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# **R&D Activities in EU and Microgrids**

**Aalborg Symposium on Microgrids  
Aalborg, 27-28 August 2015**



# Outline

**European policy context**

**European – level energy RD&D strategy**

**The European Strategic Energy Technologies Plan**

**European-level Research and Innovation Programme**

**Horizon2020 Programme**





# European Energy & Climate Policy

## Three pillars of energy policy:

- ✓ Sustainability
- ✓ Security of supply
- ✓ Competitiveness

## Actions:

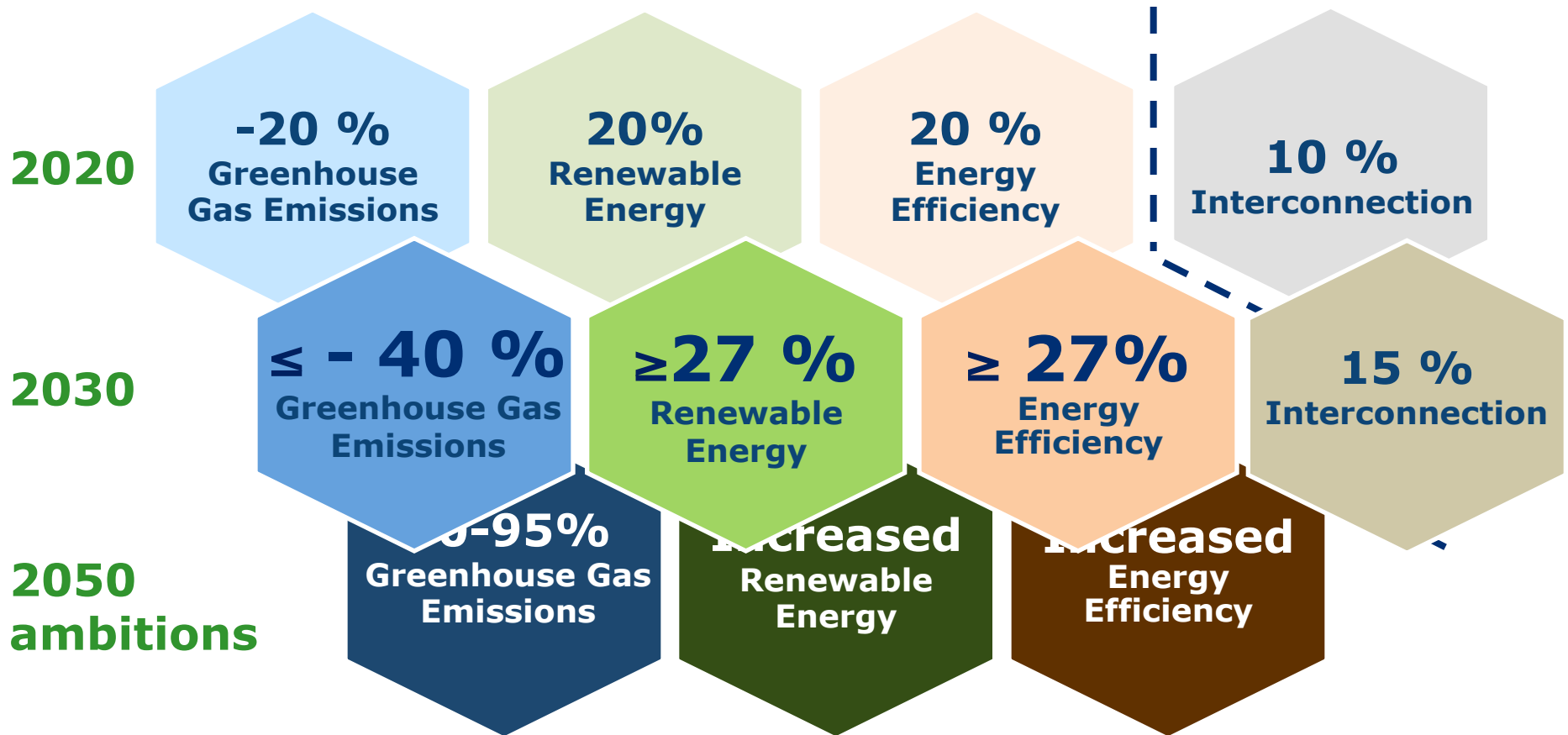
- ✓ Energy-Climate policies, security of supply
- ✓ Energy Union
- ✓ RD&D – Strategic Energy Technologies plan

## A trajectory for the long term





# European Targets for 2030 (agreed 10/2014)



27% renewable energy in 2030: 45-50% renewable electricity?





