The smartness of smart grids

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- Driving forces for smart grid development
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  - Targets for renewable integration
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  - The role of smart heat networks
- The European perspective
  - The roadmap and implementation plan of the European Electricity Grid Initiative (EEGI)
  - Smart grid demonstrators – the EEGI Member States Initiative
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What is a smart grid?
Definition provided by ETP smart grids

AUSTRIAN INSTITUTE OF TECHNOLOGY

What is a SmartGrid?

A SmartGrid is an electricity network that can intelligently integrate the actions of all users connected to it - generators, consumers and those that do both – in order to efficiently deliver sustainable, economic and secure electricity supplies.

A SmartGrid employs innovative products and services together with intelligent monitoring, control, communication, and self-healing technologies to:

- better facilitate the connection and operation of generators of all sizes and technologies;
- allow consumers to play a part in optimizing the operation of the system;
- provide consumers with greater information and choice of supply;
- significantly reduce the environmental impact of the whole electricity supply system;
- deliver enhanced levels of reliability and security of supply.

SmartGrids deployment must include not only technology, market and commercial considerations, environmental impact, regulatory framework, standardization usage, ICT (Information & Communication Technology) and migration strategy but also societal requirements and governmental edicts.

Drivers

Driving Forces

- IEA Energy Technology Perspectives 2008:
- ….“..a global **energy technology revolution** is needed….“

- IEA World Energy Outlook 2008:
- ..“…The world‘s energy system is at a crossroad. Current global trends in energy supply and consumption are patently unsustainable environmentally, economically and socially……

  What is needed is nothing short of an **energy revolution**….“

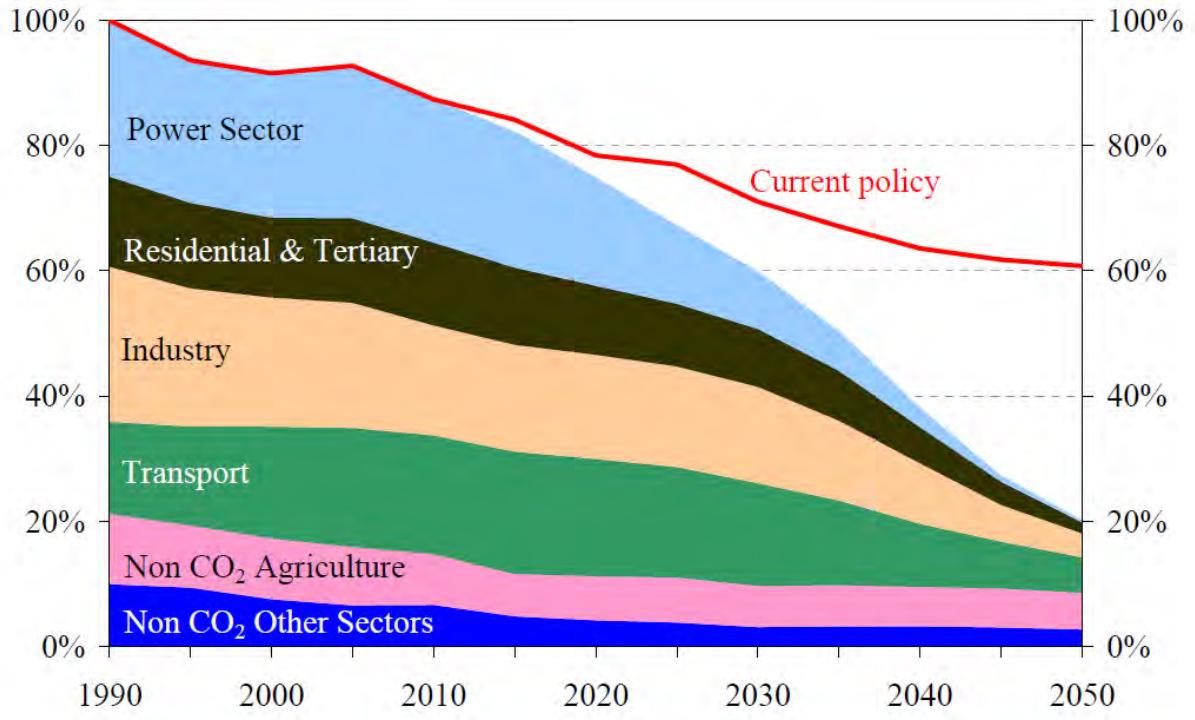
European 2020 Strategy and 2050 Roadmap

Climate change and energy – the "20-20-20 targets"

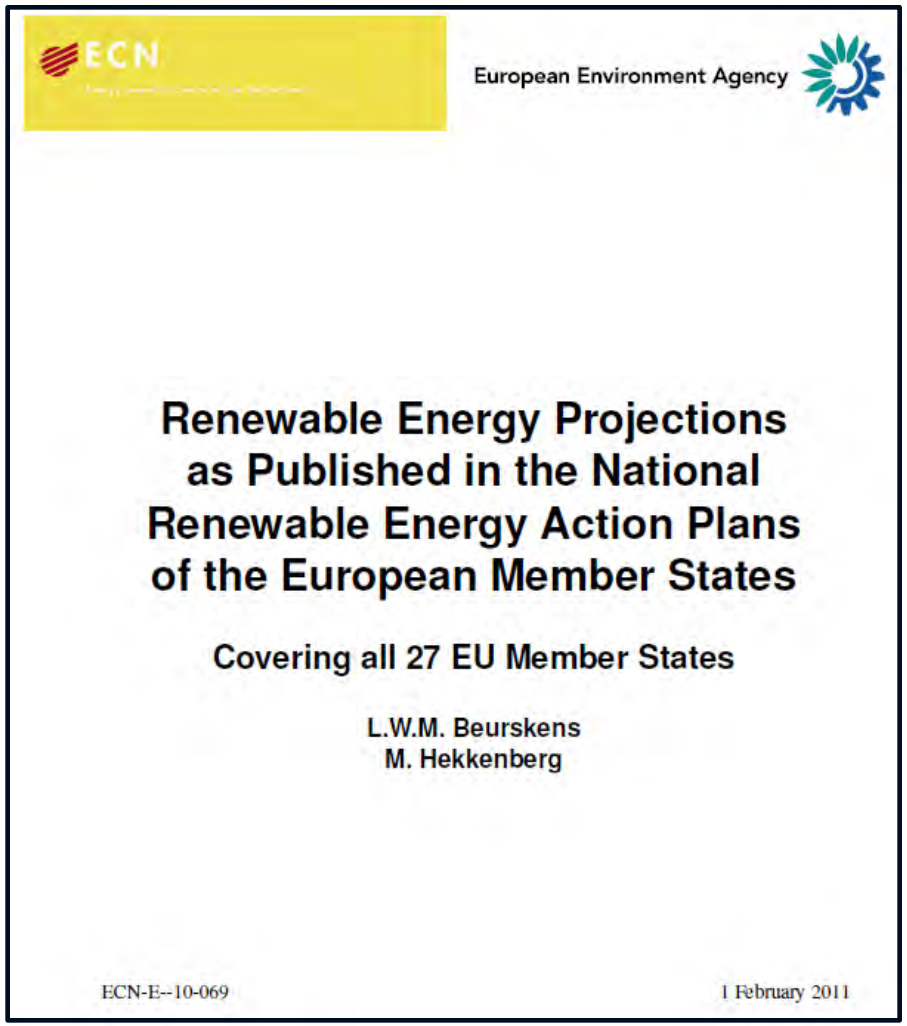
- Reduce GHG-emissions by 20%
- Increase share of renewables in EU energy consumption to 20%
- Achieve an energy-efficiency target of 20%

