Smart Grids opportunities and challenges:

activities at the Joint Research Centre

Gianluca FULLI

Action Leader

Smart Electricity Systems and Interoperability,

EC- JRC, IET

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Outline

- What is the Joint Research Centre
- Power system policies and landscape
- Activities on smart/super grids
- Final messages

Joint Research Centre (JRC)

European Commission

- **The Joint Research Centre is the European Commission's in-house science service**

President
José Manuel Barroso

27 Commission Members

Commissioner
Mairé Geoghegan-Quinn
Research, Innovation & Science

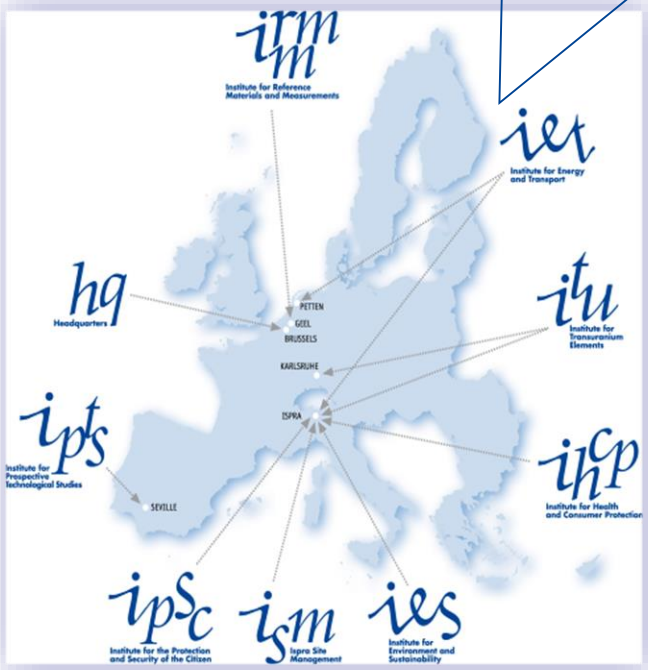
Director-General
Dominique Ristori
Joint Research Centre

DG Research & Innovation (RTD)