# Current status of renewables in the EU

## Wind Power: (end 2014)

Capacity 129 GW, energy ~ 280 TWh

- ✓ Offshore 8 GW, ~ 30 TWh
- ✓ EU share of electricity from wind ~ 9%
- ✓ Denmark, Portugal, Lithuania, Spain, Ireland > 15%

## Solar Energy: (end 2014)

- ✓ Total PV capacity: 89 GW
- ✓ Concentrated solar: 2.3 GW

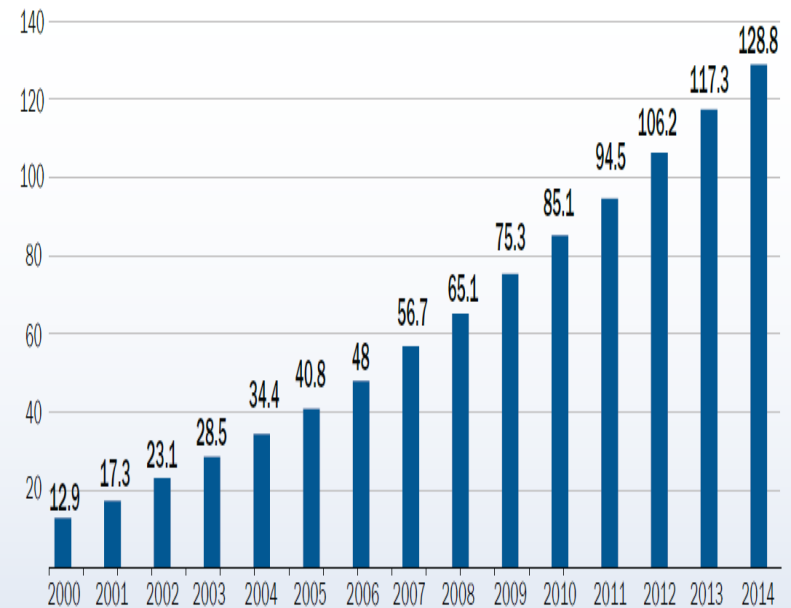
EU share of electricity from solar : 3%

Much larger in Germany, Spain, Italy

Overall EU Power system:

~ 1,000 GW capacity, ~ 3,300 TWh generation

## EU installed wind capacity



Source: EWEA



# **EU Energy Union Strategy (Feb. 2015)**

## **Energy Security, Solidarity and trust**

- ✓ Diversification of supply, joint approaches

## **Full integration of the EU energy market**

- ✓ Stronger interconnections
- ✓ New market design

## **Energy efficiency and moderation of demand**

- ✓ Buildings, transport, industry

## **Decarbonising the economy**

- ✓ EU Emissions Trading System
- ✓ Number One in Renewables

## **Research, Innovation and competitiveness**





# **EC energy summer package**

## **Transforming the EU's energy system**

### **Emission Trading Scheme revision proposal**

- ✓ A cost-efficient road to 40% CO<sub>2</sub> reduction by 2030

### **Energy Efficiency Labelling**

- ✓ Adaptation of a successful scheme

### **Empowering consumers**

- ✓ Helping savings through better information
- ✓ A wider choice for participating in the energy market
- ✓ Consumer protection
- ✓ Ability to generate and consume own energy

### **New energy market design**

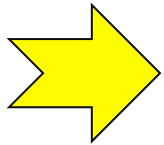
- ✓ Public consultation open until 8 October 2015





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# Energy Union Research & Innovation

## Combining actions between EU and member states

- ✓ World leader in developing next generation renewable, bio-energy and storage technologies
- ✓ Participation of consumers, smart appliances, homes, cities, grids
- ✓ Efficient energy systems, towards energy-neutral buildings
- ✓ Sustainable transport systems

## Actions with interested member states

- ✓ Carbon Capture, Storage and Use, for power and industry
- ✓ Safe nuclear energy (fission and fusion)





# The Strategic Energy Technologies Plan

## Technology action supporting European energy policy

- ✓ Accelerate technology development, technology transfer & uptake
- ✓ Reference for coordinated European and national technology innovation
- ✓ Enhance European competitiveness in low-carbon technologies

## 2020 perspective: European Industrial Initiatives

- ✓ public-private partnerships for short to medium term
- ✓ European Electricity Grids Initiative EEGI