Roadmap 2050

-80% GHG reduction



A collection of national renewable energy strategies – the National Renewable Energy Action Plan (NREAP)


ECN

European Environment Agency

Renewable Energy Projections as Published in the National Renewable Energy Action Plans of the European Member States

Covering all 27 EU Member States

L.W.M. Beurskens
M. Hekkenberg

ECN-E--10-069

1 February 2011

Wind power (according to NREAP)

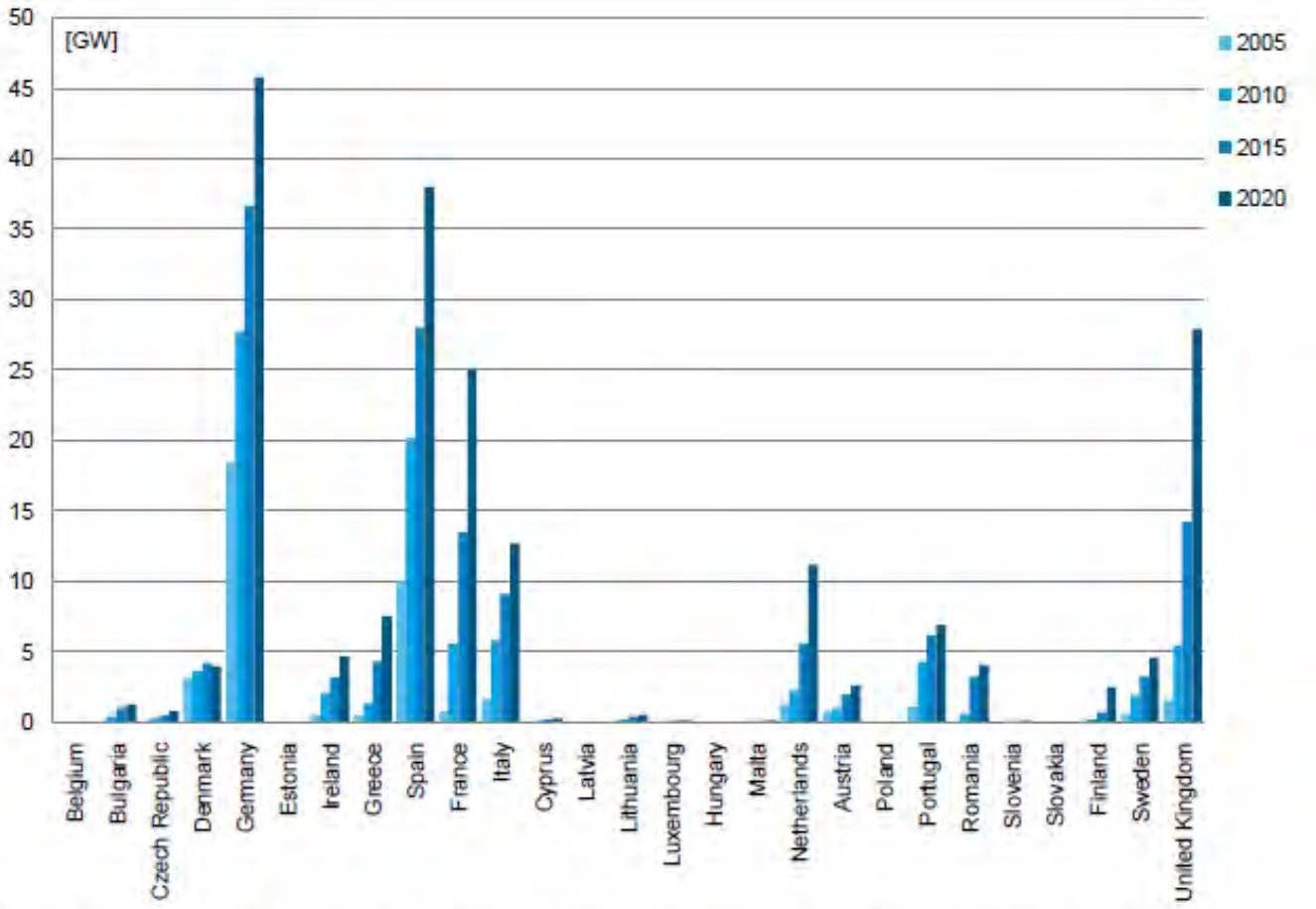


Figure 31: *Projected total wind power electric capacity [GW] for the period 2005 - 2020, including both onshore and offshore wind power*

Full operating hours (wind power)

