

An aerial photograph of a wind farm. The landscape is a mix of brown and green fields, with a road winding through the middle ground. Several white wind turbines are visible, scattered across the fields. The sky is clear and blue.

# Electricity Transmission Infrastructure: a Key to the Energy Transition

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Chairman of the Board of ENTSO-E & Deputy CEO of RTE



# Our playing field





# An open future

The European Energy Transition

# Solar energy: a decentralization roller-coaster?

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# Let's try a short quiz...

In 2000, what was the prediction for global solar capacity in 2010?

- 4 GW ✓
- 8 GW
- 24 GW
- 41 GW

IEA predicted solar capacity to reach **4 GW** by 2010

What was the actual capacity for global solar in 2010?

- 4 GW
- 8 GW
- 24 GW
- 41 GW ✓

10x what was predicted in 2000

In 2010, what was the prediction for global solar capacity in 2020?

- 87 GW
- 113 GW ✓
- 247 GW
- 324 GW

IEA predicted solar capacity to reach **113- 127 GW** by 2020

What was the actual capacity for global solar in 2013?

- 53 GW
- 87 GW
- 113 GW ✓
- 136 GW


7 years before it was predicted only 3 years before

Is this a load, a decentralized generator...



... or a flexible dispatchable storage?

# Same forecasting errors again?



- Will storage develop quicker than expected ?
- Will Dynamic Demand Response develop slower than expected ?
- Will the Paris 'COP21' climate conference in late 2015 be a success or a failure ?

**Nobody knows...**

We have to be prepared  
to a wider range of scenarios

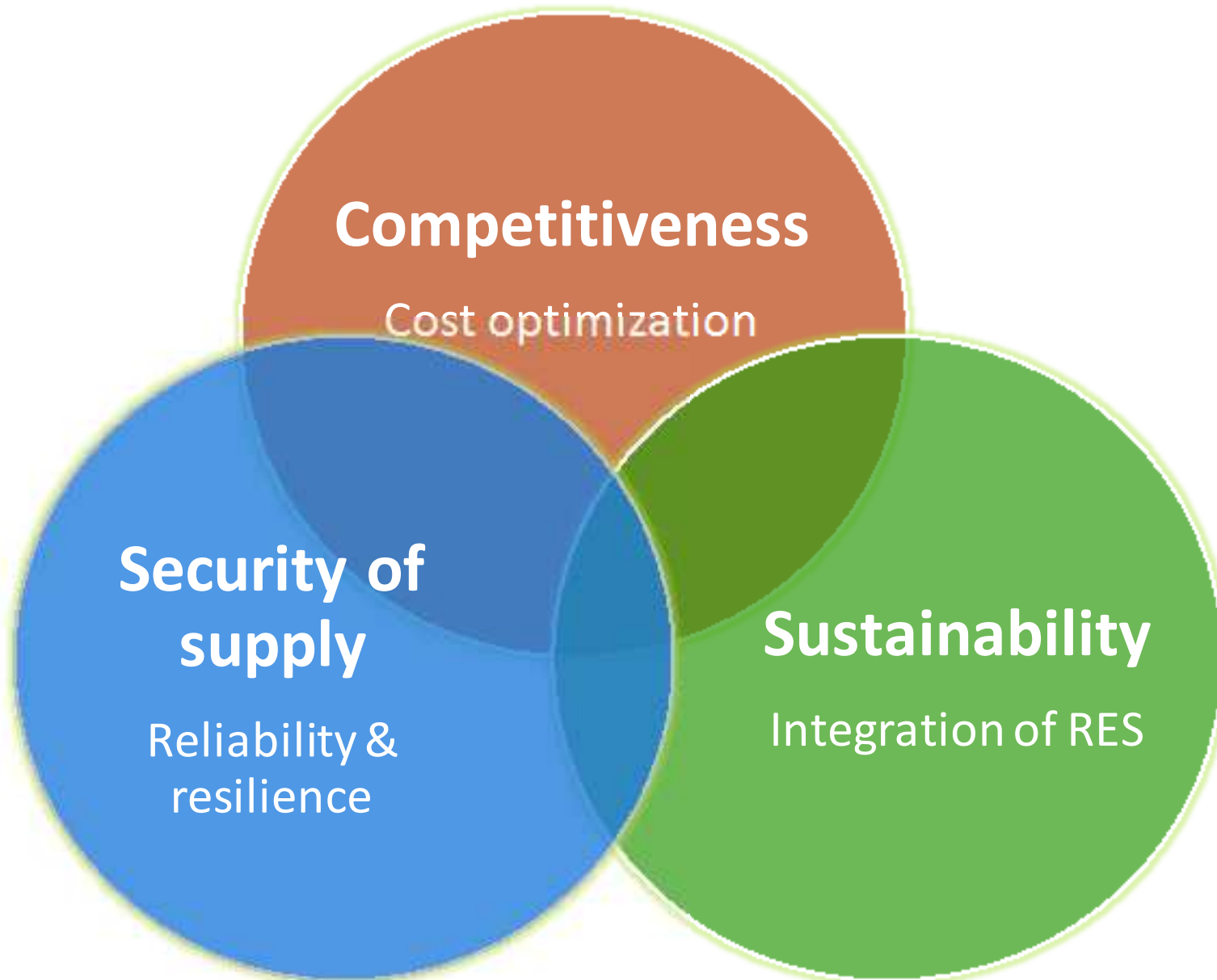




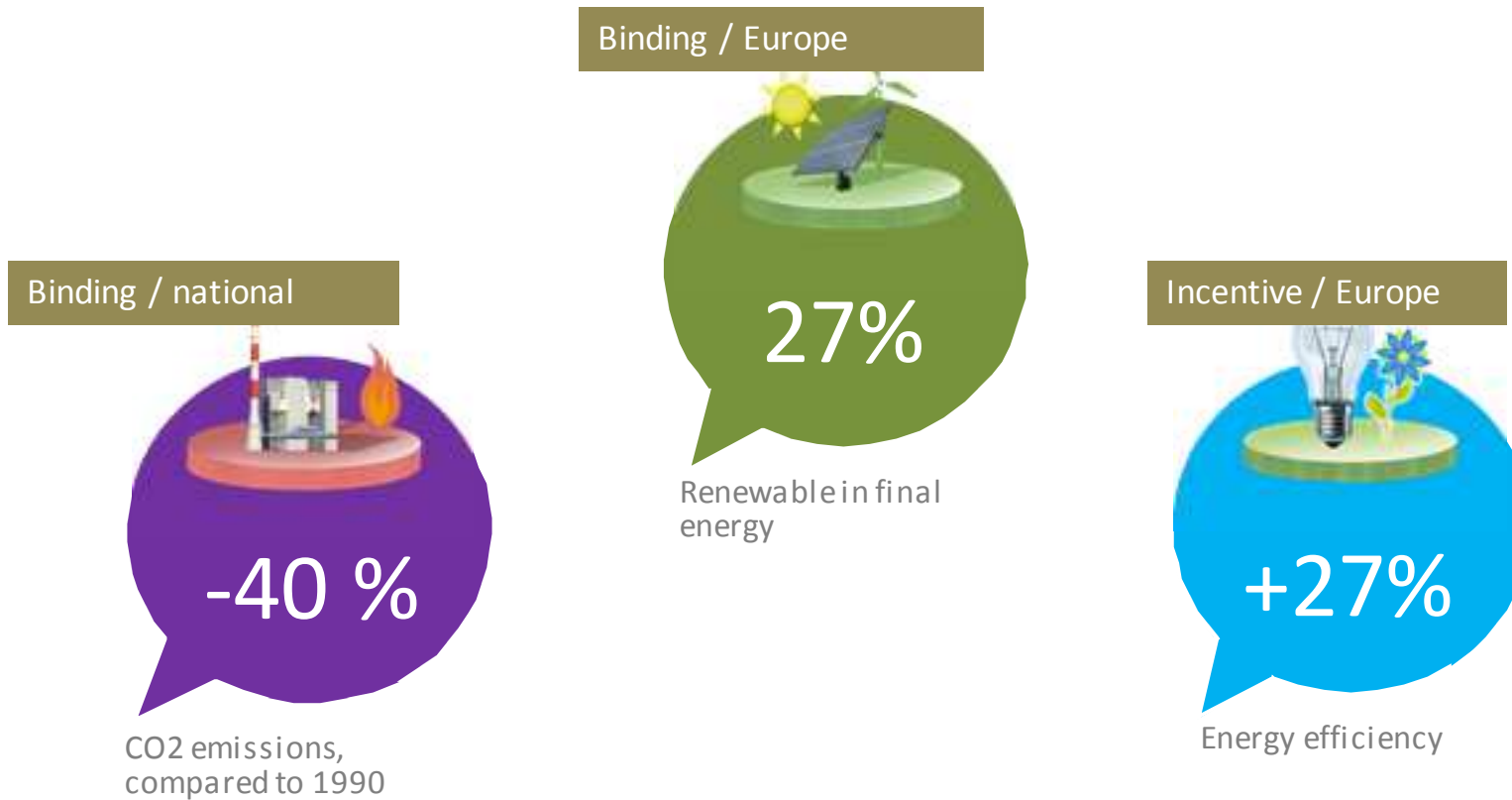
Energy Transition is  
a reality in Europe