## beyond 2020: European Energy Research Alliance

- ✓ joint programming for medium to long term
- ✓ EERA Joint Programme Smart Grids - ELECTRA

## SET Plan Integrated Roadmap 2014

- ✓ Holistic view of energy system
- ✓ Integrate consumers, demand-side actions





# The European Electricity Grids Initiative

## Main drivers:

- ✓ Integrating up to 35% of Renewable electricity by 2020, more later on
- ✓ Integrating national networks and markets into a pan-European network
- ✓ Engaging active customers in energy efficiency and markets
- ✓ **NEW** Integrating energy storage in grids and operations

## New challenges from renewable electricity

- 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





# **SET Plan Energy Research Alliance - EERA**

**Joint programmes to integrate research activities & resources  
of national research centres and accelerate R&D**

**Longer-term complement to industrial initiatives**

- ✓ Wind energy, Solar energy, Bioenergy, Electricity grids, CCS, Materials for Nuclear, Fuel cells and Hydrogen, Smart Cities

**Joint programmes in new areas**

- ✓ Geothermal energy, marine energy, energy storage, materials for energy

>150 research institutes and universities involved

Joint programmes with >2000 full-time equivalent researchers

**EERA programme on Smart Grids – ELECTRA**





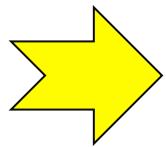
# Outline

**Challenging Climate-Energy Objectives for Europe**

**Integration of Renewable Resources in the Energy System**

**European – level energy RD&D strategy**

**The European Strategic Energy Technologies Plan**



**European-level Research and Innovation Programme**

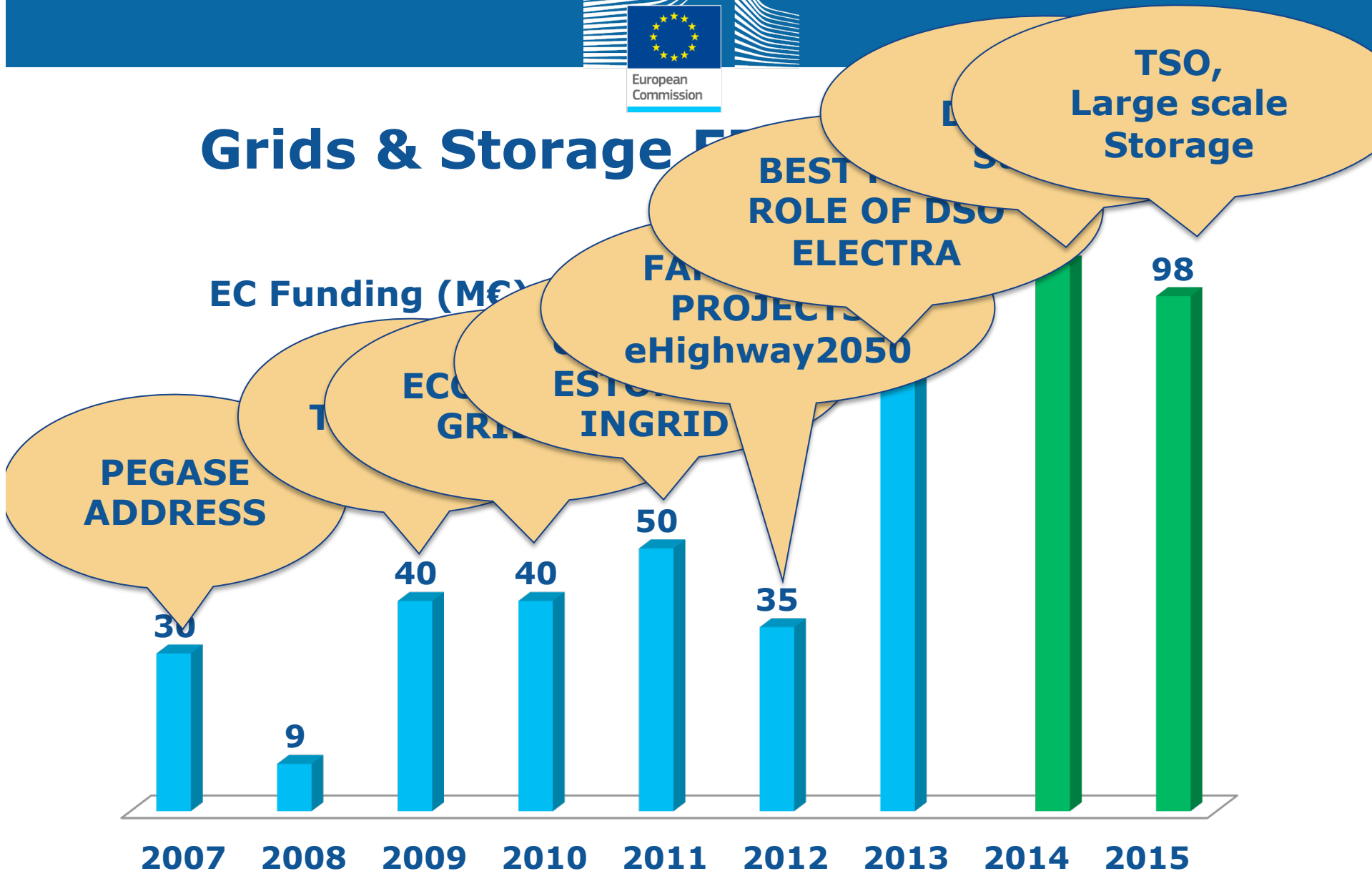
**Horizon2020 Programme**





# Grids & Storage

EC Funding (M€)