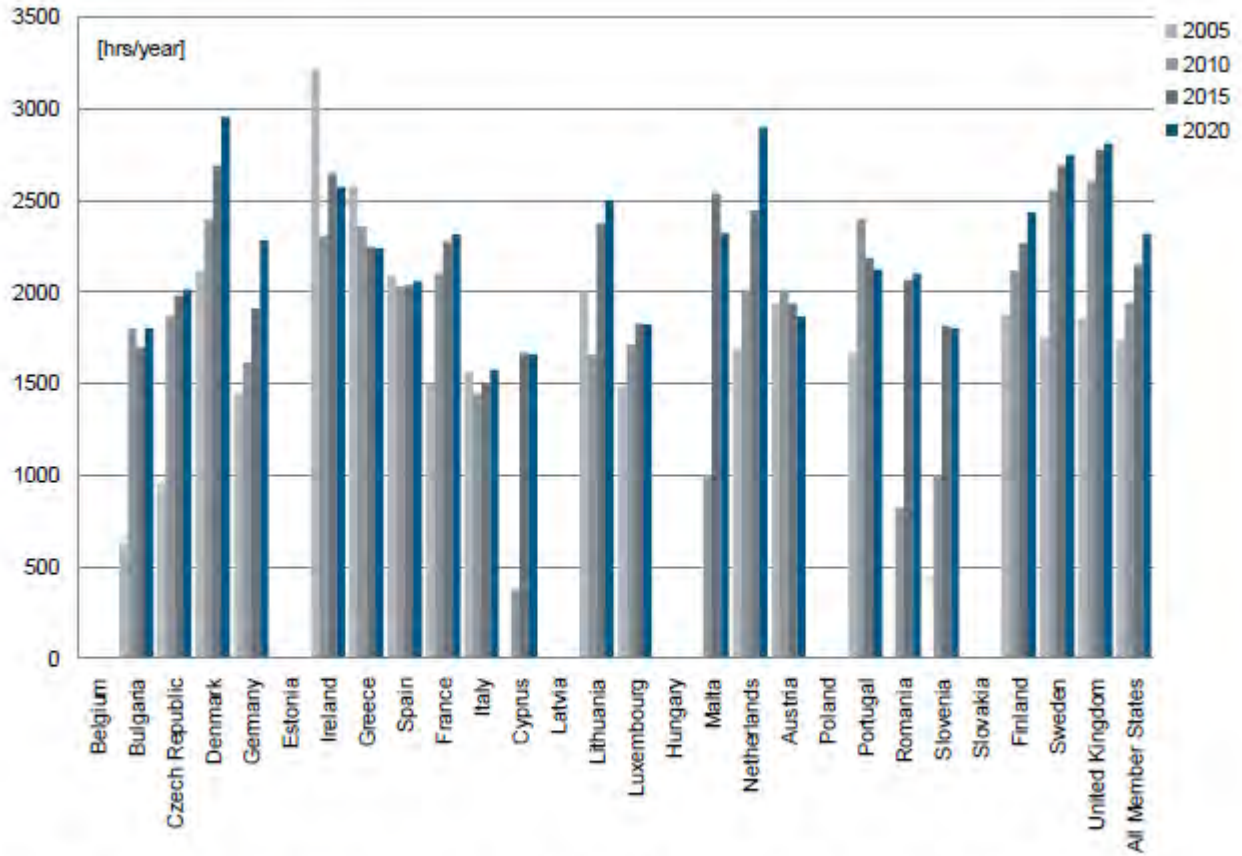
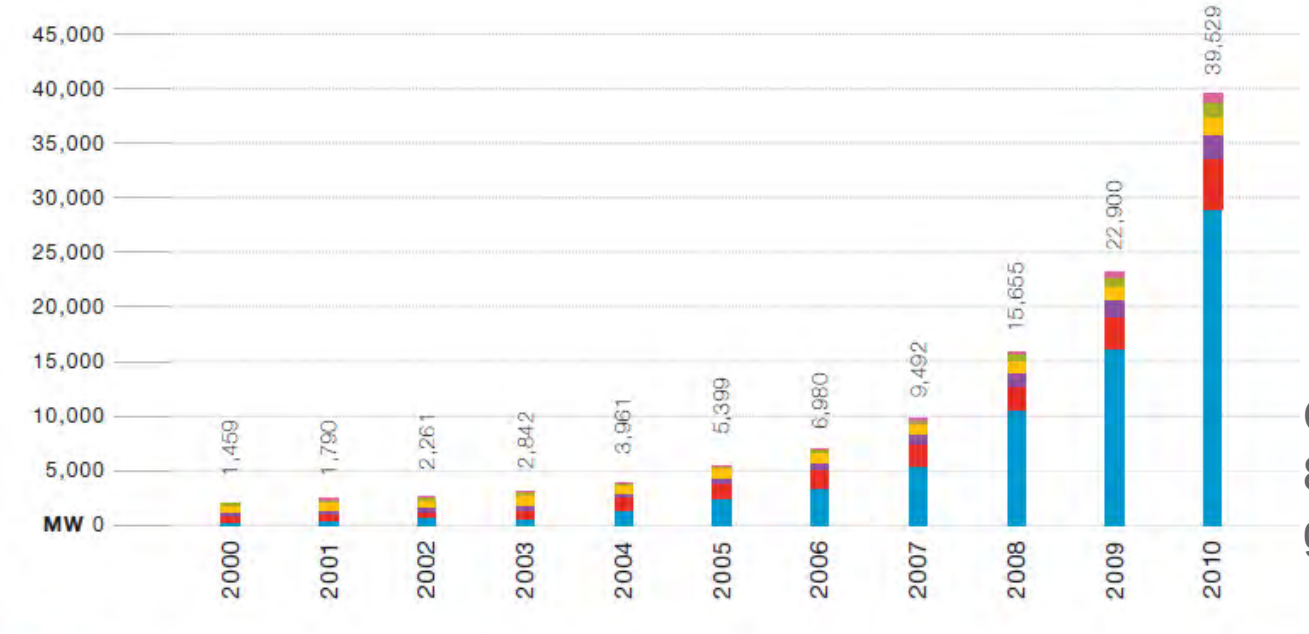


Figure 35: *Calculated average number of full load hours for total wind power [hrs/year] for the period 2005 - 2020*

Installed PV capacity



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
China	19	30	45	55	64	68	80	100	145	373	893
APEC	38	43	49	57	66	80	112	170	466	718	1,191
Rest of the world	758	814	894	971	1,000	1,010	1,128	1,190	1,303	1,427	1,844
North America	146	177	222	287	379	496	645	856	1,205	1,744	2,727
Japan	318	452	637	860	1,132	1,422	1,708	1,919	2,149	2,632	3,622
EU	181	275	414	613	1,319	2,324	3,307	5,257	10,387	16,006	29,252
Total	**1,459**	**1,790**	**2,261**	**2,842**	**3,961**	**5,399**	**6,980**	**9,492**	**15,655**	**22,900**	**39,529**

Germany:
80% in low voltage grids and < 100 kWp

taken from EPIA gobal market outlook for PV until 2015

Electricity from solar power (according NREAP)