Institute for Energy and Transport

Petten, The Netherlands

Ispra, Italy

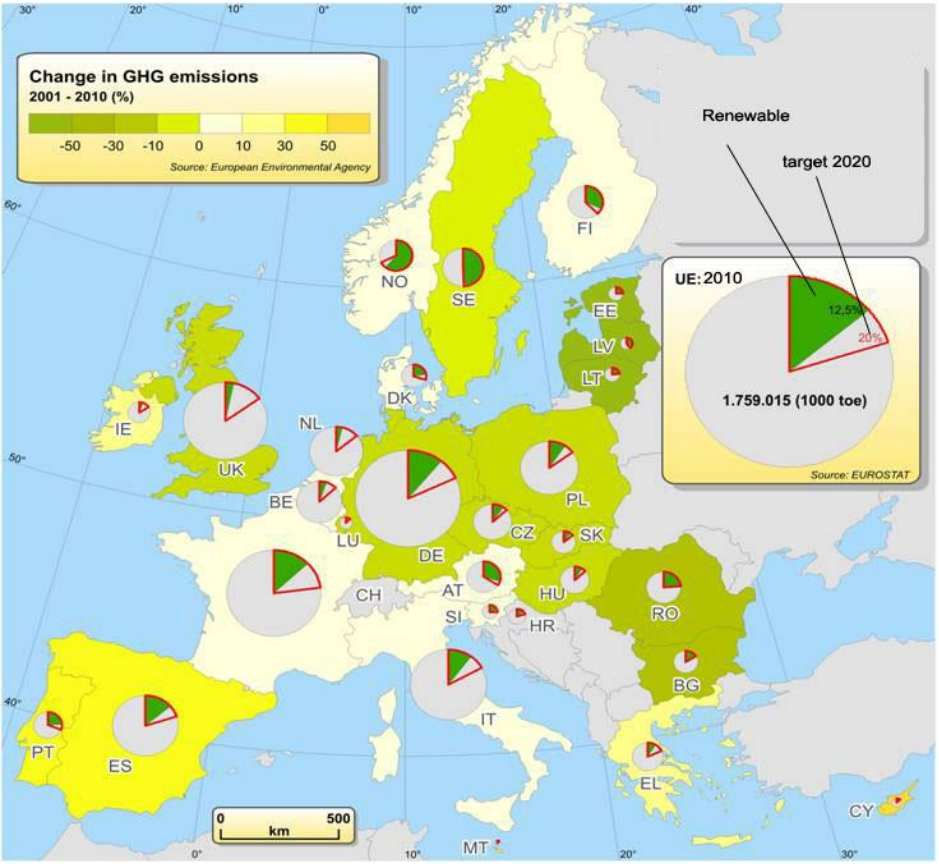


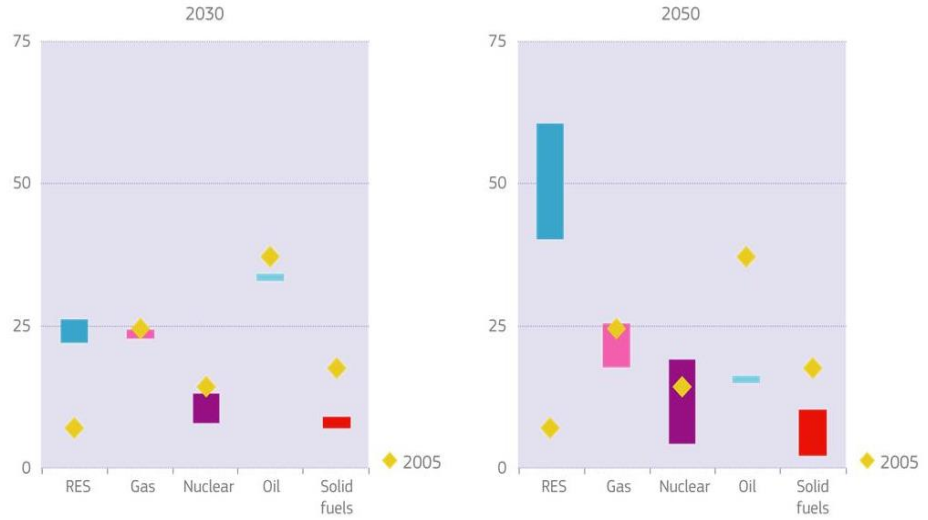
The 7 JRC Scientific Institutes

Joint Research Centre

Europe power infrastructure priorities –by 2020

European Commission





- **RES on the rise in the EU**

- **Renewables move to centre stage**

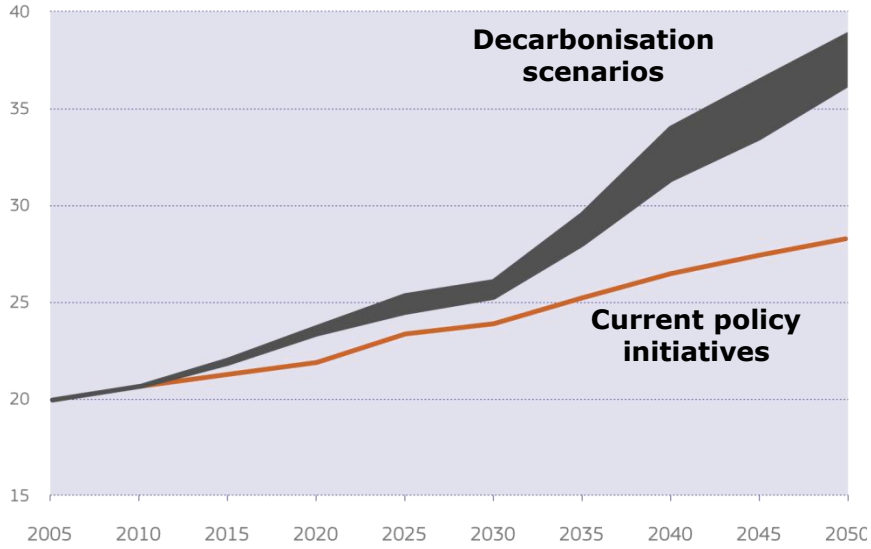
Decarbonisation scenarios - fuel ranges (primary energy consumption in %)

Joint Research Centre

Source: European Environmental Agency, European Commission

Energy Roadmap 2050

European Commission

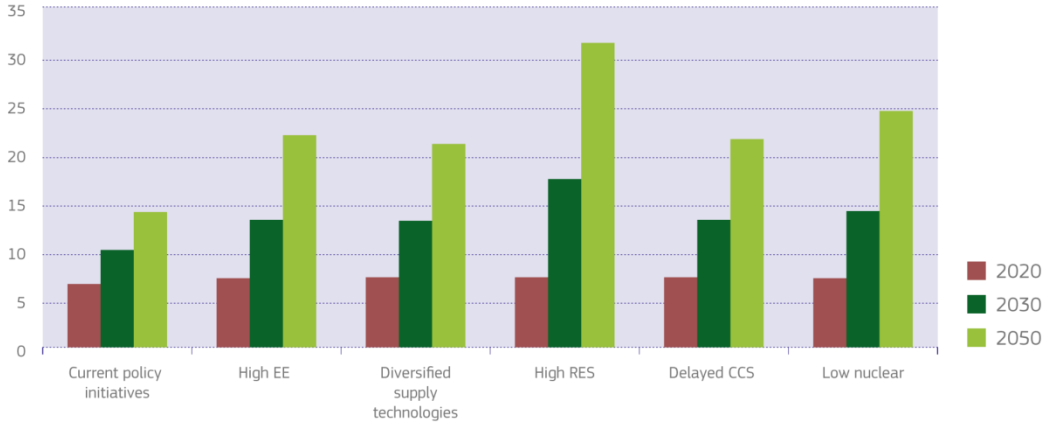


Electricity plays an increasing role

Share of electricity in current trend and decarbonisation scenarios (in % of final energy demand)

Decentralised and centralised systems increasingly interact

Share of decentralised electricity in power generation (in %)



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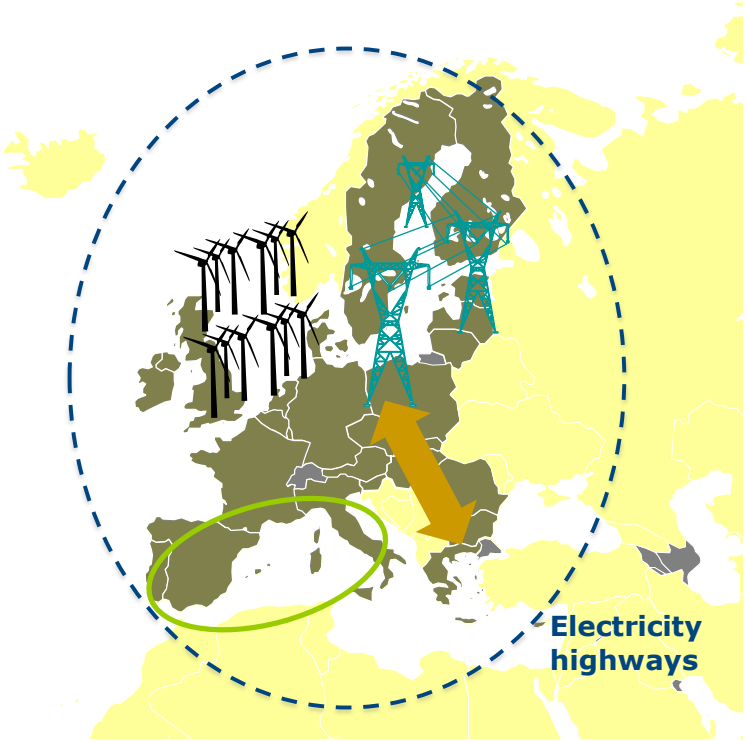
Source: European Commission 2050 Energy Roadmap

