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RESILIENCE AND ADAPTATION OF THE ENERGY SECTOR :

ÉLECTRICITÉ DE FRANCE PERSPECTIVE

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EDF Group in 1 « slide » (2014) !

- A leading player in the energy market, active in **all areas** of electricity from **generation** to **trading** and **network management.**
- **Balance** between regulated and deregulated activities**.**
- **Engineering** and **operating generation** plants and **networks**.
- Leader in the **French and UK** electricity markets, solid positions in **Italy** and numerous other European countries; industrial operations in **Asia** and the **United States**
- **Entities of EDF Group are regulated under EU ETS and EDF is operating on EU ETS and on the international credits markets through its entity EDF-T**

38,5 million
customers worldwide

623,5 TWh
electricity generation worldwide

102 g of CO_2
per kWh generated
(CO_2 emissions from EDF Group electricity and heat generation)

158,000
employees worldwide

€72.8 billion
in **sales**

64 Mt CO_2

FACTS

EDF generation is about 82% Nuclear :

19 nuclear power plants :

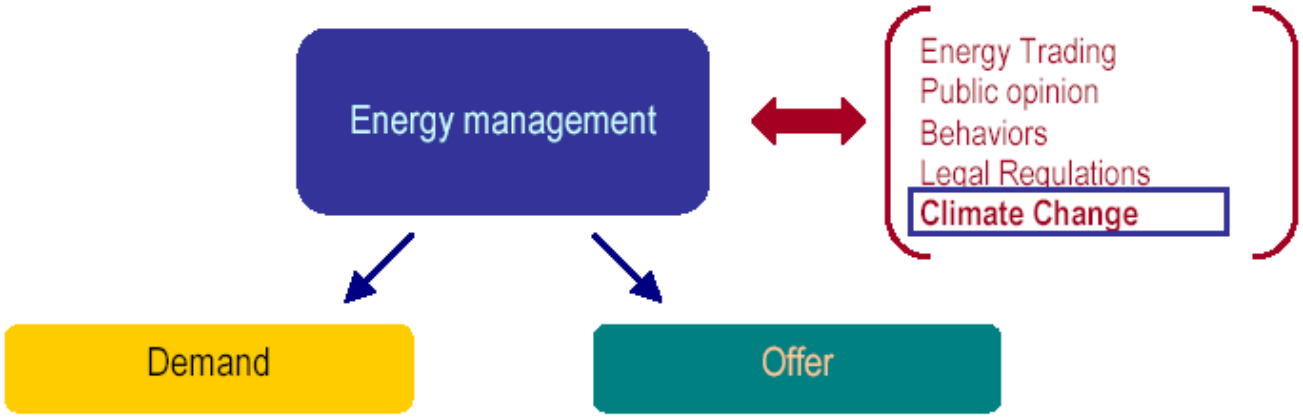
- 14 river plants
- 5 coastal/estuary plants

58 reactors, from 900 to 1450 MW capacity :

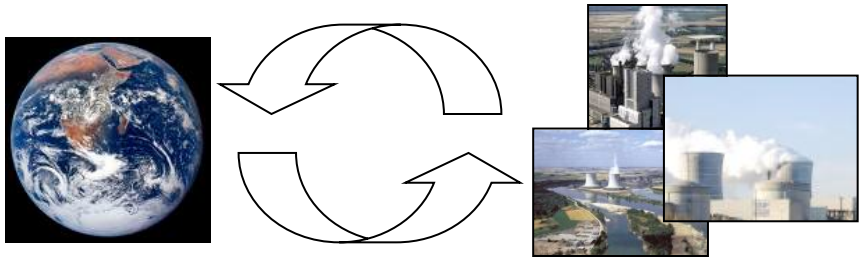
- Coastal plants :
  - Open cooling process only : 18 reactors
- River plants :
  - Open cooling process : 10 reactors
  - Recycling cooling process (with wet-cooling towers) : 30 reactors

Other generation means in the EDF mix :
Hydro plants and Thermal units (coal, GCC,..)