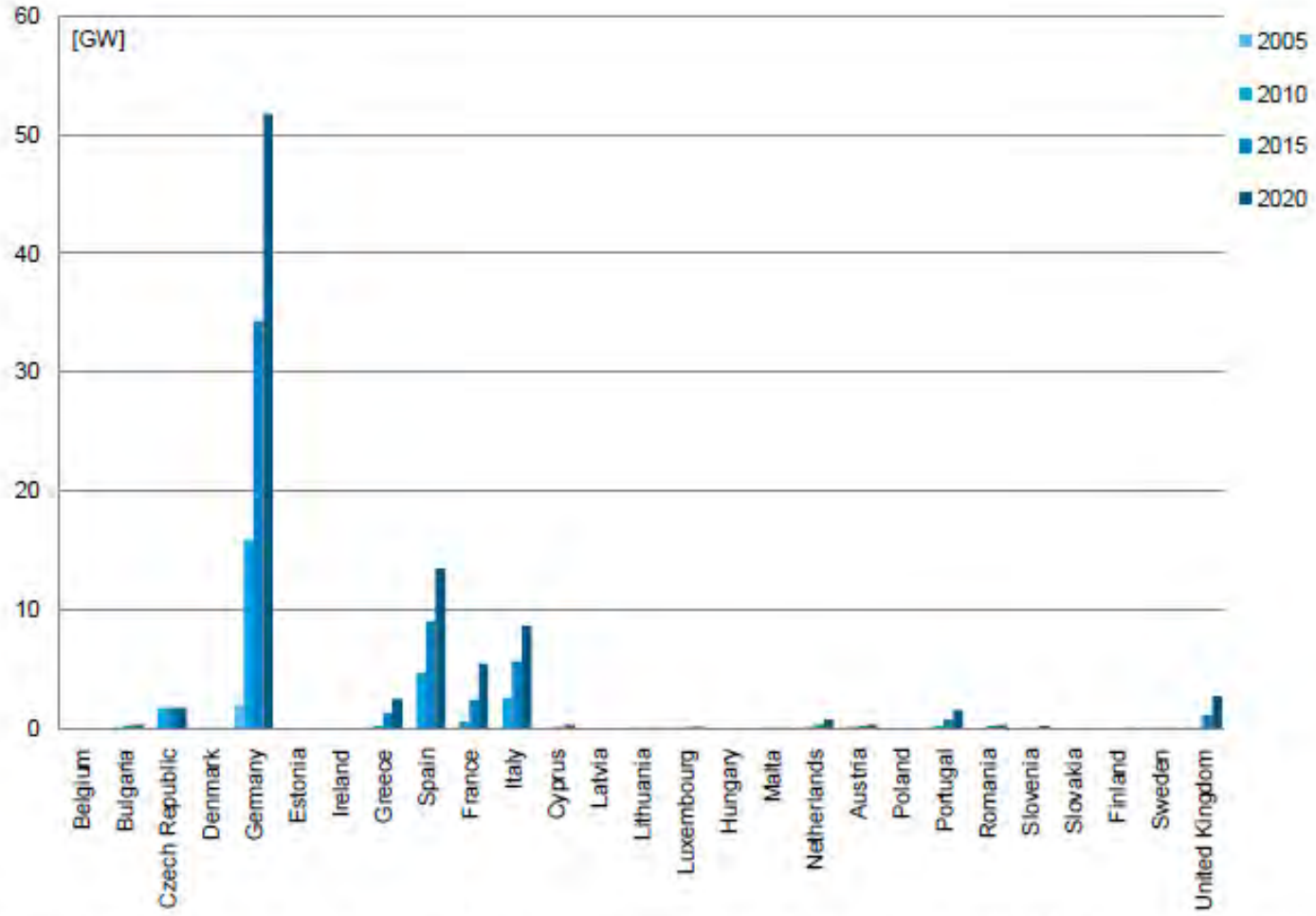
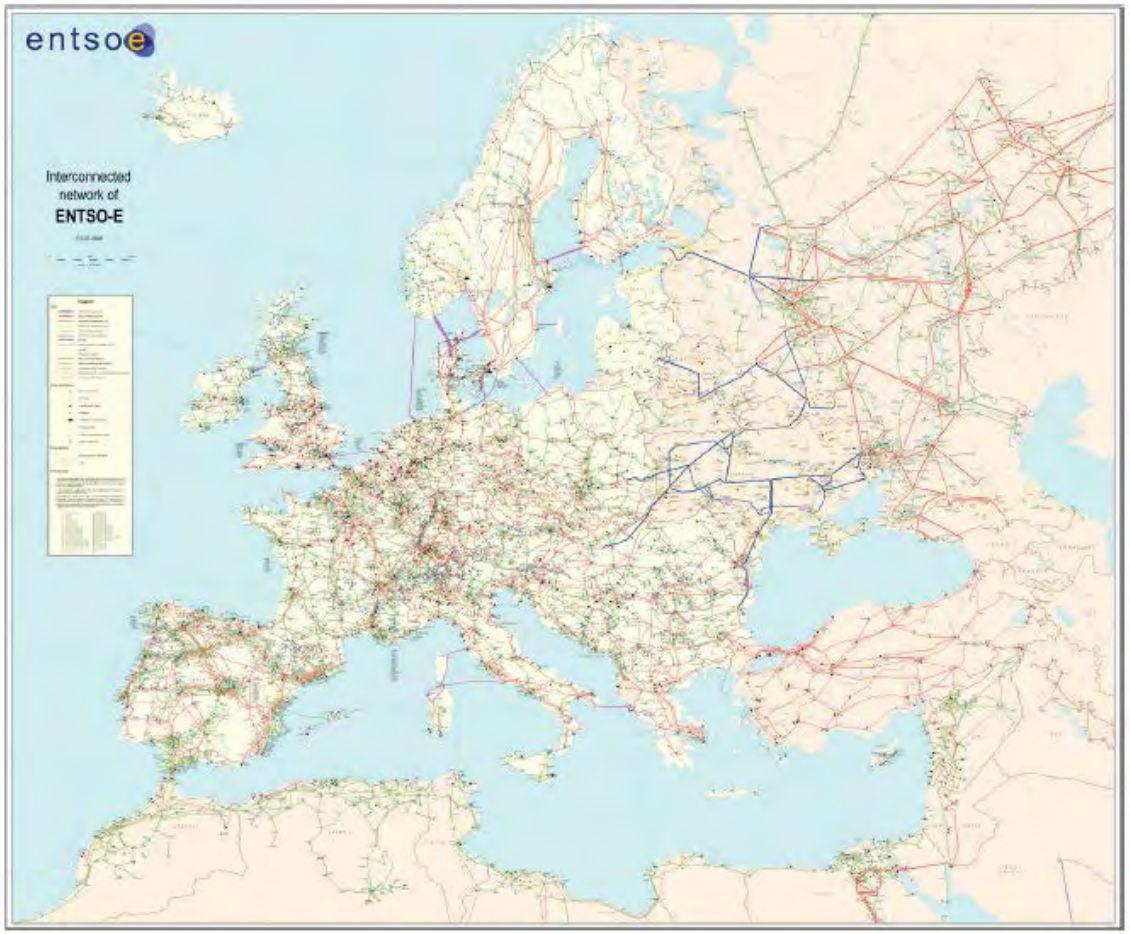


Figure 17: *Projected total solar electric capacity [GW] for the period 2005 - 2020, including photovoltaic (PV) and concentrated solar power (CSP)*

Renewables and the transmission grid I



taken from ENTSO-E ten-year network development plan 2010-2020

Renewables and the transmission grid II

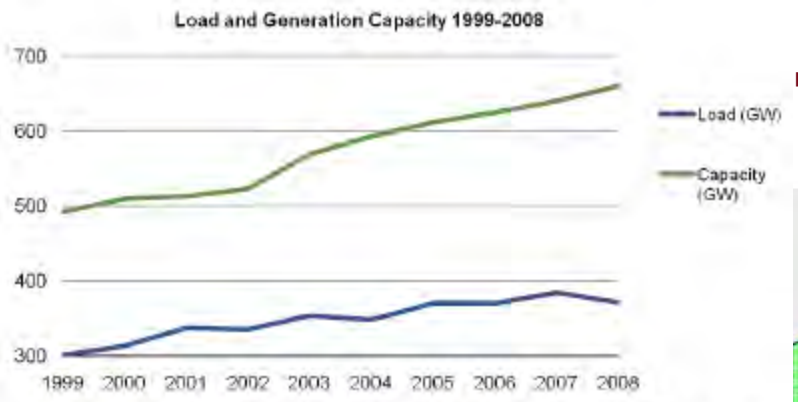
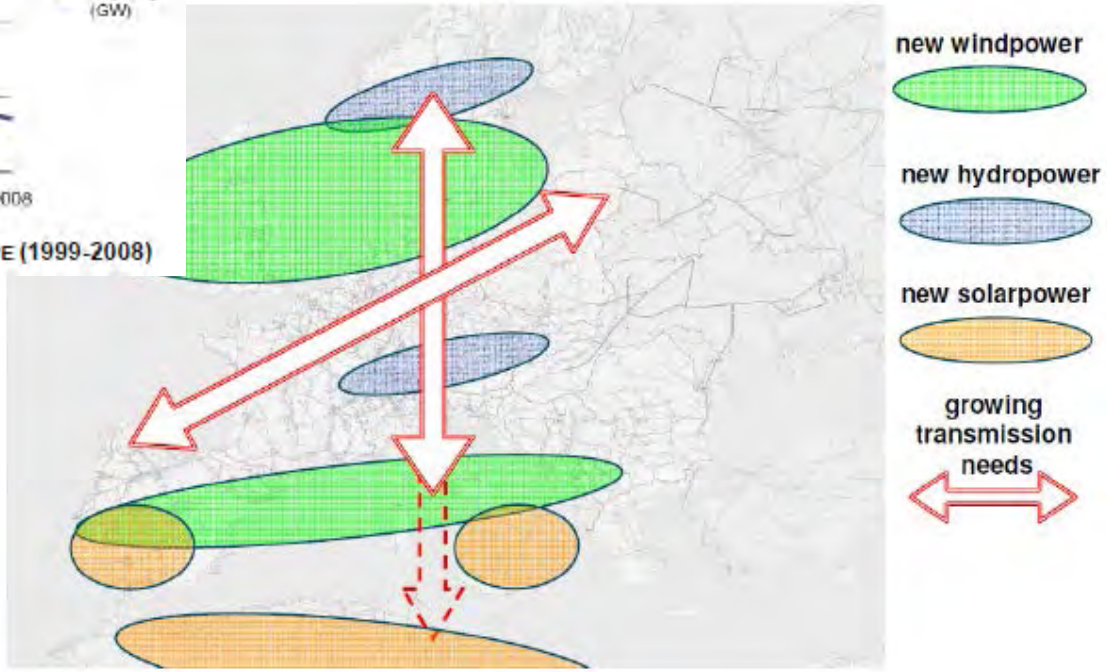


