Smart grids in European Union

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European Commission

"Energy Awarness" Seminar

Villach 02.02.2015

Joint Research Centre

- Introduction
- Smart Grid landscape
- Smart Grid projects in Europe
- Costs and benefits of smart grids
- Smart Grids Simulation Centre
- Networking and cooperation

Introduction

Smart grids are part of EU Energy Policy

EU Players:

- European Commission
- European Parliament
- Smartgrid Technology Platform

Juncker’s European Commission

- Focus on Growth, Jobs, Fairness and Democratic change
- New European Energy Union with forward looking Climate change
- No specific focus on Smartd grids yet

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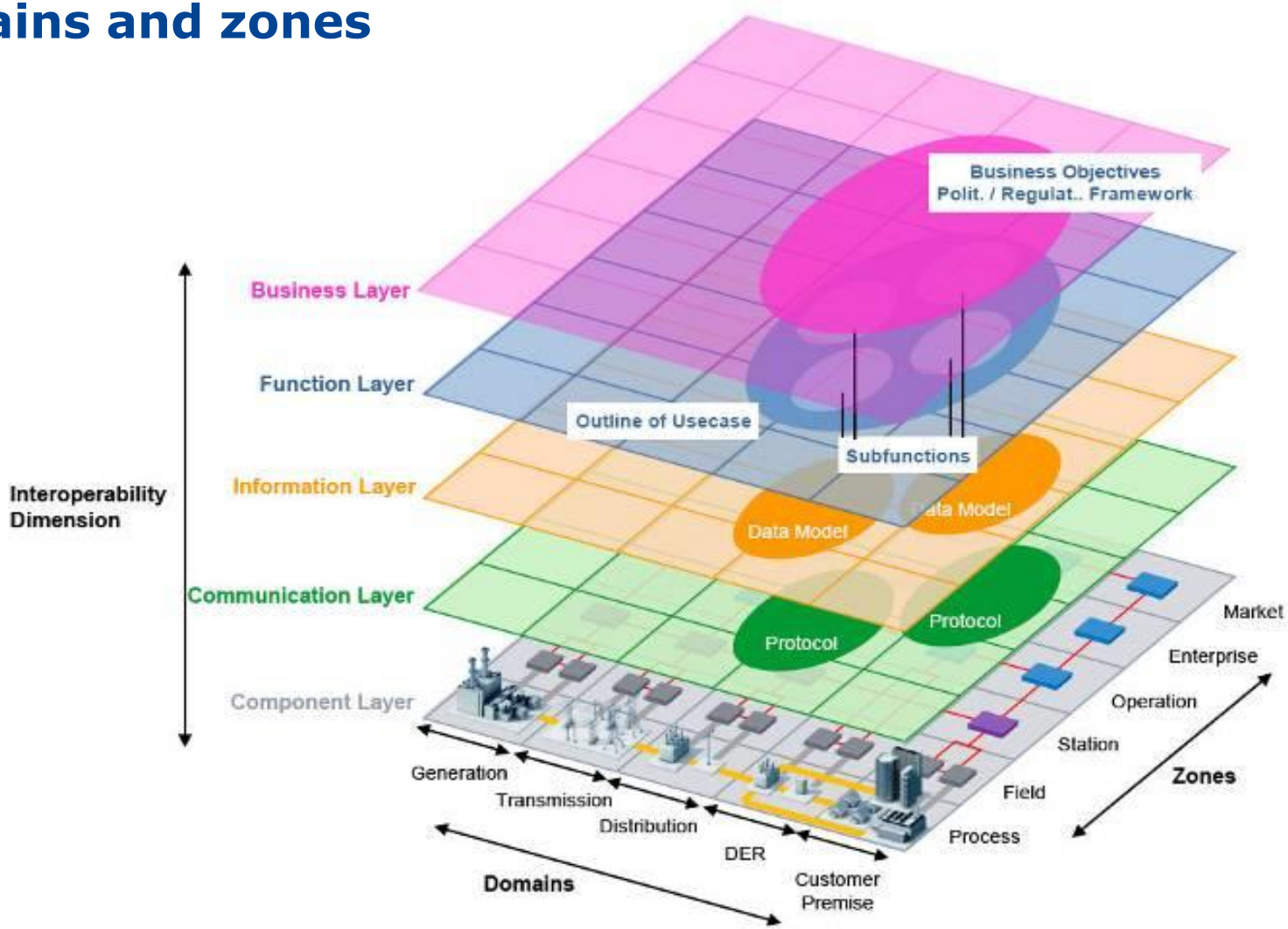
Power system – present

Smart grid: (possible) future

Smart grid: dimensions, domains and zones



Source: EC Smart Grid Standardisation Reference Group

- The JRC - Institute for Energy and Transport
- Smart Grid landscape
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A multi-layer problem

PHYSICAL

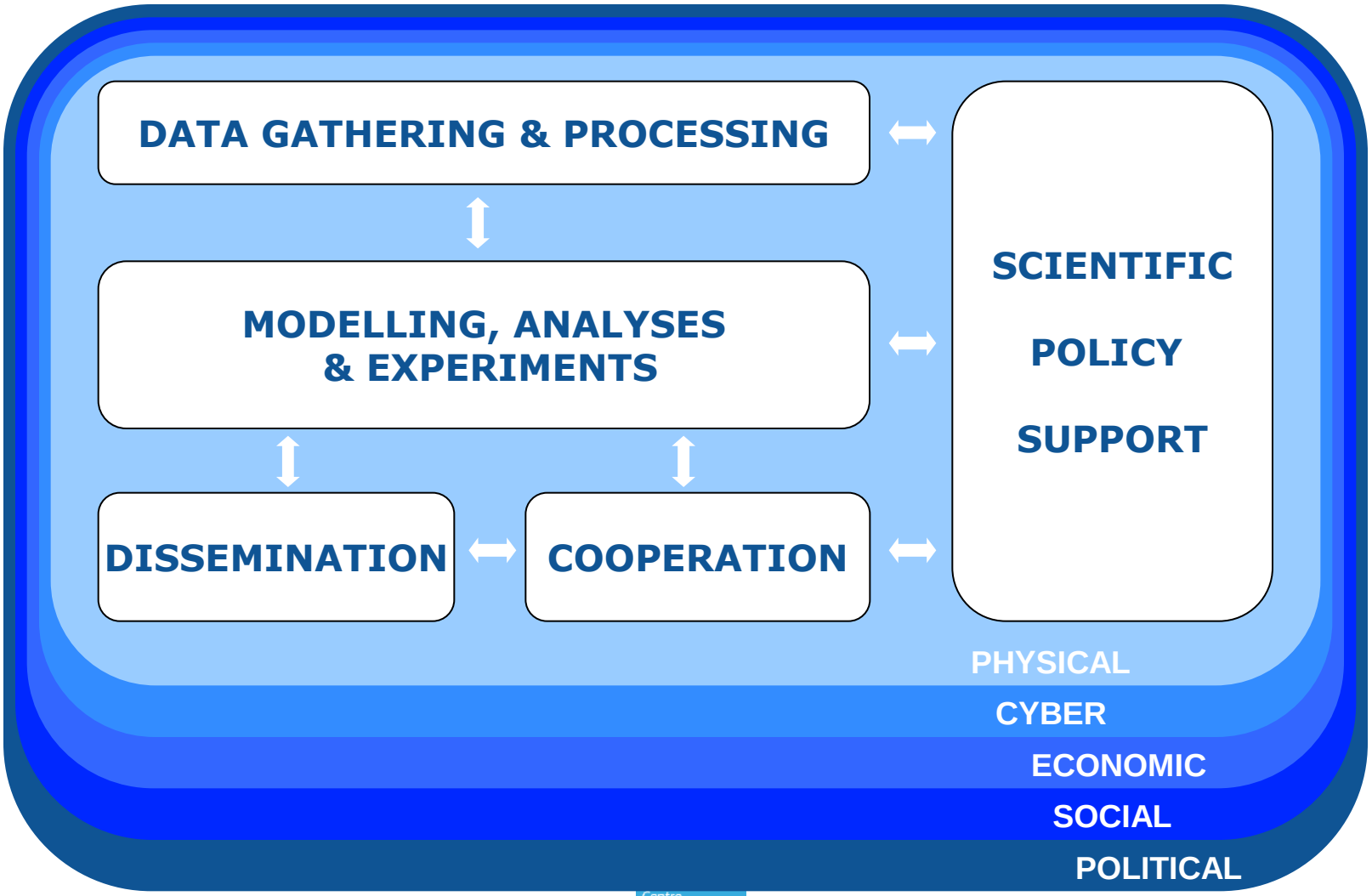
CYBER

ECONOMIC

SOCIAL

POLITICAL

The multi-layer approach of Smart Electricity Systems



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Background

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

- No inventory of Smart Grid projects in Europe available in 2011:
  - **Limited sharing of** project **experiences** and lessons learned
  - **Need to monitor** the developments on the field

