European Perspectives in implementing Smart Grids

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EBTC is a programme co-funded by the European Union and coordinated by EUROCHAMBRES, the Association of European Chambers of Commerce and Industry

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The EU electricity grid

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Generation	Transmission	Distribution	Customers
• Net Generation • Capacity +650 GW • Peak Demand ~450 GW • RES and DER	• 30-40 TSOs • HEV-HV lines 230,000 km • 5 synchronous areas	• More than 3500 DSOs • MV/LV lines 1,500,000 km • Network losses ~7 %	• Citizens served +500 millions • Consumption +3000TWh/year

Smart Electricity grids: connecting all producers and consumers

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A single pan-European electricity grid

- Sustainable
- Economic
- Reliable

Seamless integration of new applications

End user real time Information & participation

Concentrated & dispersed sources

Central & distributed intelligence

Smart materials and power electronics

Multi-directional ‘flows’

EU power grids need to change

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- **Challenges in the 2020 perspective**
  - 20% Renewable energy
  - Implementing a single market for electricity
  - Security of supply
- **European Energy Roadmap 2050**
  - Energy Efficiency
  - Strong increase in renewable electricity
  - Increased role of electricity in final consumption and energy delivery
- **Development of renewable electricity – main challenge**
  - Generation far from consumption – need more grid capacity
  - Variability of renewables – need flexibility from generation, active demand, interconnections, storage
  - From 100's to millions of supply points – need active distribution, automation

2050 EU Roadmap energy mix

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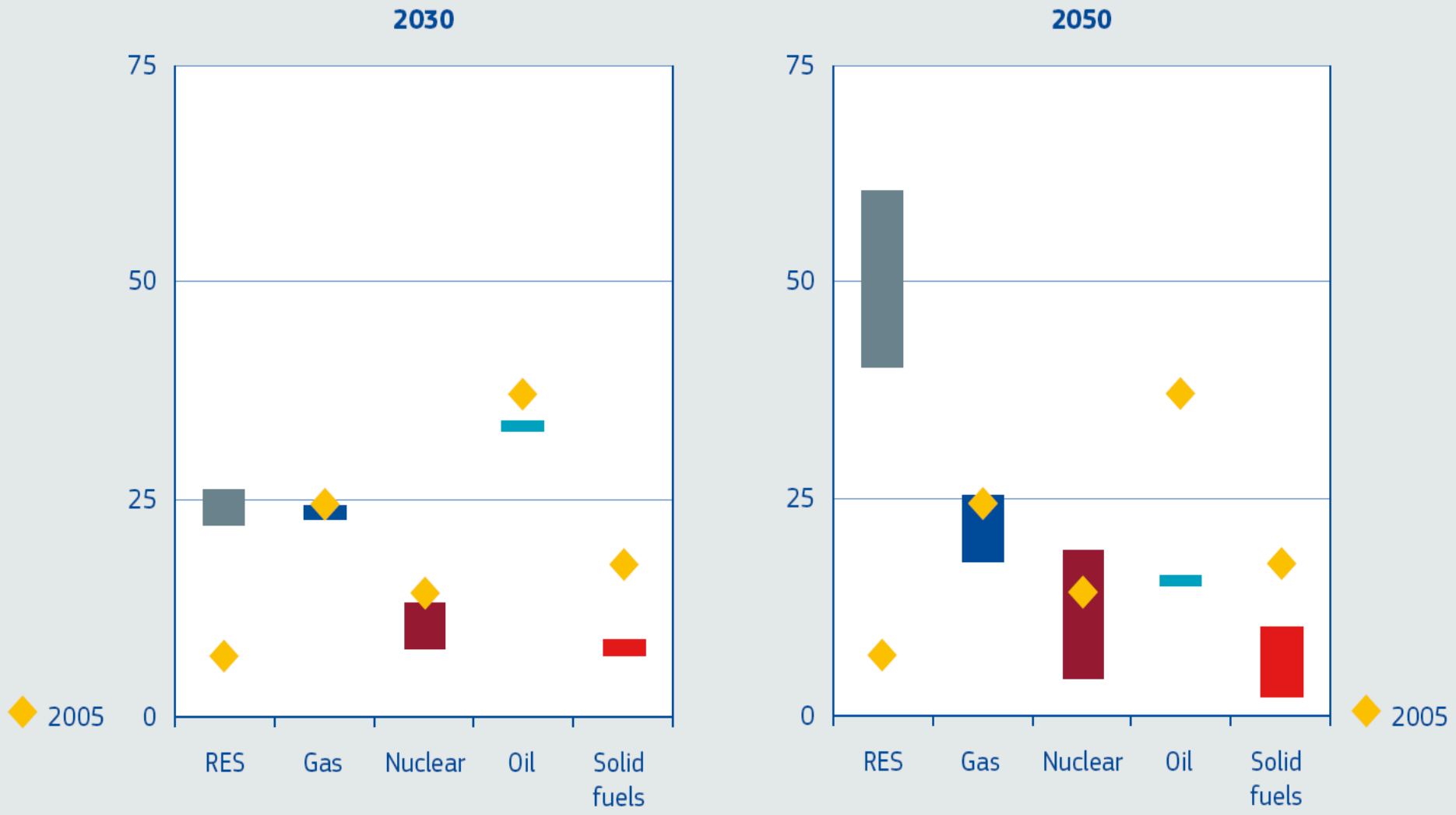

European growth of renewable energy

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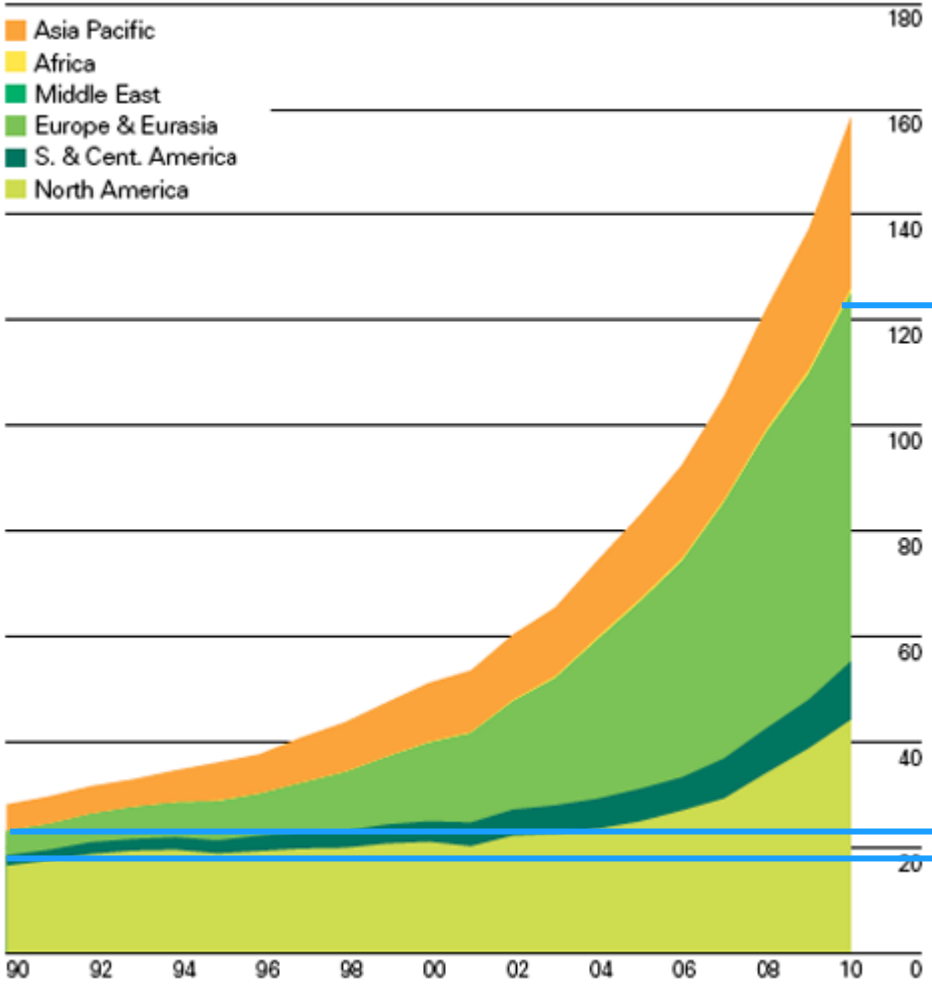