Priorities by 2020 and investment by 2050

European Commission

- Baltic energy market inter-connection plan
- Interconnections in South West Europe
- Interconnections in Central-South East Europe
- Offshore grid in the Northern Seas and connection to Northern and Central Europe

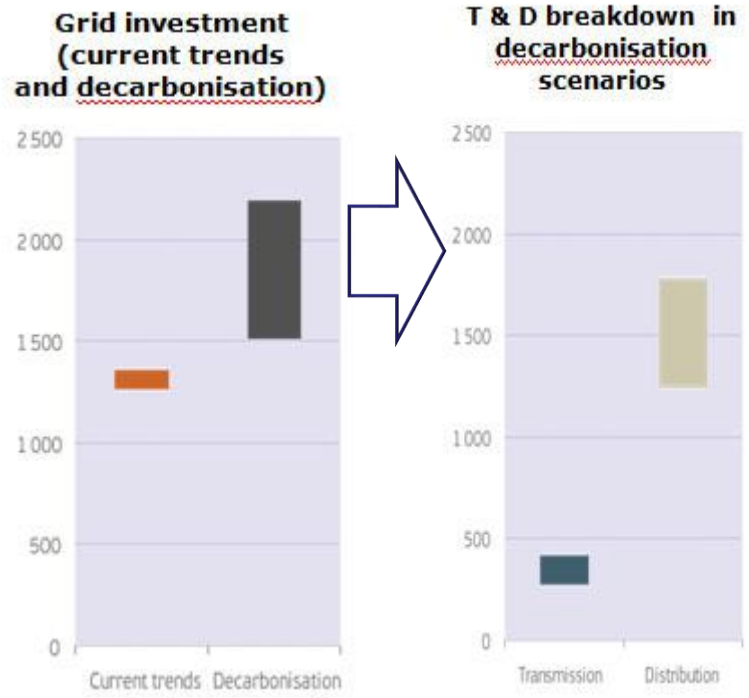
Smart grids in the EU



Grid investment costs increase

Cumulative costs 2011-2050 (in bn €)

(in ranges)



Source: European Commission 2050 Energy Roadmap

Smarter/stronger grid needed

Electricity priorities by 2020

Joint Research Centre

Today's Power system

Smart grid: possible future

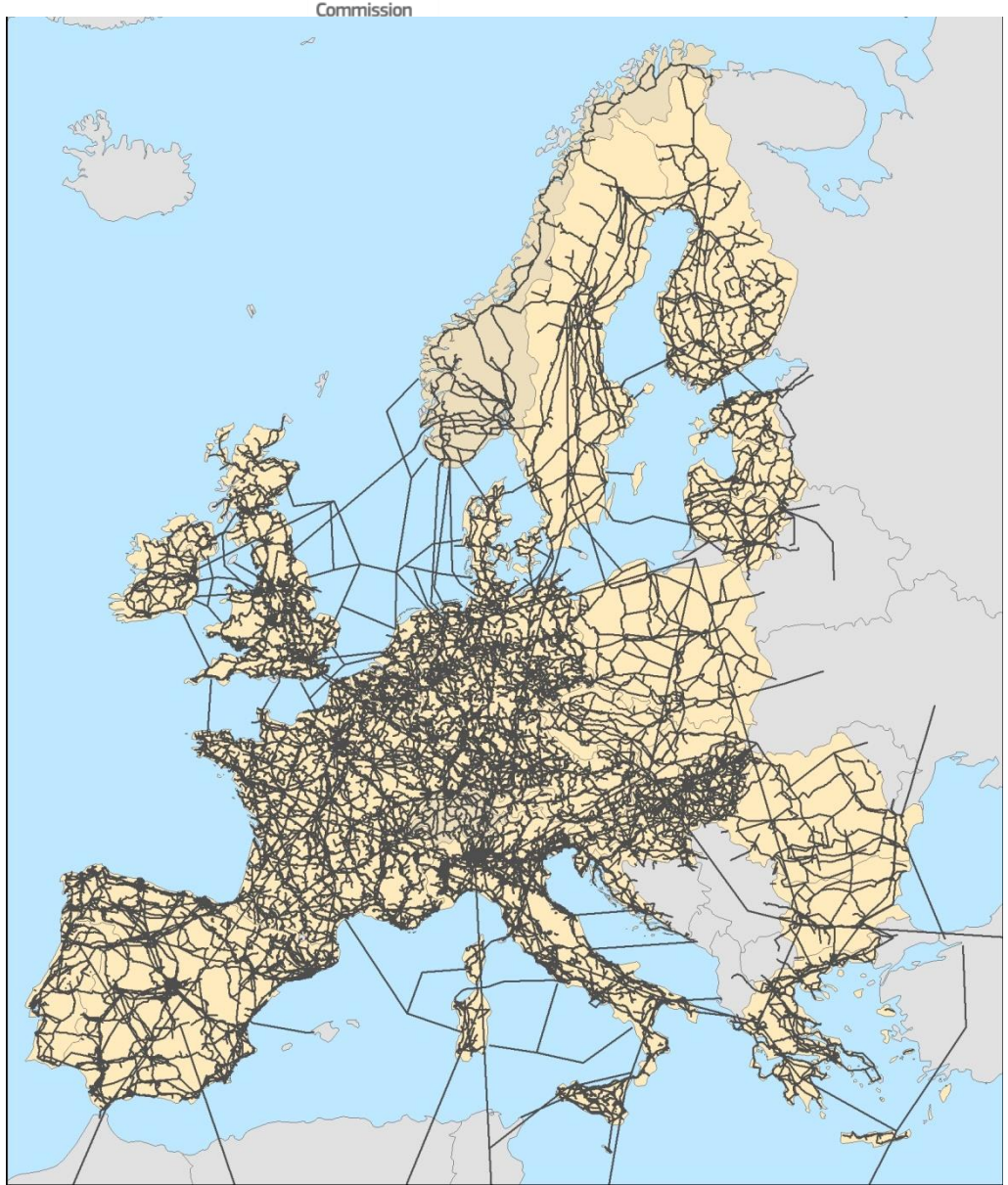
Transmission grid evolution from 1960 to 2030+