Challenges for EDF Group



→ EDF's activities are dependent on climate
→ EDF tries to reduce its influence on climate



→ Reliable and relevant information on **climatic evolutions** and their **consequences** on EDF's activities

→ Orienting **EDF's strategies**

Storyline

- From 1980 to 1990 essentially a classical activity dealing with meteorological data but two topics emerged clearly :

  - complex statistical studies for studying relationship between meteorological data and supply/demand issues

  - mesoscale modelling studies for dispersion of effluents in complex terrains

- 1989/90 – a breakthrough year ! The Scientific Advisory Board of EDF recommends EDF is paying attention to the climate change issue

- 1990 to 2000 – involvement of R&D team on climate modelling studies in relationship with French, EU and international scientific community

- Starting end of 1999 and follow up years : a suite of meteorological/climate events impacting strongly our Group (Storms, heatwave, flooding, etc….)

- **Response** :

  a climate hazard plan, then a climate change adaptation strategy

Adapting existing assets to climate change, preparing new assets accordingly, emergency preparation and R&D on climate change impacts

- Adapting existing facilities bound to stay in the landscape for a long time
  Adapt our facilities, operating processes, in addition to the Climate Hazards Plan
- Mainstreaming the expected consequences of climate change into our design of future assets and facilities
  Changes in our energy mix from the onset of the design phase, the future climate is one of the design parameters for future power generation facilities
- Boosting our resilience to extreme climate events - Direct application of our Climate Hazard Plan – Preparadeness for crisis management
  Prevent an extreme climate event from having catastrophic impacts, and return to initial status as early as possible
- Activating the right R&D to address the right topics
  Deliver information on the latest breakthroughs about the predictable effects of climate change Provide support to define their impacts on our facilities and organisations Contribute to the construction of our future asset base

Two concepts

- Resistance :
  - capacity of our installations to resist to climate hazards –
    - based on statistical approach, on historical knowledge, on capacity to predict
- Resilience :
  - capacity of our operation teams to face extraodinary events allowing to
    - Guarantee the safety of our equipments
    - Guarantee the vital services to customers
    - Recover a normal situation on the shortest timeframe
- In which collaboration with Public Authorities is needed

Concrete examples of how to prepare future

Preparing each year the next summer (water issues)

- Along the years a permanent group involving EDF and administrative authorities have been set up in order to review on a regular basis problems and questions that could be related to a warmer than normal summer (heat wave)
- This helps to anticipate possible regulation adaptation(heat release in rivers)

Contributing to the national adaptation strategy

- EDF has been active in the preparation of the national adaptation to climate change strategy,in the relevant groups of statekholders pointing out the necessity to adapt existing and future infrastructure but also the regulation itself

Develop knowledge

- **EDF is active through its R and D Division to Develop new operating environmentally-oriented tools and to Improve generation system planning optimization tools, at each time horizons : yearly, weekly, daily, with collaboration with meteo authorities, and more generally to investigate long terme climate change consequences.**

Lessons on the science and R&D side

New technical challenges are ahead of us implying the use of more and more sophisticated meteorological and climate products

- **Key success factors :**
  - **Needing a continuation of R&D effort**
  - For the new challenges related to climate change, one has been able to build some internal proxy of a climate service but at the end of the day this new activity has to find its own organisation within the society

