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Institut de Recherche sur les Transports, l'Énergie et la Société

UNIVERSITÉ DE TECHNOLOGIE DE BELFORT-MONTBELIARD

Smart Grids (SG) and European policy

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Introduction : Challenges for a sustainable energetic transition

Emergency and challenges :

- Climate change
- Natural resources depletion (higher prices, geopolitical instability…)
- World energy consumption growth: + 56% between 2010 and 2040 (IEA 2013)
- Energy system safety
- Fuel poverty

→ The current energy system reached its limits and have to change toward a low-carbon economy

→ SG technologies are acknowledged as key tools to support:
- this process of sustainable transition,
- the set-up of an internal European energy market
- an additional economic growth

The European policy has to move its priorities in order to support the SG

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Problematic

- How the European policy supports research and development, deployment and the spread of Smart Grids ?

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Outlines

I. SG: definition and spread in Europe
II. Conceptual framework : the functions of the Technology Innovation System (TIS)
III. Methodology
IV. The functions covered by the SG European policy
V. Conclusion

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I- SG : definition and spread in Europe

- A SG is “an electricity network that can intelligently integrate the behaviour and actions of all users connected to it – generators, consumers and those that do both – in order to efficiently ensure sustainable, economic and secure electricity supply” (EC Task Force for Smart Grids, 2010)

➔ SG technologies are used to integrate intelligence in the *generation*, *transmission*, *distribution grids, storage* and *demand response*.

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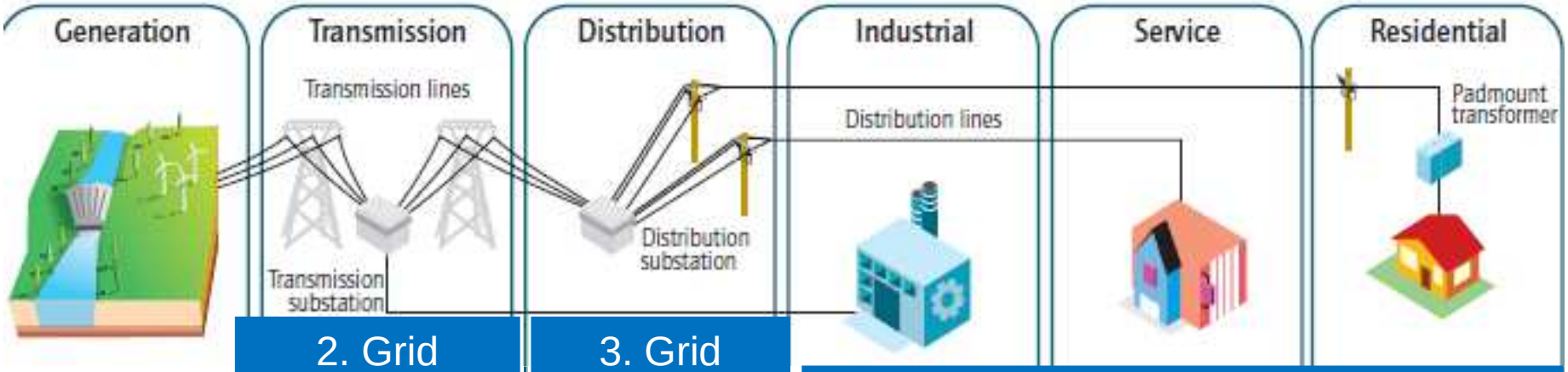
Main project applications (Catalogue JRC 2013)



2. Grid Automation Transmission

3. Grid Automation Distribution

1. Smart Meter and Advanced Metering Infrastructure

4. Integrated System

A combination of technologies for three main applications:

- Active participation of consumers
- Integration of renewable energy
- Integration of distributed energy resources

5. Home Application Customer Behaviour

6. Specific Storage Technology Demonstration

7. Other

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The actors

Role	Category
Traditional actors	Utilities (EdF, ERdF, Enel, eurelectric…)
	Institutional (national regulators, CEER …)
	Equipment suppliers of energy (Siemens, Schneider Electric…)
New actors	Actors of new technologies of information and communication
	Consomm'actor
	Institutional (ACER, ENTSO-E…)
Actors with a more peripheral role	Non governmental Organisations (Greenpeace, WWF…)
	Construction and automotive industries (Renault…)
	Laboratories / research institutes / clusters

Source : CRE

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SG projects in Europe: Investments and scale (Source : JRC Reports)