European Commission

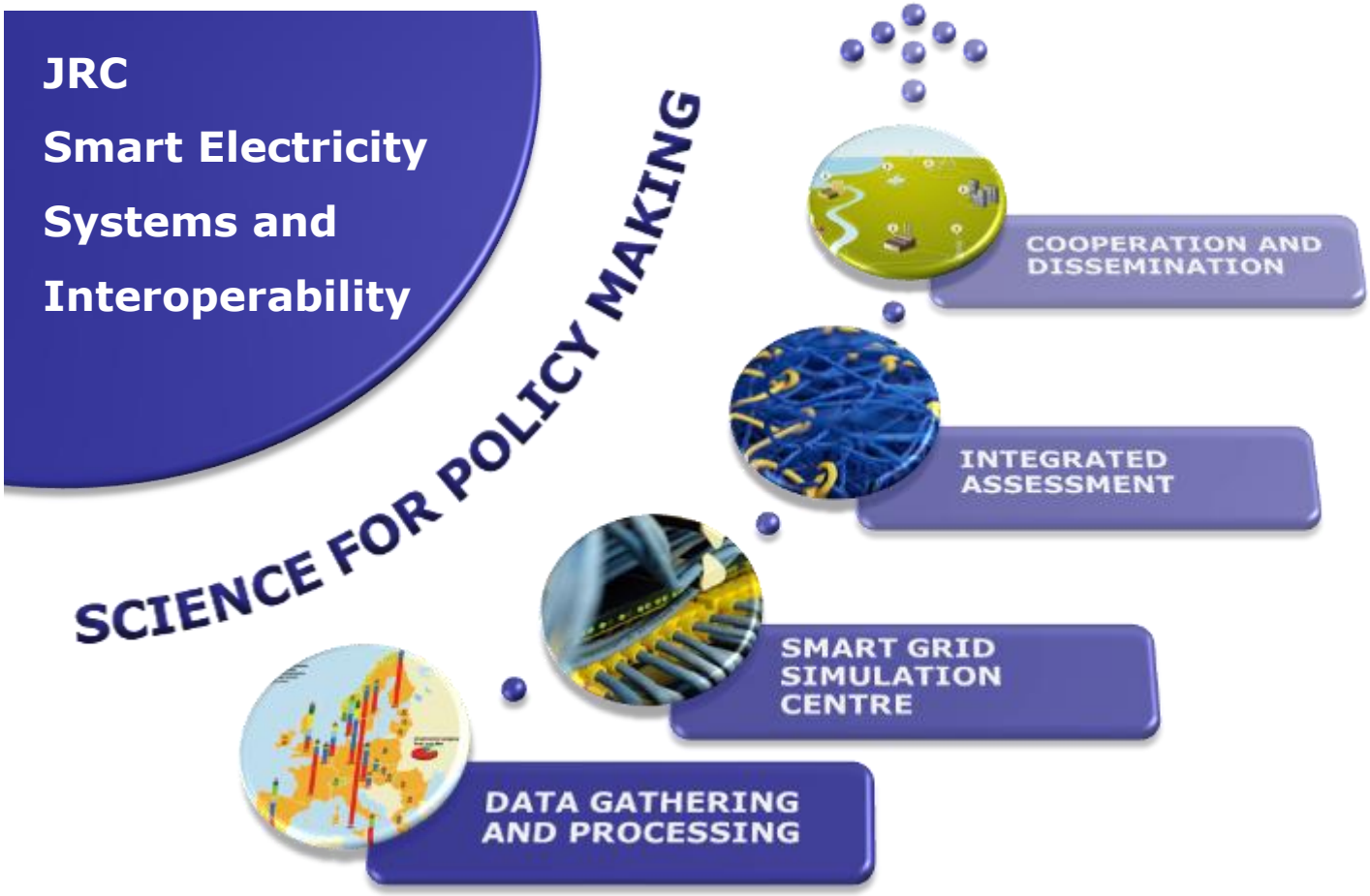
60's

now

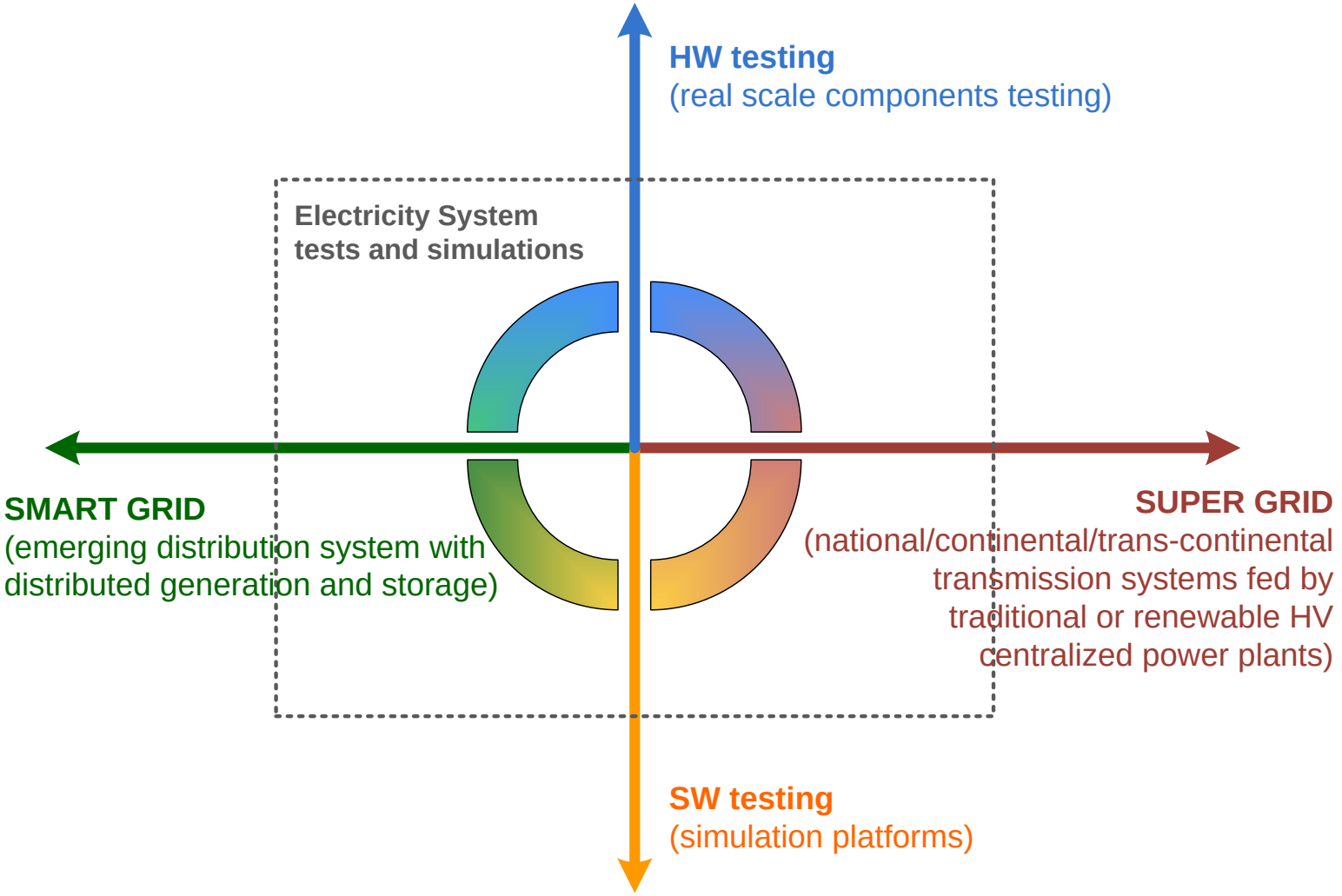
2030+?



JRC Smart Electricity Systems and Interoperability – Core activities



From desktop to hardware, from smart to super grids



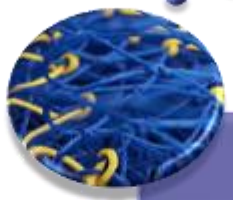
DATA GATHERING AND PROCESSING

Our target: becoming

power sector

honest data broker

COOPERATION AND DISSEMINATION



INTEGRATED ASSESSMENT

SMART GRID SIMULATION CENTRE