- Reference Report "Smart Grid projects in Europe: lessons learned and current developments"

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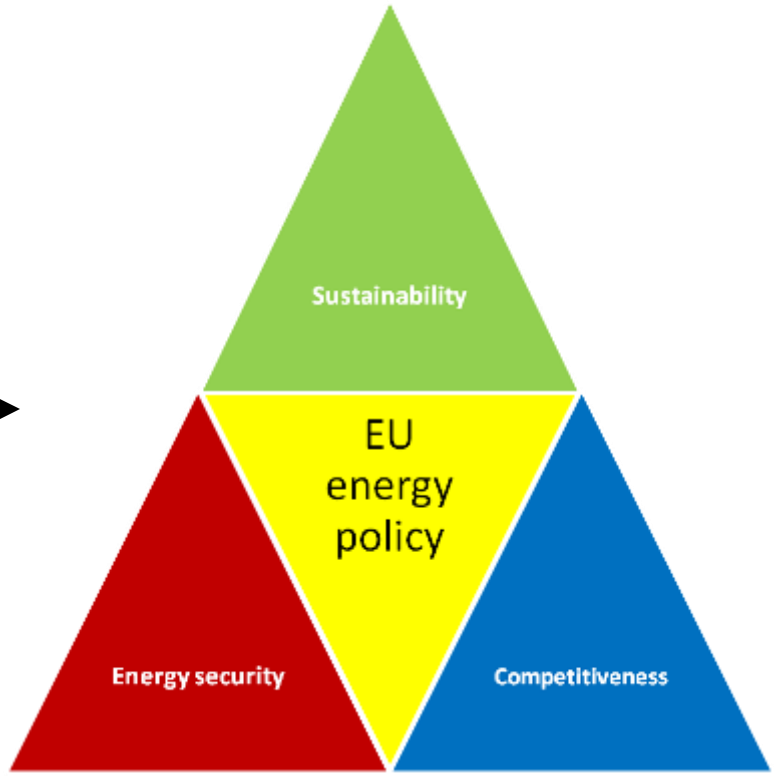
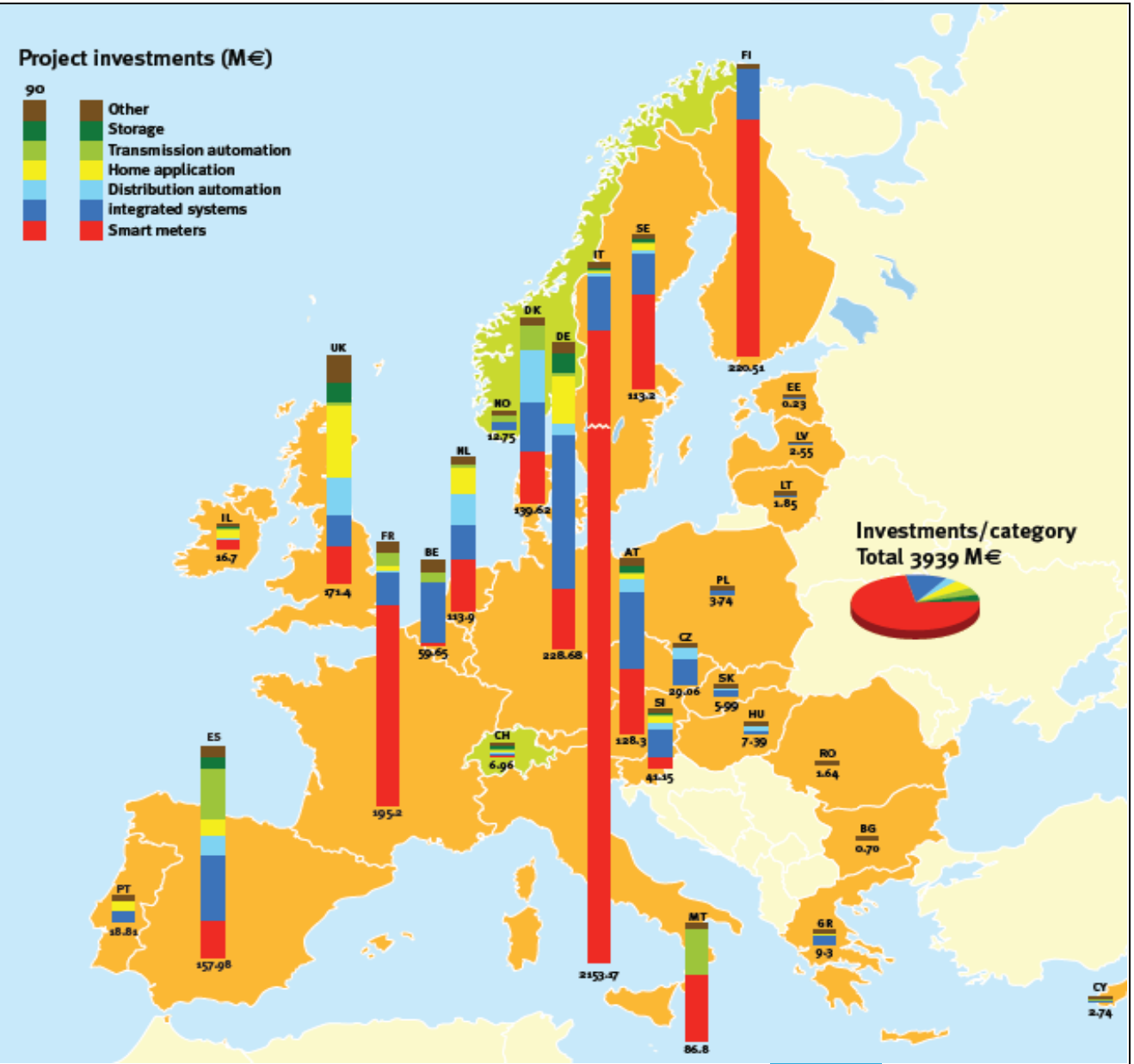
Background

Rising political attention on Smart Grids as a means to achieve EU energy policy objectives. Need to unlock market investment potential.