Europe 2010

Europe 1990

Growth in the supply of electricity from renewable sources in million tons of oil equivalent (BP Statistical Review)

Tackling key Smart Grid challenges…

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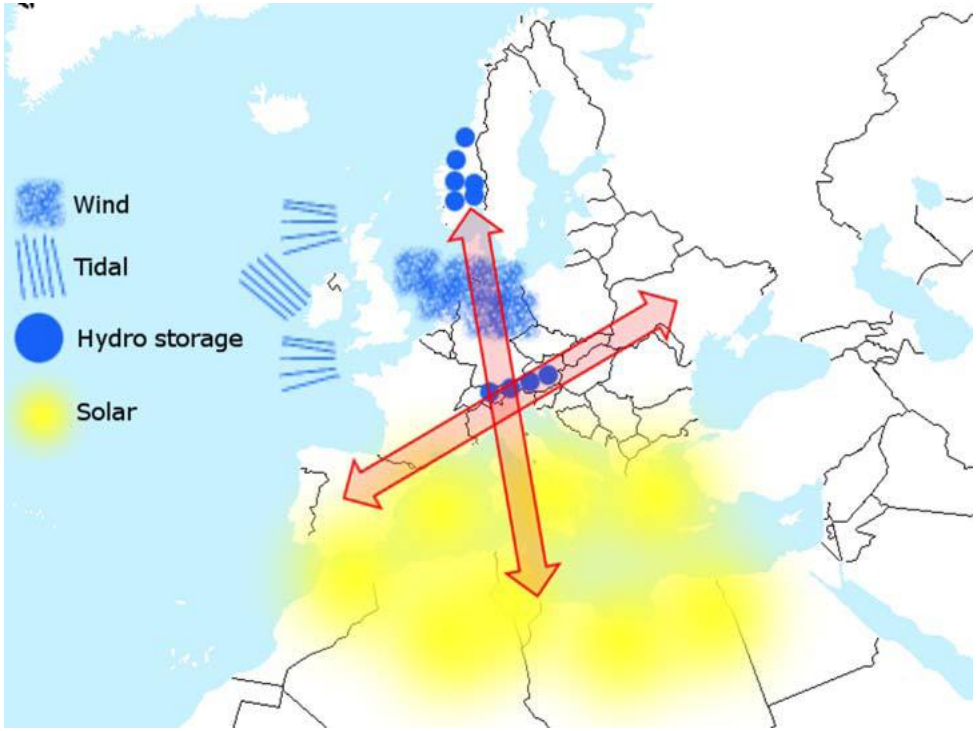

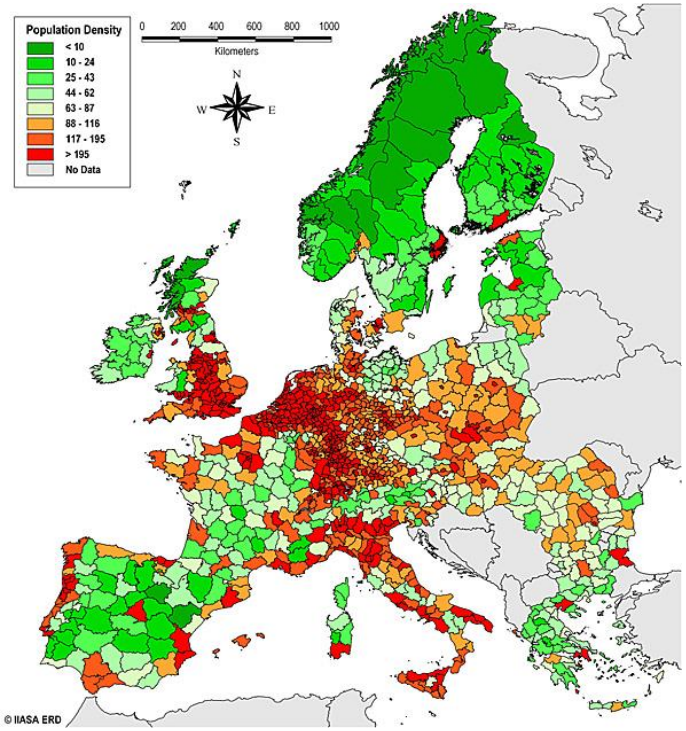

Population density in Europe
source: IIASA

EU Imperative - grids must become Smart…

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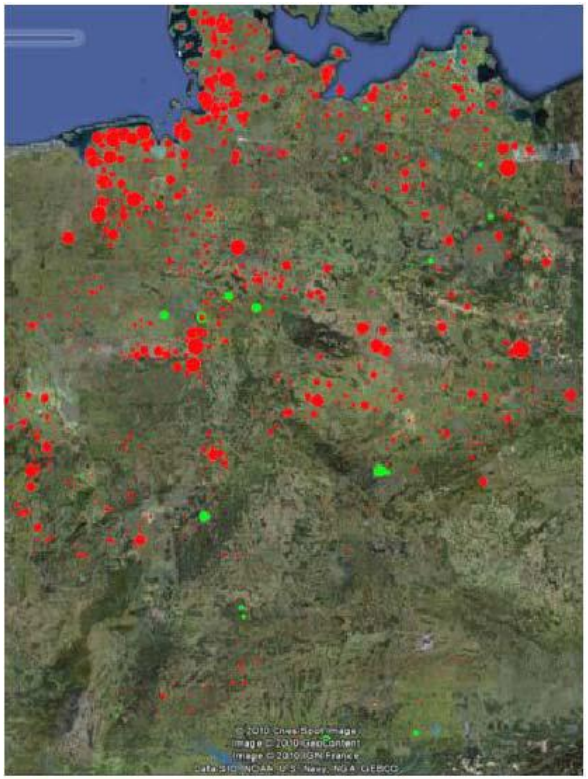
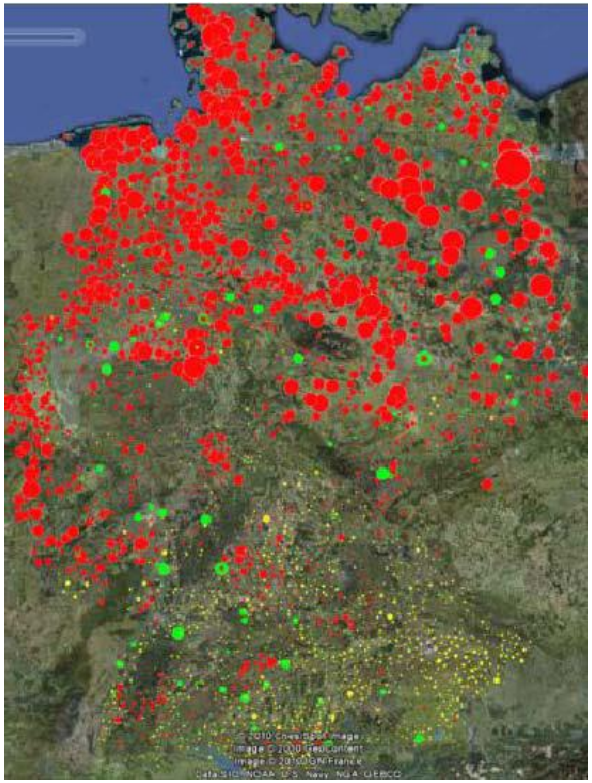
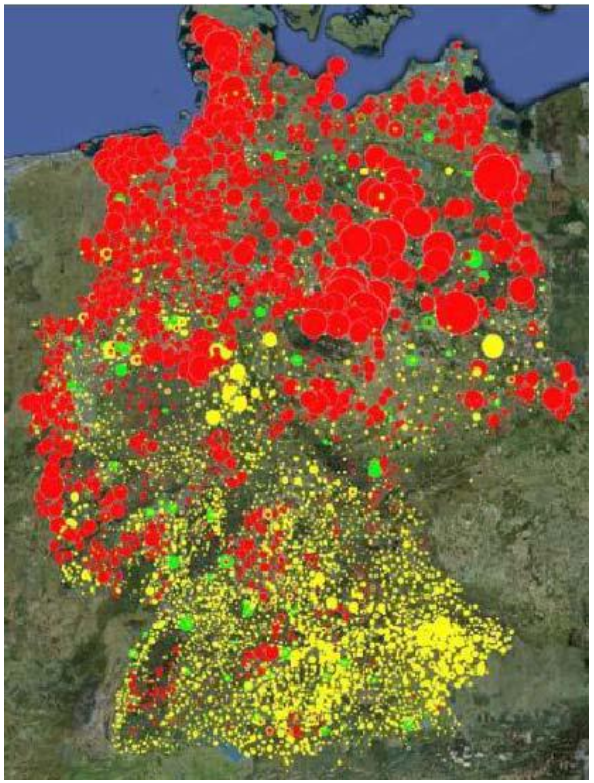


