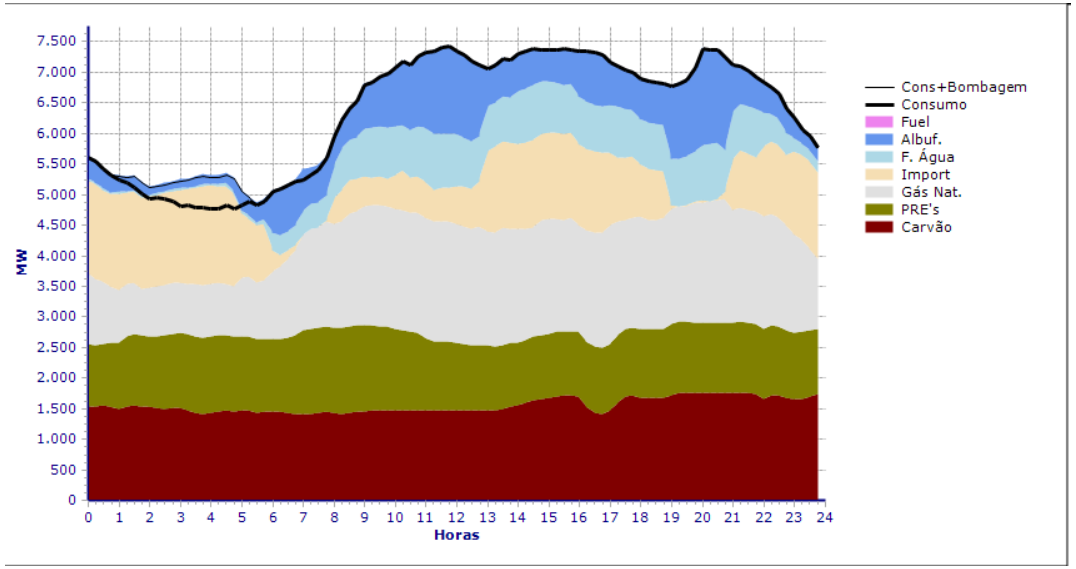
Solar PV generation will increase largely → 5000 MW