Storage
Prosumers
Renewables
Distributed Generation
EV
Aggregators
Demand Response
Smart Meters

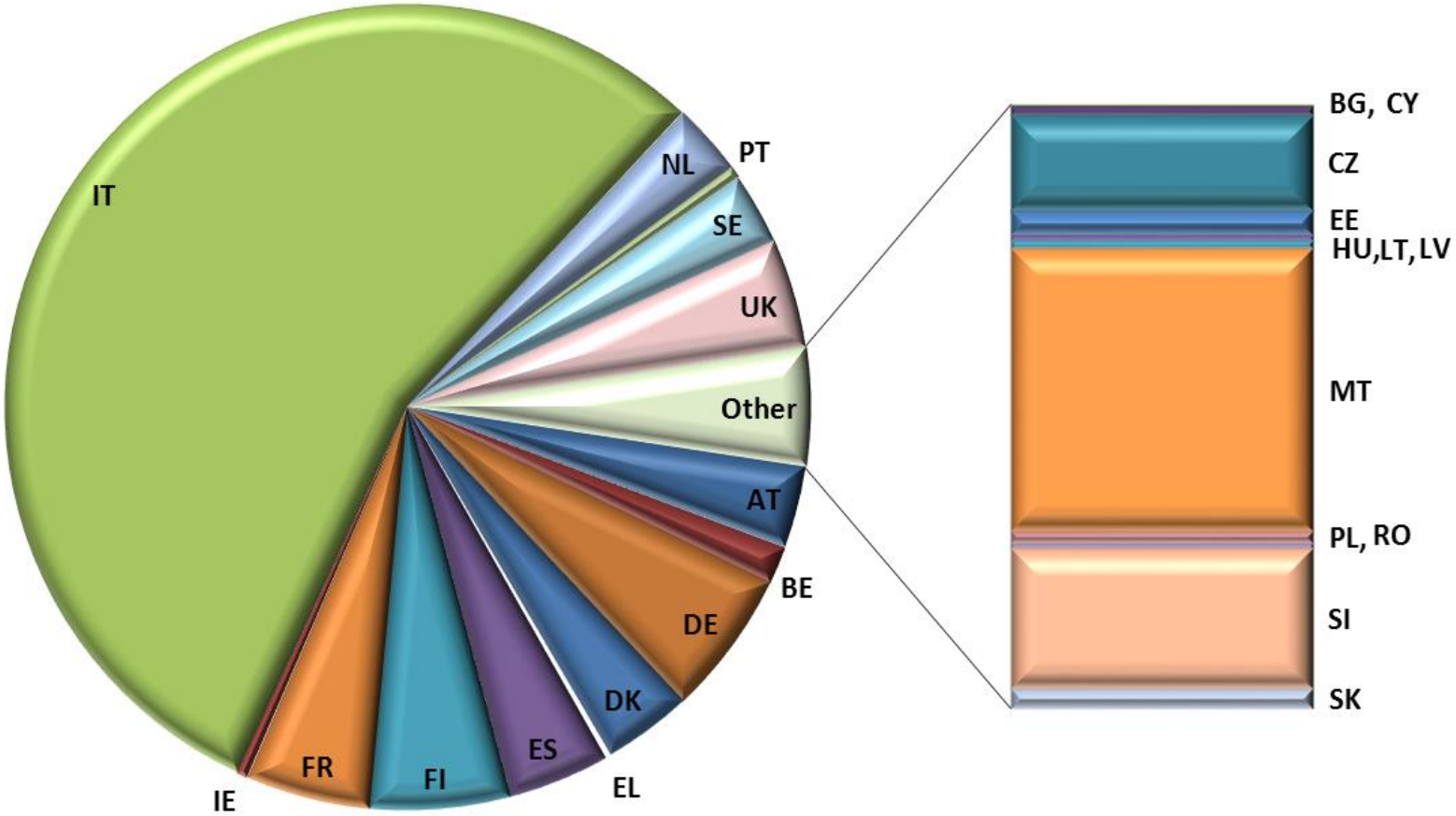
Market





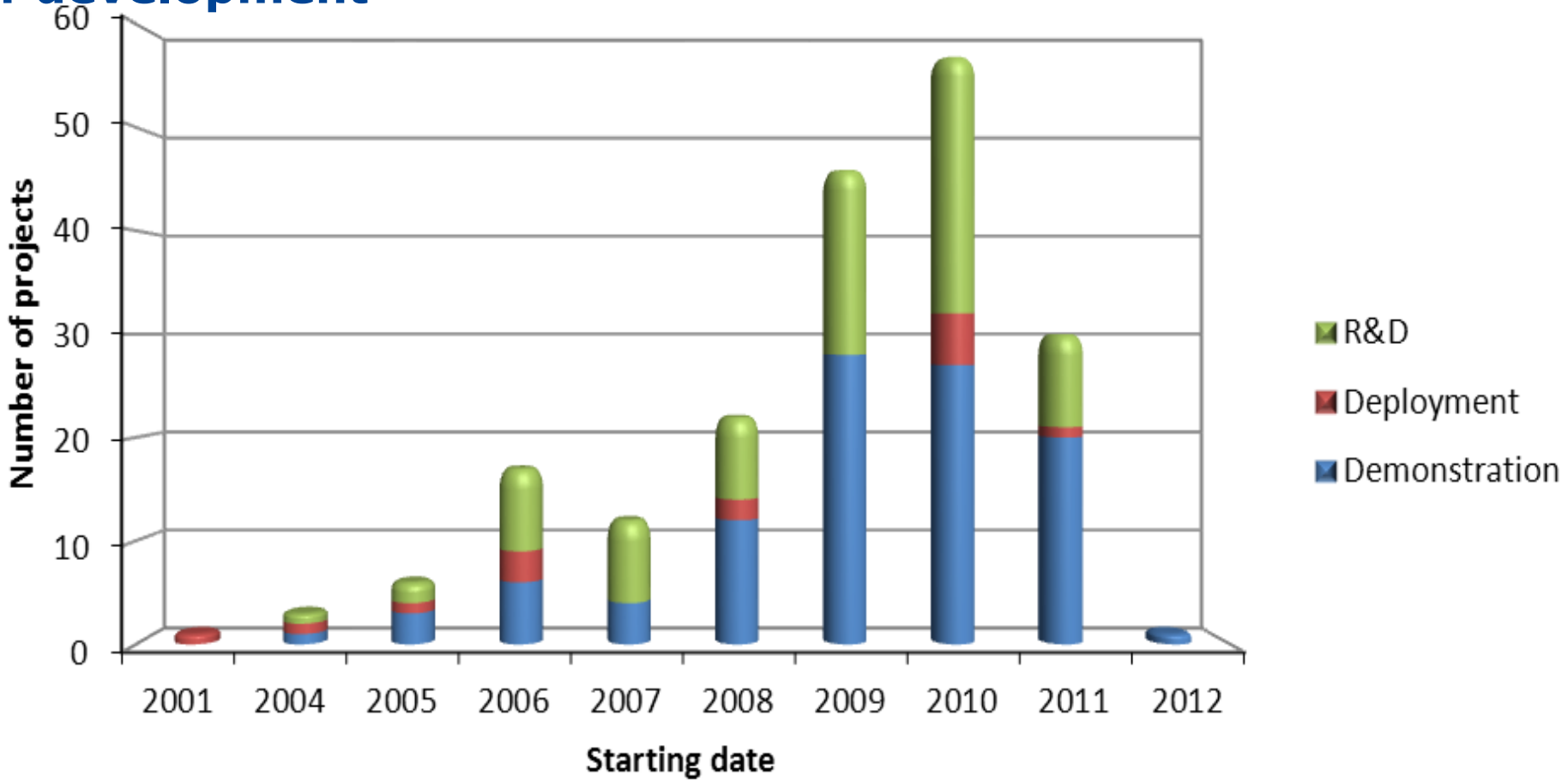
- Uneven distribution of investments across Europe. Most of investments in EU-15 Countries
- Over 5 billions of investments, but still at the beginning of the Smart Grid transition

