Smart Grids aus der Sicht der europäischen Netzbetreiber

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Head of Unit - Networks

e-control
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At the forefront of the ELECTRICITY INDUSTRY:

- eurelectric
  ELECTRICITY FOR EUROPE
Representing the electricity industry at expert, strategic and policymaking levels.

- 33 FULL MEMBERS
- 9 EUROPEAN AFFILIATE MEMBERS
- 7 MEDITERRANEAN AFFILIATE MEMBERS
- 7 INTERNATIONAL AFFILIATE MEMBERS
- 9 EI ASSOCIATE MEMBERS
- 25 BUSINESS ASSOCIATE MEMBERS
EURELECTRIC represents the whole value chain of the European electricity industry

Generation > Trading/Wholesale > Retail

Transmission > Distribution > End-customers

(MoU with TSOs)
Highlights

1. The regulatory framework should adapt to the new challenges
   - DSOs have a new mission – The regulatory framework must adapt to this
   - Not all technology related activities must be regulated – regulation must also facilitate a market development
   - Adding “smartness” to the regulatory framework

2. Smart Grids Case Studies

3. Implications for the wholesale and retail market
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The IEA sees about 6 600 billion USD investments into the global power grid by 2030

- Power Generation: 7 100 billion USD
- Transmission: 2 100 billion USD
- Distribution: 4 500 billion USD

\[ \sum 13 700 \] billion USD (without inflation) Years 2008-2030

Source: IEA World Energy Outlook 2009; p.106; own calculations
The role of electricity: The 20-20-20 targets are interlinked

- 20% reduction in CO2 emissions
- 20% increase in energy efficiency
- 20% contribution of renewables in the energy sector (resulting in 35% for the electricity sector)

Triple benefit of using electricity:
Stronger case than ever for DSM (Demand Side Management)

- **More useful:** More intermittent power (renewables) that needs to be balanced -> volatile power prices
- **More to play with:** Higher energy efficiency increases electricity demand (electric vehicles, spatial heating...) and distributed generation
- **Better tools:** New Information and Communication Technologies available to steer demand based on demand analysis
Balancing intermittent power requires network investments in one way or the other

- Better connection of markets in order to get a better balance of generation and consumption
- Better physical interconnection of the transmission grid and new lines in order to allow wide area transmission and balance
- Increased use of energy storage options
- Installation of additional peak power plants
- Increase of capacity and interconnection of distribution grids
- Fostering Demand Side Management
The requirements of the 20/20/20 targets, customer needs and electric vehicles integration will change DSO mission

**New Challenges:**
- Higher share of distributed and/or intermittent generation (renewables)
- Consumers participating actively in the market (producing, managed load)
- Energy efficiency targets
- Moving load (electric vehicles)

**In addition to Traditional mission:**
- Transport electricity from G to L
- Ensure reliability
What is a smart grid?
Alternative definition

+ Network reinforcement and interconnection
+ Network automation
+ Distributed Generation
+ DSM
+ Data management

= Smart Grids
**Smart metering**
- Smart meters
- AMI and customer information portal
- Tariffs and billing systems
- Database for network information

**Power management**
- Integration of distributed generation
- Preparations for large market penetration of EV/PHEV
- Power flow and power balance control
- Island operation

**Fault management**
- Network automation equipment
- Smart assets (substations, cables etc.)
- Self-sectioning/self-healing network
- Outage management systems
- Mobile equipment (generation, transformer, switchgear etc.)

**Asset management**
- Monitoring and diagnostics
- Decision support tools (risk based analysis)
- Net and asset strategy planning tools

**Communication and system integration**
- Communication infrastructures
- Communication standards
- System integration
- Cyber security
Electrical grids play an important role

- The future will be greener, however, it also will be more electric
- Smart grids for smart customers
- If you like renewables you also have to have like electrical lines
The main **traditional rationale** behind regulation is to prevent the abuse of a **monopoly position** and will have to be extended…

<table>
<thead>
<tr>
<th>Utility</th>
<th>Customer/ Network user</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost compensation</td>
<td>Low prices</td>
</tr>
<tr>
<td>Investment incentive</td>
<td>Quality</td>
</tr>
<tr>
<td>Cover capital cost</td>
<td></td>
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</table>
...the climate package and the evolving retail market adds elements to the regulatory scope

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New Mission (EU market and climate packages):

<table>
<thead>
<tr>
<th>Supplier</th>
<th>Society / Environment</th>
</tr>
</thead>
<tbody>
<tr>
<td>New products</td>
<td>Reduce emissions</td>
</tr>
<tr>
<td>Processes (Customer switching)</td>
<td>Renewables integration</td>
</tr>
<tr>
<td></td>
<td>Increase energy efficiency</td>
</tr>
</tbody>
</table>
Regulatory framework must **consider the new mission of DSOs**

- Integrating environmental goals **on distribution level**
- **Incentivising smart grids** that enable the creation of a **better functioning retail market place**
- Removing barriers for investing in **technological innovation**
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2. Smart Grids Case Studies