DATA GATHERING AND PROCESSING

Smart grid projects

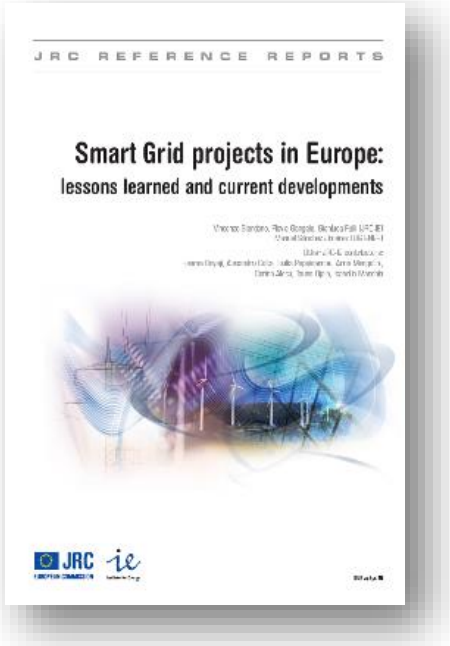
Energy networks

Power system

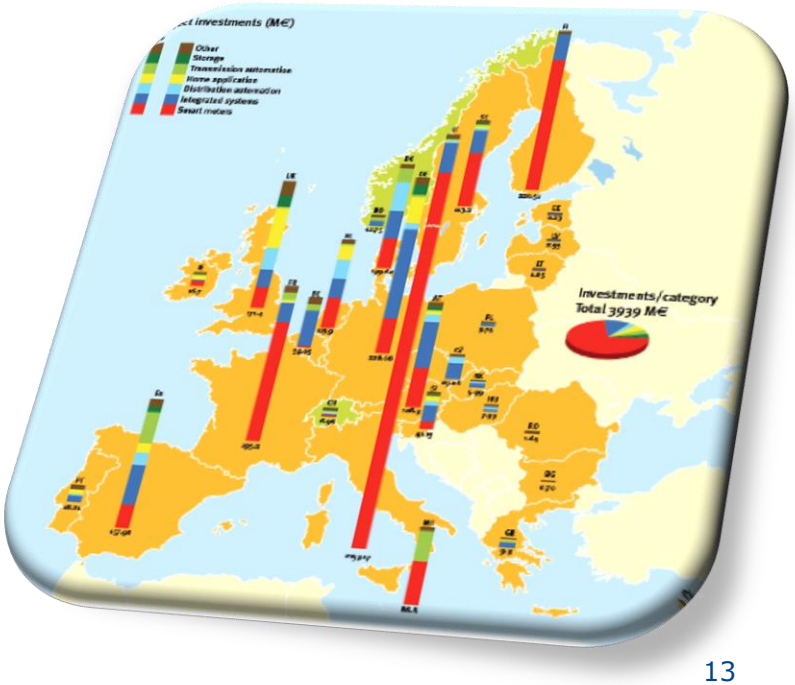
Other models/ sources

2011 JRC First inventory of smart grids in Europe

European Commission



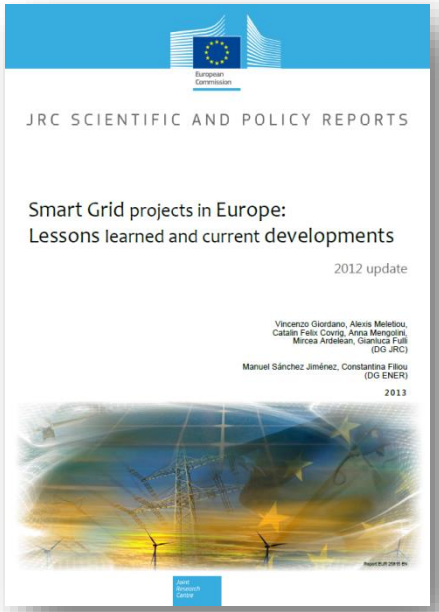
- Report **Smart Grid projects in Europe:** lessons learned and current developments
- Feeding into **Smart Grids Communication COM(2011)202**