- Up to 2012, **281** SG projects across 30 countries (EU-27, Croatia, Switzerland and Norway), accounting for a total **investment of € 1.8 billion**
- Activities in SG projects increased dramatically from 2006 onward
- In the period 2008-12, investments in SG projects were above **€200 million per year**, reaching **€ 500 million in 2011**
- Project budgets have been growing steadily. The investment share of projects with **budgets of over € 20 million grew from 27 % in 2006 to 61 % in 2012**
- 55 % of the total budget for the SG projects surveyed comes from various sources of funding (national, EC, regulatory) and the remaining 45 % from private capital;

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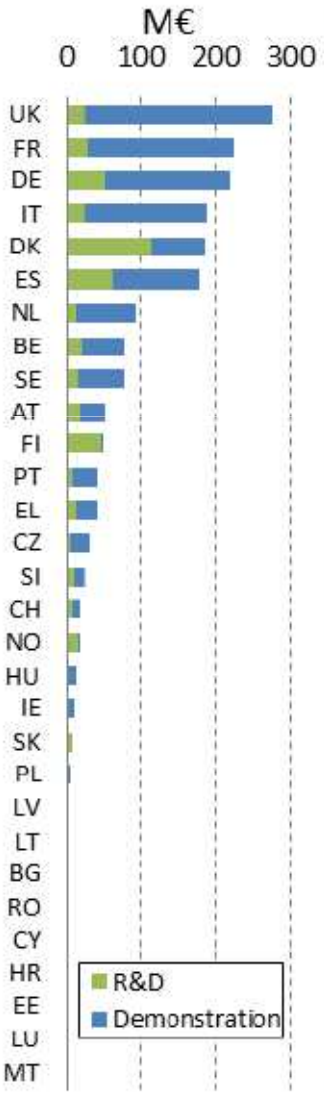
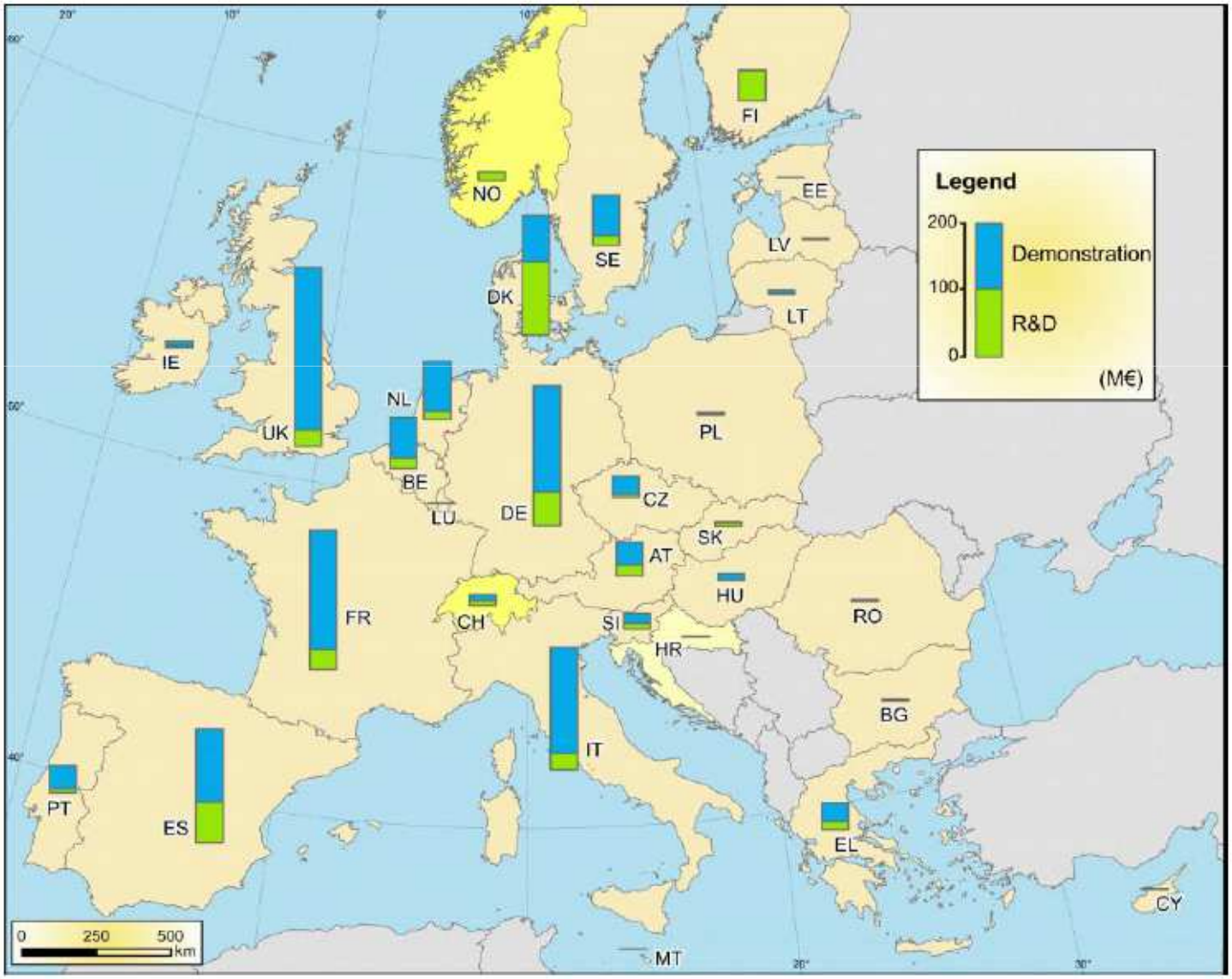
Investments in R&D and demonstration SG projects across Europe *(Source : JRC Reports 2013)*