3. Implications for the wholesale and retail market
There are areas where regulation is essential

- Economies of scale
- Externalities
- Setting standards enabling interoperability
Investments for smart grids might benefit several parties but are often only done by DSOs.
Unbundling rules need to be respected when implementing smart grids

- Existing **unbundling rules** pose a challenge for synchronisation of network investments and the creation of new services.
- **Interoperability** standards enable the market to compensate for lack of synchronisation due to existing functional and information unbundling.
- Not everything must be regulated but **regulation is needed to create the right environment** for a market to be developed.
A stable and predictable regulatory framework ensures market development and avoid stranded investments

- Danger of stranded investments (smart meters)
- For customers to put trust in new technologies data protection issues must be addressed in a credible and predictable manner
- In order to give equal access to new players in the new market interoperability of technology is key for success.
Example Electric Vehicles: Standardization benefits customers, utilities and car manufacturers

<table>
<thead>
<tr>
<th>Benefits from standardization</th>
<th>For customers</th>
<th>For Utilities/ Automobile Manufacturers *)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&gt; High convenience</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• One single solution worldwide</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• No adapters or different cables needed</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt; Faster electric vehicle run-up/market success</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt; No retrofit costs for adopting to new charging systems</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt; Cost benefits</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• No sunk costs for proprietary interim solutions</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Shared development and standardization costs</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Economies of scale</td>
<td></td>
</tr>
</tbody>
</table>

*) in particular OEMs (original equipment manufactures)
Electric vehicles

EURELECTRIC supports an OEM/Utility standardisation initiative started end of 2008 to accelerate and improve standards definition

- Draft Proposal accepted as pre-standard
- Initiative will be converted into official ISO/ IEC standardisation groups

Within the Framework of the Task Force Electric Vehicles EURELECTRIC participates in this initiative.
Principals of electric vehicle/ grid standards can be transferred to smart grids components

- Open communication standard (TCP / IP)
- All market stakeholders can use protocol to communicate
- Several software provider can be used ensuring competitive prices that keep cost and tariffs low
- Standards offer investment security and give market opportunities to new players
#### Example: DSM requires the “right” smart devices

<table>
<thead>
<tr>
<th>Conventional meter</th>
<th>Simple Smart Meters (AMR)</th>
<th>Advanced Smart Meter SmartGrids / DSM</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Deferred information on consumption</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Annual billing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Energy efficiency actions not directly effective on bill</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Accurate and timely consumption Information</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Peak pricing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• More frequent billing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Real time metering</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Bi-directional flow of information; contribution to energy balance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Highly flexible pricing models connected to the availability of energy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Consumer needs to actively response to info to reduce bill</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Permanent reduction of bill without permanent consumer decisions</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Energy suppliers can use meters to extend their services

- meters according to legal requirements as pre-requisite for new services
- system is modular and extendable

### EXAMPLE

#### regulated

<table>
<thead>
<tr>
<th>Electricity meter</th>
<th>Gas meter</th>
</tr>
</thead>
</table>

#### Non-regulated (but based on standards)

- **Multi Utility Communication Controller**

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Smart Home
Suppliers’ and new service providers’ roles should be defined and let the market work

- The roles of the meter operation and metering service have to be defined and assigned
- As soon as smart meters play a physical role with respect to system stability this also has to be reflected in the regulatory framework
- Concerning costs it should be defined who pays for customer information, more frequent billing or energy balancing
- New roles like (data) exchange agent have to be defined
Not all technology related activities must be regulated – regulation must also facilitate a market development…

- **When geographical or coordinated roll out of smart grids elements offers cost advantages it should be done by one company e.g. the DSO**
- **Interoperability standards enable the market to compensate for lack of synchronisation due to existing functional and information unbundling**
- **Not everything must be regulated but regulation is needed to create the right environment for a market to be developed**
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3. Implications for the wholesale and retail market
The cost and risks incurred cannot all be covered by the market or existing recovery mechanisms

- Risk
- Capital cost
- Operating cost

expected effects
Ideas for adding “smartness” to the regulatory framework (1/2)

• **Internalise positive externalities**
• **Foster collaboration projects among stakeholders**
• **Tariff of use – reallocate network tariffs among stakeholders**
Ideas for adding “smartness” to the regulatory framework (2/2)

• Performance based ratemaking (guaranteed/overall standards)
• Smart Grids factor in regulation formula (direct effect on DSOs revenues)
• Load revenues – charge customers for actual load (capacity tariff €/kW)
Conclusion

Regulation must...

• Open new **market opportunities** for existing suppliers and new players
• **Empower the customers** to make use of new possibilities
• **Contribute to define the right market model**
• **Incentivise investments in new technologies** with positive externalities
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Case Study: ESB (Ireland)
A.M.I. is more than just meters – it's a complex integration of an engineered system of sensors, devices, communications, and software technologies.
Can the Electricity Grid cope with EVs?