Year 2000
~30,000 power plants



Year 2005
~221,000 power plants



Year 2010
~750,000 power plants

Source 50Hz-Transmission

European actions for development & deployment of smart grids

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- **Market pull – legislation & regulation**
  - "Renewables Directive"
  - 3rd Internal Energy Market Package 2009
  - Energy Efficiency directive (October 2012)
  - European Energy Infrastructure package (proposal 2011)
  - Smart grids task force: policies, regulations
  - Standardisation mandates
- **Technology push**
  - SET Plan European Electricity Grids Initiative (EEGI) – industry led
  - European Energy Research Alliance – aligning national research agendas
  - EC R&D Framework programme – Energy and ICT, now with H2020
  - Member state actions

EU & Smarts Grids – Policy boost

- EU's "20-20-20" target now revised – by 2030 – 40-27-27
- Smart Grids are considered key enablers for an open and efficient energy market in Europe.
- To facilitate and support the process of an EU-wide Smart Grid implementation, the European Commission set up a Task Force on Smart Grids in 2010.
- The 3rd Energy Package provides the conducive environment for the implementation of Smart Grids across Europe
  - One element gives provisions for Smart Meter to be installed with 80% of consumers in Europe by 2020
- Coordination of efforts at European level to exploit synergies and consistency among regulatory authorities, regulated companies, end users and technology providers

Tackling key Smart Grid challenges…

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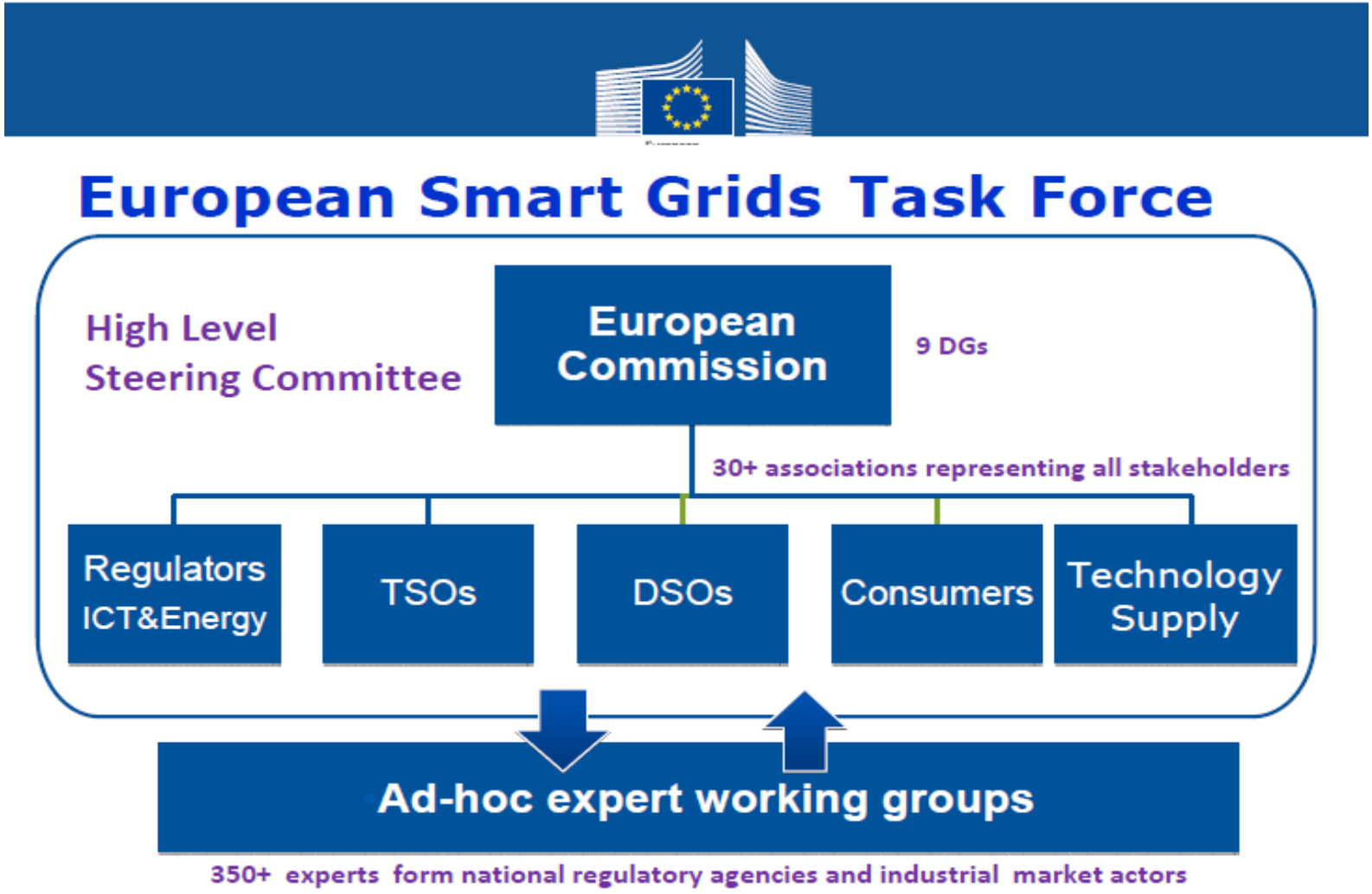

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SG Task Force - Plan of Work for 2012/13

http://ec.europa.eu/energy/gas_electricity/smartgrids/taskforce_en.htm

Standards and interoperability	• Validation the M/490 Work Plan • Monitoring work and deliverables • *Ensure coordination within and other Mandates*
Privacy, Data Protection and Cyber-security	• Develop a proposal for Privacy and Data Protection Impact Assessment Framework Template • Develop a cyber-security assessment framework
Regulation	• Define a few reference market models • Examine the potential implications for the regulatory *frameworks*
Infrastructure	• Establish a process for identifying projects of common interest • *Organise structures and procedures*

Energy

EU & Smarts Grids – few facts today

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- € 5.5 billion has been invested in about 300 Smart Grid projects during the last decade in EU.
- The EU is still in the early stages of the actual deployment of Smart Grids.
- Around 10% of EU households have some sort of smart meter installed, although most do not necessarily provide the full scale of services to consumers.
- Consumers with smart meters have reduced their energy consumption by as much as 10%.
- Some pilot projects suggest that actual energy savings can be even higher.
- Other pilot projects have indicated that Smart Grids can make a major contribution to CO2-emission reduction.