FIG. 12 LOAD AND GENERATION EVOLUTION IN EUROPE (1999-2008)

- Load & generation capacity not parallel anymore
- Current system design: grid capacity has to follow generation capacity



taken from ENTSO-E ten-year network development plan 2010-2020

Transmission grid development – ENTSO-E TYNDP

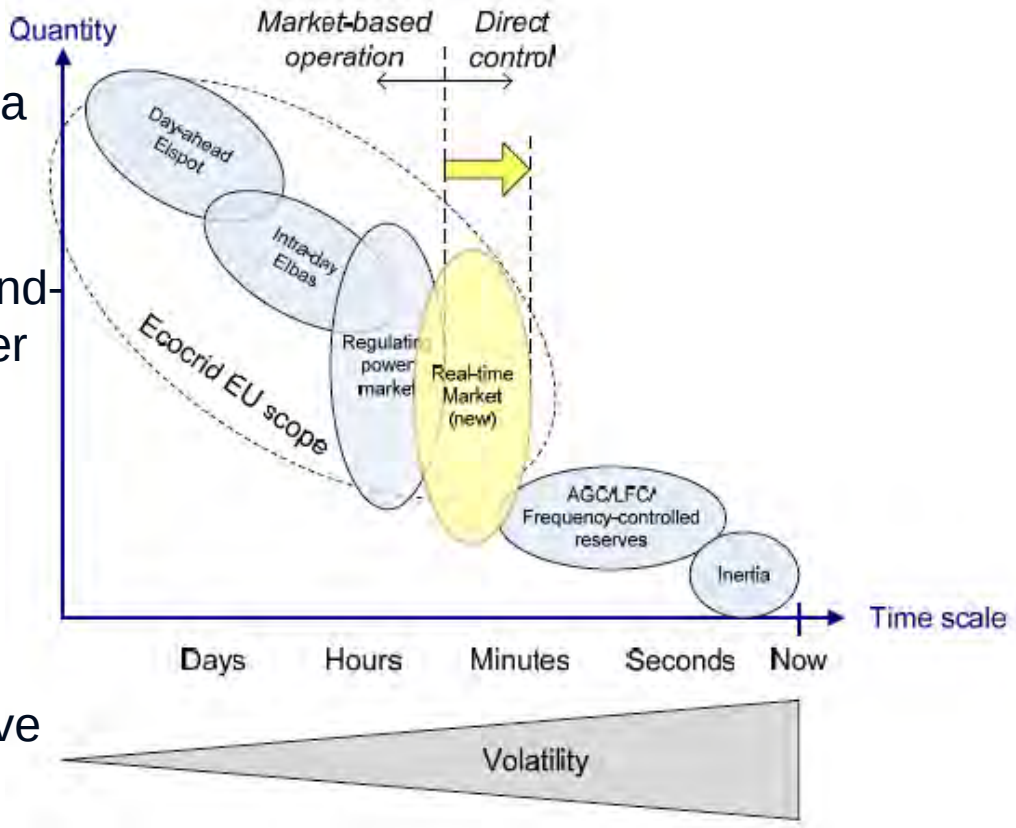
TABLE 9 LENGTH OF NEW AND REFURBISHED POWER LINES UNTIL 2020 (PROJECTS OF EUROPEAN SIGNIFICANCE)

Project tehcnology	Total Length Km	Length of new connections Km	Length of upgraded connections Km
AC	32500	25700	6900
of which >300kV	*29600*	*23200*	*6400*
DC (mainly subsea)	9600	9600	0
TOTAL	**42100**	**35300**	**6900**
of which in mid-term	*18700*		

taken from ENTSO-E ten-year network development plan 2010-2020

Scope of the real-time market within Eco-Grid EU

- The EcoGrid real-time market will be an integrated part of current power markets and supports the need of direct control options on a very short time scale
- An efficient instrument to wide spread adoption of small-scale end-users and prosumers in the power market(s)
- Increasing competition on power market(s)
  - Small scale end-users can attain economic benefits
  - TSOs get access to alternative balancing resources



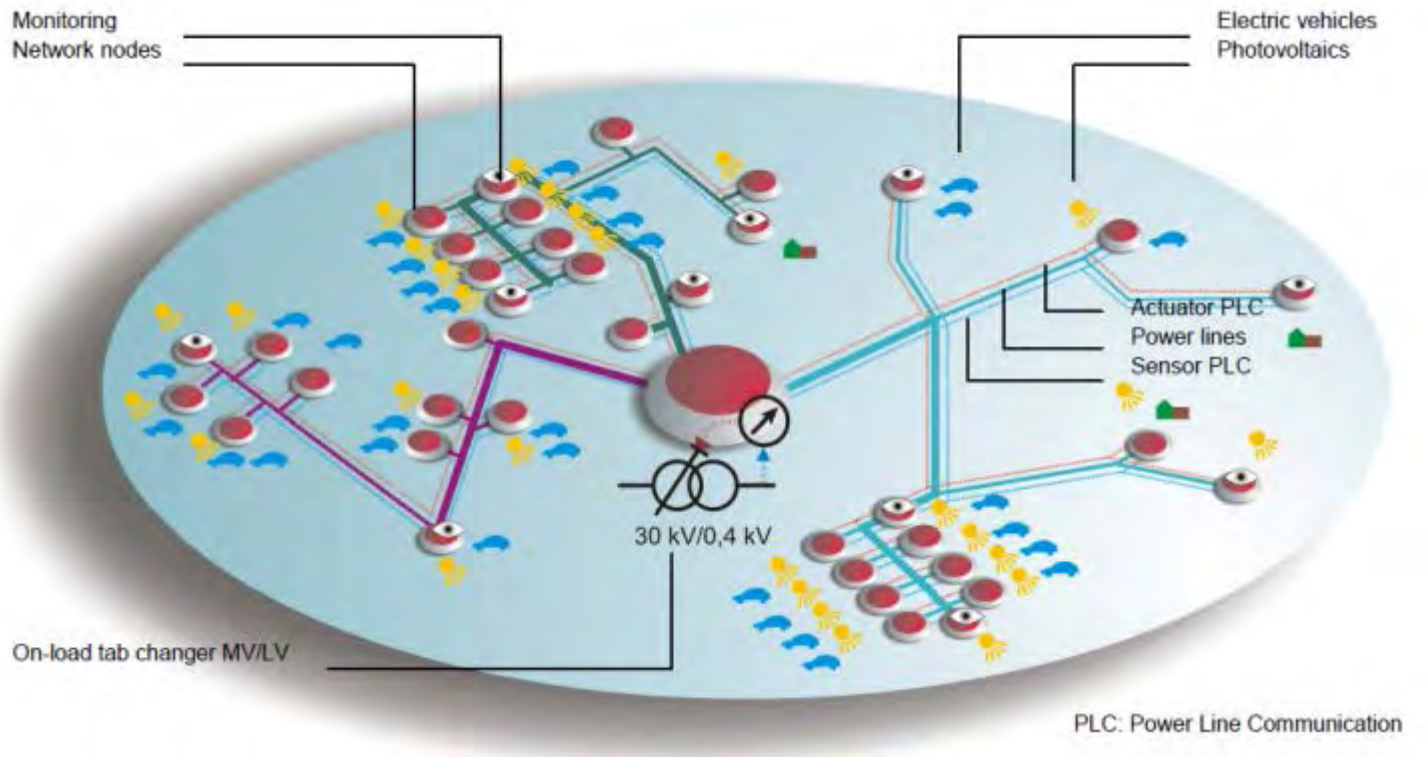
Solutions

The EcoGrid EU project

- A large scale demonstration of a real-time market place for distributed energy resources
- A demonstration of a *real* power system with more than 50 percent renewable energy
- Preparation for a fast track towards European real-time market operation of RES & DR