The variability of the RES generation





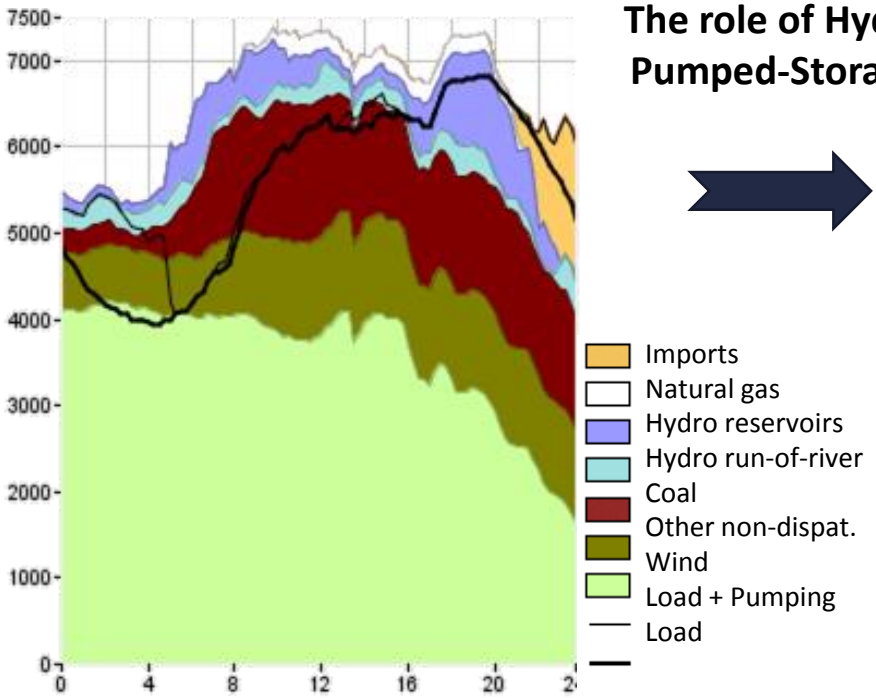
Different generation profiles from RES



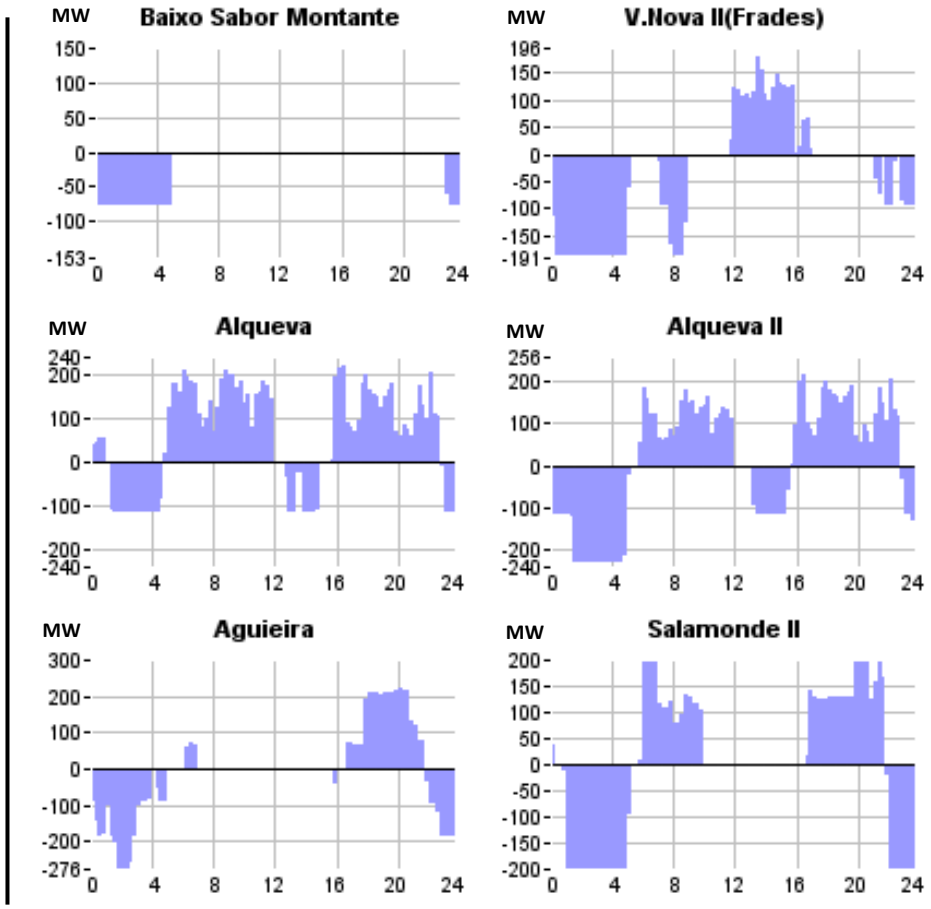
From REN:
http://www.centrodeinformacao.ren.pt/PT/InformacaoExploracao/Paginas/EstatisticaDiariaDiagrama.aspx