Still nascent sector in the EU, high focus growing

Source: European Commission, A view on Smart Grids from Pilot Projects: Lessons learned and current developments. JRC, issued in June 2011.

EU Smart Metering Initiative

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Smart Metering

European Commission

- Around 250 million smart meters in Europe
- Target (80%) is 200 million smart meters by 2020

According to a preliminary analysis of CBAs and roll-out plans, we estimate:

✓At least 30 billion€ of investments by 2020

✓At least 170-180 million Smart Meters by 2020 –>70% of penetration

Starting with Smart Metering mandate

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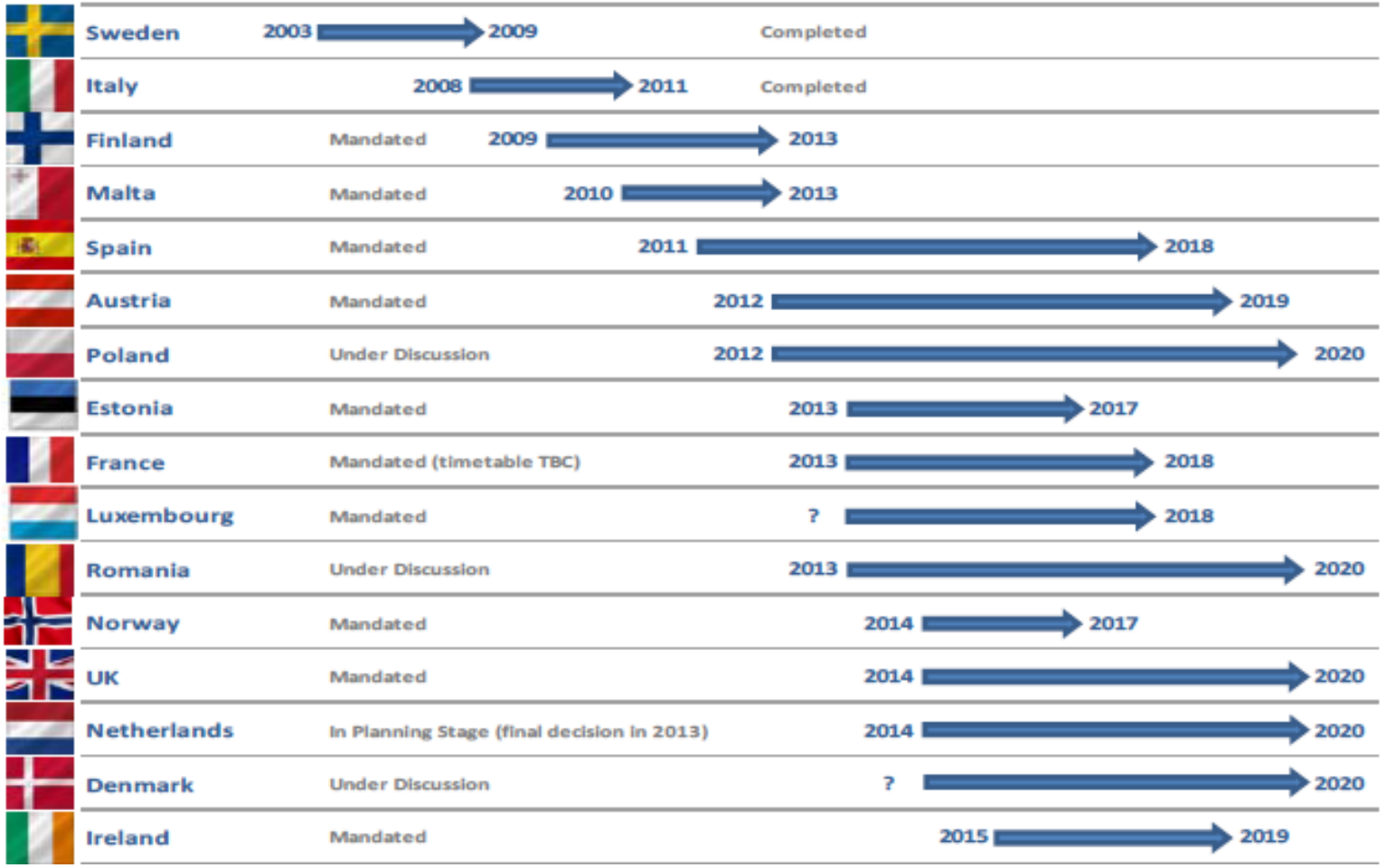
Roll-out plans for smart electricity metering systems



EU Smart Grid projects so far…

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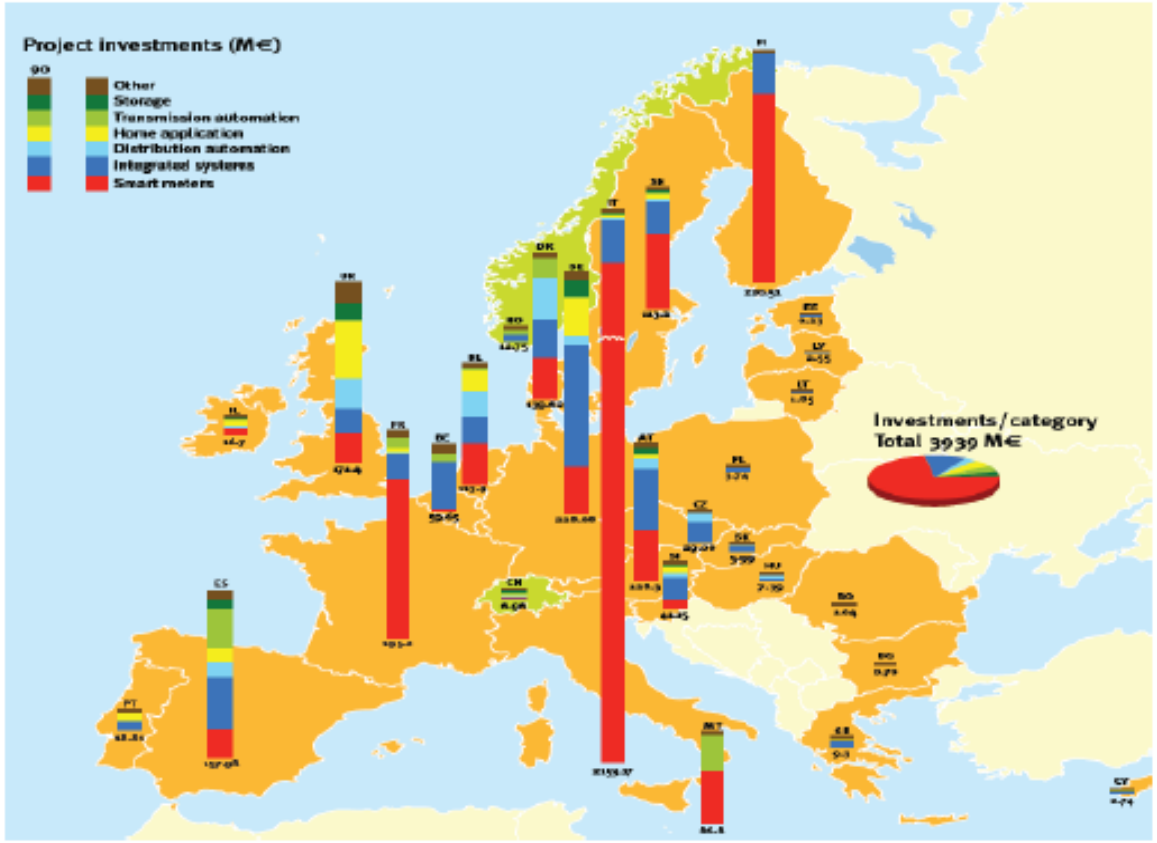
Smart Grid projects spread all over Europe

Investment per country and category



- ✓ Over €5.5 billion investments
- ✓ But still at the beginning of the transition
- ✓ Most investments in EU-15 Countries

Towards demo to real projects…..