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Conclusion : SG

- The current energy system begins to change with the increasing diffusion of SG demonstration projects.
- But it is still locked into a **carbon-intensive system** (Unruh 2000) due to different barriers (low renewable energy generation, grids and storage limited capacities, behavior of technology suppliers and users)
  - ➔ The magnitude of the challenge points to the need for a systemic perspective : it requires the emergence of a new socio-technical system (Elzen et al. 2004) based on the transformation of the **overall** electricity system
  - ➔ This process of transformation takes considerable time

We analyze the SG like a Technology Innovation System and focuses on the role of European policy in the SG innovation process.

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II- Conceptual framework : the functional dynamics of Technological Innovation System

Innovation system:

Group of components (actors, networks and institutions) contributing to the overall function of developing, diffusing and utilizing new products (goods and services) and processes (Calrsson and Stankiewicz, 1991, 1995, Bergek, 2002)

Technical innovation system:

A dynamic network of agents interacting in specific economic/industrial area under a particular institutional infrastructure (...) and involved in the generation, diffusion, and utilization of technology (Carlsson and Stankiewicz 1991)

Processes driving TIS dynamics or TIS functions:

Description and evaluation of 7 **key processes**, labelled **functions**, in the evolution of a TIS. This framework focuses on what is actually achieved in the system, rather than on the structure of the system (Bergek et al, 2007)

Useful to identify the key policy issues and set goals in any given TIS.

Functional pattern of TIS
(Hekkert et al., 2007, Bergek et al 2008)

Functions	Description
Knowledge development and diffusion	To create knowledge and to facilitate information and knowledge exchange.
Influence on the direction of search	To induce actors to enter the TIS, to direct their search and investments towards the system. To direct the attention of actors in the system towards specific problems and growth opportunities.
Entrepreneurial experimentation	To create new businesses, to experiment with new products, to identify and test new markets or opportunities
Market formation	To identify markets or market niches as well as to stimulate the formation of local markets
Legitimacy/ counteract resistance of change	To create/build support and legitimacy for the TIS activities and agendas (internally and externally).
Resource mobilization	To allocate financial, material and human capital to the innovation process
Development of positive externalities	To stimulate identification and utilization of synergies within the system.

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Conceptual framework : Functional pattern of TIS

- Interactions between system functions exist and could lead to setting off virtuous or viscous cycles
- All the functions can potentially be supported by policy makers
- Policy is needed at each stage of the innovation process
- **Challenges of this research :**
  - To provide an analysis of European policy about SG from the theoretical framework of TIS functions
  - To identify which functions are covered by the European policy
  - To understand the mechanisms of emergence / deployment of SG, and more generally the sustainable transition process

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III- Methodology

- From the EUROPA web site :
  - To highlight the European political context of energy
  - To identify the key policy issues about SG
  - To list the legislation used by the European Commission (EC) in order to promote the SG
- To analyse TIS functions identified
- To put in perspective the most covered functions and the timing of innovation process

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European policy of Energy:
Security of supply – Competitiveness - Sustainability