# Three “pillars” for the European policy

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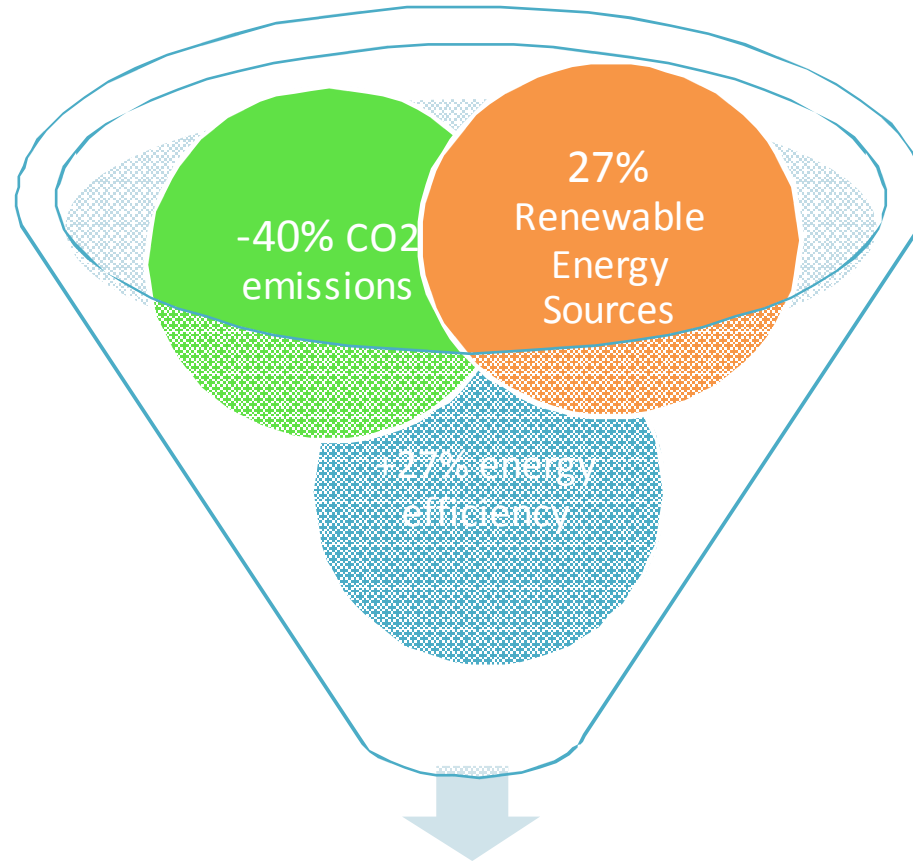


# European Targets for 2030



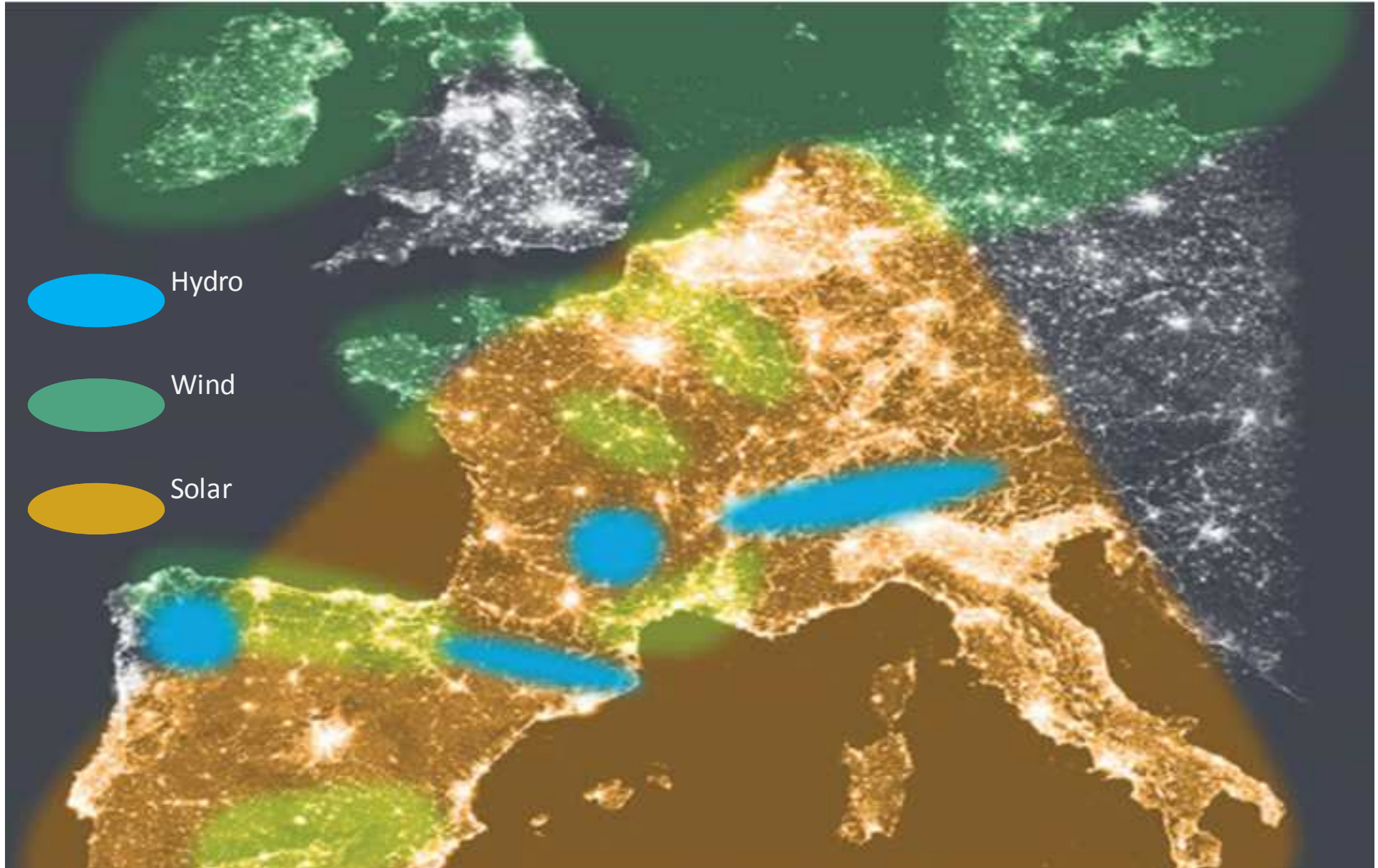
Transition énergétique – Energiewende – Transizione energetica – Energy Transition...

# The 2030 EU targets



About **45%** of RES generation in the electricity transmission system

# At stake: A better use of natural resources



# Definition of energy mix scenarios is key for an adequate Power System design



*But... the Lisbon Treaty gives this responsibility to Member States*

*“Union policy on energy shall aim, in a spirit of solidarity between Member States, to:*

- *ensure the **functioning of the energy market**;*
- *ensure **security of energy supply in the Union**;*
- *promote **energy efficiency and energy saving** and the development of **new and renewable forms of energy**; and*
- *promote the **interconnection of energy networks**.”*

***“Such measures shall not affect a Member State's right to determine the conditions for exploiting its energy resources, its choice between different energy sources and the general structure of its energy supply”***

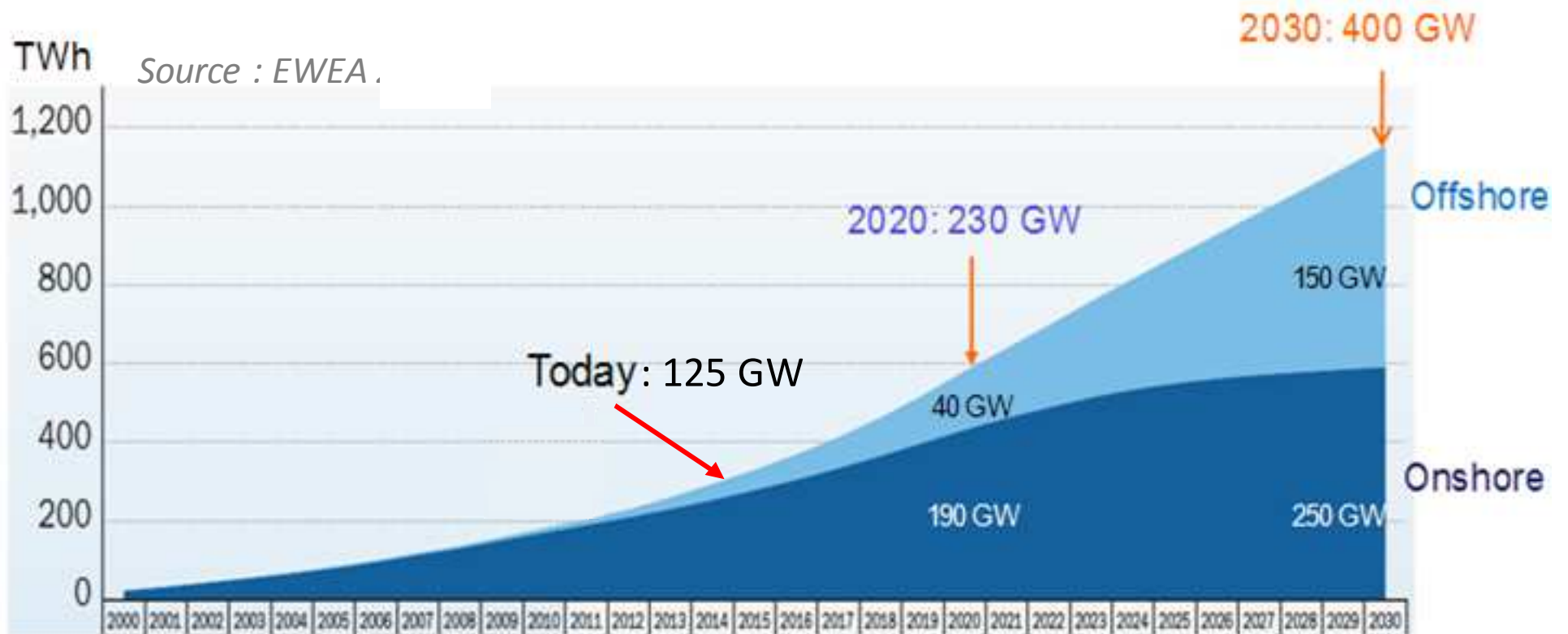
# Wind power development

Wind share of demand:

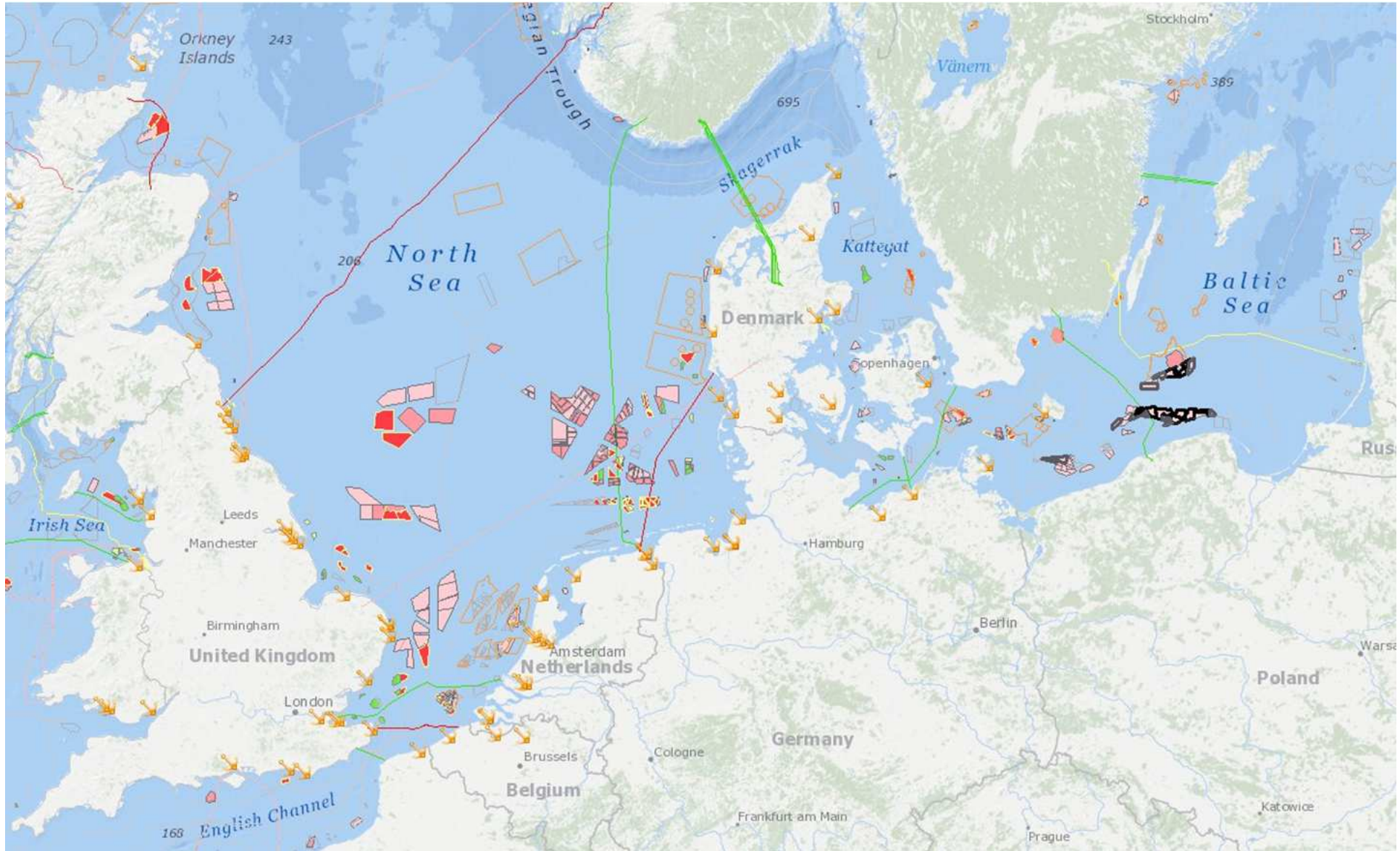
2010 → 5%

2020 → 23%

2030 → 36%



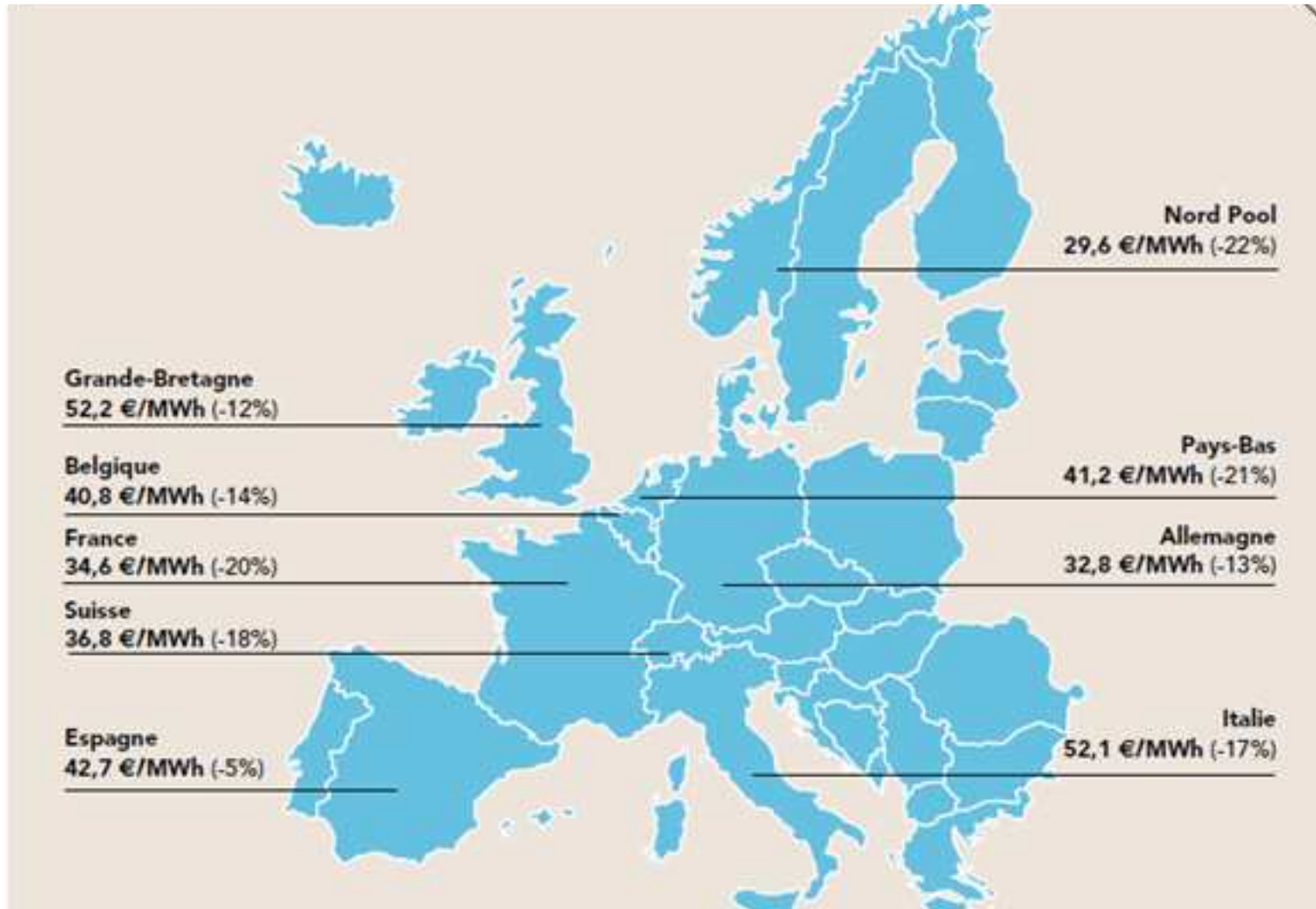
# North Sea and Baltic Sea get crowded...





# Toward an integrated market

Average spot prices on power exchanges in 2014 (variation / 2013)

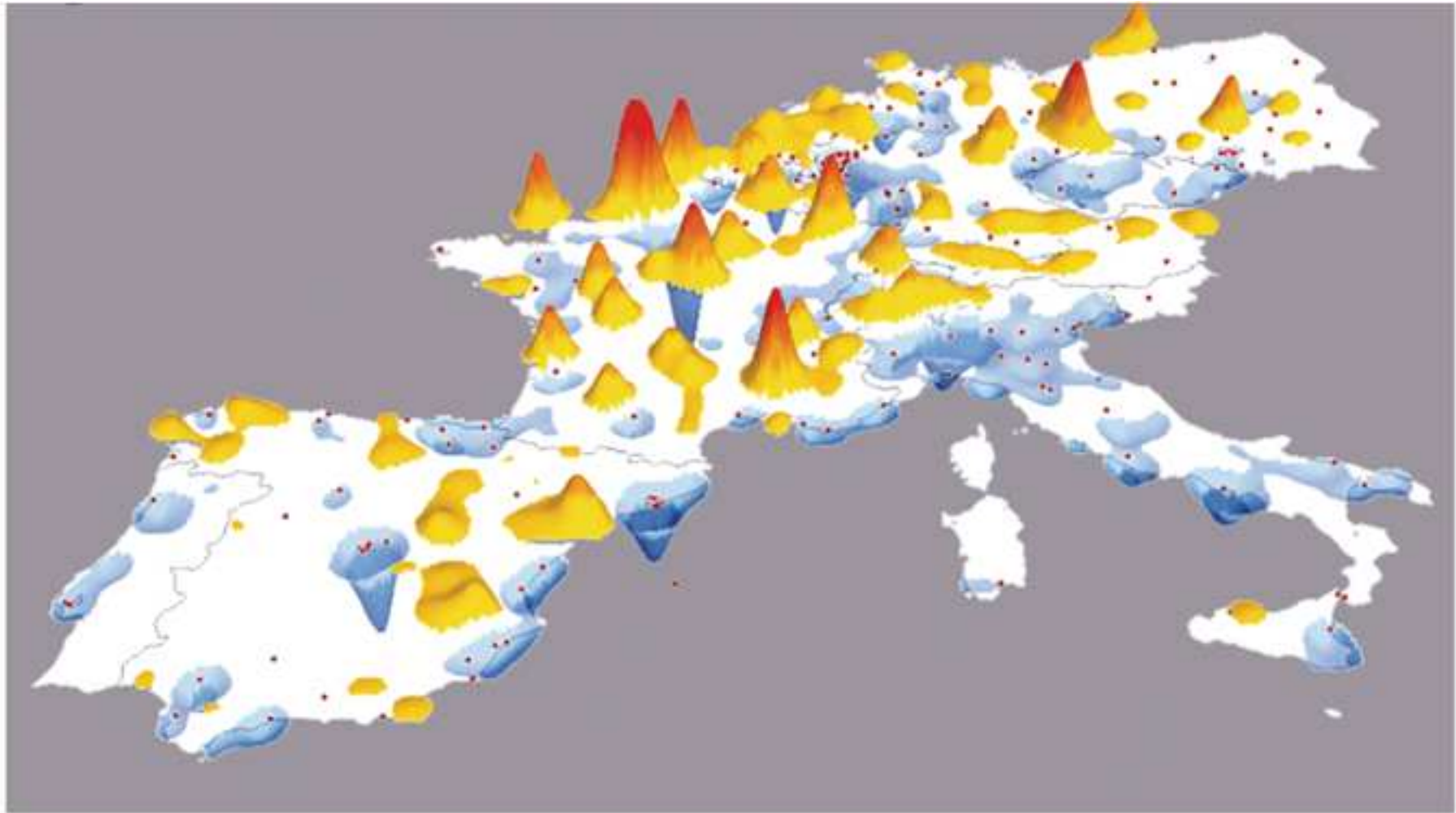


An a still debated question: what target Security of Supply?