The variability of the RES generation

Load diagram 28th December 2015

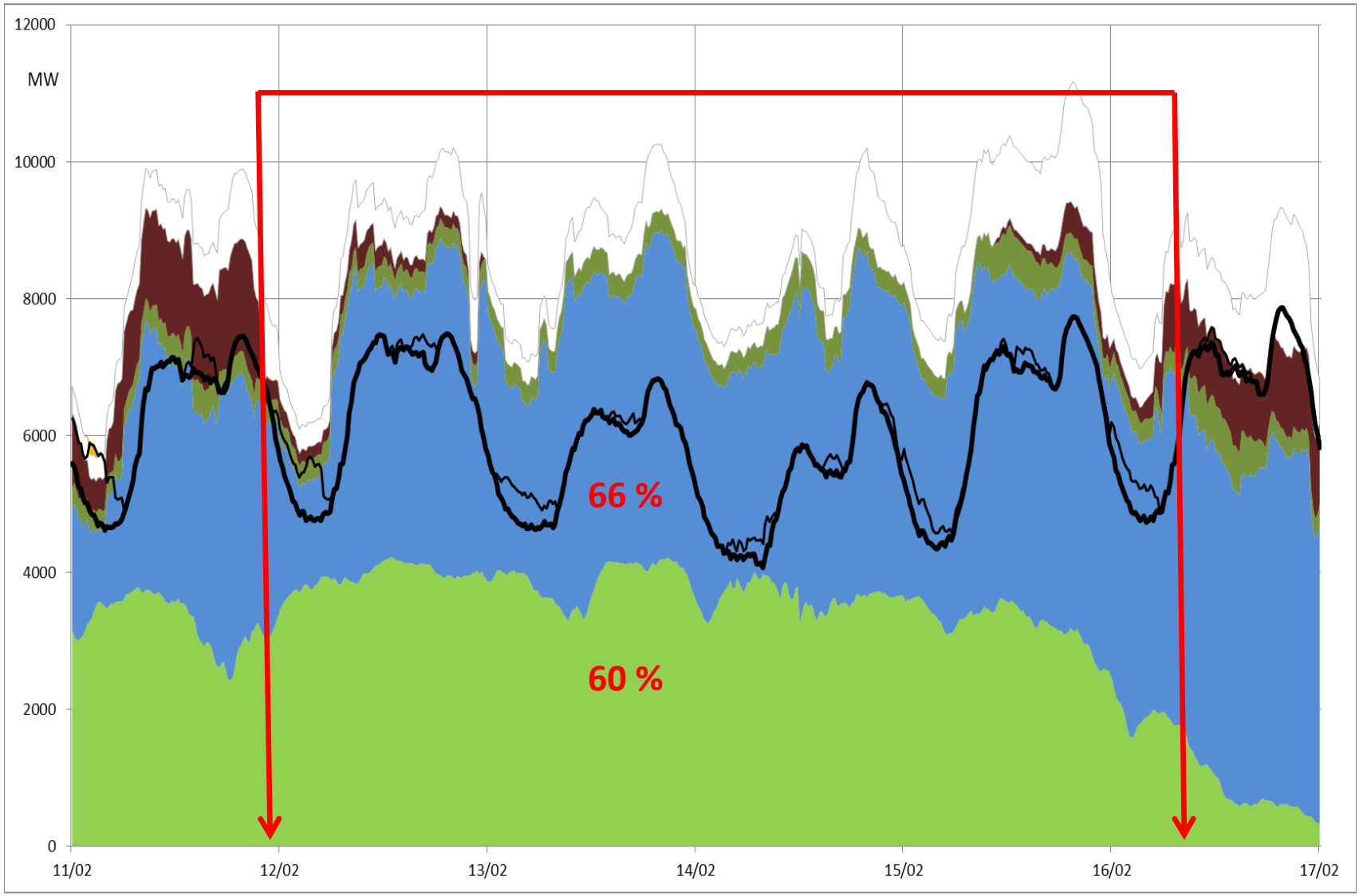


The role of Hydro Pumped-Storage



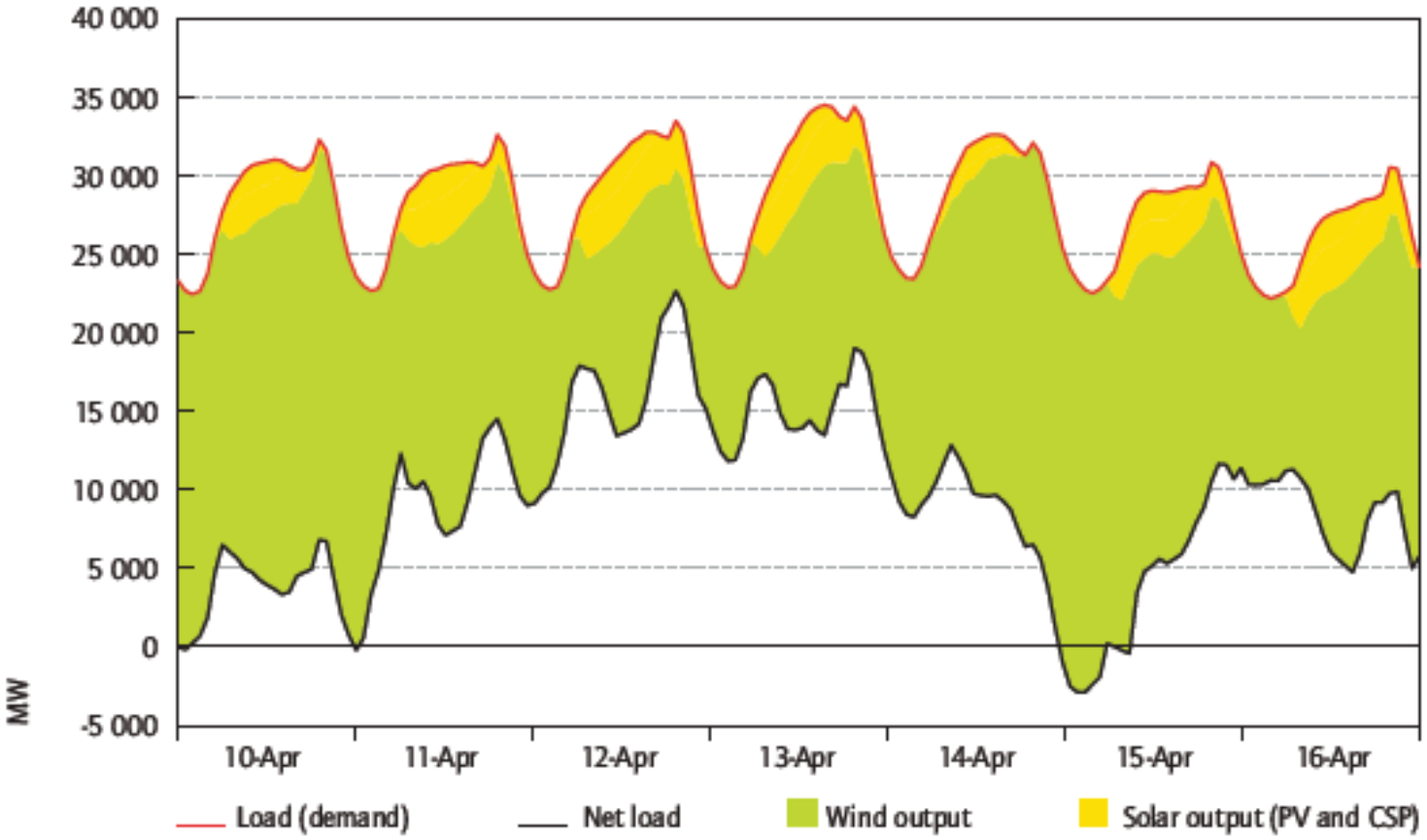
Renewables may exceed Portuguese load during some periods;
Hydro pumped-storage and interconnections contribute to assure full energy usage.