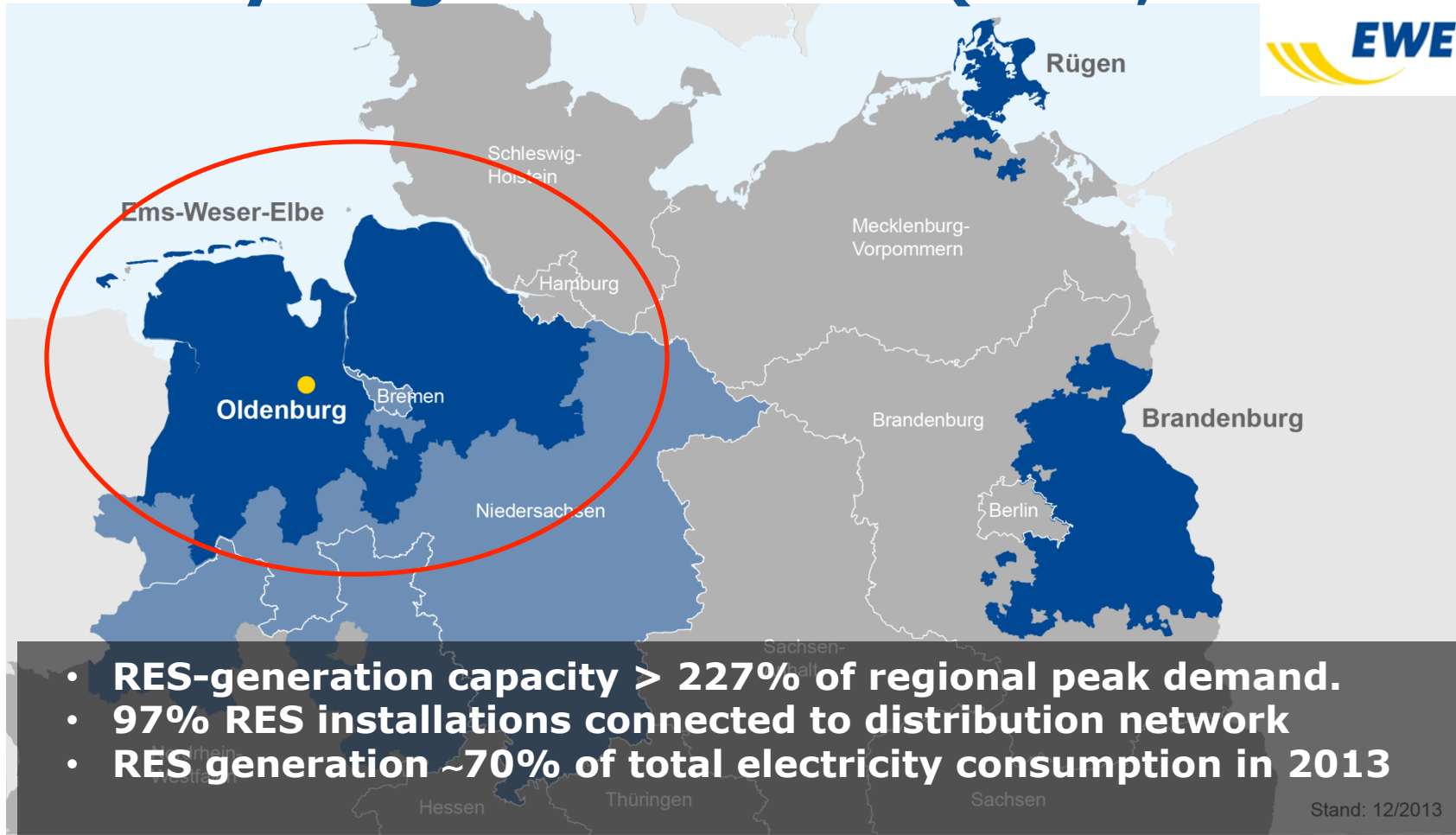
# Integration of Renewable Electricity

## Balancing and managing flexibility

- ✓ Flexible generation
- ✓ Demand response