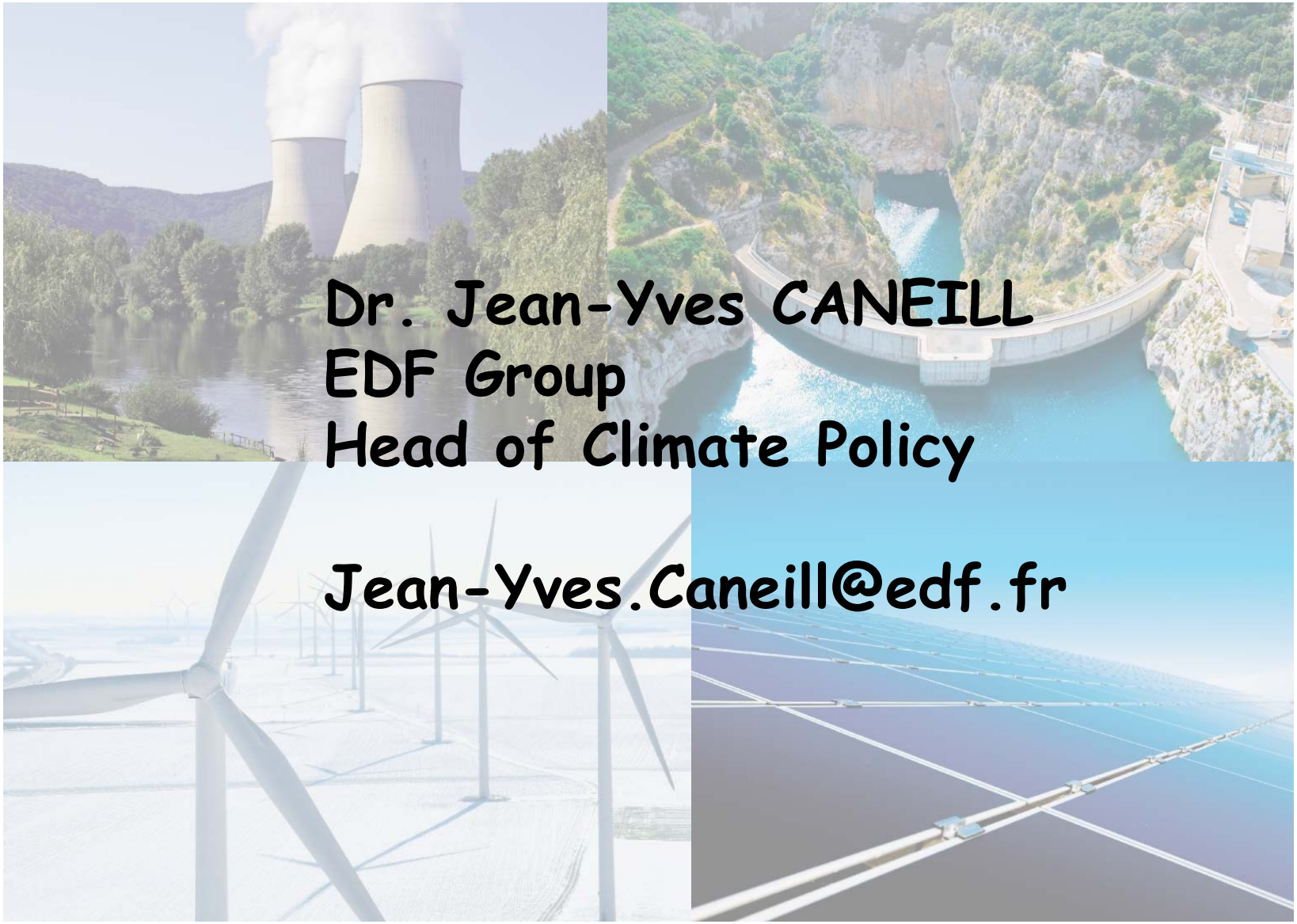
- **To morrow what are the key issues ?**
  - Management of renewable energy (intermittency)
  - How can we take benefit from seasonal, decadal, etc.. and probabilistic forecasts

Lessons on the organizational side

Public Private collaboration in the adaptation and resilience business

- **Key success factors :**
  - Anticipation
  - Clear organisation between authorities and industrials (to manage crisis but not only)
  - Mutual knowledge and mutual recognition of skills between public and private actors

- **To morrow, what are the key issues ?**
  - What balance between resistance and resilience ?
  - What appropriate regulations ?



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