Smart grid investments



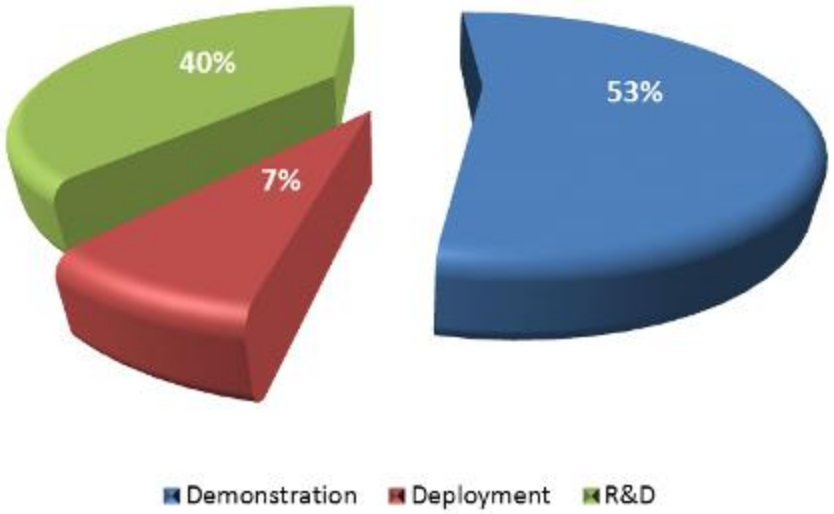
Bulk of investment in a few countries

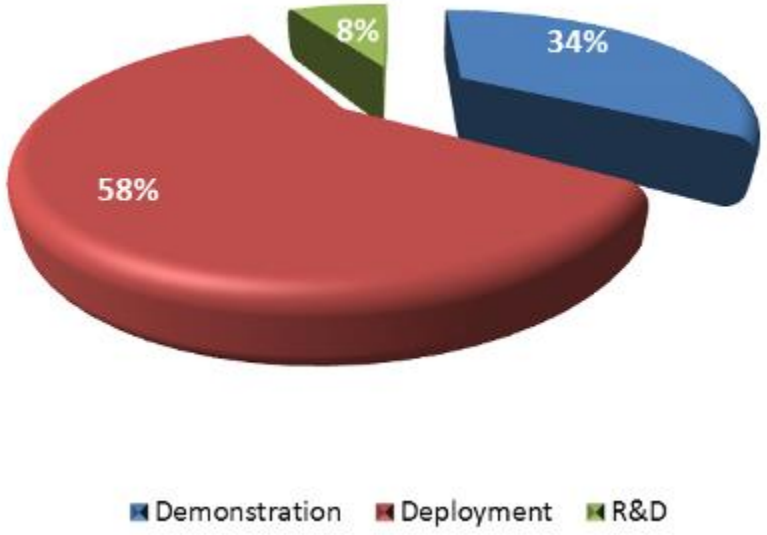
Starting date across stages of development



Note: not all projects planned to start in 2011 answered yet to survey

Share of R&D, demo and deployment projects

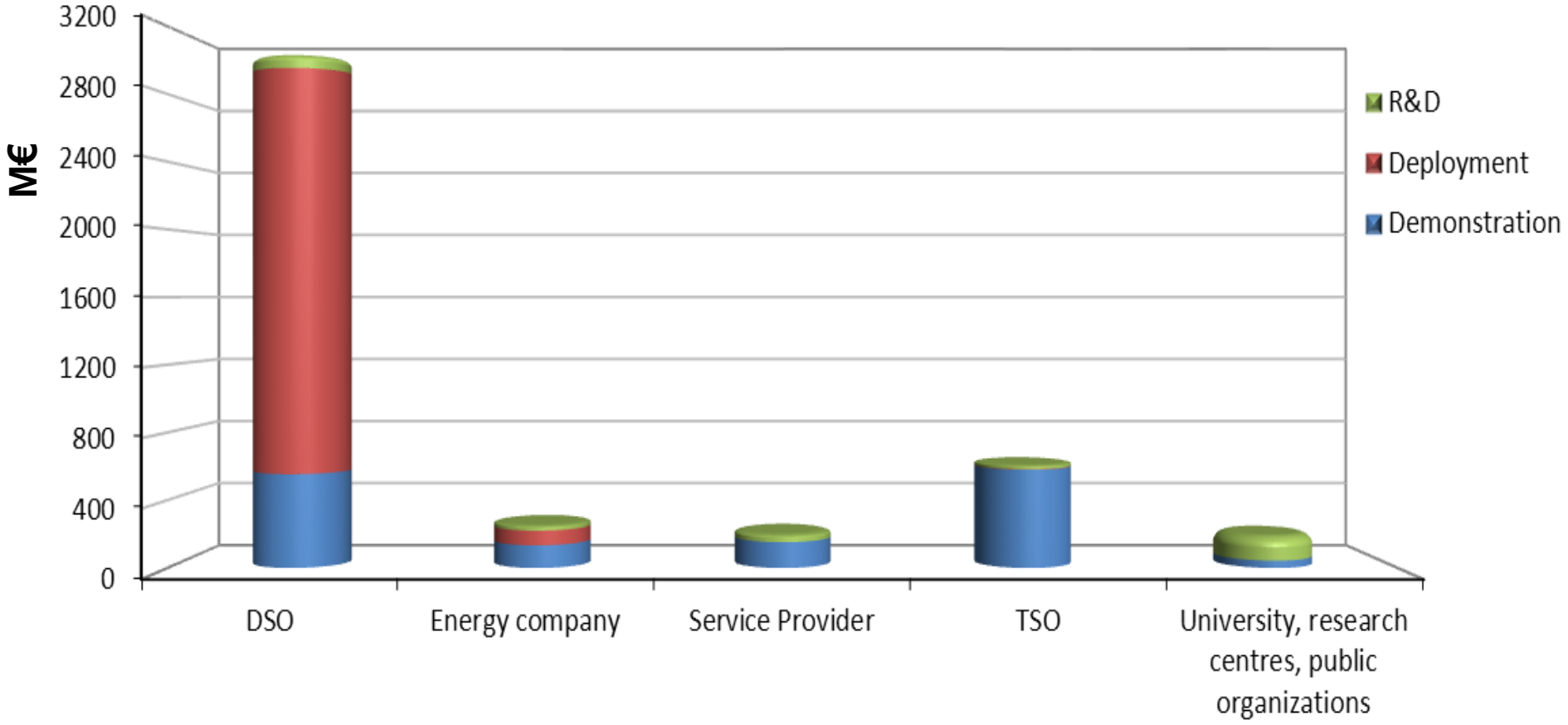




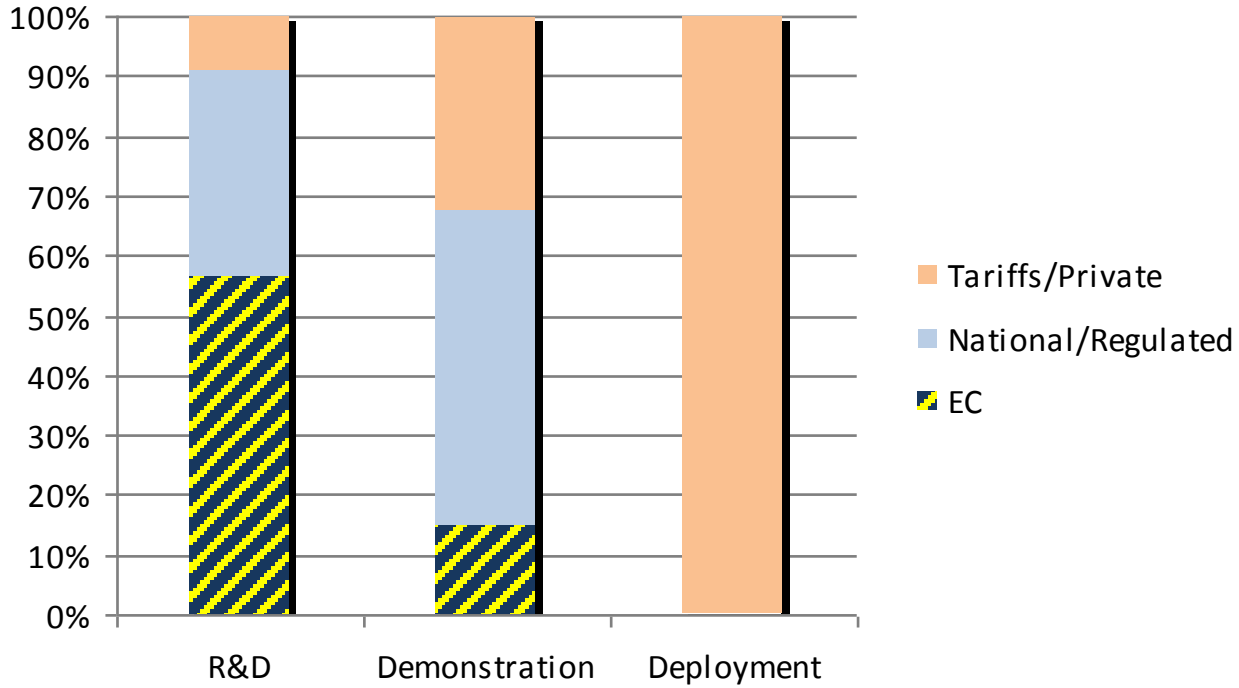
- Deployment projects: greatest part of investment, main focus: Smart Meters roll-outs
- R&D and Demonstration projects: mostly small-medium scale (4.5 and 12 million € of average budget respectively), wider portfolio of technologies and applications