- ✓ Storage
- ✓ Interconnections – balancing over larger areas



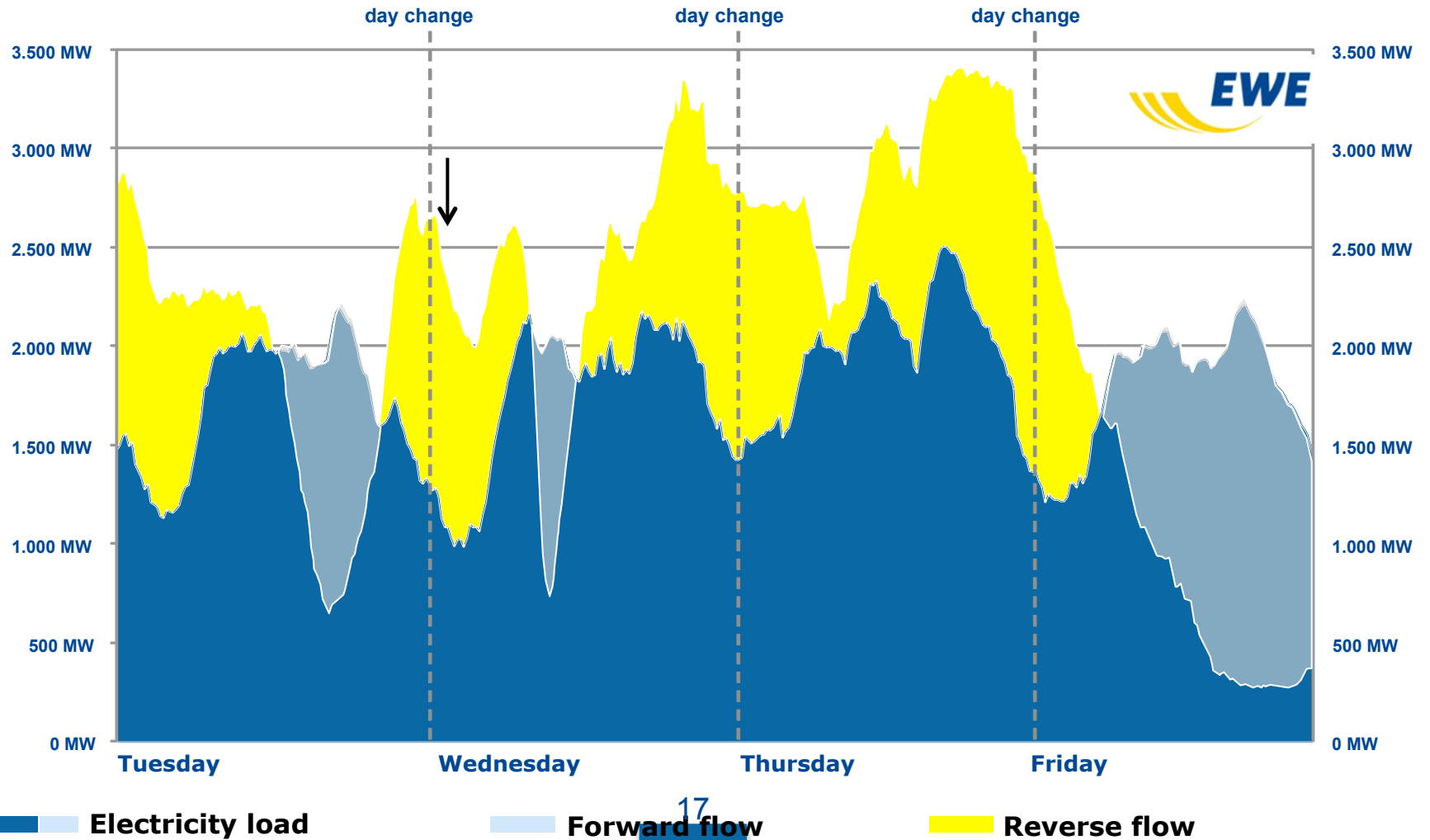
## Germany: High share wind (EWE, N-W DE)