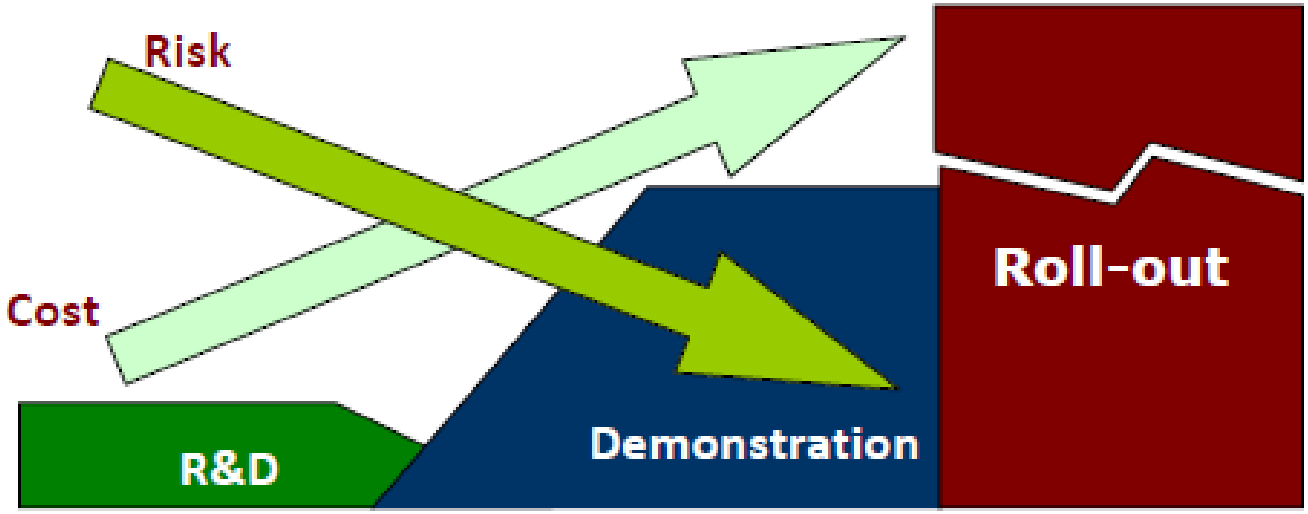
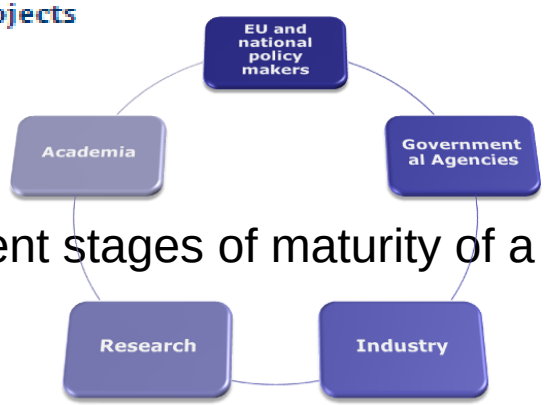


Figure 2 — Risk and cost levels in R&D, demonstration and roll-out projects



Inverse relationship between Risk and cost through different stages of maturity of a technology or application

EU Innovative Smart Grid Pilots

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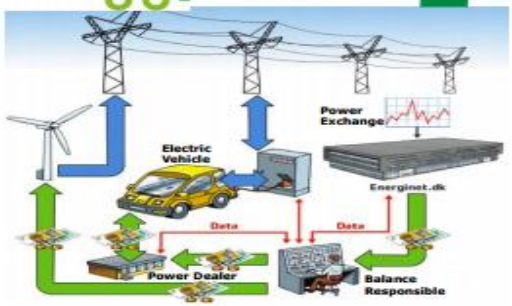
iPower

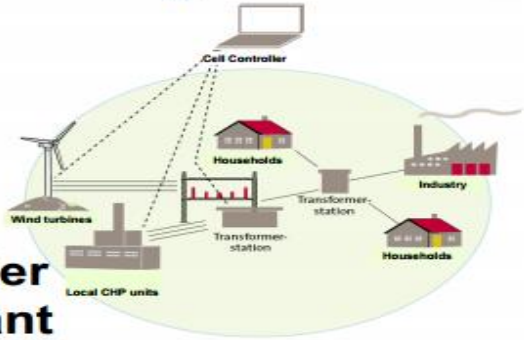
National Research projects in Denmark
- from Cell Controller to iPower