Budget, leading organisation and development stage

Distribution System Operators (DSOs) are the main investors

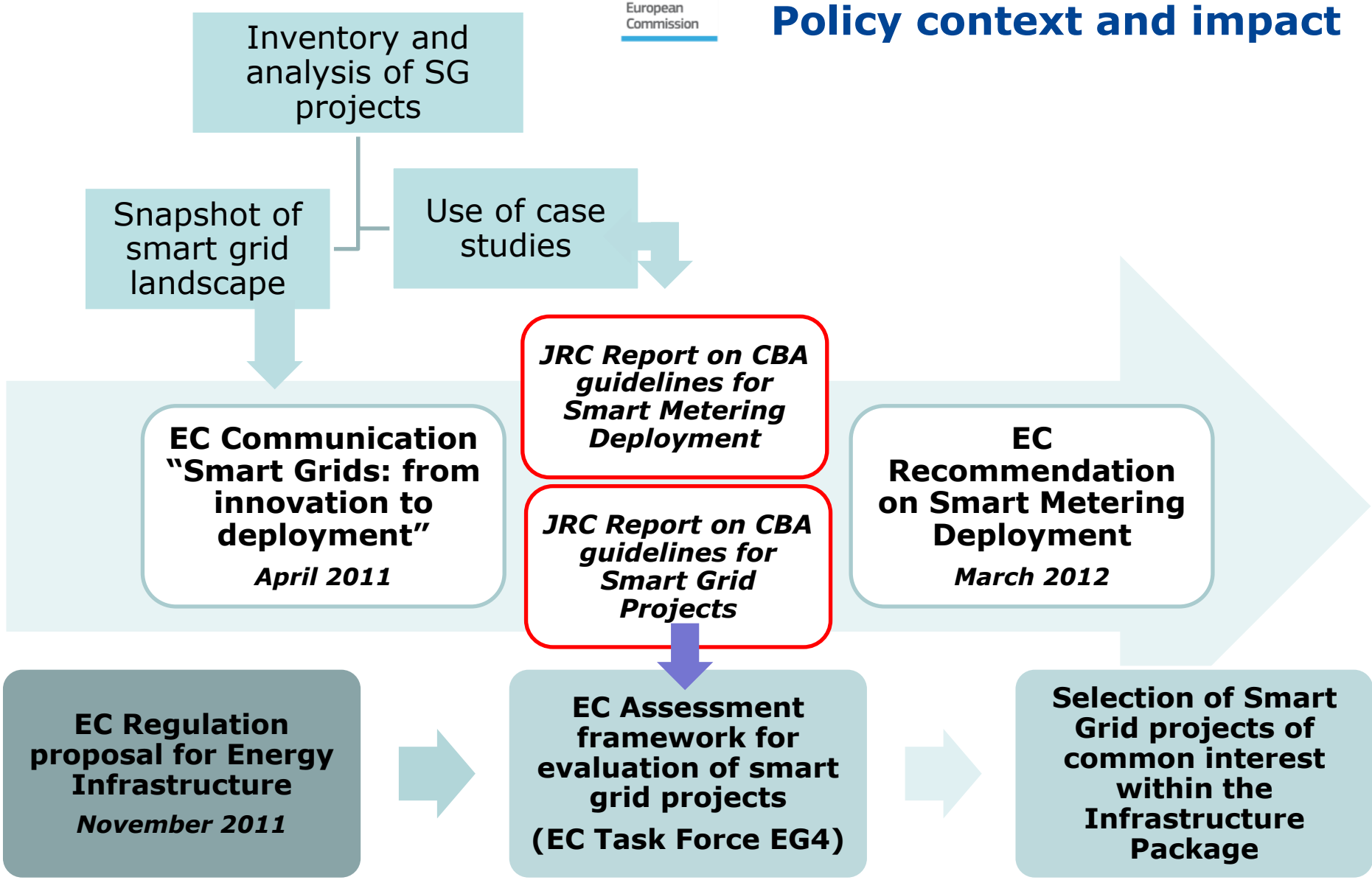


Funding by development stage (DSO-led projects)



- Most of the DSO-led projects in RD&D are financed through **public-private partnerships**
- Funding comes mainly from EU Framework programmes (FP6 and **FP7**), **national funds** and **regulatory funds**
- **Funding and incentives** for RD&D are important for further progress in the development of Smart Grids

Policy context and impact



Intervention areas	Recommendations
Technology	*R1 - Research funds should prioritise projects and initiatives (including large-scale pilots) that concentrate on the operational integration of technologies along the entire value chain. Particular emphasis is recommended on the integration of ICT devices and services at all steps of the chain.* *R2 – Project design and appraisal for smart grid deployment should consider alternative or complementary solutions for different climate zones, and different contexts of renewable generation availability, based on consumption profiles.*
Regulation	*R3 - A new regulatory framework must be devised. The key issue to be addressed by regulation is to ensure the right balance in the sharing of costs, benefits and risks.* *R4 – The new regulatory framework must provide the right incentives for utilities to invest in smart grid technologies and solutions, failing which the innovation process will inevitably be hampered. Incentives from the regulatory framework should therefore encourage the actors to seek benefits from efficiency increases rather than additional sales.*
Business	*R5 - New business models must be devised and tested with the primary goal of ensuring customer participation, to support energy efficiency and demand response, including more smart appliances and less of the current bulky regulation rules. In parallel, to ensure fair benefits to the involved stakeholders, business models have to transform the highly complex market mechanisms into simple transactions for their customers.* *R6 - While market platforms for the aggregation of distributed energy resources on the supply-side are highly developed, additional research and experimentation must be promoted on the demand-side, especially considering that the experience so far indicates a strong correlation between platform profitability and consumer engagement.* *R7 - New business models must ensure that customers can enjoy:* • *Visible and credible monetary savings (at least 10%);* • *Ease of use of home automation systems and other enabling technologies;* • *Retained control over own consumption.* *R8 - In the short term, the successful development of innovative business models will require that:* • *utilities fully acknowledge the potential benefits of transforming the formerly limited customer relation into a mutually profitable partnership;* • *stakeholders are strongly encouraged to jointly establish the new technology framework, with its standards and its real-time economics;* • *policy-makers provide continuing support to smart meter investments;* • *fair cost-sharing schemes are devised to exploit the full potential benefits;* • *new business model concepts systematically involve the customer beyond the meter.*

Economics	*R9 - Smart grid investments should be seen neither as a substitute, nor as fully additive to conventional grid investments (replacement, extensions), as future investment costs include both "conventional" and "smart" components.* *R10 - An innovative, targeted approach to cost benefit analyses of smart grid projects must be promoted and adopted, which makes it possible to account for:* • *the heterogeneity of the technologies involved and their differentiated lifetime;* • *the time-related value of energy consumption;* • *indirect and external effects.*
Society	*R12 - Information and communication campaigns must be deployed to ensure an adequate level of customer motivation, and to overcome a number of currently widespread misconceptions, such as the over-estimation of the impacts of smart meters (both positive and negative).* *R13 - A two-pronged approach is required, combining a legal and regulatory framework that safeguards the basic privacy rights and principles, with a cooperative approach between service suppliers and customers that should guarantee not only transparency, but, most importantly, the empowerment of customers, if only through the provision of "opt out" alternatives.*

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European Electricity Grid Initiative Initiative