Smart Grid Technologies in three field tests

DG DEMO NET SMART LV GRID



- Monitoring & intelligent probabilistic planning
- Intelligent voltage control at secondary substation
- Active and reactive power control at DG unit
- Demand response: controllable loads – e-mobility

Field test regions and focus

- Oberösterreich: Linz AG
  - **Use case "intelligent planning and smart monitoring“** - verification of the **probabilistic planning** method by measurements in a grid with high penetration of PV
- Oberösterreich: Energie AG OÖ
  - **Use case "smart sensing and coordinated generation control“** - testing of control- and monitoring solutions in a grid with **high penetration of PV** based on smart metering communication infrastructure
- Salzburg: Salzburg AG
  - **Use case "smart sensoring and coordinated load control“** - examination of effectivity of control- and monitoring solutions in a grid with high penetration of **PV linked with a high penetration of electric vehicles**

The role of smart heat networks

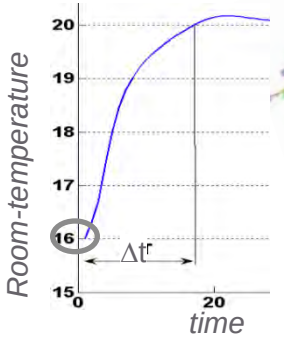
- Urban areas account for 69% of the primary energy demand, approx. 55% is used for heat
- An intelligent and integrated grid-bound heating and cooling supply as important **enabler for a smart city:**
  - is able to absorb and distribute thermal/cooling energy from various sources
  - offers opportunities for load-shifting between buildings
  - reduces peak load (aggregating individual consumers)
  - is able to connect various energy sources and storage systems on local level via distributed „micro-grid“ consumers
- Current development: low temperature district heating (TVL: 30-50° C)
  - Economical transport of thermal energy
  - Increasing the potential of renewable energy

Case Study: SmartHeatNet Project

Salzburg AG

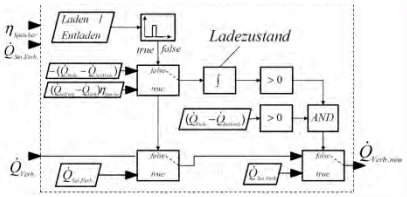
- National-funded research project (New Energies 2020, 3rd Call)
- **Objective**: Development of intelligent operations strategies and control algorithms (for suppliers and consumers), reduction of peak loads
- **Method:** current state analysis, transfer of smart grid concepts, evaluation using dynamic power system simulations