# Correlation of RES generation with demand Forward & Reverse Flows





# Integrating Off-shore wind (North Seas)

## Offshore wind deployment in the North Seas:

- Capacity factors: 40 – >50%
- Limited “Nimby” effect
- End 2014: 8 GW; National plans 2020:  $\approx$ 40 GW





# Smart Grids R&D&I - New Drivers

**Increasing role of the customer - prosumer**

**Fulfilling the customer expectations**

- ✓ Choice
- ✓ Quality of supply
- ✓ Cost
- ✓ Engagement

**Decentralised approaches**

- ✓ Decentralised generation
- ✓ Decentralised storage
- ✓ Use of decentralised flexibility
- ✓ Decentralised intelligence





# FP7: Examples of decentralised operation

## ECOGRID-EU

- ✓ Market-based mechanisms close to real-time to exploit flexibility
- ✓ Demonstration with 2,000 customers in Bornholm (>50% RES electricity)

## GRID4EU – islanded operation in 2 of 6 demonstrations

- ✓ "NICE GRID" – PV, DR & storage integration in LV grid
- ✓ Vrchlabi – MV & LV, EV charging, CHP

## SINGULAR

- ✓ Optimisation and stability of insular grids
- ✓ Forecasting, storage, scheduling, market design...

## DREAM

- ✓ "Heterarchical" management of power grids
- ✓ Control & management based on autonomous agents

## ELECTRA R&D

- ✓ "Cell concept"





# Horizon 2020 (2014-2020)

## "Challenge-based" approach

- ✓ Focusing on main objectives, no prescription of means

## 2014-2015 calls

- ✓ 2014: R&I on grid & storage at distribution level; storage technology  
Examples of demonstrations of decentralised approaches:  
EMPOWER (grid), TILOS (storage)
- ✓ 2015: R&I on grid & storage at transmission level  
Evaluation on-going

## 2016-2017 calls

- ✓ Final stage of preparation
- ✓ Information days in Brussels on 14-15 September 2015





# **EMPOWER: Local electricity retail markets for prosumer smart grid power services**

**New market design for prosumers and local trading**

**Prosumer oriented business models for market design**





# TILOS: Technology Innovation for the Local Scale, Optimum Integration of Battery Energy Storage

## Storage solution development

- ✓ Battery cells, Interface and control

## Microgrid management: stand-alone and connected operation

- ✓ Exploiting battery and distributed heat storage

**Sites: Tilos, Pellworm, Corsica, La Graciosa**





# Food for thought

## Aims of distribution operators after unbundling

- ✓ Connect all grid users
- ✓ Cost to serve
- ✓ Quality of supply

## New roles?

## Balance of flexibility?

- ✓ Generation
- ✓ Demand Response
- ✓ Storage
- ✓ Interconnections







# Conclusion

## **Energy Union, Energy-Climate objectives 2030**

### **Integration of Renewable Resources in the Energy System**

Ready technology, validation, further developments in Europe

### **Strategic R&D&I programme for energy system**

Open to different approaches,

A number of microgrids projects running

### **Horizon 2020 European Programme for Research and Innovation**

Information days in Brussels on 14-15 September 2015





**Thank you for your attention**

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**[http://ec.europa.eu/research/energy/index\\_en.cfm](http://ec.europa.eu/research/energy/index_en.cfm)**

**[http://ec.europa.eu/energy/index\\_en.htm](http://ec.europa.eu/energy/index_en.htm)**

**<http://www.gridplus.eu/>**

**<http://www.electrairp.eu/>**

**<http://ses.jrc.ec.europa.eu/smart-grids-observatory>**





# Opportunities for international cooperation

## Horizon2020

- Participation of European subsidiaries & non-European organisations fully included
- Joint projects issued from Joint Calls

## EERA Joint Programme Smart Grids - ELECTRA

- Laboratory – to - Laboratory collaboration
- Developing cross-continental cooperation, international coordination board
- Opportunities for researcher exchanges

## Multilateral cooperation with major economies: ISGAN