- Since 1996, 3 **Energy Legislative Packages** in order to support the energy market liberalization and the setting up to common rules *(the 2009 package includes the use of smart meters)*
- 2007 : **"20-20-20 agenda"** (GHG / energy saving / renewable energy):
  - The 2009 **climate and energy legislative package**
- 2007/2009: The **Treaty of Lisbon** gives to energy a new legal basis
- 2010 **: "Energy 2020 : A strategy for competitive, sustainable and secure energy**"
- 2011 : **"Roadmap 2050"** (Competitive low carbon economy)
- 2012 : **Energy Efficiency Directive**
- *2013 :* Public consultations: **Green Paper on a 2030 framework for climate and energy policies**
- 2013 : **Guidelines for trans-European energy infrastructure** (Regulation of the European Parliament and of the council)

Strategic papers identify SG deployment among the priorities

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European policy of SG

- 2006: **Vision and Strategy for Europe's Electricity Networks of the Future** (European Technology Platform SG).
- 2007 : **Agenda for Europe's Electricity Networks of the Future** (European Technology Platform SG)
- 2011: **Smart Grids: From Innovation to Deployment** (EC 2011)
  *"SG will be the **backbone** of the future decarbonised power system" (p.2)*
- 2012 : **Smart Grid Strategic Research Agenda (SRA)** 2035. (European Technology Platform SG)

SG depend on Energy legislative Package (2009), Energy Efficiency Directive (2012) and Guidelines for Trans-European energy infrastructure (2013)

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Policy initiatives enabling SG deployment in Europe

Set up by the EC of a **Task Force on SG (2009)**

Mission: To advice the Commission on policy and regulatory directions and to coordinate the first steps towards the implementation of SG

4 expert groups: SG Standards / Regulatory Recommendations for Privacy, Data Protection and Cyber-security In the SG Environment / Regulatory Recommendations for SG Deployment / SG infrastructure deployment

1. Developing technical standards;
2. Ensuring data protection for consumers;
3. Establishing a regulatory framework to provide incentives for Smart Grid deployment;
4. Guaranteeing an open and competitive retail market in the interest of consumers;
5. Providing continued support to innovation for technology and systems

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TIS Functions and European SG policy *(Based on EC 2011)*

Functions	Actions
Knowledge development and diffusion	•Expert groups between Energy / ICT •Web site of European Technology Platform •JRC Report (2012): Lessons learned and current developments •Seven Framework Program
Influence on the direction of search	•Task Force •European Technology Platform (SRA 2035) •Seven Framework Program •European Electricity Grid Initiative (EEGI)
Entrepreneurial experimentation	•Binding framework : •To roll out 80% of Smart Meters •To improve efficiency (building, product…) •EEGI : “Projects and investments must now aim for ‘real life’ demonstration and validation” •To encourage SME participation in European projects (ERA)

TIS Functions and European SG policy *(Based on EC 2011)*

Functions	Actions
Market formation	•Standardisation (condition for SG deployment) •Data protection (condition to consumers acceptance) •KPI to identify market opportunities •To roll out 80% of Smart Meters : Information on real consumption allows to propose new services and products •Taxation on energy products •New products to achieve the targets of efficiency or renewable energy •Regulatory framework in order “to move from a ‘volume-based’ business model to a quality- and **efficiency-based model”**

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TIS Functions and European SG policy *(Based on EC 2011)*

Functions	Actions
Legitimacy/ counteract resistance of change	•**Discourse** : •Energy 2020 , •Roadmap 2050, •Vision and Strategy for Europe's Electricity Networks of the Future •Agenda for Europe's Electricity Networks of the Future •Smart Grids: From Innovation to Deployment •SRA 2035 •Web site •JRC Report (2012): Lessons learned and current developments •**Actions :** •Green Paper on a 2030 framework for climate and energy policies, •Data protection

TIS Functions and European SG policyGrids *(Based on EC 2011)*

Functions	Actions
Resource mobilization	•KPI to identify the beneficiaries and to encourage them to invest •Regulatory framework to drive the investments in SG •EEGI •Seven Framework Program
Development of positive externalities	•Coordination of actions •ETP: Forum / Exchange or information in order to create a common vision •Joint Report EN JRC – US DOE (2012) •European projects •Consultation of industrials and shareholders (ex.: **Green Paper on a 2030)**

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V- Conclusion

Functions	Number of initiatives identified
Legitimacy	10
Market formation	7
Development of positive externalities	5
-Resource mobilization -Influence on the direction of search -Entrepreneurial experimentation -Knowledge development and diffusion	4

- All functions are covered
- Focus on the functions linked to the market :
  - Legitimation
  - Market formation
  - Development of positive externalities
- These results are coherent with the degree of maturity of SG TIS

Beyond this institutional approach, this research must be complemented by an analysis of public and private investments carried out

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