Electrical demand on an average day in 2020

- **Load without Ev’s**
- **Load with controlled charging of 250,000 vehicles**

Source: ESB
Electric Vehicle Implementation in Ireland

Early Adoption phase

- 2009
- Initial Project
  - Ensure supply of EV’s to Ireland!
  - Demonstration: Cars + Charge I/S
  - Identify IT /Market System Options
  - Link to Smart Networks
  - R&D

Large Scale Roll-Out Phase

- 2010/11
- Secure large scale penetration
- Address scale infrastructure requirement
- Address System Issues - storage/demand
- 2020
- Regulated Business
- Other Business

Source: ESB
Case Study: EdP (Portugal): Inovgrid
Controlled deployment – Services

When developing new tariffs and services, it is essential to ensure a good articulation between distribution, retailers and ESCOs.

**Clients / Consumers**
- Selection of target customers and services implementation

- Distributor Base Services
  - Consumption data (EDP OnLine)
  - Information on planned interruptions

- New tariffs and services
  - Tariffs for identified segments
  - Alert services for consumers

- Added Value Services
  - Energy efficiency services
  - Micro generation
  - Others

There is a need to ensure proper coordination between the Distribution and the Retailers and ESCOs.

Monitoring the impact of services on the platform InovGrid

InovGrid Platform

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Distribution  Retailers / ESCOs
Controlled deployment – Other initiatives

There are also several complementary initiatives under way, and it is necessary to ensure a good relationship with the overall project.

- Development of a study to determine the best location for the charging stations, by the University of Minho.
- Ongoing installation of the first charging station in Praça do Sertório.
- Held first contact with DGEG elements to eliminate or reduce restrictions on micro generation in Évora.
- It was suggested the development of a concrete project (EDP Innovation) to present to the Secretary of State.
- Ongoing evaluation of projects to renew the public lighting in symbolic places in Évora, in line with the city council.
- Implementation of the Protocol with the National Association of Portuguese Municipalities (ANMP) for modernization of public lighting, with efficiency gains.

To ensure the alignment between the defined initiatives, namely actions to develop on the field.
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Aggregate distributed generation will allow prosumers and small producers to sell in the wholesale market

- VPPs create a single operating profile from a composite of the parameters characterizing each distributed generator
- Flexible representation of a portfolio of distributed generators to make contracts in the wholesale market and offer services to the system operator
  - Capture the value of flexibility
  - Increasing value of assets through the markets
  - Reduce financial risk through aggregation
  - Improve the ability to negotiate commercial conditions

Source: Fenix Project (with adoptions)
More renewables make more backup capacity necessary

- Only 3.9% installed wind capacity has same (95%) firmness/availability as “conventional” plants
- Close to 45% of installed wind capacity has a level of firmness lesser than 5% and need permanent backup
- Between 3.9% and 55.2% of installed wind capacity needs backup on intermittent basis
There is a need for more flexibility

Between day ahead and real time, there are still huge differences, that only can be solved via more availability of flexible plants.

Flexibility options:
- Gas procurement, gas storage as well as grid access
- Electricity storage solutions
- Demand side management
Impact on balancing

Some studies show “moderate” costs (4€/MWh) but more quantitative analysis is needed to include all system cost components:

- **Energy cost** is only one part
- **Downwards regulation** will require to reduce conventional plants to their $P_{\text{min}}$ or even baseload plants in order to keep flexible CCGT
- Keeping out of the money flexible plants creates a **capacity cost** (socialised via grid tariffs)
- Shift from low to high RES penetration requires additional investment of flexible plants which will only be (economically) built if balancing prices justify their investment

**Reduction of balancing costs can be achieved via a well functioning XB intraday market**

Source: EWEA report: The Economics of Wind Energy
DSM as new option for balancing

Demand side management

- Primary control: no
- Secondary control: no
- Minute reserve: yes – 15 min interval
- Load shaving: yes – 60 min interval
- Load shift: yes – 60 min interval
Generic Market Model

Market model today

- Virtual Structures / Contracts / Market
- Uranium
- Natural gas
- Coal
- Lignite
- Biomass
- Generation
- Wholesale
- Transmission
- Distribution / Meter
- Retail
- Supply / Customer
- Physics / Regulation
- Transmission
- Distribution / Meter

Up stream

Down stream
Generic Market Model

Market model tomorrow

Up stream
- Uranium
- Natural gas
- Coal, Lignite
- Biomass
- Generation

Down stream
- Meter Operator
- Data Handling
- Exchange Agent
- Wholesale
- Retail
- Transmission
- Distribution
- Supply / Customer
- Value added service Provider
- Logic
- Data / IT
- Logic
- Data / IT
Further Information

Conference: How will Smart Grids change the face of how we distribute and consume electricity

- EURELECTRIC 2 x ½ day Conference
- 13/14 April in Brussels

www.eurelectric.org
- Smart Metering position paper (2008)
- Upcoming: Smart Metering roll-out recommendations
Thank you for your attention!

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