GRID+

THE GEOGRAPHY OF GRID+

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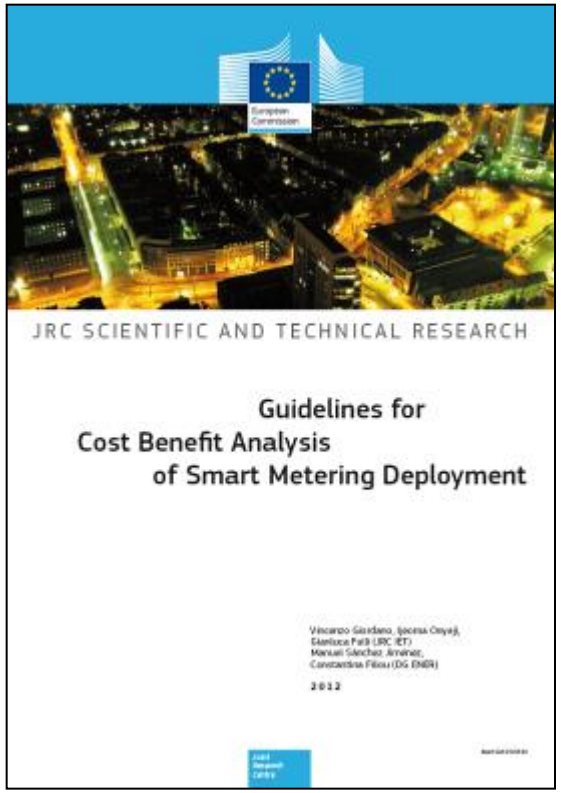
CBA for smart meters/grids

- An assessment framework to provide guidance for conducting cost benefit analyses of **Smart Grid** projects and **smart metering** deployment.
- This work draws on the existing collaboration between the EC and the US Department of Energy (DoE) in the framework of the **EU-US Energy Council**



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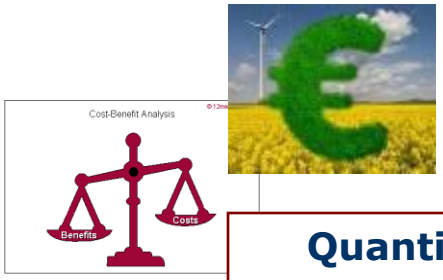
CBA for smart meters/grids

- The assessment framework is based on the work performed by **EPRI** (Electric Power Research Institute).
  - Several modifications to fit the European context have been proposed.
- A European Smart Grid project (**InovGrid**, led by the Portuguese distributor EDP Distribuição) has been used as a case study to fine-tune and illustrate the proposed assessment framework.

Guidelines for Cost Benefit Analysis of Smart Grids projects

General assessment framework



Quantifiable impacts (Societal CBA)

Non-quantifiable impacts (Qualitative impact analysis)

- ✓**Economic Net Present Value (ENPV)**
- ✓**Economic internal rate of return (ERR)**
- ✓**B/C ratio**

Merit deployment of the roll-out (contribution to policy goals, e.g. security of supply, RES integration) → *KPI analysis*

CBA Externalities (e.g. employment, safety, environmental impacts) → *Qualitative descriptions / physical units*

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Smart Grids Simulation Centre

- standardisation: pressing need for smart grids component testing and integration evaluation

- cooperation on e-mobility and smart grids through the interoperability centres:

Joint Research Centre

Interoperability lab

Petten (NL)

Smart Grids Simulation Centre

Petten (NL)

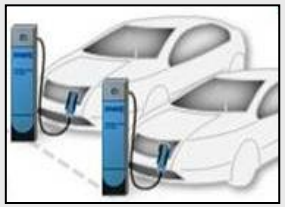
Batteries, components and new materials

Ispra (IT)

Integrated Testing Centre

Ispra (IT)

Electric Vehicles



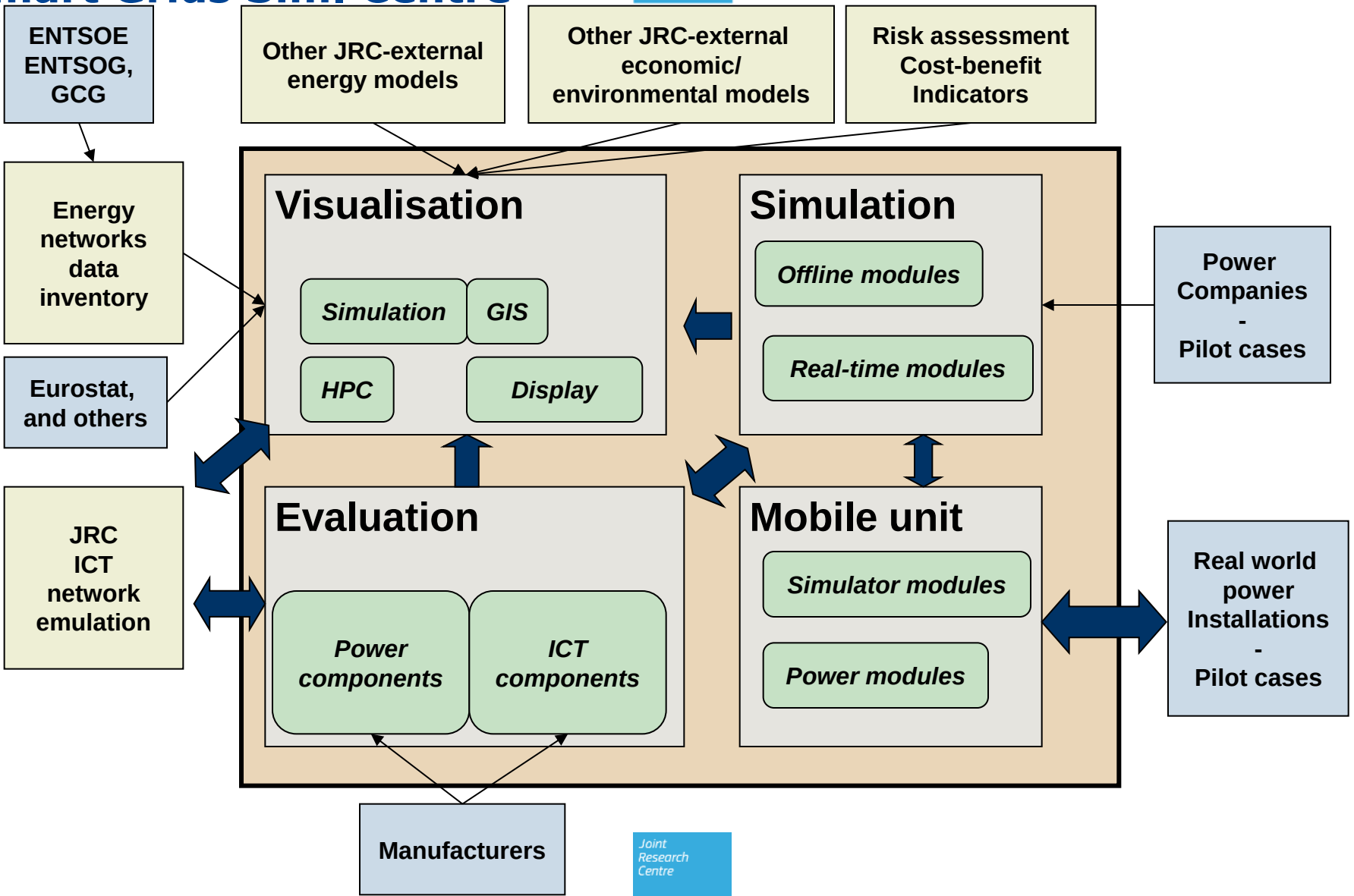
Ispra (IT)

Information and communication technology

The centres research will include:

