The EDF Group at a glance

United Kingdom
EDF Energy (100 %)
# 1 distributor

France
Capacity: 101 GW (63 GW nuclear)
Customers: 28m
Networks: 1 340 000 km
Gas: 3 bcm

Germany
EnBW (45 %)
# 3 German electricity utility

Italy
Edison (50 %)
# 2 Italian utility (electricity+gas)

Revenues: € 59.6 billion
EBITDA: € 15.2 billion
Customers in the world: 37.8 million
Employees in the world: 156.500
Generation: 128,200 GW (installled capacity)
633 TWh (generation)

EDF Trading
Volumes handled: electricity (745 TWh)
Gas (116 bcm)
Coal (237 Mt)
Oil (141 Mb)
The electricity sector in France

- A fully open market since July 2007

- A legal separation of T&D activities from those subject to competition (2003 European Directive)

- Development of renewable energy on distribution networks

<table>
<thead>
<tr>
<th>Date</th>
<th>Eligibility threshold</th>
<th>Number of customers</th>
</tr>
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<tbody>
<tr>
<td>Feb 1999</td>
<td>100GWh/yr</td>
<td>1,400</td>
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<tr>
<td>May 2000</td>
<td>16GWh/yr</td>
<td>2,600</td>
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<tr>
<td>Feb 2003</td>
<td>7GWh/yr</td>
<td>4 millions</td>
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<tr>
<td>July 2004</td>
<td>All non-residential customers</td>
<td></td>
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<tr>
<td>July 2007</td>
<td>All customers</td>
<td>28 millions</td>
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Electricity considered as an energy vector for the future: increased focus on system power quality, reliability, security and costs

Climate change and environmental concern

- Drivers to develop renewable energy sources
- Drivers to develop energy efficiency
- Grid modernization is the cornerstone to enable more flexibility and adaptability

Lots of challenges for network operators: ageing assets, workforce renewal, regulation, …

Economy crisis: public and local authorities supporting infrastructure investments including electricity networks to support economic recovery
Smart Grid opportunities

- Ongoing Smart Grid research programs have identified the associated risks and opportunities for distribution systems
  - Ageing assets
  - Distributed Energy Resources integration
  - Standardization of data exchanges
  - Advanced operation and automation functions
  - Advanced metering
  - Communication and information technologies

- Remaining integration, sociological and regulatory barriers need to be solved via research demonstration programs

- Need to explore on the field existing and identified Smart Grid solutions on all aspects with the different stakeholders
R&D: EDF Challenges 2007-2009

OUR WORLD
- Water: anticipating the climate constraints on a shared resource
- Always improving the characterisation of the environmental impacts of our facilities

CUSTOMERS
- Home and building: developing technologies and services for energy efficiency
- Industry: developing energy efficiency and new electric uses

OUR OPTIMISATION
- Anticipating the new energy landscape
- Generation optimisation into the market: re-establishing methods and tools
- Finding new flexibilities between consumption, generation and storage

EDF R&D at a glance: 2,000 individuals, 375 million €/year

GRIDS
- Preparing the distribution in 2015

GENERATION
- Enabling 60 year lifespan to our nuclear power plants
- Integrating new technologies to operate more efficiently
- Innovating in renewable energies and storage

Simulate and decide
An integrated vision of the Smart Grid concept…
Technology roadmap

**Demonstrations**
- 1st Deployment FAR
- Deployment FAC
- Pre-deployment VVC
- Demo DG monitoring and forecast functions
- Demo distributed storage + islanding
- Protection adaptation
- Demo DSM
- EV charging stations
- AMM Pre-deployment
- AMM Mass roll-out
- CPL G3, RF
- IT Standards
- Future MV/LV stations
- Mobility tools
- Diagnostics (cables, overhead lines, HV/MV transfo.)

**Implementation – New Demos**
- Pre-deployment reconfiguration
- Aggregation DG, load, storage
- Commercial offer integration
- V4G
- Data flow
- Diagnostics (MV/LV transfo.)
- IT « Cement » ....