# 2

Some challenges  
for the physical Power System

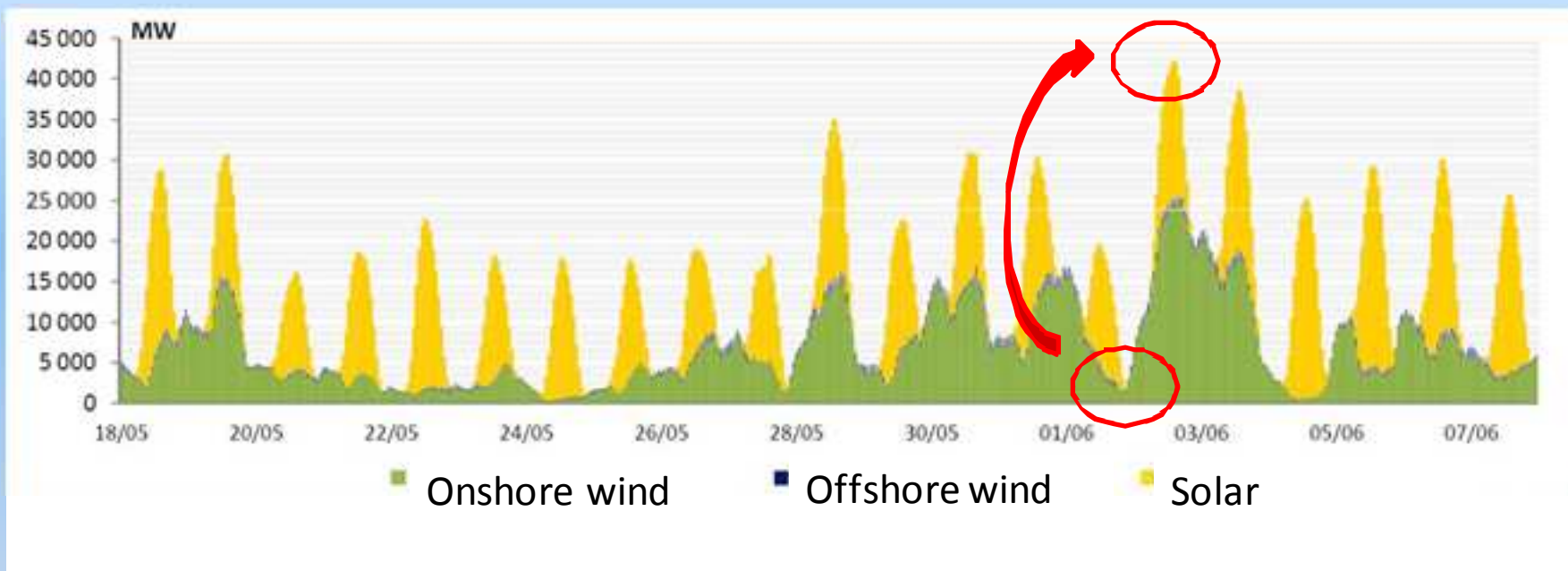
# Optimize & Match



*Typical winter day : generation (red), load (blue)*

# Variability in Generation

## GERMANY



40 GW in 12 hours on June 2<sup>nd</sup> 2015

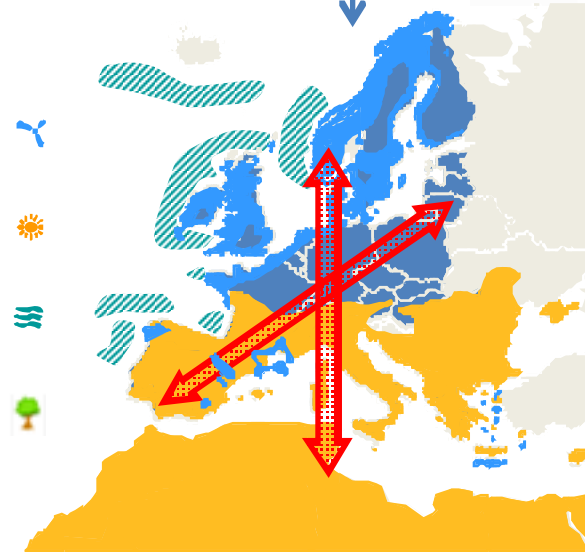
(25 GW in 1 hr during the 2015 March 20<sup>th</sup> solar eclipse)

# Inducing variability in flows

Variable, non dispatchable generation



Thousands of small units



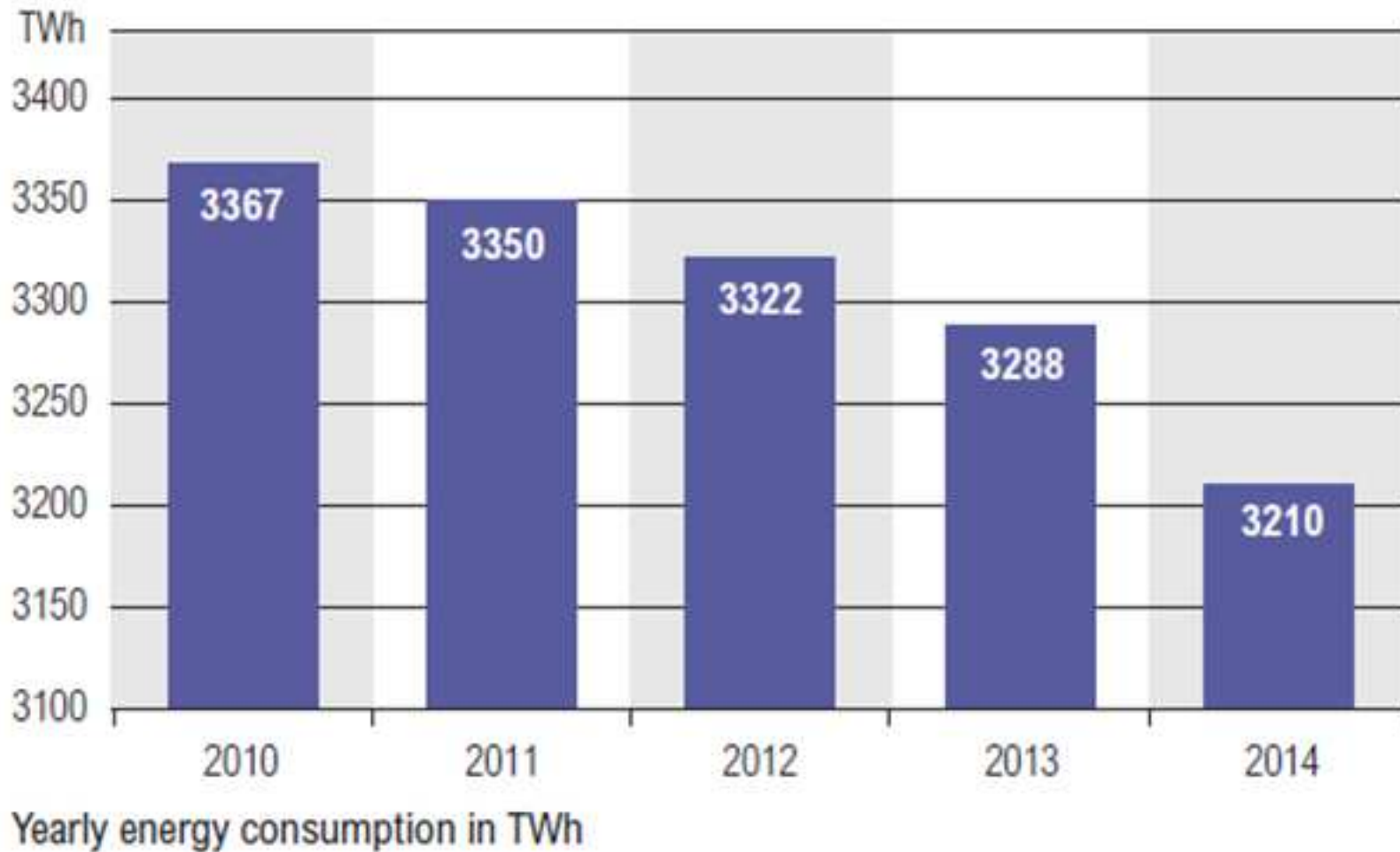
Huge and uncertain flows all over Europe

3

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The need for re-engineering  
the infrastructure