- **219** Smart Grid **projects** in EU27
- **Majority** of projects **in EU15** while most of EU12 lag behind

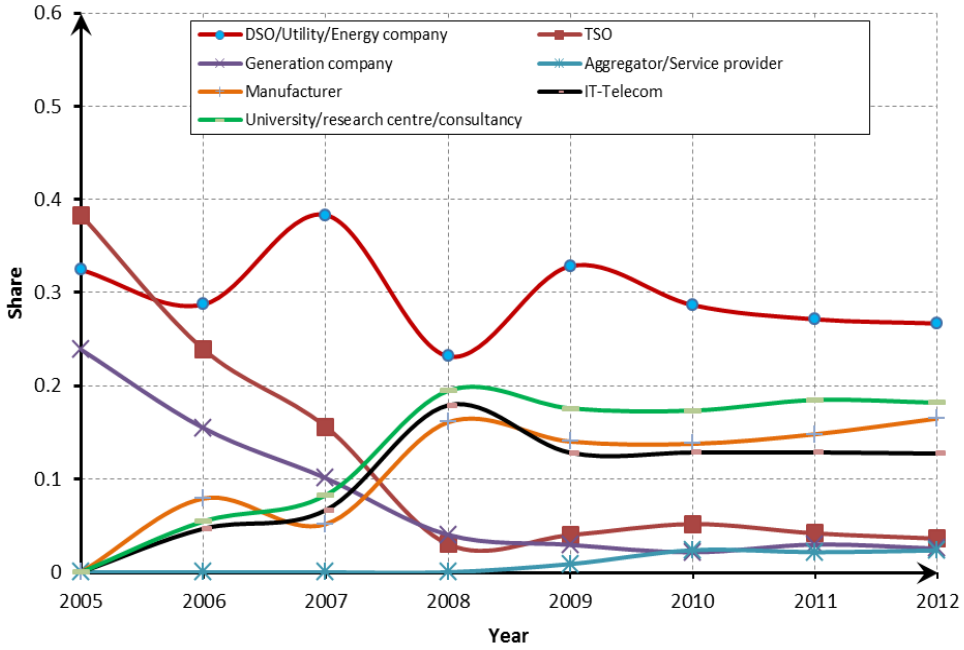
Joint Research Centre

NEW JRC smart grid inventory – 2012 update



- **281 Smart Grid projects** (Smart Metering Projects analysed in report due by end 2013)

- **Main barriers** for smart grid development**:** lack of **interoperability, standards** and **regulation** and **consumer acceptance**