Lastverschiebung

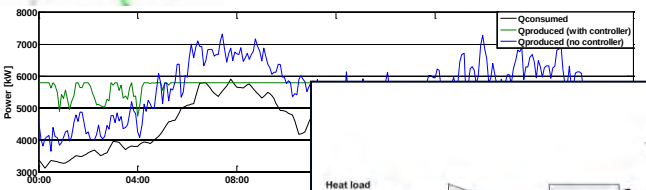


Bestandserfassung, Analyse

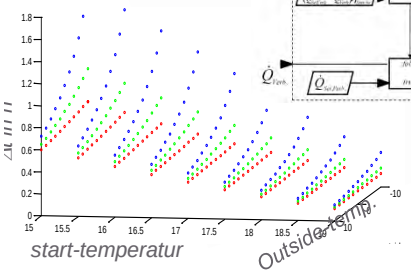
Zentrale/ dezentrale Speicher



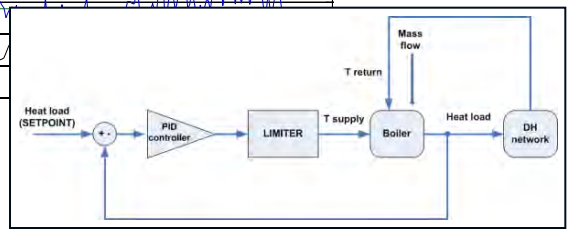
Vorlauftemperatursteuerung



Dynamische Gebäude-simulation

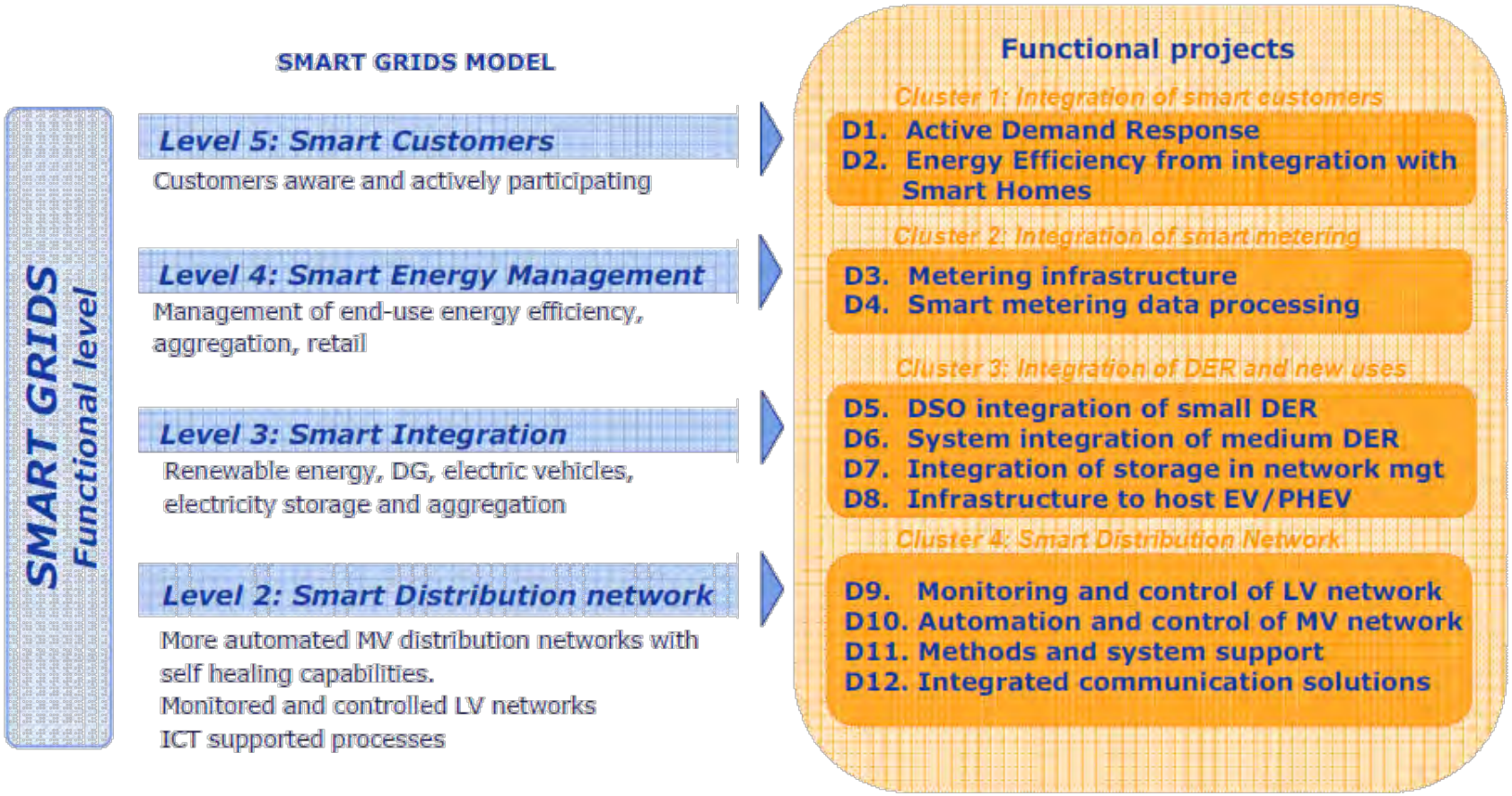


Sozio-ökonomische Faktoren



The European perspective

Functional projects according to the EEGI Roadmap



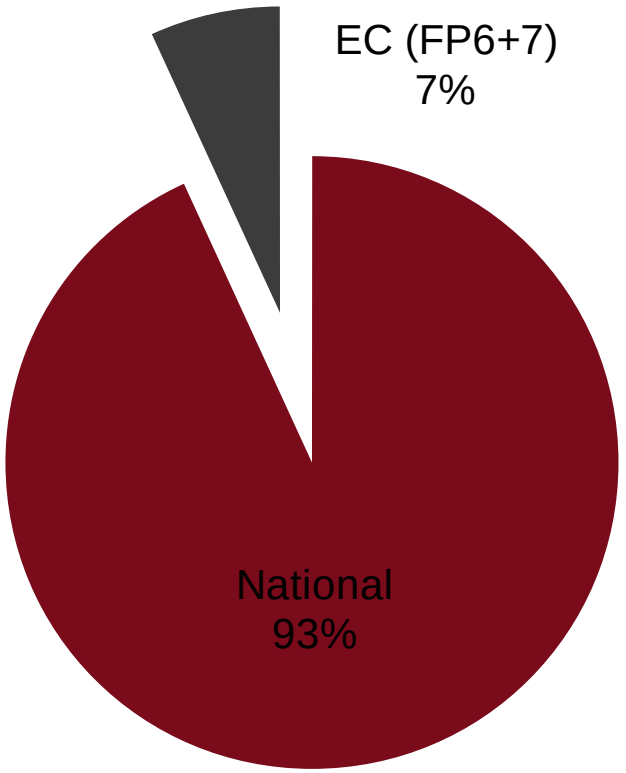
- Functional projects shall be implemented by local demonstration projects and related research projects

Project and investment overview

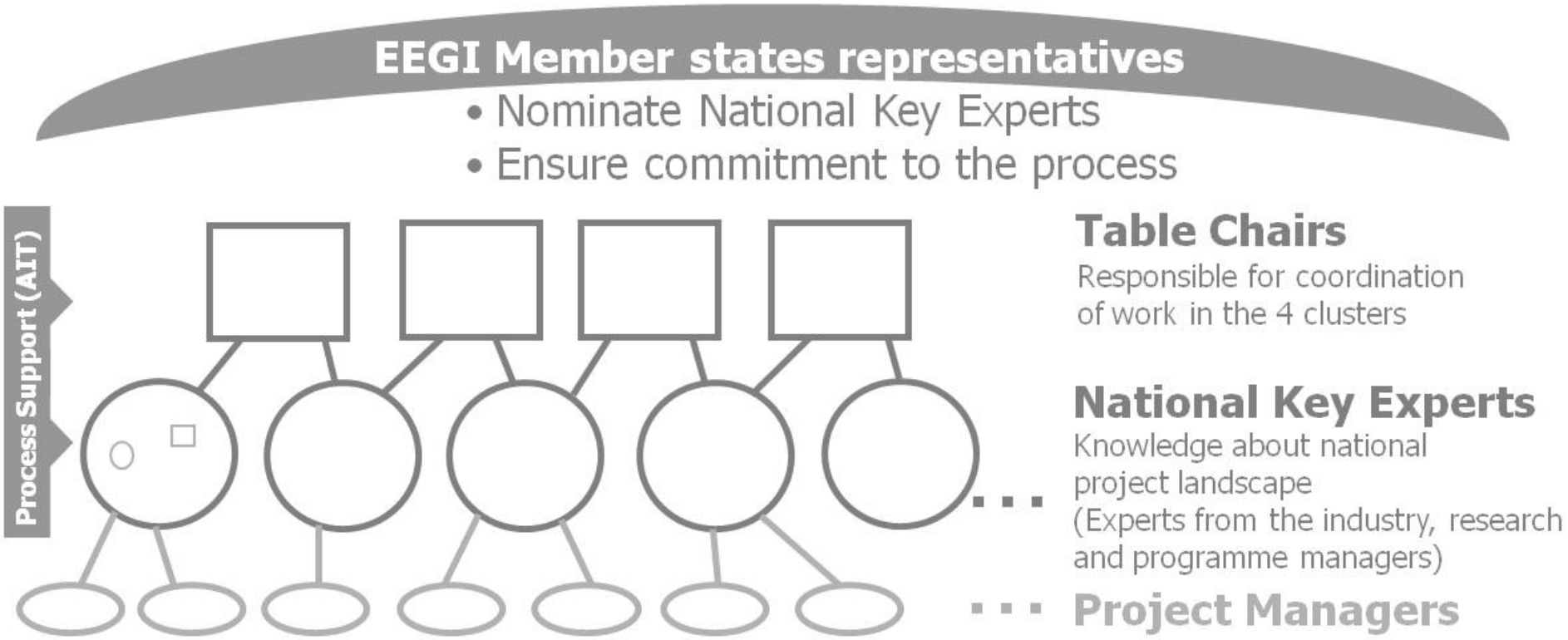
- 203 European projects in total
  - 111 projects with significant demo part; 15 projects EC-funded, 189 MS-funded
- Budget for SG projects on national level (industry + public funding): € 2.5bn acc. to JRC (excl. € 2.5bn smart-meter roll-outs)
- Budget for SG projects on EU level (industry + EC funding): € 184m acc. to JRC (FP6 and FP7 funding)