# Load growth no longer a driver in Europe



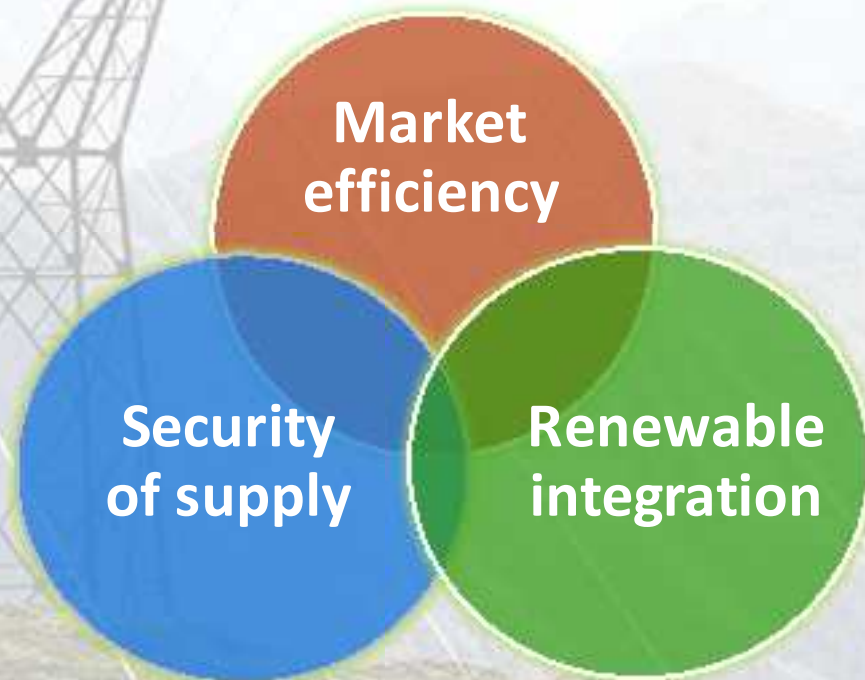
Source: ENTSO-E

# A technical and financial challenge



- Upgrading interconnections and main backbone
- Collecting wind power onshore and offshore
- Rethinking distributions grids

**Necessary for :**





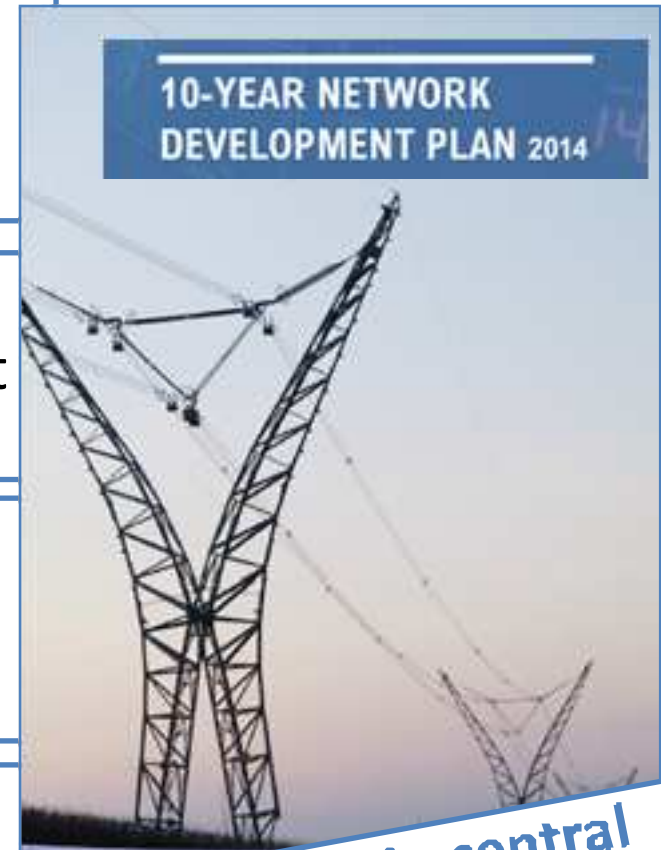
# ENTSO-E is in charge of grid planning at the EU level

The Third Energy Package has given ENTSO-E major responsibilities, including infrastructure planning

The Ten-Year Network Development Plan (so-called “**TYNDP**”) is a **non-binding** investment plan updated **every two years**

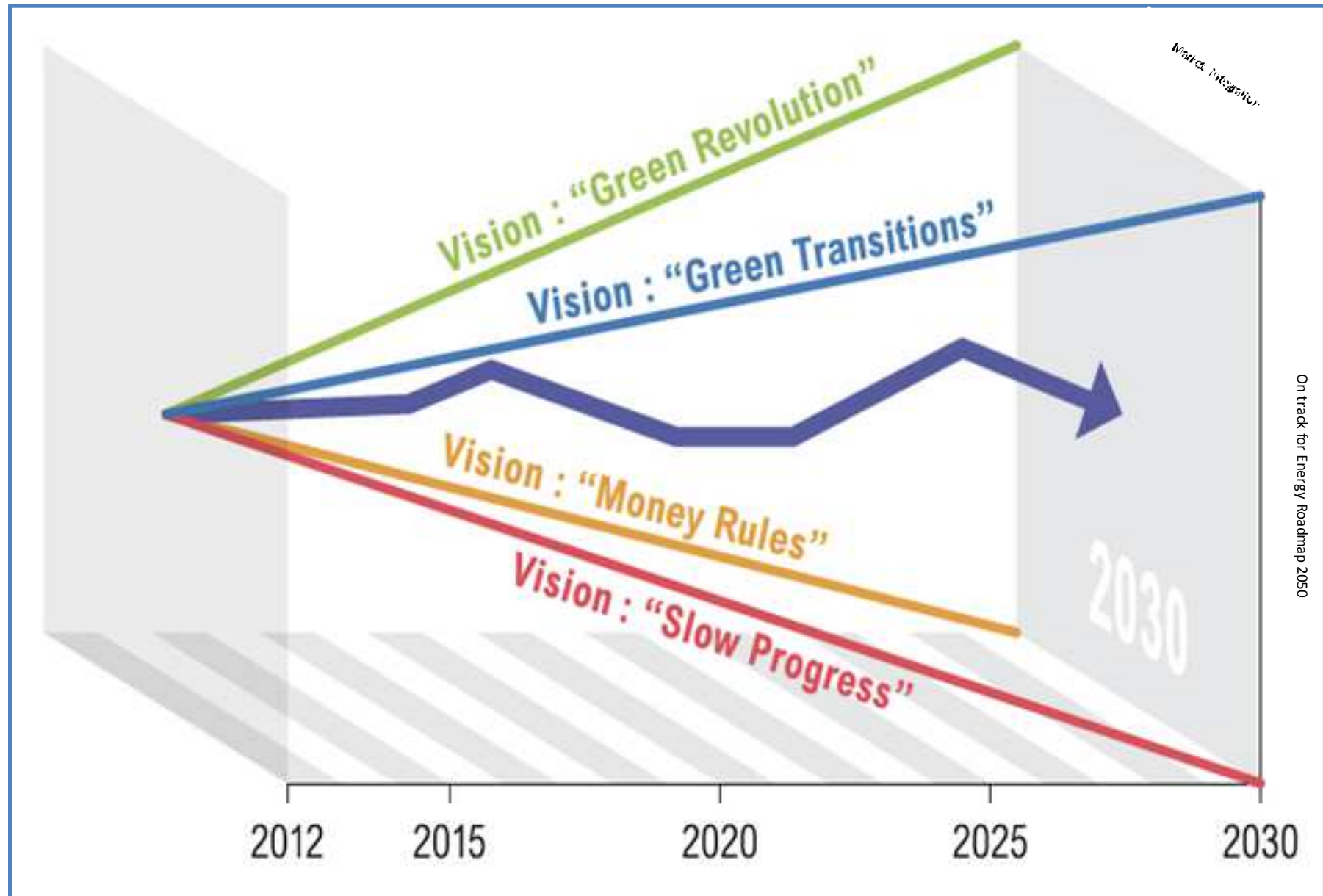
Based on an **adequacy outlook** and **common market and network studies**. Includes projects selected on the basis of a Cost Benefit Analysis

Based on an open consultation process and subject to the opinion of the Agency for the Cooperation of Energy Regulators



**ENTSO-E is given a key role in central EU-wide vision for the grid planning  
This vision is challenged by stakeholders**

# TYNDP: Framing uncertainties to build the right infrastructure



# TYNDP 2014 main findings



**Costs of up to €150 billion for projects of pan-EU significance by 2030**

**(1-1.5 €/MWh, about 1% of bill)**



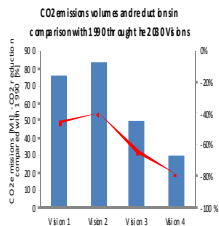
**Savings of 2 to 5 €/MWh for bulk power prices by 2030**