The variability of the RES generation



2016 Feb. RES enough to feed all the load and export during 106 h

Large variability of renewables generation



Source: GE Energy, 2010.

Flexibility

- **Load**
- **Generation**
- **Storage**

Main Future Challenges

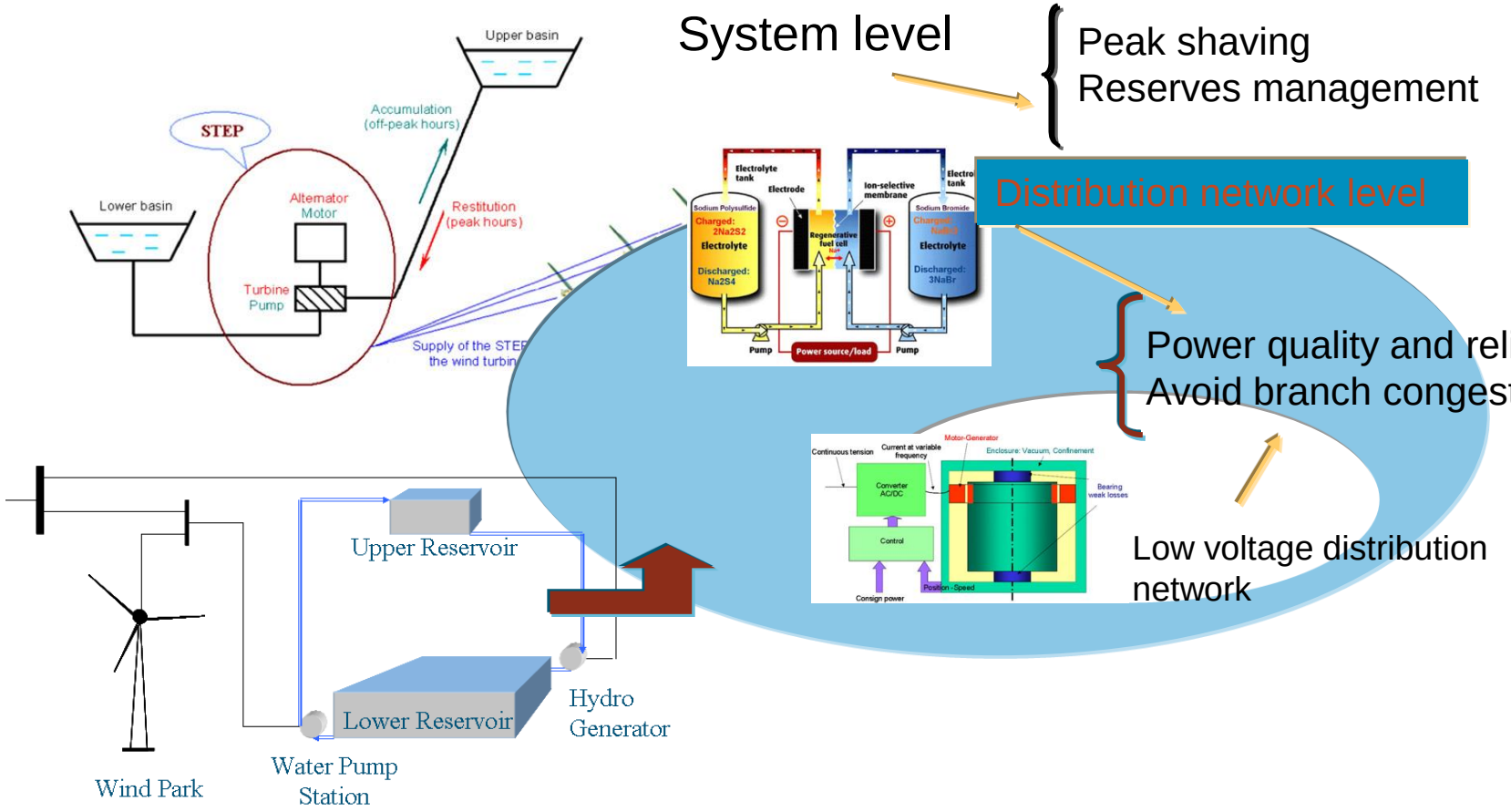
- Small size of the players (challenging management)
- Large presence of power electronic interfaces
  - Reduction of inertia
  - Reduction of short circuit currents
- Advanced communication solutions to allow full system monitoring
- Scalability: most of the ICT solutions does not scale easily in the real world
- Markets and regulation: technology moves 10 x faster than energy policies → new market architectures and regulation solutions
- Treatment of large volumes of data → Data Mining techniques
- Data Privacy and Cyber Security