→ Lots of results but lack of European-wide coordination

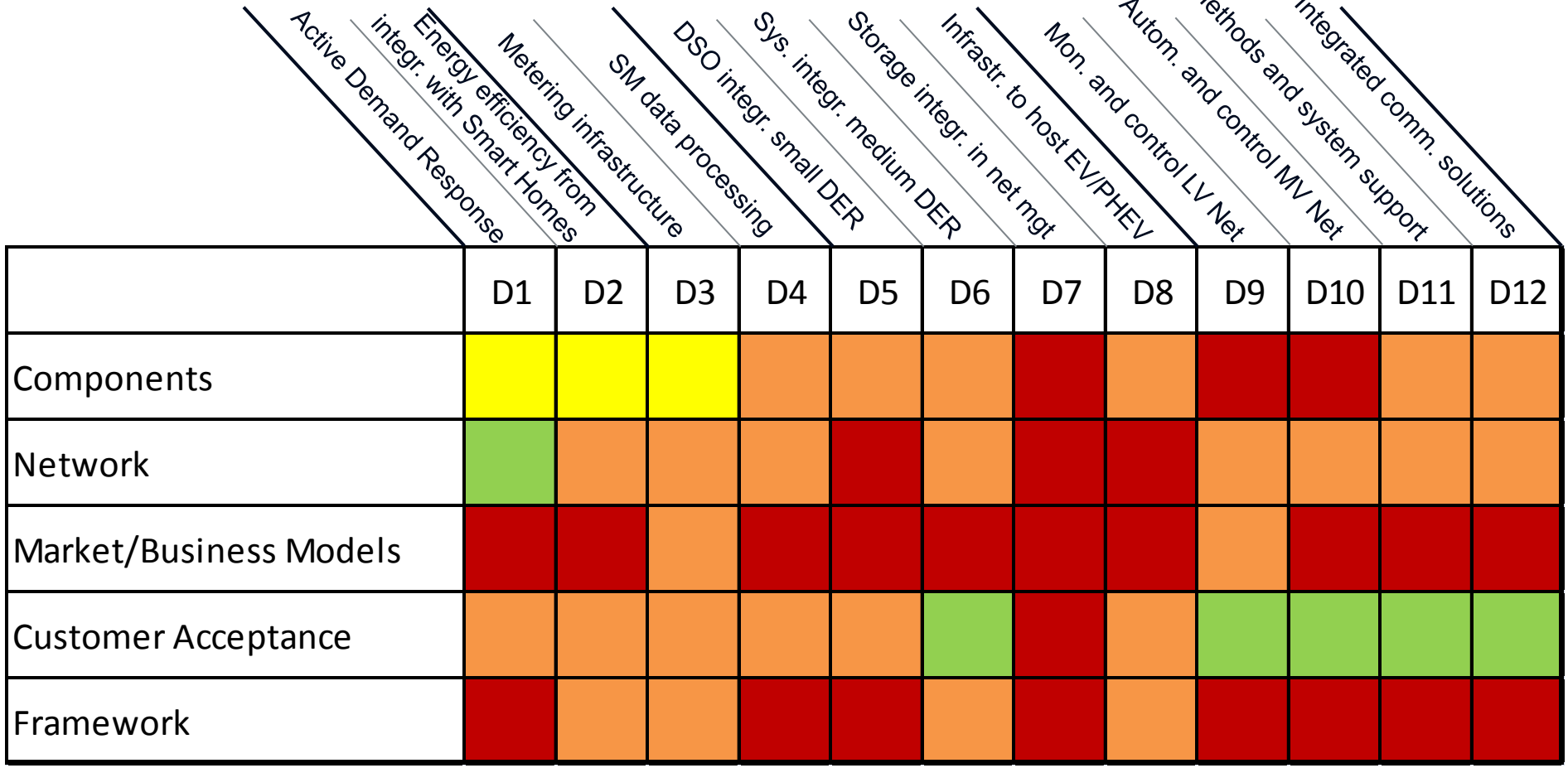
Smart Grid investment



Member States Initiative within the European Electricity Grid Initiative (EEGI) Cooperation Structure – Network of Experts

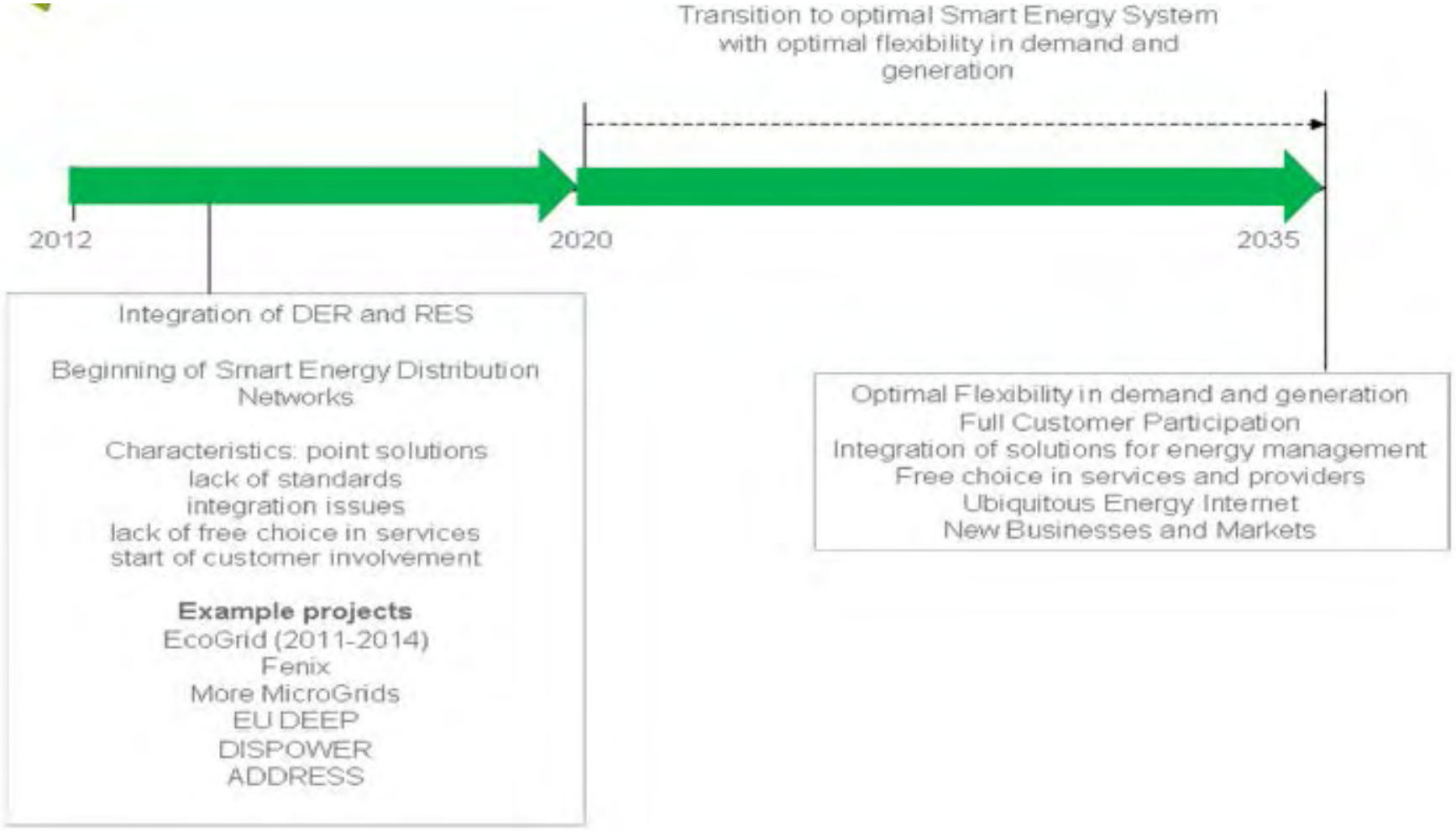


Overview: progress of functional projects



	Defined objectives of functional projects fulfilled or not relevant
	Significant number of projects; other European countries would considerably benefit from dissemination
	Objectives partially met or likely to be met in existing projects within the next two years
	Objectives not addressed at all or in very few projects

Future development of smart grids (SRA2035)



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