**Up to 50,000 km of new or refurbished grid investments (23,000km new overhead lines)**



**Optimised land use: the crossed urbanised areas account for less than 4% of the total km of lines**

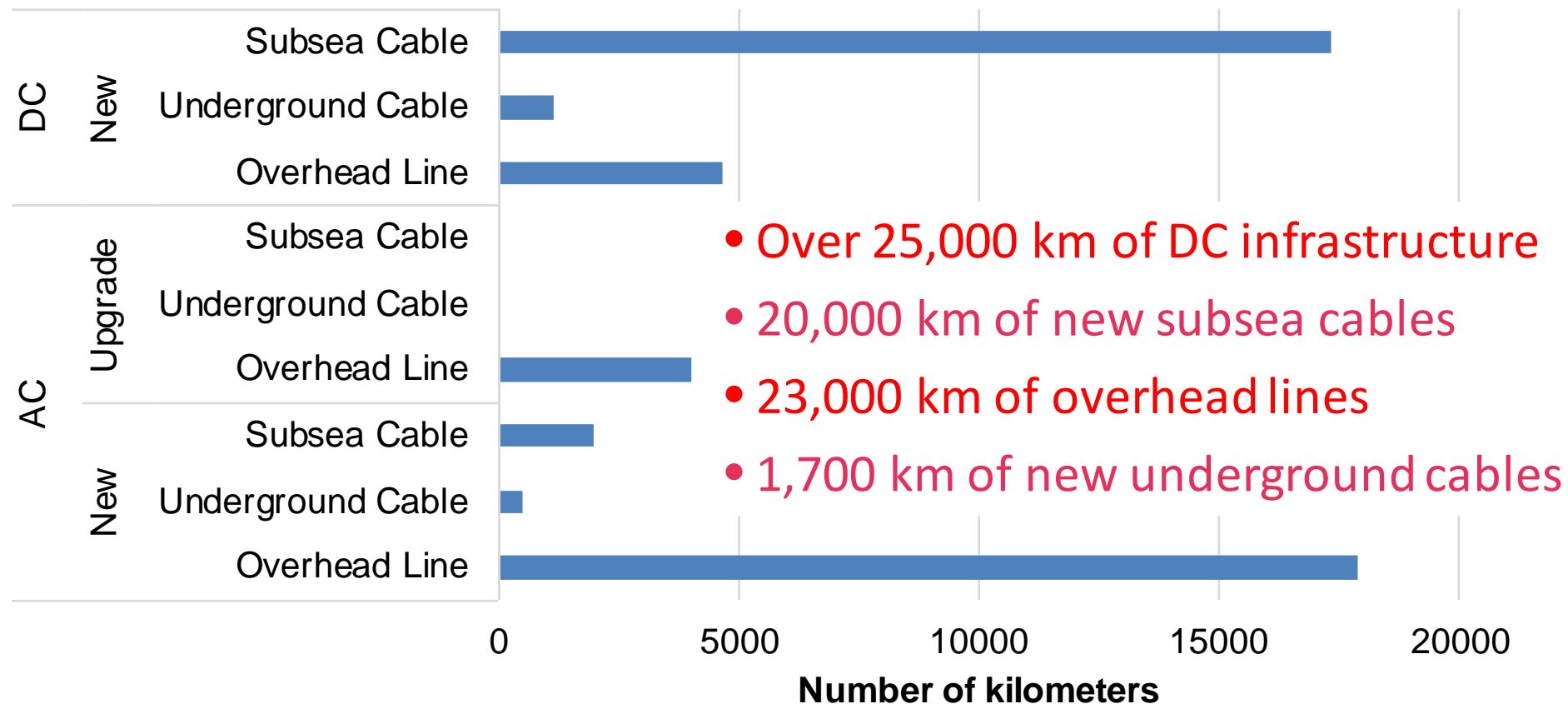


**Mitigation of 20% of CO2 emissions for the European power sector**



**Accommodating up to 60% RES of total consumption in 2030**

# TYNDP 2014 main findings



## Diapositive 28

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- IMI1** in 2 slides  
Irina Minciuna; 03/07/2014
- IMI2** hvdc ?  
Irina Minciuna; 03/07/2014

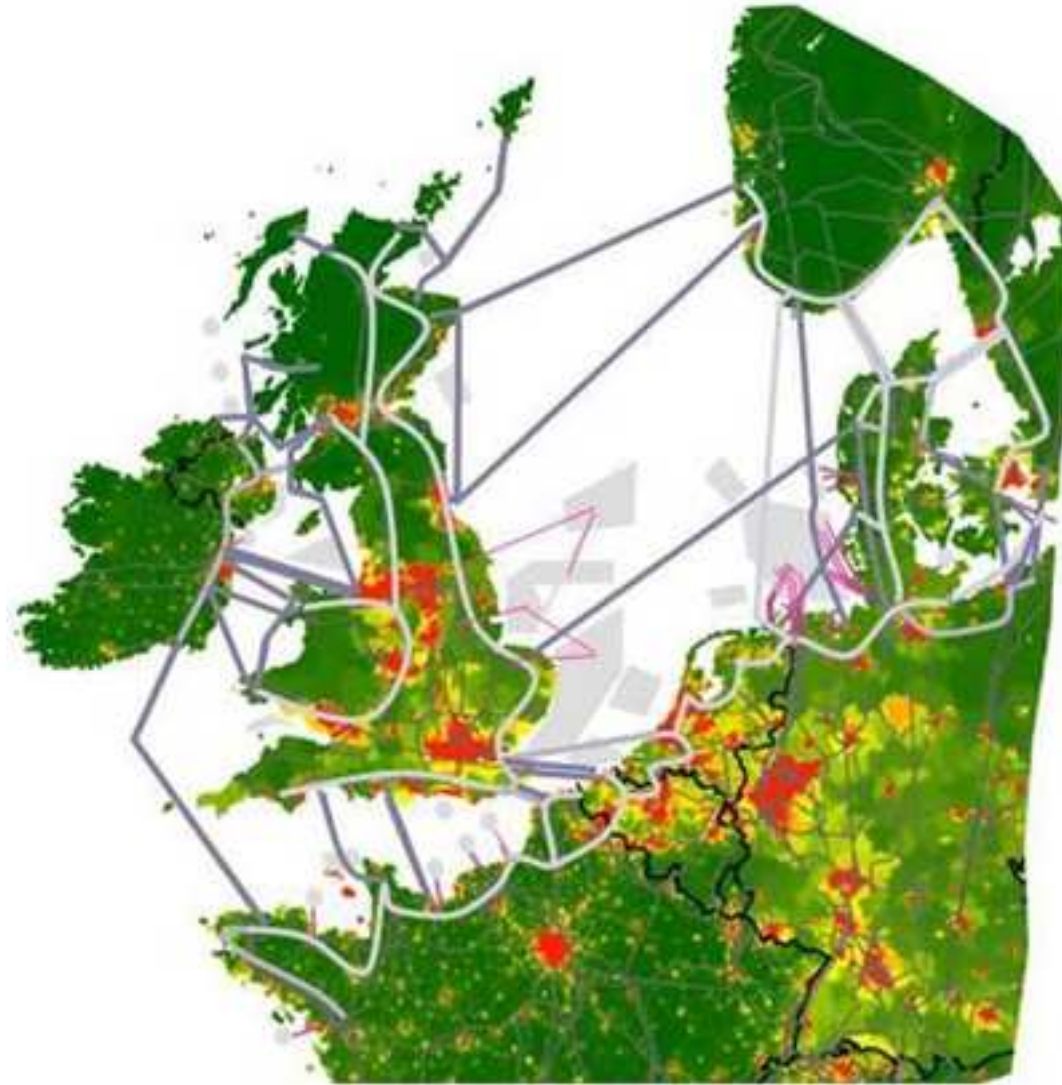
# More interconnections between countries

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*Main interconnectors  
projects for 2030*