SMART GRID SIMULATION CENTRE

European Commission

Lab functions and capabilities

OFFLINE POWER SYSTEM SIMULATION

REAL TIME SIMULATION AND COMPONENT TESTING

INTEROPERABILITY AND COMMUNICATIONS

SIMULATION

EVALUATION

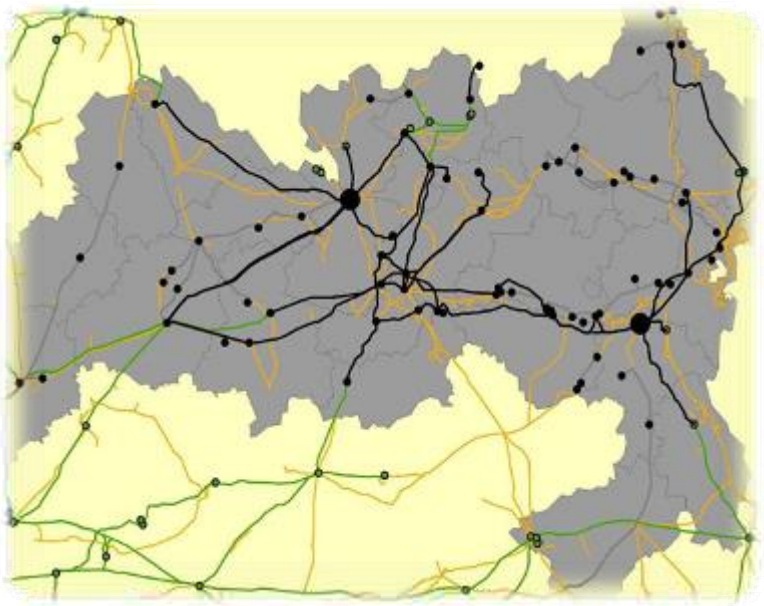
MOBILE LAB AND FIELD TESTING

VISUALISATION

VISUALISATION AND INTERACTION

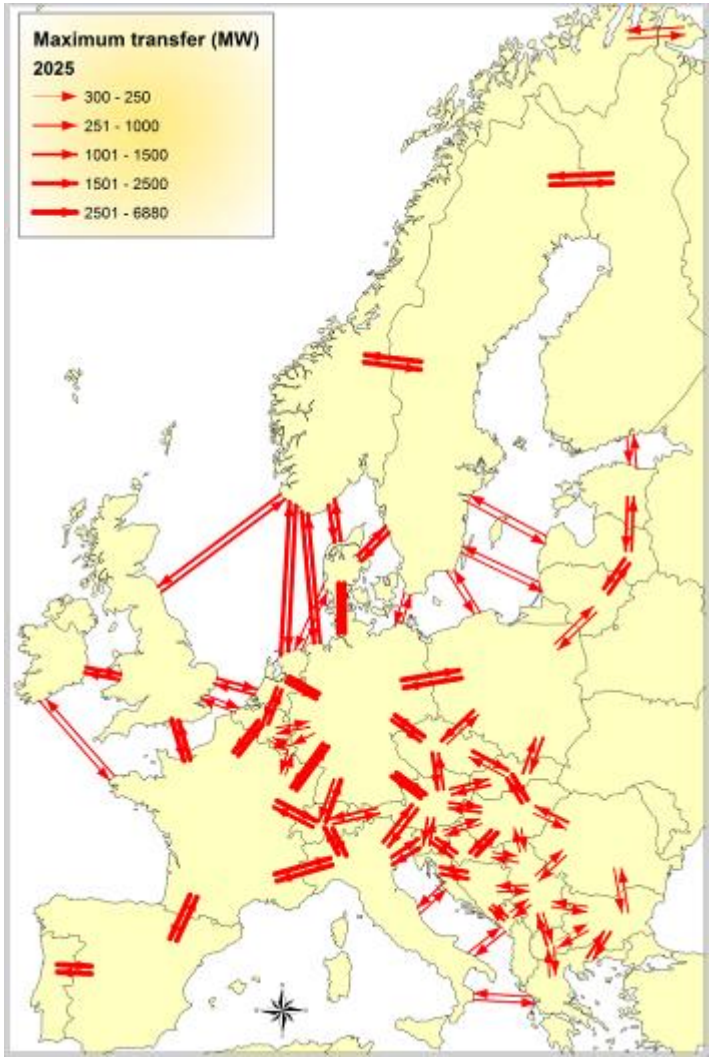
Critical infrastructure (JRC-ENER Admin. Arrangement)

- Identification of 'European critical infrastructure' (whose disruption has a significant impact on at least 2 Member States)
- **Web-based** application for the **visualisation** of Europe-wide electricity systems and for the assessment of energy network criticality and vulnerability



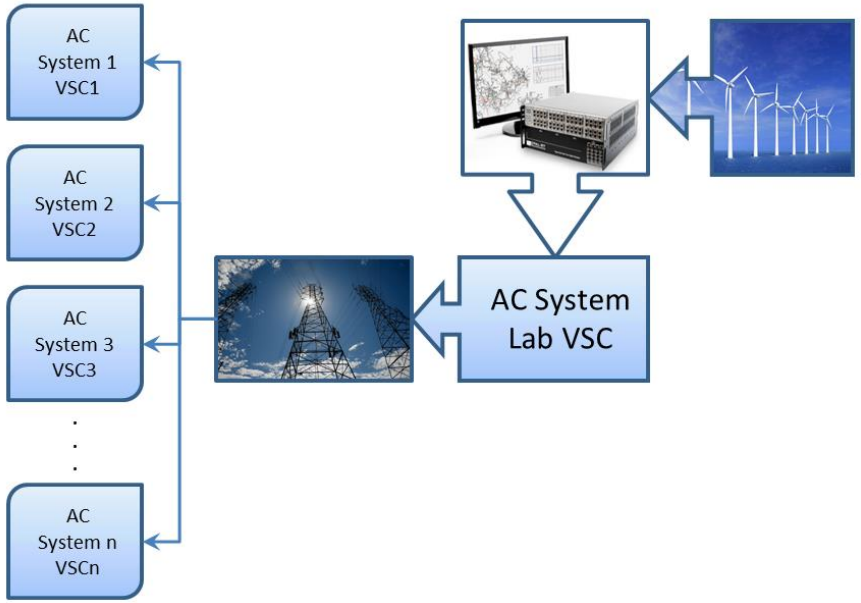
Renewables integration in Europe/Mediterranean

- The **EUPowerDispatch** model analyses the impacts of variable renewable energy increase on the European cross-border transmission capacity needs
  - Minimum Cost Flow Problem (MCFP) taking into account generation and transmission constraints
- The model minimises the annual electricity variable production costs in the interconnected European system



Multi-terminal links for super grids

- Assessment of **multi-terminal DC (MTDC) grids** to integrate large scale **offshore wind power** in the North Sea (in cooperation with **ECN** and **TU Delft)**
- Set-up and testing of a stand-alone configuration with three small-scale **Voltage Source Converters (VSCs)**
- Real-time digital simulator interconnection with the VSC-based multi-terminal DC grid for testing and validation of different models and control strategies
- The same concept can be used for multi-terminal grids in the Mediterranean Sea



Smart Home - Smart Grids interoperability

- **Cooperation with "Model City Mannheim" project for testing their equipment (**http://www.modellstadt-mannheim.de/**)**
- **SmarTest Energy Butler**
  - an intelligent electricity meter
  - a system (energy butler) for switching electrical appliances automatically, and
  - an Internet-based Web portal (electricity consumption and costs, information on rates)

EU – US cooperation on EV & smart grids interoperability

European Commission

Letter of Intent (LoI) has been signed:

we are currently twinning our EV / SG Interoperability Labs in US (Argonne) and EU (JRC Ispra, Petten)

Goals:

- *Support standardization, promoting a EU/US common approach*
- *Address the interoperability issues between e-vehicles & smart grids (including ICT)*
- *Provide testing facilities for electric vehicles and the related equipment*
- *Ensure a permanent link with car industry on EU and US markets*

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Integrated EV / smart grid interoperability Reference Laboratory at JRC

European Commission

Petten (NL)

Smart Grids Simulation Centre

Petten (NL)

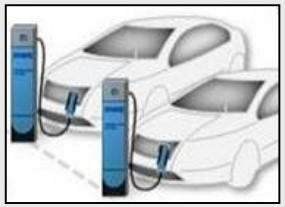
Batteries, components and new materials

Ispra (IT)

Integrated Testing Centre

Ispra (IT)

Electric Vehicles



Ispra (IT)

Information and communication technology

The centres research include:

- Electric vehicle performance, safety and energy efficiency
- Vehicle battery safety, durability and charging time and performances
- Vehicle-to-grid communication and compatibility