How to tackle with the challenges of large scale integration of DER

- Increasing Flexibility
  - From DER units
    - Wind generators and PV generation should be capable to provide ancillary services and adapt their operating points (deloading strategies)
    - Increasing the **presence of storage**
    - Increasing **active load demand participation** (including managing charging on **Electric Vehicle** deployment) in the provision of ancillary servives and in helping controlling the grid
  - From Large Generation Units
    - Allow them to change operating points in a faster way
    - Increase efficiency in different operating regimes
  - Through the adoption of new technical and management tools
    - Better forecasting load and renewable generation
    - New Control architectures – **Microgrids / Multi-microigrids**
    - Increase monitoring and control through new communication solutions

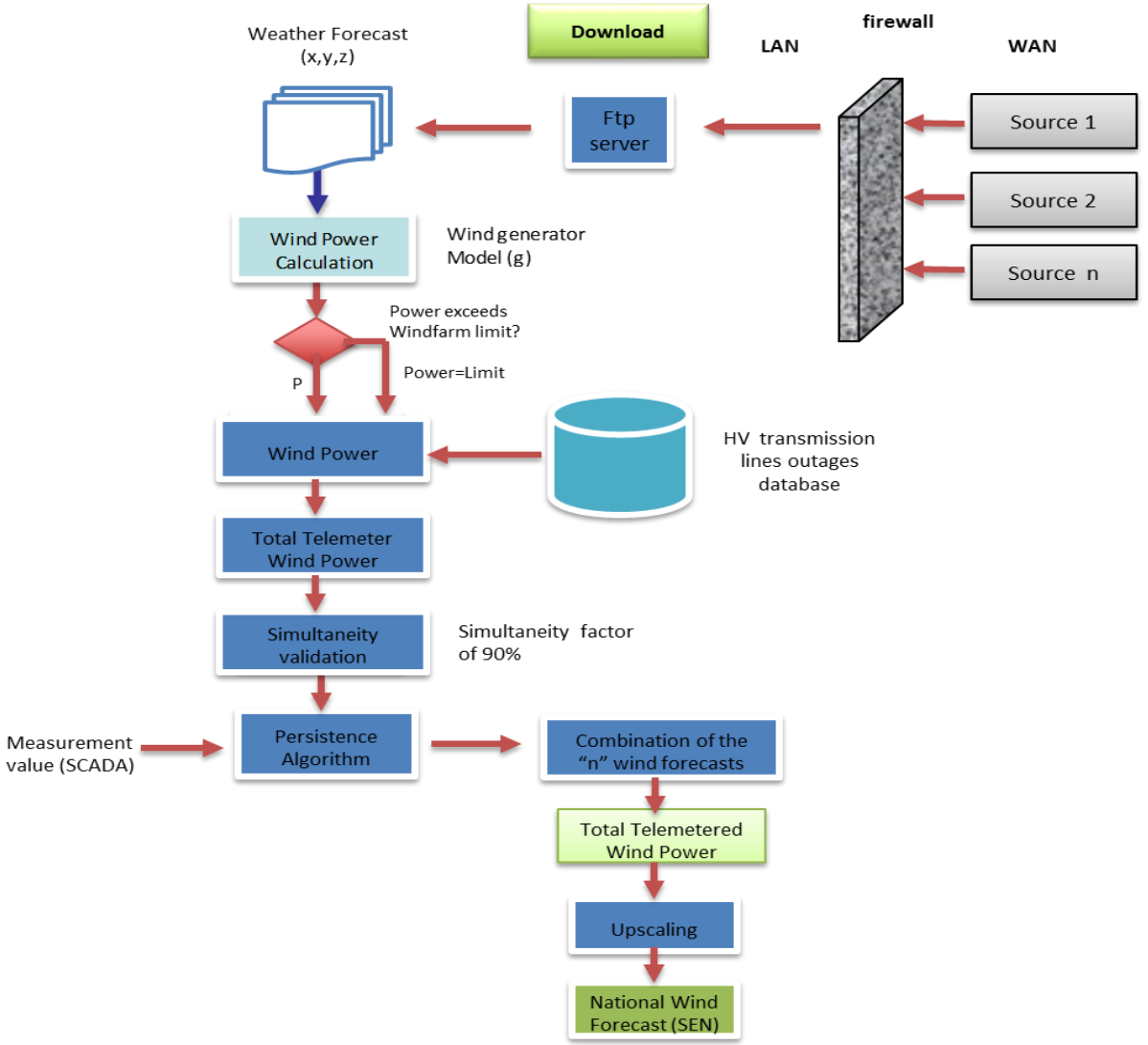
Multi-level storage management

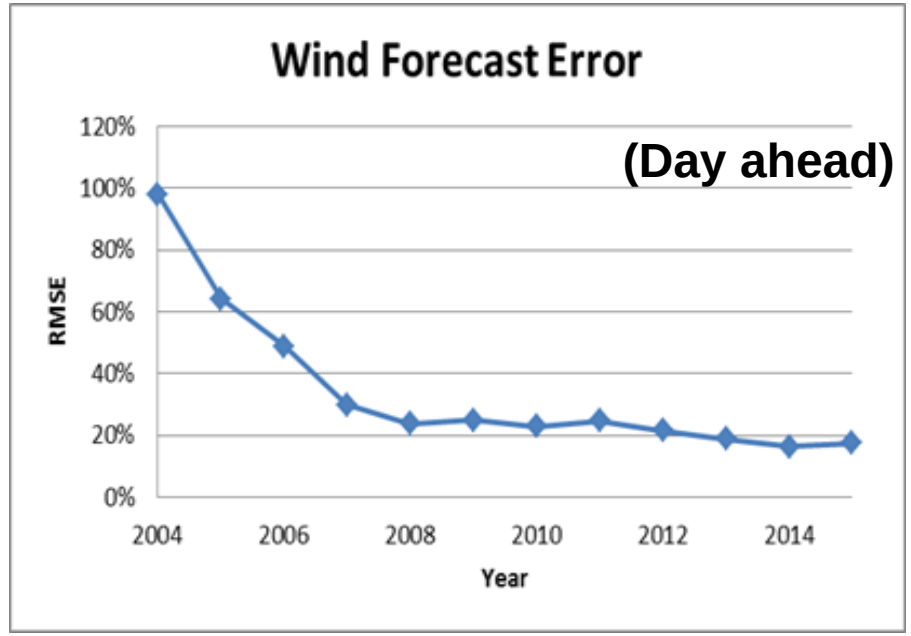
- Storage should be managed at diferent levels:



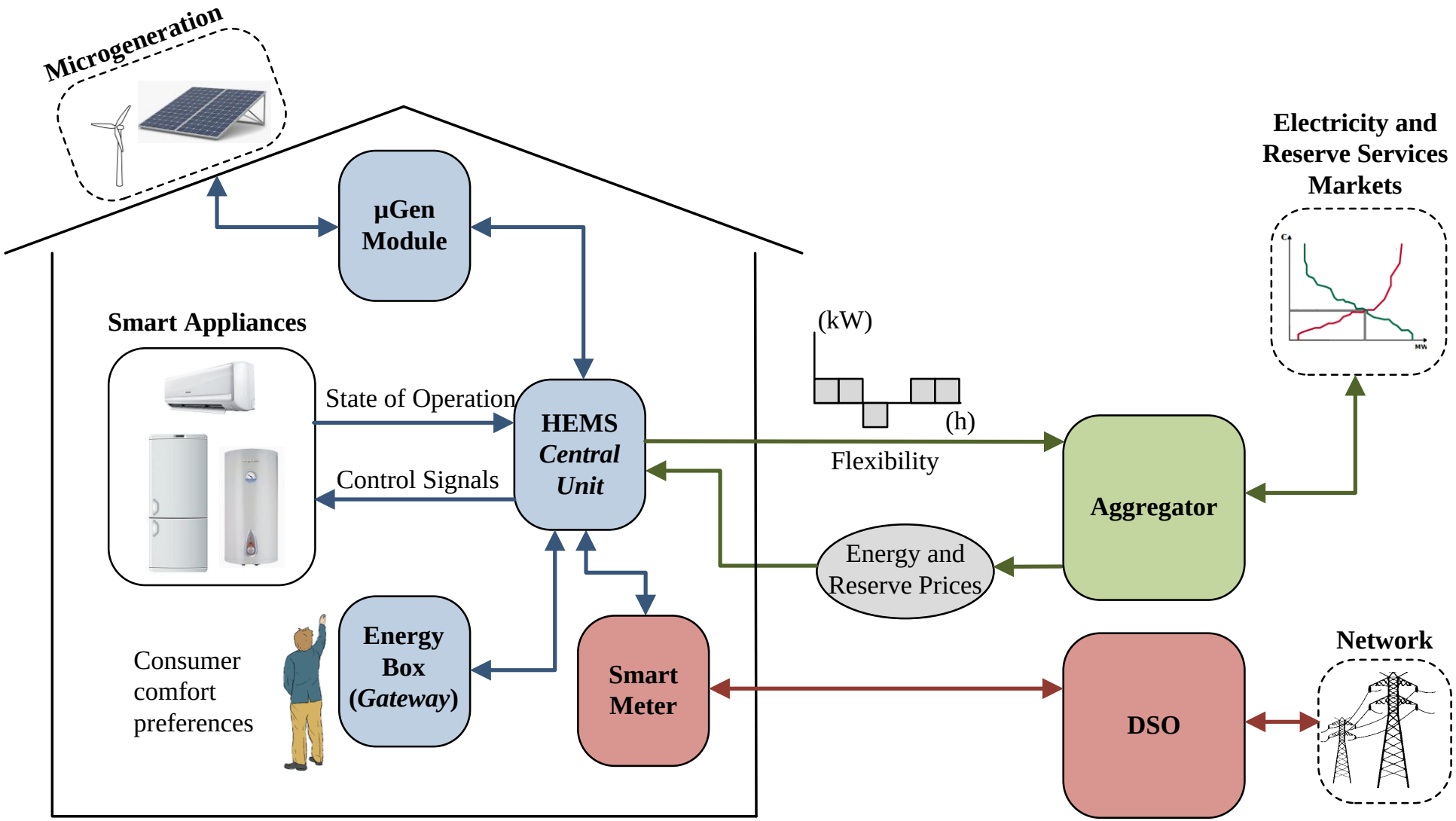
Generation level → Market participation
Provision of ancillary services (different technologies)