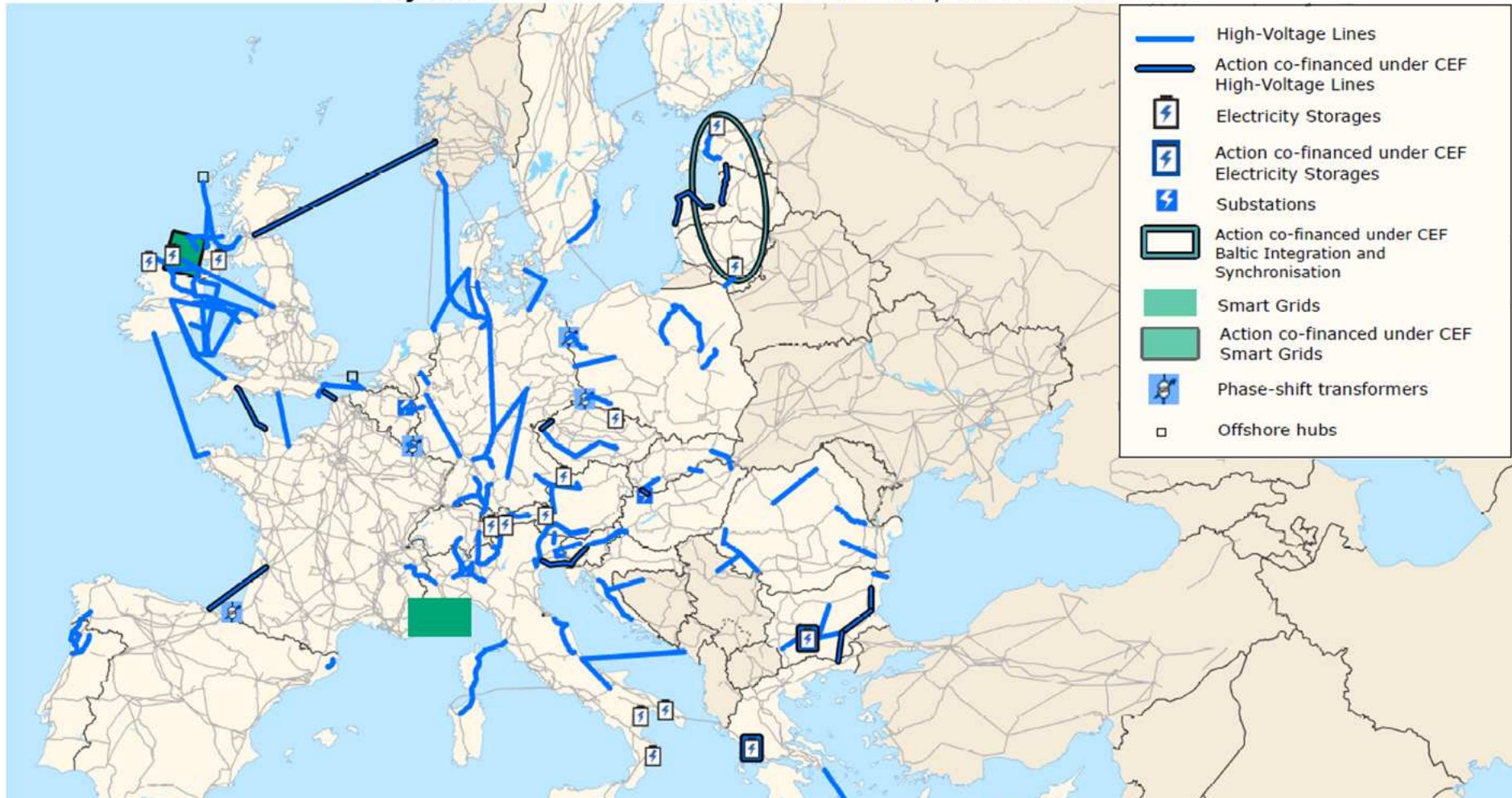


# An early view of North-West Europe in 2030



# Examples of PCIs ('Projects of Common Interest')

## Projects of common interest – Electricity and Smart Grids



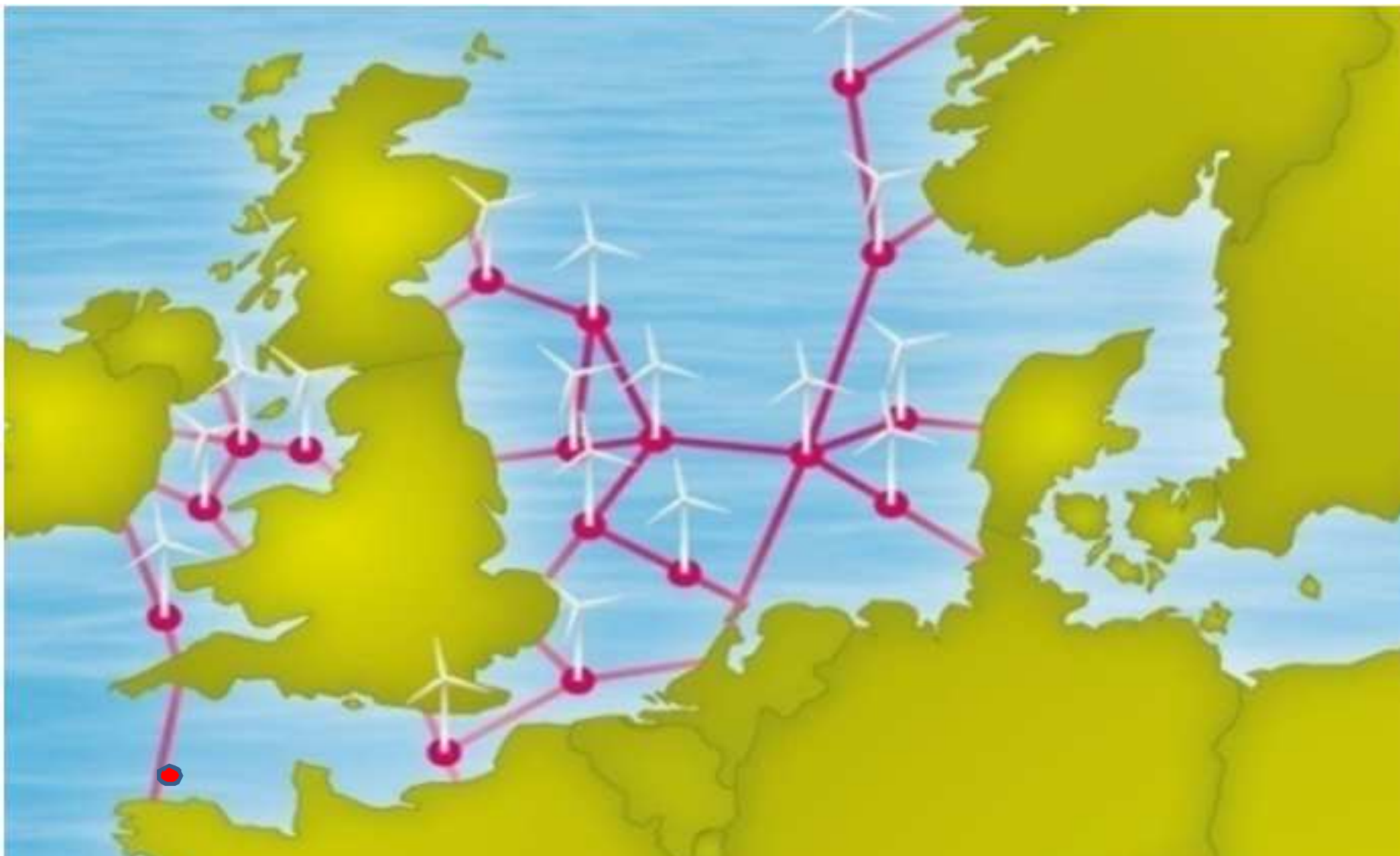
Project of common interests benefit from a **priority status** (most preferential treatment in Member States, 3 years and a half time limit for permit granting), a **dedicated regulatory framework**



# France-Italy interconnection (work in progress...)



## From embedded HVDC to HVDC grids ?



More intelligent DC... at a competitive price!



Adequate  
infrastructures,  
minimizing the  
impact on the  
environment,  
**timely available**

**Temporalities are too often ignored**

# From progress to NIMBY... and from NIMBY to violence





**For a better  
acceptance :**

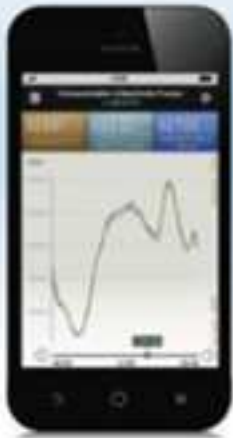
Work in  
cooperation with  
all stakeholders

Limit the  
footprints...

... also for cables!



## Tout savoir de l'électricité en France et dans votre Région



### Visualiser en temps réel les caractéristiques de l'électricité en France

Cette application vous permet de découvrir au fil des heures les variations:

- De la production par filière
- De la consommation
- Des émissions de CO<sub>2</sub> associées à la production électrique
- Des échanges commerciaux d'électricité aux frontières



### Découvrir les caractéristiques de votre région heure par heure

- La production par filière et la consommation de votre région
- Bilan électrique heure par heure en fonction de la consommation de votre région

Les données régionales sont disponibles en affiché.



### Mettre en perspectives les données de votre région

- Observer l'importance de la solidarité interrégionale
- En un coup d'œil comparer la situation des régions
- Au fil des heures, constater les variations de ces indicateurs




### Un outil de transparence à la disposition de tous

Pour réaliser vos études, les données sont également disponibles en téléchargement avec un historique remontant au 1<sup>er</sup> janvier 2012.



## Transparency

Developing transparency is a key value, generating performance... and improving trust



A bright future for  
underground cables also  
for subtransmission grids ?

# 'Long' AC cables projects

*Remember:  
At Jicable'07, a long 225 kV  
link was considered as long  
as... 10 km!*





4

Now let's take the best  
of this infrastructure...

# The solutions are in each power system layer

4.

Governance layer



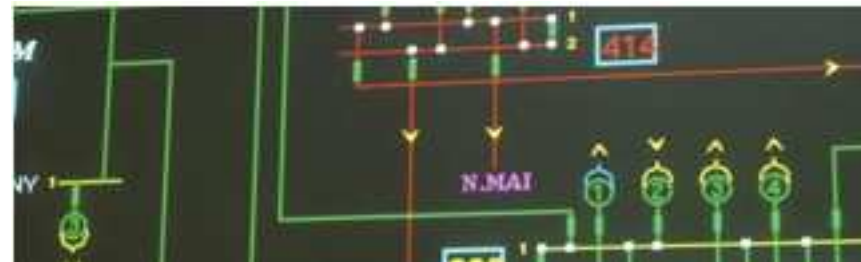
3.

Market layer



2.

System Operation layer



1.

Infrastructure layer



# Improve System Operation...

- Increased complexity
  - Wider areas to be controlled and coordinated
  - More short term uncertainties
- ▶ No more ICT performance constraints: our brain is the limit
- ▶ News sensors to take the full benefit of conductors thermal inertia

... to use at best all transmission infrastructures

# Markets have to provide...

- Demand response for load to match generation
- Incentives to alleviate physical constraints
- Incentives for TSO / DSO cooperation towards coordinated planning, smarter grids and better integration of renewables