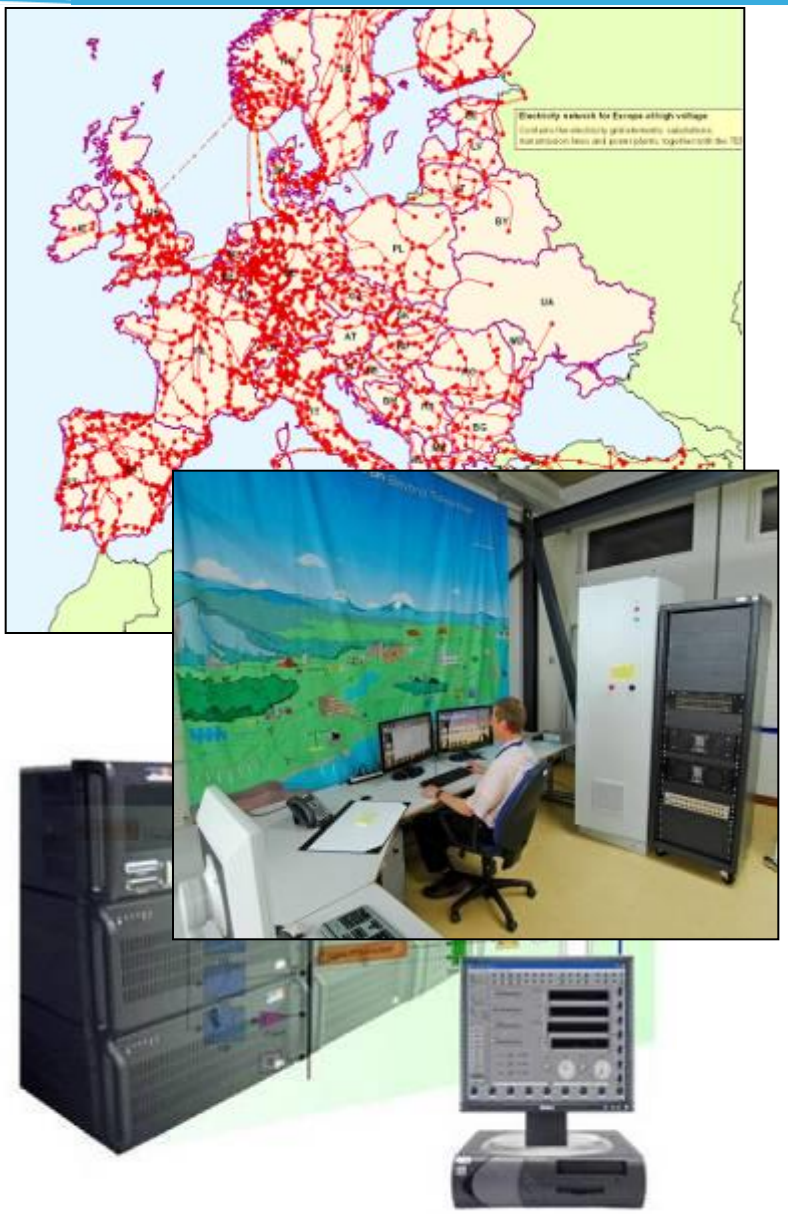
- Electric vehicle performance, safety and energy efficiency
- Vehicle battery safety, durability and charging time as well as performance under different environmental conditions
- Vehicle-to-grid communication and compatibility

Smart Grids Sim. Centre



Smart Grids Simulation Centre

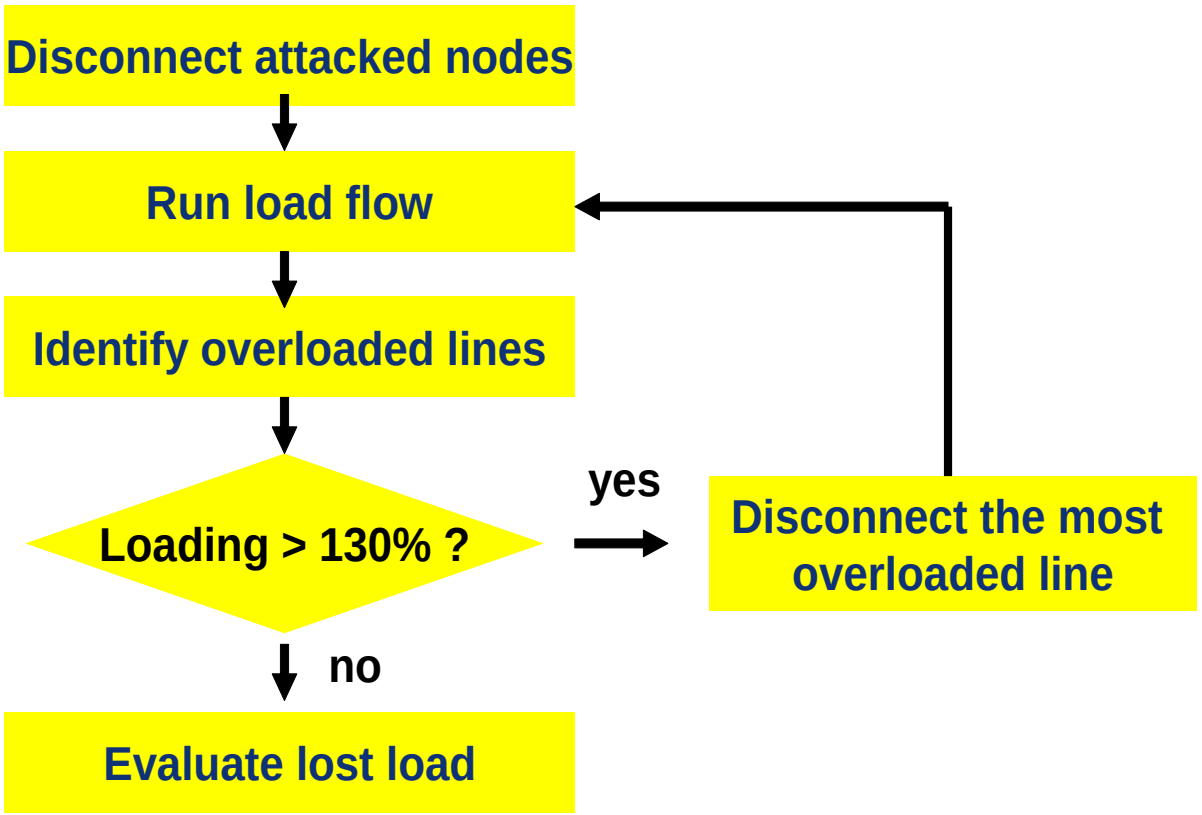
- Real time simulator and several hardware equipment:
  - First set bought 2010-11
  - Plans for further modules
- Objective
  - Ultra-fast Dynamic simulations of power system behaviour
  - Hardware-in-the-loop testing (electric vehicles, batteries, …)



Critical infrastructure protection

- **OBJECTIVE - Identification of 'European critical infrastructure'**
  - Critical infrastructure whose disruption or destruction might have a significant impact on at least 2 member states
- **MAIN ASSUMPTIONS:**
  - The most critical infrastructure for a cyber-attack are the 400 kV substations
  - A coordinated cyber-attack would aim at opening all switches at the substation(s) busbars
- **PROBLEM - classical contingency analysis tools do not analyse:**
  - consequences of failure (disconnection of overloaded lines and transformers)
  - possible failure propagation (cascading effect)
  - network reaction (primary reserve, load shedding,…)

Simulation of cascading effects



- Disconnection in steps of highly overloaded lines (I > 1.3 x Imax), until there is no congestion
- All generators contribute to load balancing (simulation of the primary reserve)
- No load shedding is implemented
- European criticality measured by lost load abroad

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Smart grid security certification in Europe