DTU

EDISON

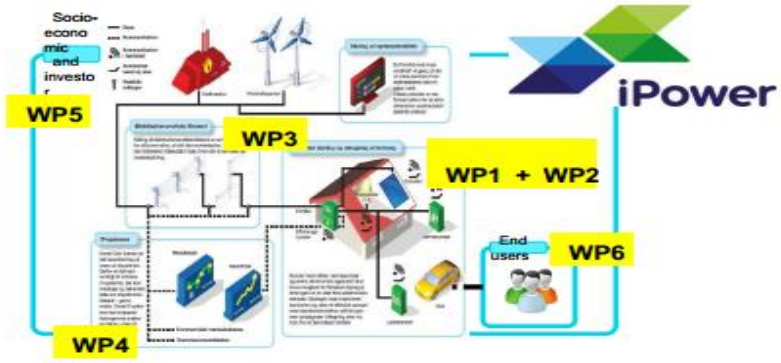


EcoGrid eu
www.eu-ecogrid.net



Cell Controller Pilot Plant

Intelligent Energy Systems



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EcoGrid EU

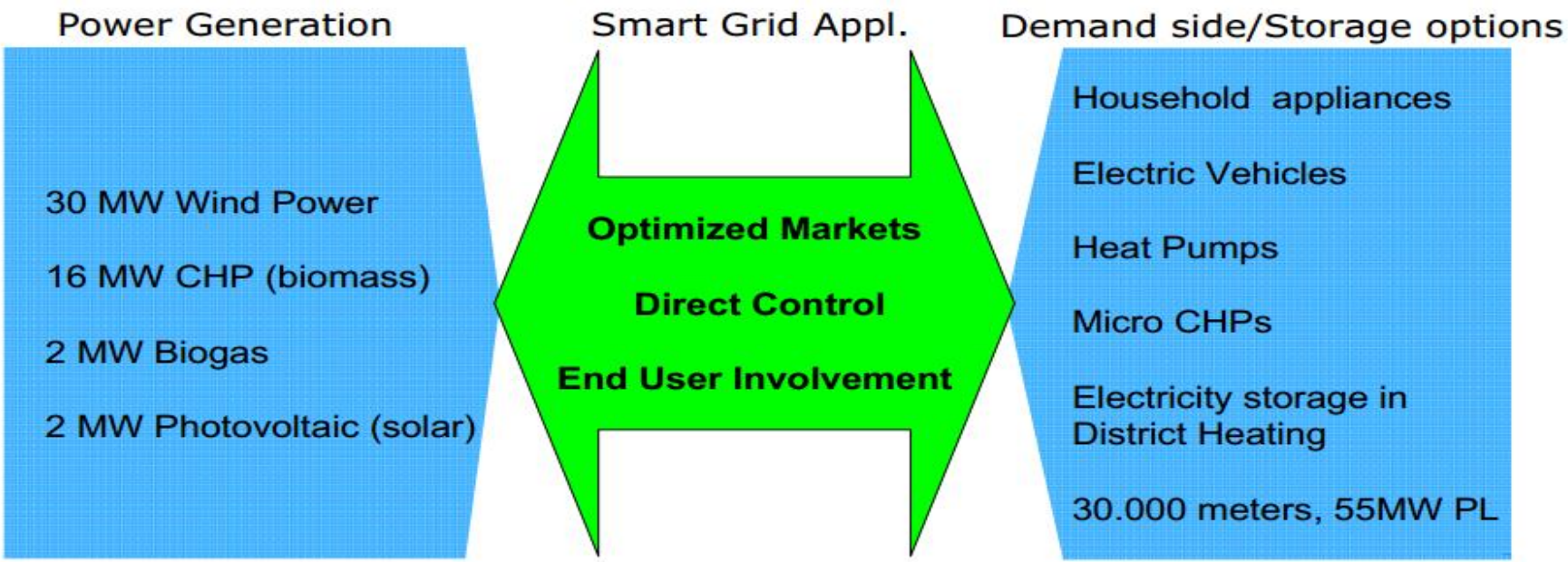
EcoGrid EU is a promising pilot project, in which Danish Island Bornholm will become a test island for the future intelligent electricity system. The results will be replicable throughout the world – with adaptations.

- An intelligent electricity system which can integrate more wind power and other renewable energy sources. In order to make the set-up work in the future, it is necessary to turn all resources in regional grids into active players.

EcoGrid eu
www.eu-ecogrid.net

ENERGINET.DK

Scope of the EcoGrid EU Project



Flexibility in Production and Demand to be tested at Bornholm Island

COOPERATION

An EU FP7 Smart Grids project

GRID4EU
INNOVATION FOR ENERGY NETWORKS

CO - FUNDED BY
THE EUROPEAN UNION

- Project lead by **6 Electricity Distribution System Operators** - covering altogether more than 50% of metered electricity customers in Europe
- Overall **27 partners** from various horizons (utilities, manufacturers, universities and research institutes)
- Duration: **51 months** from November 2011 to January 2016
- Total eligible costs: €54M - requested EC Grant €25.5M

ERDF	Enel	IBERDROLA
Project Coordinator	**Technical Director**	**Chairman of General Assembly**

ČEZ DISTRIBUCE · RWE The energy to lead · VATTENFALL

Tackling key Smart Grid challenges…

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- **Smart Grids projects:**
  - Growing number: deployment, demonstration/pilots, R&D
  - Participants: Grid operators, service providers, etc.
  - Wide scope: smart meters, integrated systems, etc.

- **Inventory of Smart Grid projects in Europe:**
  - The goal is to monitor the developments on the field
  - Limited sharing of project experiences and lessons learned

http://ses.jrc.ec.europa.eu

EU Smart Grid Projects – lessons learned and current developments

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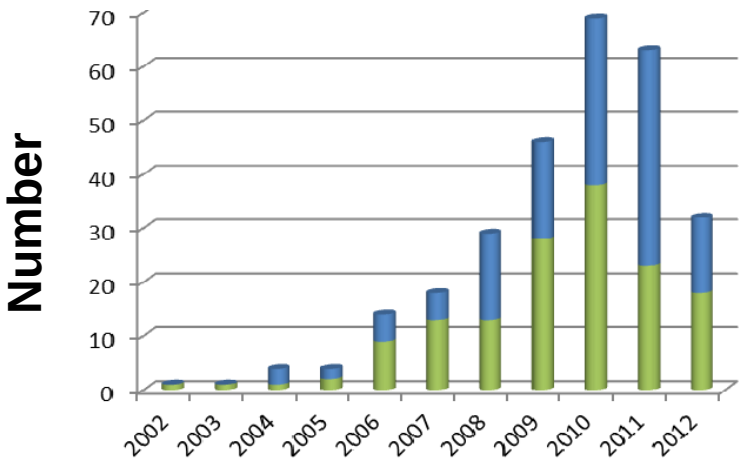
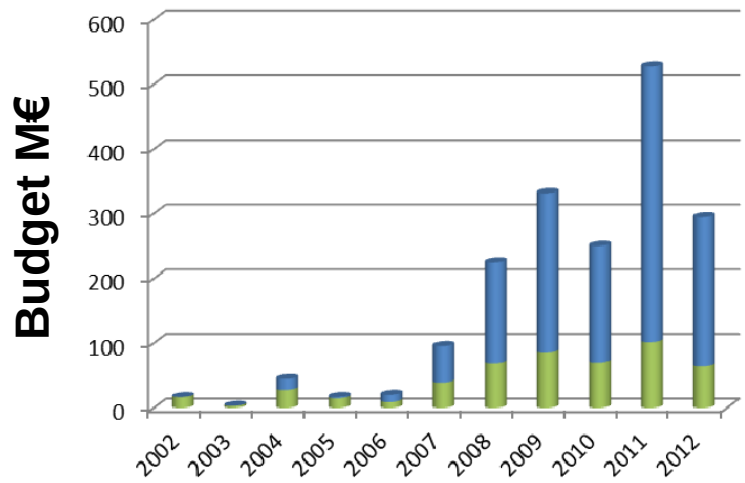
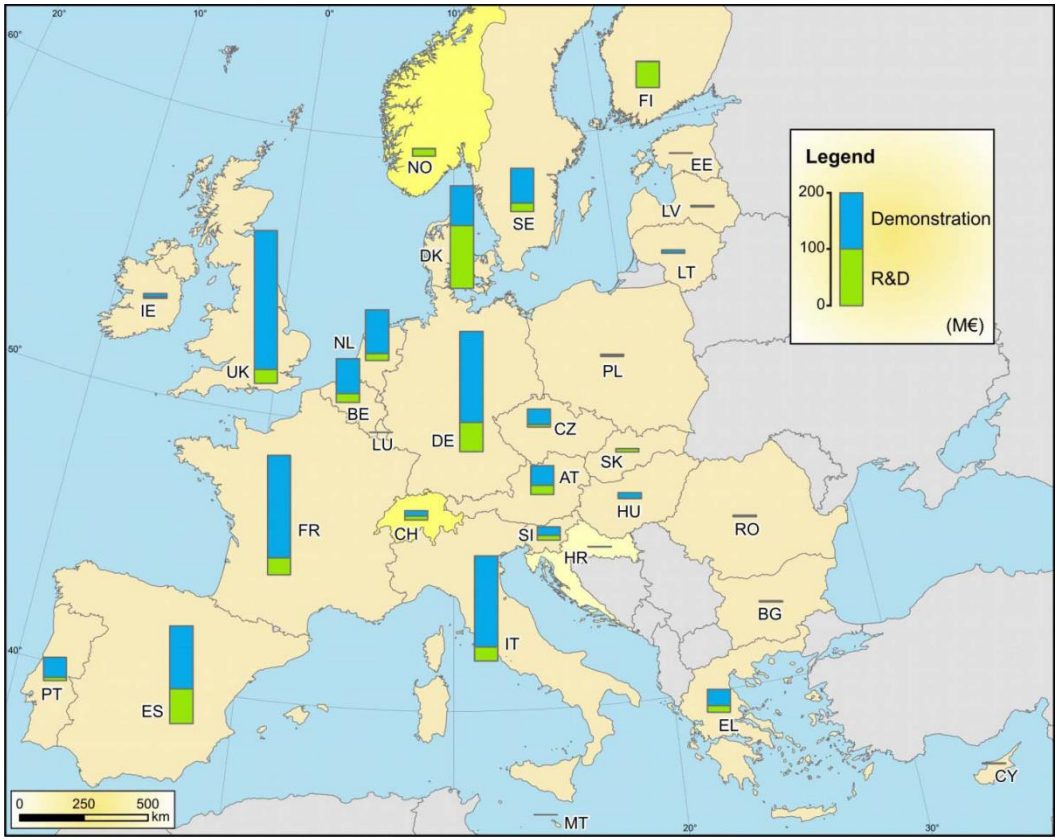