**Targets**
- Enhanced network control and operation thanks to more automation and better distributed intelligence
- Successful integration of distributed generation: costs and ancillary services
- Enhanced system flexibility, generation / consumption optimization
- Leveraging advanced metering infrastructure: less costs and more services
- High performing and flexible telecommunication tools
- Improved balance between system reliability, power quality and costs via more effective asset management
Candidate functions for demos

Advanced operation functions (state estimation, volt/var control, fault location, isolation, reconfiguration, …)

Network operation functions integrating DER and Storage

DER interconnection and decoupling protection

HV/MV

Virtual Power Plant A

Virtual Power Plant B

Remote controlled equipments (breakers)

DER interconnection and decoupling protection

Auto adaptive / directional protections

Communicating and directional fault indicator

G3 PLC

Local use of metering data to enhance network observability

Local use of storage to facilitate integration (congestions management, ancillary services, power quality)

Intelligent MV/LV station: multitasking concentrator (AMM, network monitoring)

Intelligent substation

Preventive maintenance tools

Mobile operator

Mobile operator

Control Center

Control Center

Mobile operator

G3 PLC

Intelligent substation

Remote controlled equipments (breakers)

EV charging infrastructure

DSM via AMM

AMM V1, V2, …

Local use of storage to facilitate integration (congestions management, ancillary services, power quality)
AMM Pilot project (ERDF)

- General system architecture

- To prepare the massive roll-out (2012)
  - 300 000 meters
  - 7000 concentrators

**Around Tours** (100 000 customers)
- Rural area,
- Pole mounted transformers,
- Overhead network,
- Villages, isolated houses
- Vacation houses

**Around Lyon** (200 000 customers)
- Urban area,
- Underground network,
- Underground sub-stations,
- Downtown area, Domestic high rises
Local energy aggregation into « Virtual » Power Plants enable:

- To reach the necessary size to access to market to prepare the step following the actual political support to encourage renewable development;
- To rise an infrastructure (data and communication) giving to network operators a tool to integrate this local production in the global and local system operation in a win win win approach.
... to load aggregation

ADDRESS - Active Distribution networks with full integration of Demand and distributed energy RESourceS (2008-2012)

Towards active loads:
Domestic and small tertiary customers participation providing services to electric system players

=> Contribution to the RES development and to their integration into the electrical system

ADDRESS - Project co-financed by EC within the 7e RDFP
PREMIO: a demand response coordination example

General objective

- To demonstrate an innovative and replicable architecture (in the South of France) aimed at optimizing distributed generation, storage, renewable energy sources, demand response and energy efficiency measures and at reducing the constraints of a local grid and CO2 emissions

Technical scope
Complementary objectives

Enable DER to participate into the electricity supply system in a cost efficient, secure and sustainable way through aggregation into **Large Scale Virtual Power Plant** (LSVPP)

- Develop technical solutions to **integrate the LSVPP into the T&D network control** and information interface.
- Develop prototypes of new **EMS** and **DMS**.
- Design **commercial framework** to support system operation and quantify the costs and benefits of status quo and FENIX futures.

**Active Demand (AD) =** participation of **domestic and small commercial consumers** in markets and provision of services to power system participants

- Develop technical solutions to **enable active demand** both at consumer's premises and at power system level
- Design contractual and market mechanisms for the **exploitation of the benefits of AD**
- Propose **accompanying measures** for societal, cultural & behavioural aspects …

**Local Energy management =**
local dynamic management of electric generation and consumption to:

- **Optimise local energy system** and achieve
  - **energy savings** (reduction of the bill), **better integration of local DG, storage and Renewable Energy Sources**, **reduction of CO2 emissions**, **while taking into account consumers comfort**
  - **React to DSM signals and solve local grids constraints**

Makes use of **communications, computing & power electronics** to create a system that is:

- **Self-healing and adaptive**
- **Interactive** with consumers and market
- **Optimized** to make best use of resources and equipment
- **Predictive** rather than reactive, to prevent emergencies
- **Distributed** across geographical and organizational boundaries
- **Integrated**, merging monitoring, control, protection, maintenance, EMS, DMS, marketing and IT
- **More secure** from attack
Markets and Services

Local energy & load management
⇒ Services to consumers, aggregators, DSO, VPP, …

Load shaping services (e.g. load shaving)
Local energy optimisation

Energy market
- Steady state V control
- Balancing services (incl. compensation of RES variability)
- Overload and network congestion relief

Dynamic Volt VAr Control

DR & EE* included in the capacity market
Integration of RES and PHEV
Secure & integrated information exchange infrastructure

* DR: Demand Response, EE: Energy Efficiency

Project co-funded by the European Commission within the 7th Framework Programme

Interactive energy

IntelliGrid™

fenix

…a step towards the future of electricity network
Conclusion

- A favorable context and environment
  - Network as a bottleneck to be modernized
  - Strong political concern and push

- Need for new research and demonstration initiatives
  - France: ongoing RFP for demonstrations (ADEME)
  - EU: ongoing activities in FP7

- Enhanced collaboration and coordination needed to enable Smart Grid development
  - Between the local electricity system players
  - Between the ongoing worldwide initiatives
Questions

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