Challenges and recommendations

December 2014

enisa

European Union Agency for Network and Information Security

www.enisa.europa.eu

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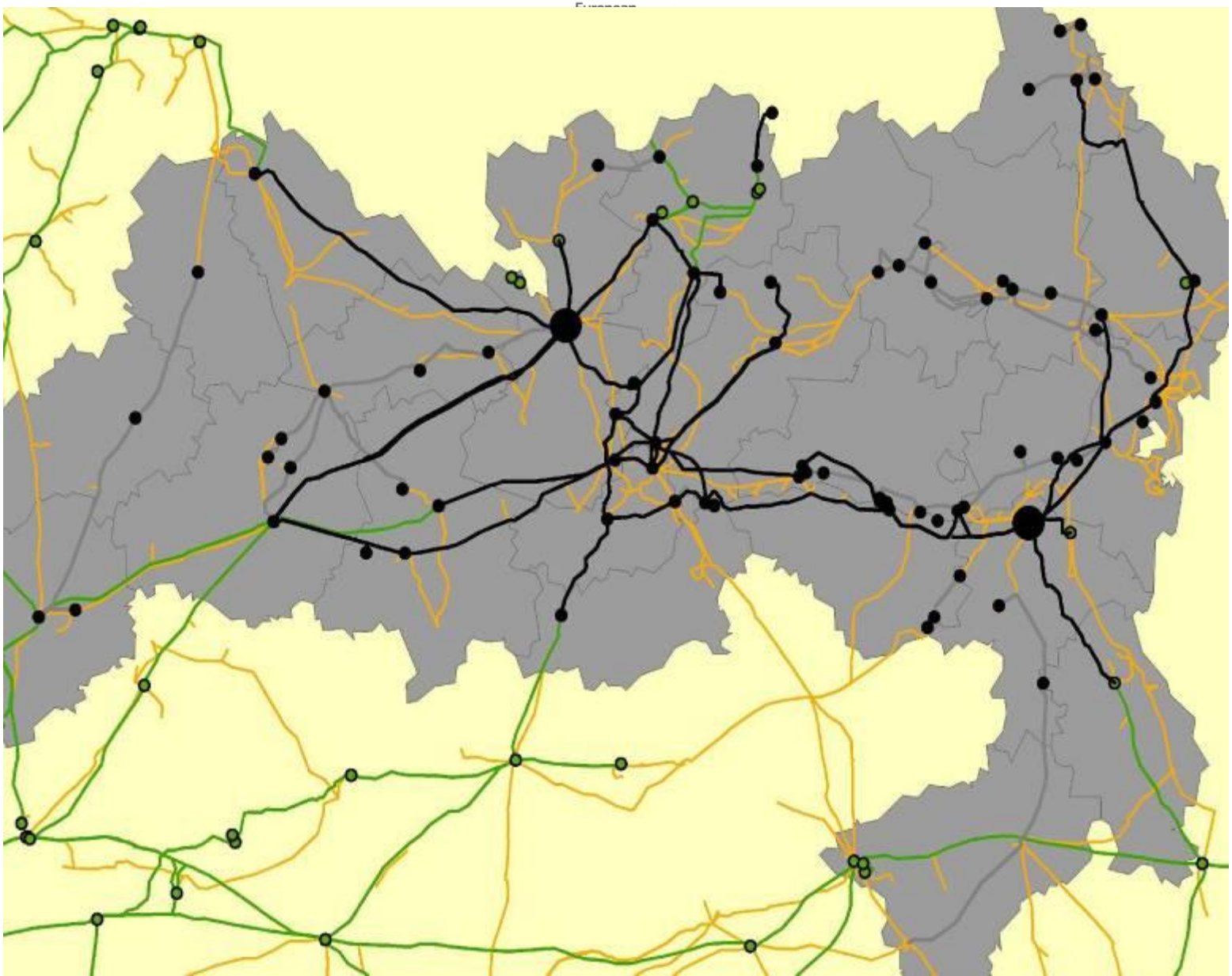

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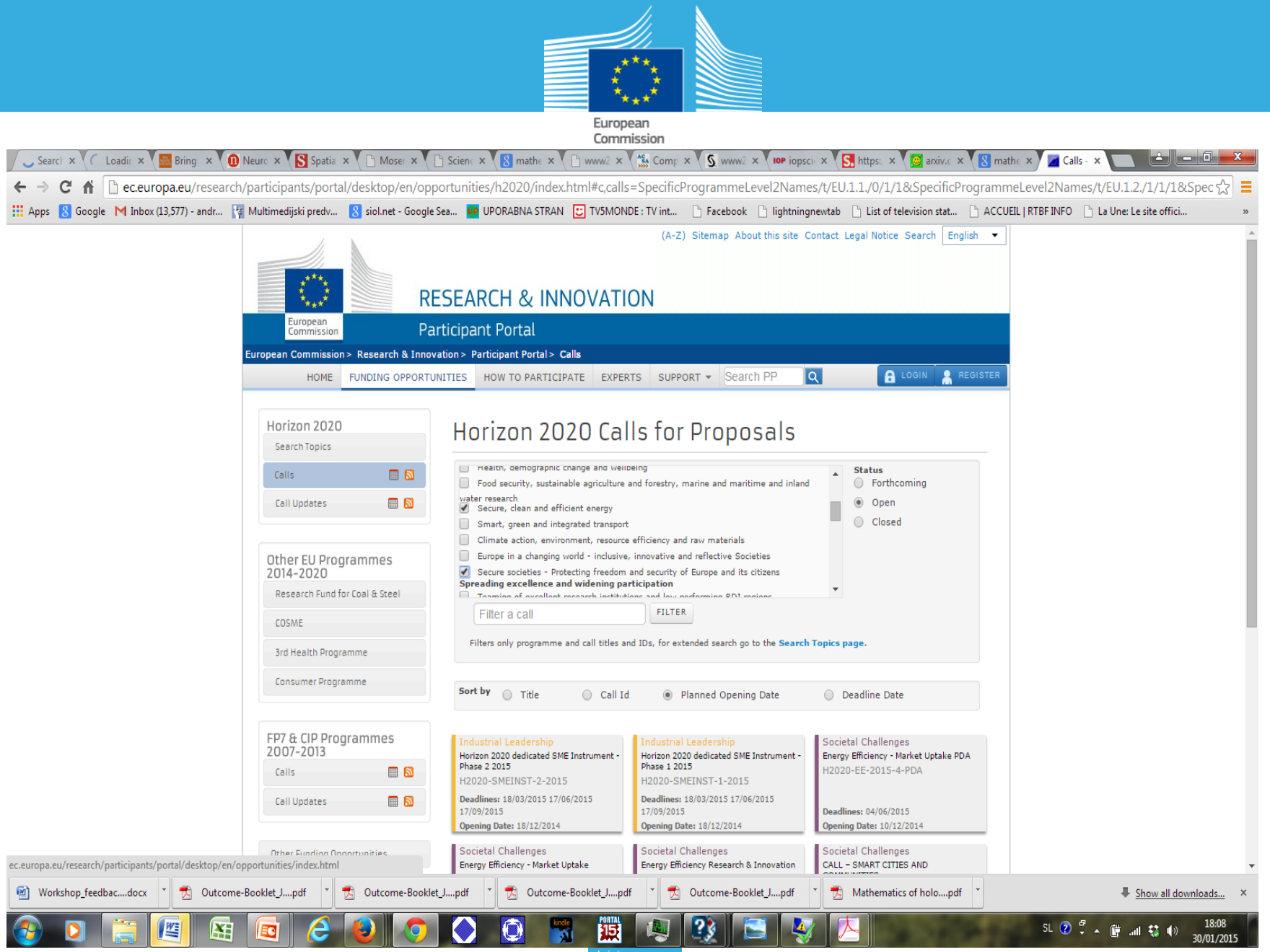
Complexity science approach to energy system

Complexity in energy systems is in general a vague concept. It is often used as a synonym of complicated systems.

I suggest a strong complexity approach:

- **Study of nonlinear, emergent, self-organized, resilient dynamic properties in new types of energy systems**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Secure, clean and efficient energy
Smart, green and integrated transport
Climate action, environment, resource efficiency and raw materials
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Spreading excellence and widening participation
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Deadlines: 18/03/2015 17/06/2015 17/09/2015
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Industrial Leadership
Horizon 2020 dedicated SME Instrument - Phase 1 2015
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Deadlines: 18/03/2015 17/06/2015 17/09/2015
Opening Date: 18/12/2014
Societal Challenges
Energy Efficiency - Market Uptake PDA
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Thank you for your attention

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