Develop renewable generation forecasting solutions: example – wind power



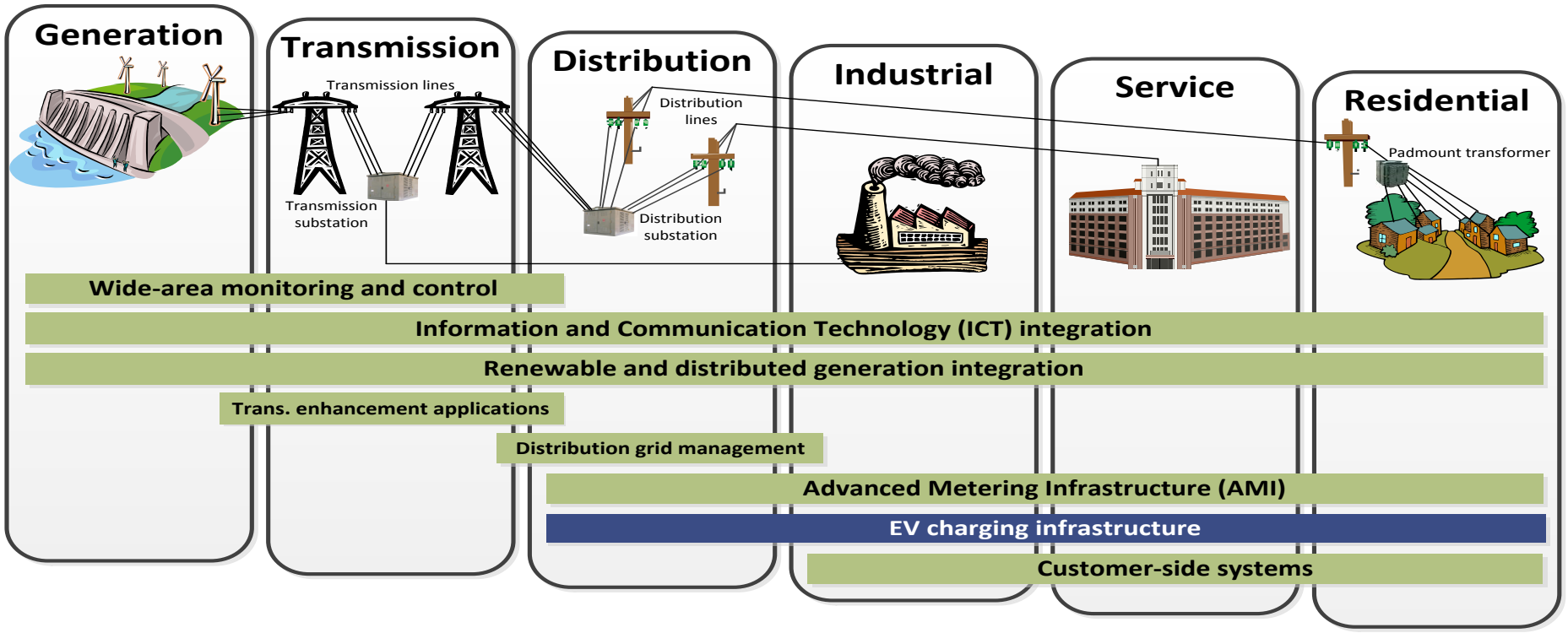


Residential demand response: the smart house

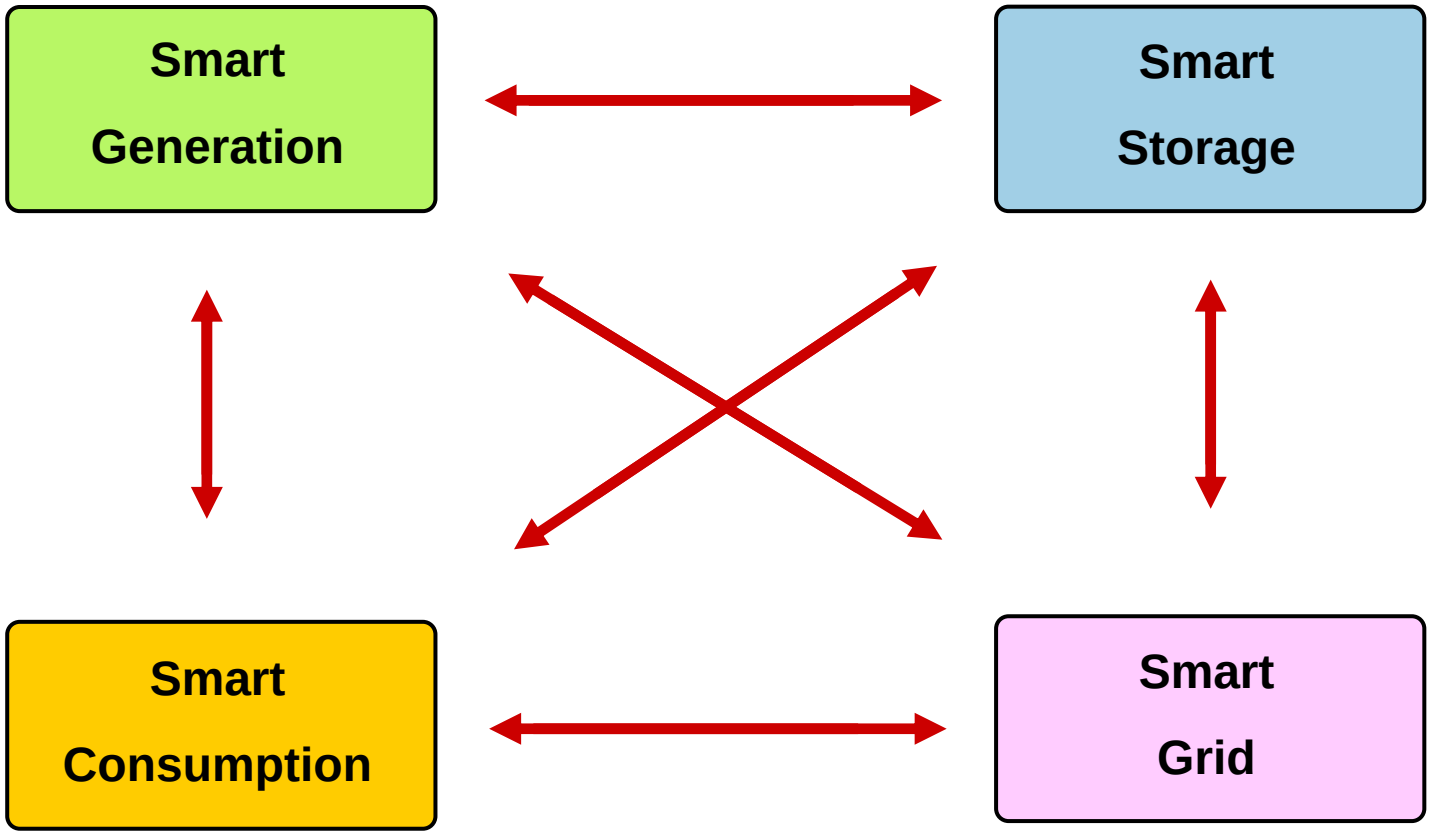


Electric Mobility Deployment

- Main concern:
  - EV must be capable of exchanging information with coordinating entities
- Two pillars support EV integration in AS provision:
  - Technical operation layer → physical support to the developed concepts
  - Market operation layer → link to the electricity markets (energy, services)
- Integrate EV in the Smart Grid concept providing FLEXIBILITY (Smart charging, V2G, V2H operation)



Smart Players



The success of the shift requires:

Smart Regulation

Distribution system operators need to manage Flexibility from consumers, DG and network (including new ancillary services)

Conclusions

- We are on the verge of a fundamental shift in the Energy Industry. A Smart Grid will be the fundamental service platform for future years.

- The smart grid platform will act as a catalyst for current green technologies (e.g., energy efficiency, demand response, electric vehicles) and emerging green technologies (e.g., photovoltaic, energy storage, plug-in hybrid electric vehicles).

Some Future Research Domains

- **Need for more Operation reserves and their management**
- **Advanced forecasting solutions for wind and solar PV generation**
- **New dynamic security tools dealing with inertialess system due to the large deployment of RES**
- Evaluation of the demand response participation
- **Managing storage solutions (concentrated and distributed)**
- Model aggregated RES/DER, flexible conventional generation, demand and storage systems for **new market design and new market mechanisms (allowing "faster" responses, new ancillary services)**
- **Validate the contribution of RES and DER to voltage and frequency control** and, balancing using VPP concepts
- **Exploit DER to increase resilience of the system when facing catastrophic events**
- Stochastic planning and operating tools
- **Regulatory solutions to accomodate Flexibility**
- **Increase the articulation between TSO and DSO** (exchange of information on interconnection buses, forecasts, dynamic equivalents..) to enable identification of ancillary and balancing services provision

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