... flexibility and efficiency



# ...in a complex decision process

1 Union

28 Member States... + Switzerland, Norway, Balkans, Turkey!

34 regulators

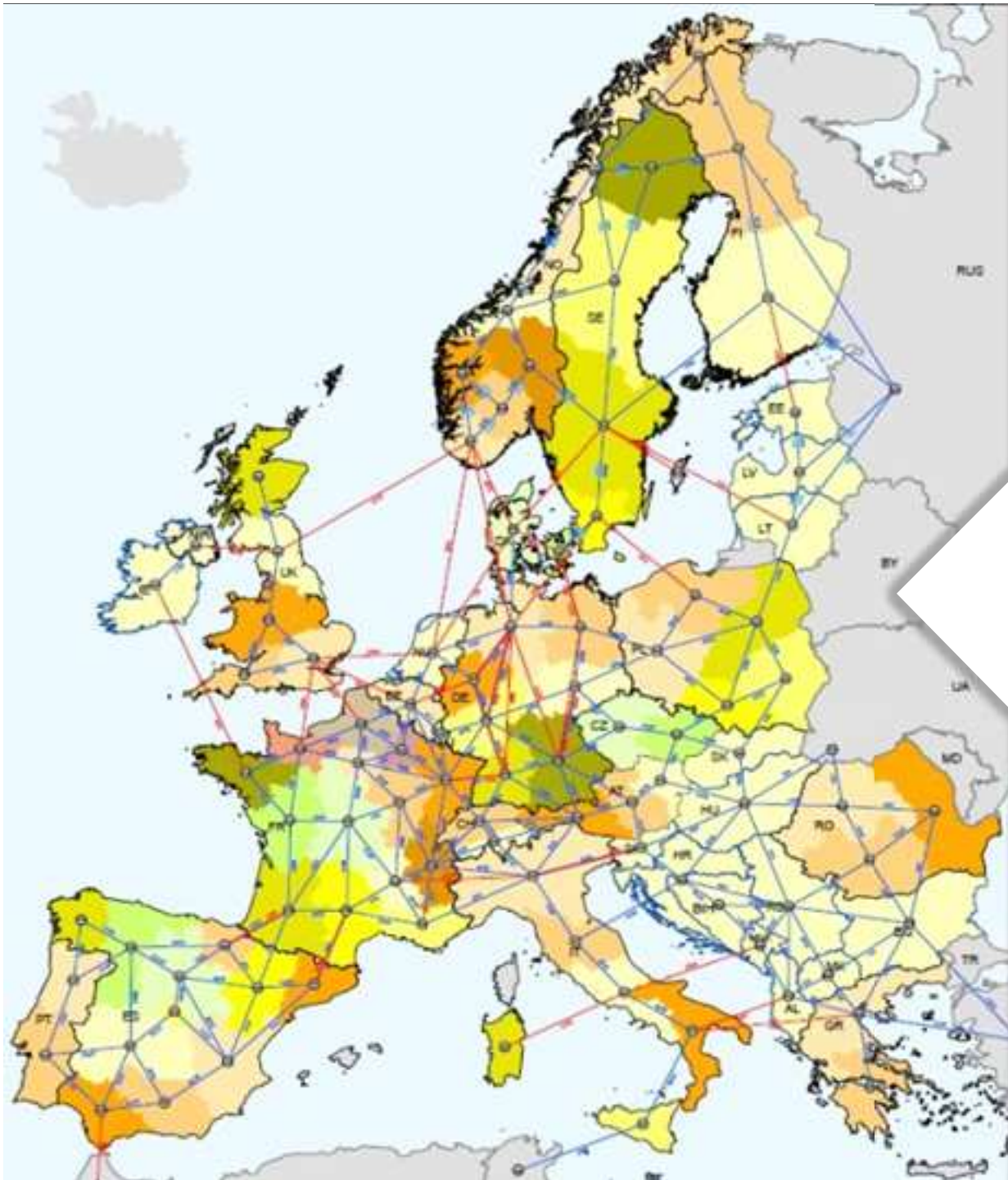
41 TSO

1 association ENTSO-E

... and many others

5

Anticipation is key...



## A necessary look at **2050**

### **E-highways 2050**

- New methodologies for grid planning on a European scale
- Identify the “e-Highways” necessary in 2050 in order to help the investment decisions of the coming years

# Scenarios and architectures

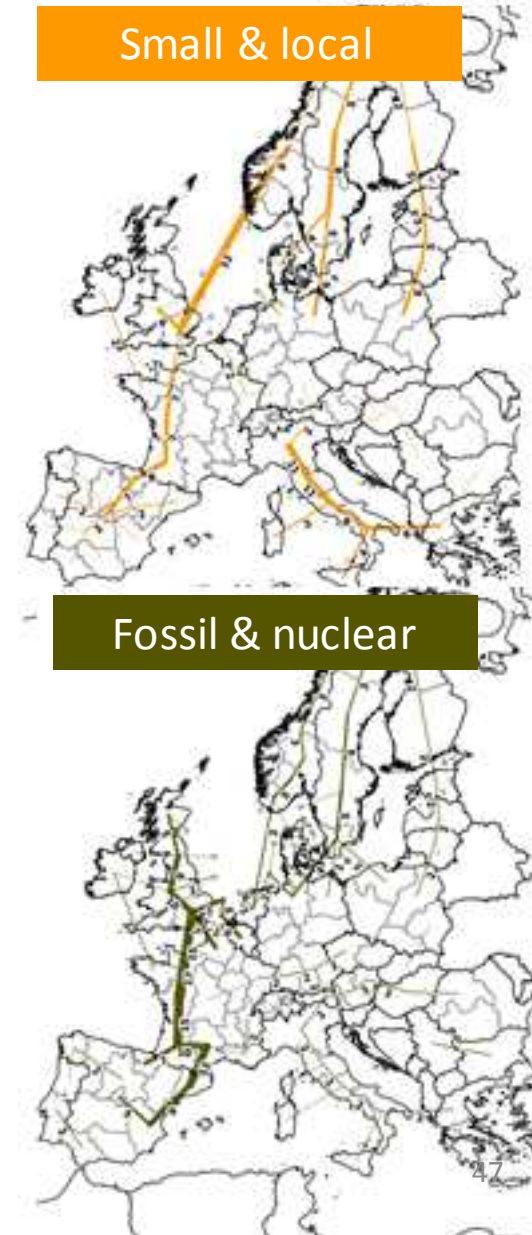
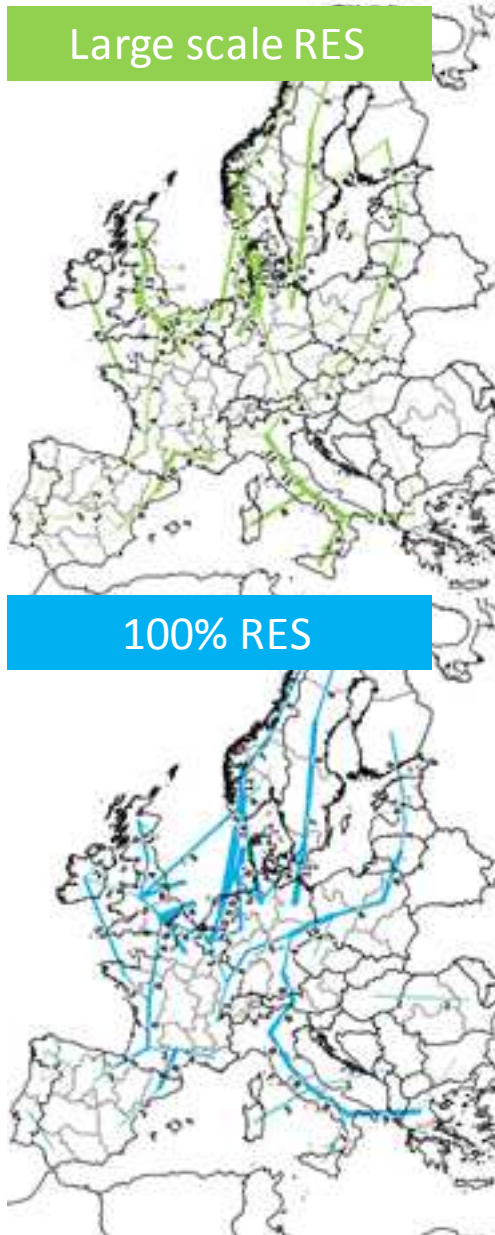
Large scale RES

Small & local

Big & market

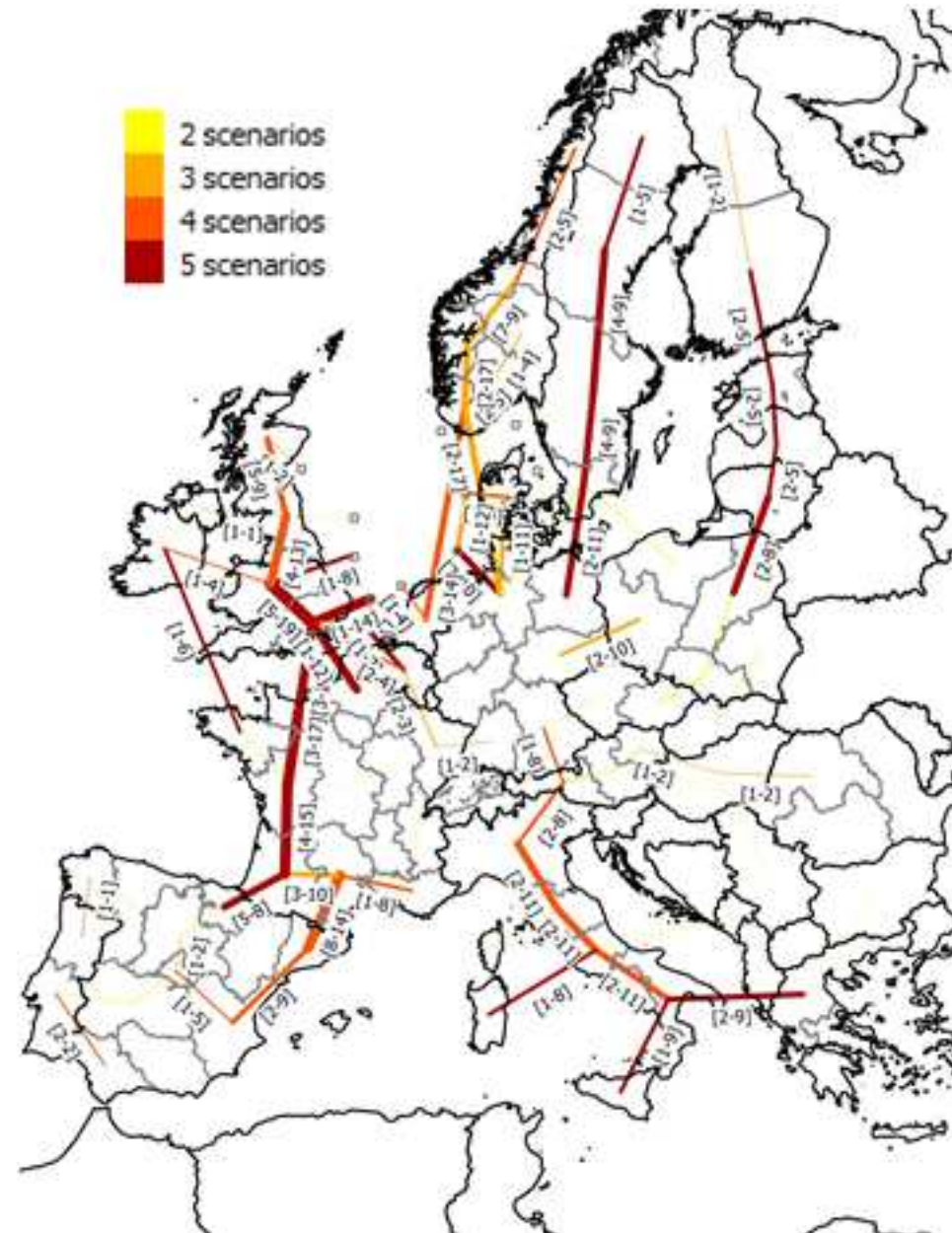
100% RES

Fossil & nuclear





# With a number of common reinforcements



# R&D needed in every industry segment

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Grid components



System operation



Market design



Soft sciences

Thank you for your attention

