An Electricity Utility View on R&D Priority Setting:
lessons learned and priorities for the future

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Using long term scenarios for R&D priority setting,
Outline

EDF and R&D key figures

A Long Term Scenario on Global Resources Availability

- Energy Demand Assumptions
- Supply:
  - Fossil Fuels Resources Assumptions
  - Non-fossil Energy Supply
  - Electricity Mix
- Global Energy Balance

From a LT Scenario to R&D Priorities

- EDF’s R&D : Portfolio of Challenges
- Long Term Challenges:
  - Power Generation and Optimisation
  - Customers
  - Global Environment
EDF Group

Installed power

130.7 GWe

Customers worldwide

40.2 million

((28 million in France)

Worldwide workforce

161,560 people

Production worldwide

Nuclear
70%

Renewable
8%

Thermal
22%

Revenue in euros

51.05 billion

Net income in euros

3,242 million

EDF Group is:

➢ the major player on France’s electricity market and a major player on European electricity and gas market

➢ the world leader for Nuclear power

➢ Europe’s first player for Renewables
EDF R&D: Key figures

- 4 locations: 3 around Paris, 1 in Germany
- 2,000 individuals
- 300 PhDs and 200 doctoral students
- Partnerships:
  - CNRS, CEA, Universities
  - EPRI, Thermal Power Research Institute (China), Karlsruhe University, Boconi, Politecnico de Milano...
- Joint laboratories with: EnBW, Edison, EDF Energy...

2005 budget: €377 million

- Generation 51%
- Networks and environment 7%
- Energy management 7%
- Sales and marketing 17%
- Transversal 9%
A Long Term Scenario on Resources Availability
In industrialised countries, per capita final energy demand is supposed to flatten after 2020 and slightly decrease thereafter.

Per capita final energy demand in developing countries will continue to grow over the projection period, especially for Transport and Electricity.

**OECD and Russia**

**Developing Countries**
In 2030, energy demand per capita in this scenario is in the range of most other projections...

...and among the lowest in 2050

Global energy demand will reach 15 Gtoe in 2030 and 17 Gtoe in 2050
Oil Remaining Ultimate Recoverable resources were put at 2200 billion barrels

This scenario assumes a total of 380 trillion m$^3$ of gas to be recovered

- Coal reserves are abundant (633 billions tce)
- Huge resources, according to BGR, 3963 billions tce. How reliable is this number?

Note: BGR excluding aquifer gas and Hydrates
Fossil Fuels Resources Assumptions (2/2) – Fossil Fuel Decline Rates

The date of peak depends mainly on:

- Demand growth
- Global resources level and the capacity to mobilise it
- and also the rate of production decline: faster it is, later could be the peak

This has implications for the global balance
This scenario assumes a very rapid increase of renewable and nuclear productions.

A large Contribution of non-fossil fuels in the power mix in 2050:
- more than a third of total electricity production from renewables
- 21% for Nuclear
Under this scenario assumptions

- Supply disruption could occur as early as 2040
- This would have dramatic consequences: economic, social and political crisis...

- Especially if we are not prepare to the required transition to a low-carbon world
Lessons from this scenario:

- Under “reasonable” assumptions concerning energy resources, this scenario illustrates that it could be difficult to meet energy demand by 2050.
- A supply disruption could occur as early as 2040.
- More optimistic assumptions on fossil fuel resources would postpone this risk for a few years, but.
- A transition to a low-carbon world would be needed: to fight climate change effects and to prepare the second half of the century.

R&D policy implications from now on:

- Limiting energy demand growth.
- Increasing efforts on Renewables and Nuclear.
From a LT Scenario to R&D Priorities
EDF’s Portfolio of Challenges

**Our Environment**
- Anticipating the new energy landscape
- Water: anticipating the climate constraints on a shared resource
- Improving the characterisation of the environmental impacts of our facilities

**Our Optimisation:**
- Generation optimisation into the market: methods and tools
- Finding new flexibilities between consumption, generation and storage
- Simulate and decide

**Customers**
- Home and building: developing technologies and services for energy efficiency
- Improving efficiency and new electricity end uses in Industry
- Preparing the Distribution Market

**Generation**
- Enabling 60 year lifespan to our nuclear power plants
- Integrating new technologies to operate more efficiently
- Innovating in renewable energies and storage
Customers - Long Term Challenges

Home and building: developing technologies and services for energy efficiency

- Energy efficiency: development of new technologies (thermal insulation, heat pumps, thermal solar, PV panels)
- Managing customer demand and reduce peak consumption: remote services, storage in buildings,

Improving efficiency and new electricity end uses in Industry

- Developing electrical end uses and processes
- Developing generic solutions for small and medium sized enterprises
- Developing generic tools for remote energy diagnostics and consumption monitoring

Preparing the Distribution Market

- Integration of distributed energy sources and storage capacity
- Potential development of plug-in hybrid electric vehicles
Power Generation and Optimisation - Long Term Challenges

Innovating in renewable energies and storage

- Technology monitoring and experimenting
- Renewables: PV, Thermal Solar, Ocean energy and hydro turbines
- Storage: CAES, NaS batteries, inertial storage

Creating new flexibility between consumption, generation and storage:

- Insure a better coverage of intermittent energy sources
- How to flatten the load curve by price incentives, ICT, local heat or electricity storage, combined use of gas and electricity
- Evaluate the economic benefits of peak demand reduction through DSM and storage peak demand reduction
Our Environment - Long Term Challenges

Water: anticipating the climate constraints on a shared resource
- Forecasting water availability over different time horizons
- Evaluate potential technological breakthroughs in the water sector
- Impacts of new and future regulations

Anticipating the new energy landscape
- Overview of existing studies on the energy future
- Impacts of new and future regulations on energy markets
- Macro-energy Scenarios building:
  - Identifying key drivers
  - Assessment of risks and uncertainties
  - Quantification

Implications
- Analyse global implications
- Propose alternative solutions
- Implication for EDF and Recommendations