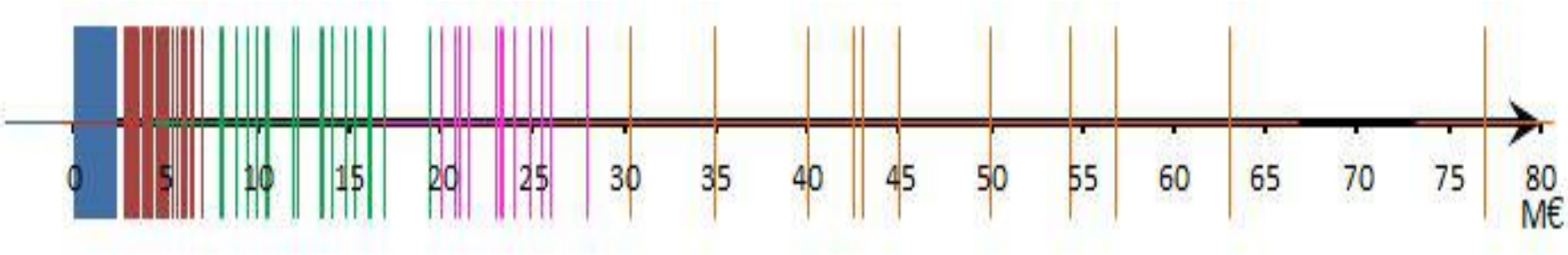
- A total of 281 EU projects surveyed with 1.8 billion€ investments
- Average budget 6.5 million€
- Over 200 M€ of investments per year in the last four years

Smart Grid projects - investments per country



- EU-15 countries leading investments, EU-12 countries lagging behind
- UK, Germany, France and Italy are leading Investments
- Denmark is the leading country in R&D projects

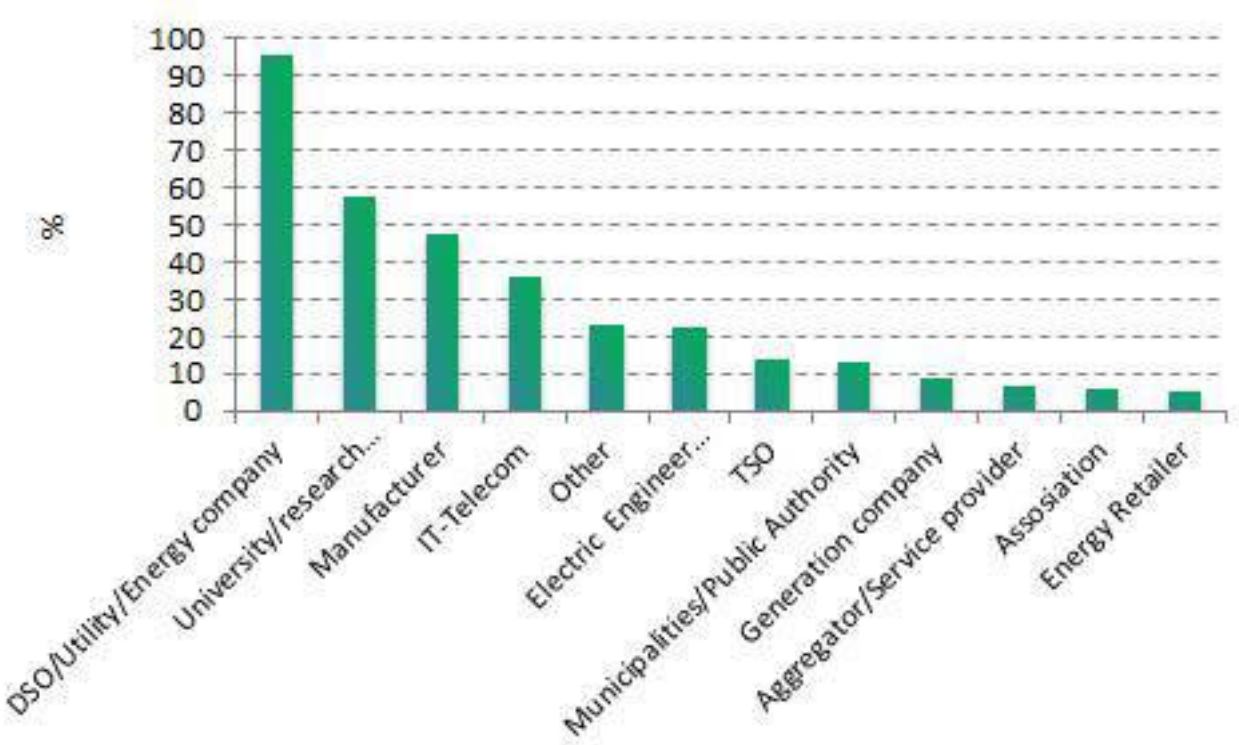
Project distribution according to budget size



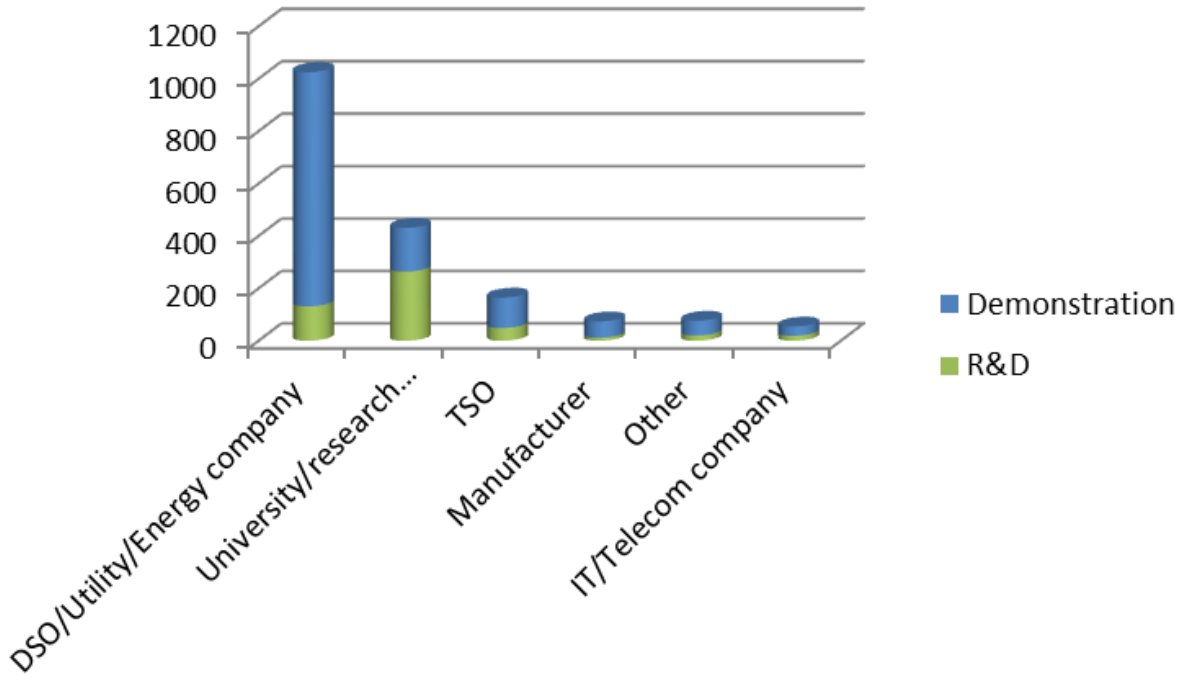
- Very Small scale projects: 0€< Budget<2.5 M€ (blue)
- Small scale projects: 2.5 M€ < Budget<7.5 M€ (red)
- Medium scale projects: 7.5 M€ < Budget<20 M€ (green)
- Large scale projects: 20 M€ < Budget<30 M€ (purple)
- Very large scale projects: Budget>30 M€ (orange)