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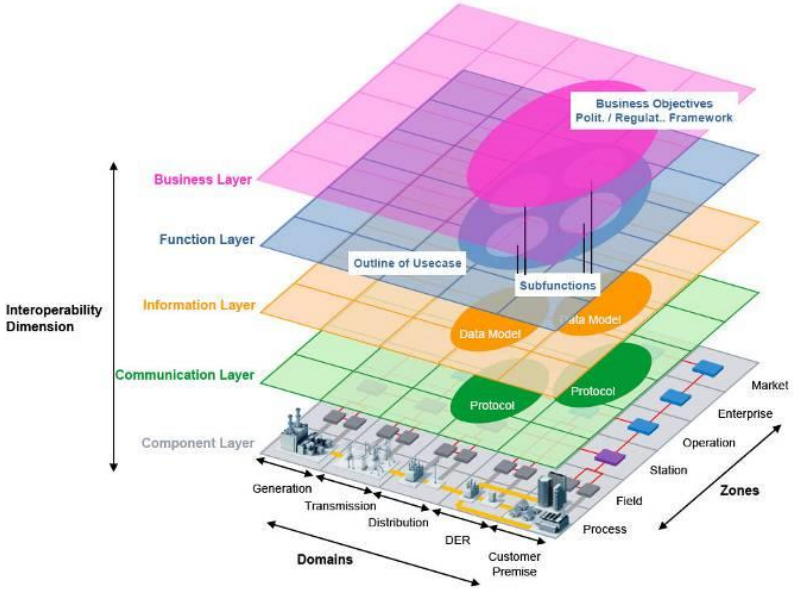
INTEGRATED ASSESSMENT

- **Smart Grids** are **complex systems**
  - with multiple layers (physical, cyber, environmental, social, policy)
  - and multiple interacting decision makers, with autonomous behaviours and goals



- **JRC** is developing a **systemic framework to assess smart grid** projects throughout Europe
  - Work feeding into EU policy making

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Cost-Benefit Analysis for smart meters/grids

European Commission

- Assessment framework to provide guidance for conducting cost benefit analyses of **Smart Grid (**and **smart metering)** projects
  - based on **EPRI** (Electric Power Research Institute)'s work and on collaboration between EC and US (Department of Energy, DoE) in the **EU-US Energy Council**
  - Contribution to Recommendation 2012/148/EU "roll-out of smart metering systems"
- A European Smart Grid project (**InovGrid**, led by the Portuguese distribution operator EDP Distribuição) used as a case study to fine-tune and illustrate the assessment framework

Joint Research Centre

JRC policy impact

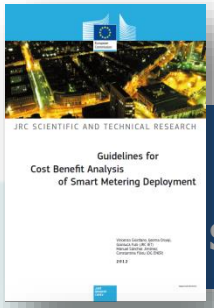
European Commission

Inventory and analysis of smart grids

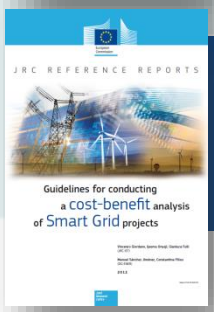
Use of case studies

EC Communication Smart Grids: from innovation to deployment

Apr-2011



Cost-Benefit Analysis for Smart Metering



Cost-Benefit Analysis for Smart Grids

EC Recommendation on Smart Metering Deployment

Mar-2012

EC Regulation proposal for Trans-European Energy Infrastructure

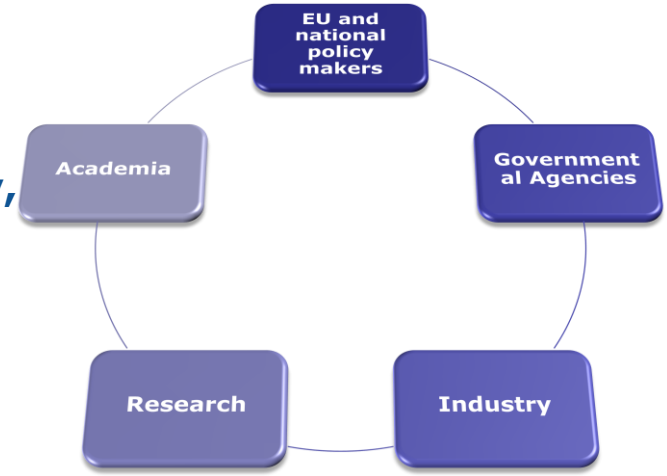
Nov-2011

EC Assessment framework for evaluation of SG projects (EC Task Force EG4)

Selection of Smart Grid projects of common interest within the infrastructure package

COOPERATION AND DISSEMINATION

- **EU: DG ENER, INFSO, RTD,…**
- **Portugal, Israel, Germany, Lithuania,…**
- **US Department of Energy, Brazil**



- **MIT, Cambridge University, TU Delft, TU Eindhoven, KTH, PoliTO, PoliBA, …**
- **Argonne Nat Lab, RSE, ECN, EERA**

- **ISGAN, ENTSOE, EURELECTRIC, CIGRE, EDP, EDF, ENEL, TERNA, ACEA……**
- **Mediterranean solar power integration (MED-TSO, MEDGRID, MEDREG,…)**

In sum

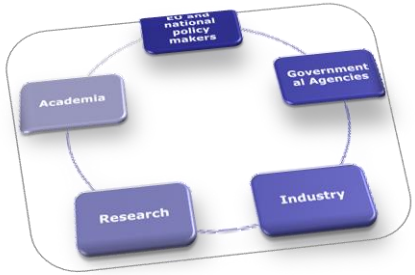
European Commission

The Joint Research Centre:

- acknowledged reference for **smart grids policies and initiatives**
  - Smart grid projects monitoring
  - Assessment framework

- expanding **analytic and experimental capacities** on power systems

- strengthening **cooperation** with industry, research and other stakeholders on smart/power grids



Joint Research Centre

European Commission

Croatia, welcome on board!

European Commission

Smart Electricity Systems and Interoperabiilty

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

Thank you
for your attention

gianluca.fulli@ec.europa.eu