Who is leading

% of projects where each organization type is present



Who is leading the projects



- Projects led by DSOs/utilities amount to over 50% of the total budget
- IT/Telecom companies are participating in many projects but are leading just a few

European Business models

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Service-based business models, differently from volume-based, can make efficiency and sustainability part of the industry's mission, not simply a constraint to deal with.

Electric vehicles as storage capacity for renewable energy resources: projects investigate and test the viability of using electric vehicle batteries as storage capacity to help balancing the grid during periods of high energy feed-ins by fluctuating renewable energy resources.

Transmission networks of the future – long distance power wheeling at affordable costs: Smart Long Distance Electricity Wheeling

System technologies and **incentives for flexible electricity consumption** of large scale consumers

Business models pass through three phases - Experiment, Consolidate & Expand

Barriers to overcome – EU experience

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- Technology barriers: standards, interoperability, cyber security and data privacy.
  - even though technical solutions often exist at component level, large scale system experiments are needed to validate "system solutions" such as the management of generation intermittency and to promote standardisation and interoperability of the technology solutions which will reduce deployment costs.
- RD&D organisation barriers: fragmentation of efforts across borders and across the electric system value chain.
- Market failures and distortions:
  - the costs and resulting benefits of the RD&D activities are asymmetric: whereas the investments in Smart Grids fall largely on the network operators, the benefits are largely with other stakeholders (society, electricity system, customers, generators etc…)
- Public barriers: customer engagement and public acceptance of infrastructure developments.

Worldwide Smart Grid Market

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Country/ Region	Forecast Smart Grids investments [billion of EURO]	Smart Grids R&D&D projects funded by 2010 [billion of EURO]	Millions of Smart Metering deployed and/or planned
European Union	56 by 2020	5.5	45 by 2011 200 by 2020
USA	238-334 by 2030	4.9	8 by 2011 60 by 2020
China	284 by 2020	5.1	360 by 2030
South Korea	16.8 by 2030	0.58	0.5 by 2010 0.75 in 2011 24 by 2020
Australia	-	0.25	2.4 by 2013 in Victoria

Ref: http://ses.jrc.ec.europa.eu/index.php?option=com_content&view=article&id=93&Itemid=137

Tackling key Smart Grid challenges…

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System Complexity	• Standardization • Seeking and promoting Energy/ICT/Telecom synergies • R&D and demo projects to reduce uncertainties
Industry Incentives	• Priority to Smart Grids within regulatory framework, including in Connecting Europe Facility • Industrial Initiatives under the SET Plan • International cooperation
Consumer involvement	• Consumer oriented retail market models promoted • Smart meters: functionalities to empower consumers • Data Security & Privacy Protection • Retail price regulation to be assessed by full impact on demand response, energy efficiency, consumer benefit, sector impact

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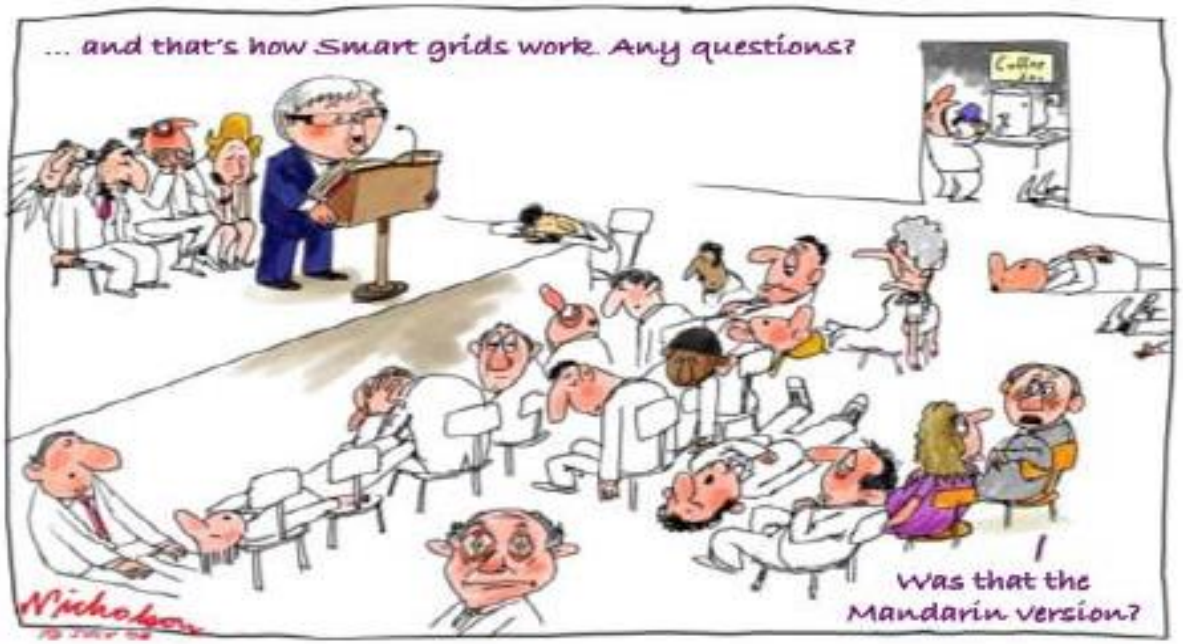
Smart Grids: multi-piece puzzles for many players



System Complexity?

Industry Incentives?

Investment Needs?

Consumer Involvement?

Ref: http://ses.jrc.ec.europa.eu/index.php?option=com_content&view=article&id=93&Itemid=137

EU-India Smart Grid Cooperation – Policy to Pilots

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- European Smart Grid expert missions: EU Experts and Institutions visited Indian Policy makers both at Central government as well as a state to share experiences and initiatives
- Witnessed progress in Smart Grid policy & pilot projects
- Visited Gujarat Solar park
- Exploring to develop pilot projects to evaluate & field test smart grid technologies in India

EU-India Smart Grid Cooperation – Policy to Pilots

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- High level Indian Smart Grid Delegation visited Europe on European Commission Invitation
- Discussed policy framework and shared experiences especially Smart Grid policy evolution and current status
- Visited EU smart grid pilot implementation projects
- Shared European Distribution and Transmission operator's onsite experience wrt challenges and benefit of embracing smart grid strategies
- Witnessed interesting DSM pilots & research set ups

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- Are you planning to develop project?
- Looking for business & academic partners?
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