IESI International Institute for Energy Systems Integration

European Workshop, Copenhagen, May 2014

Regulation, Policy & Market Design Session

An appraisal of the EU Internal Energy Market

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There is a clear trend towards “pooling” in electricity markets

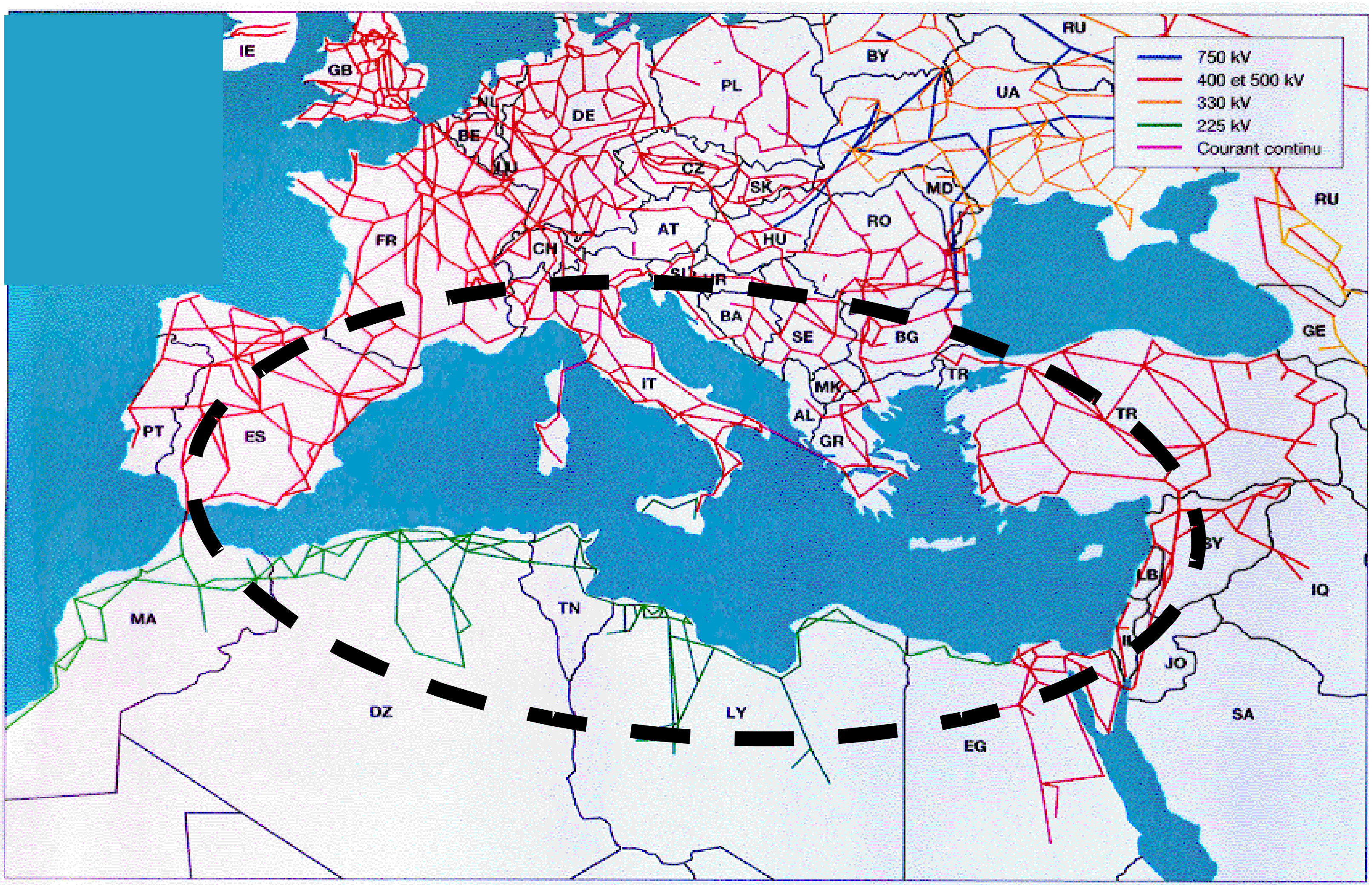
The European Union

A huge energy market…

Member States of the European Union (2013)

Candidate and potential candidate countries

... and beyond: Euro-Mediterranean Electricity Initiatives



Med-TSO
MEDITERRANEAN TRANSMISSION SYSTEM OPERATORS

Medgrid

Mediterranean Solar Plan

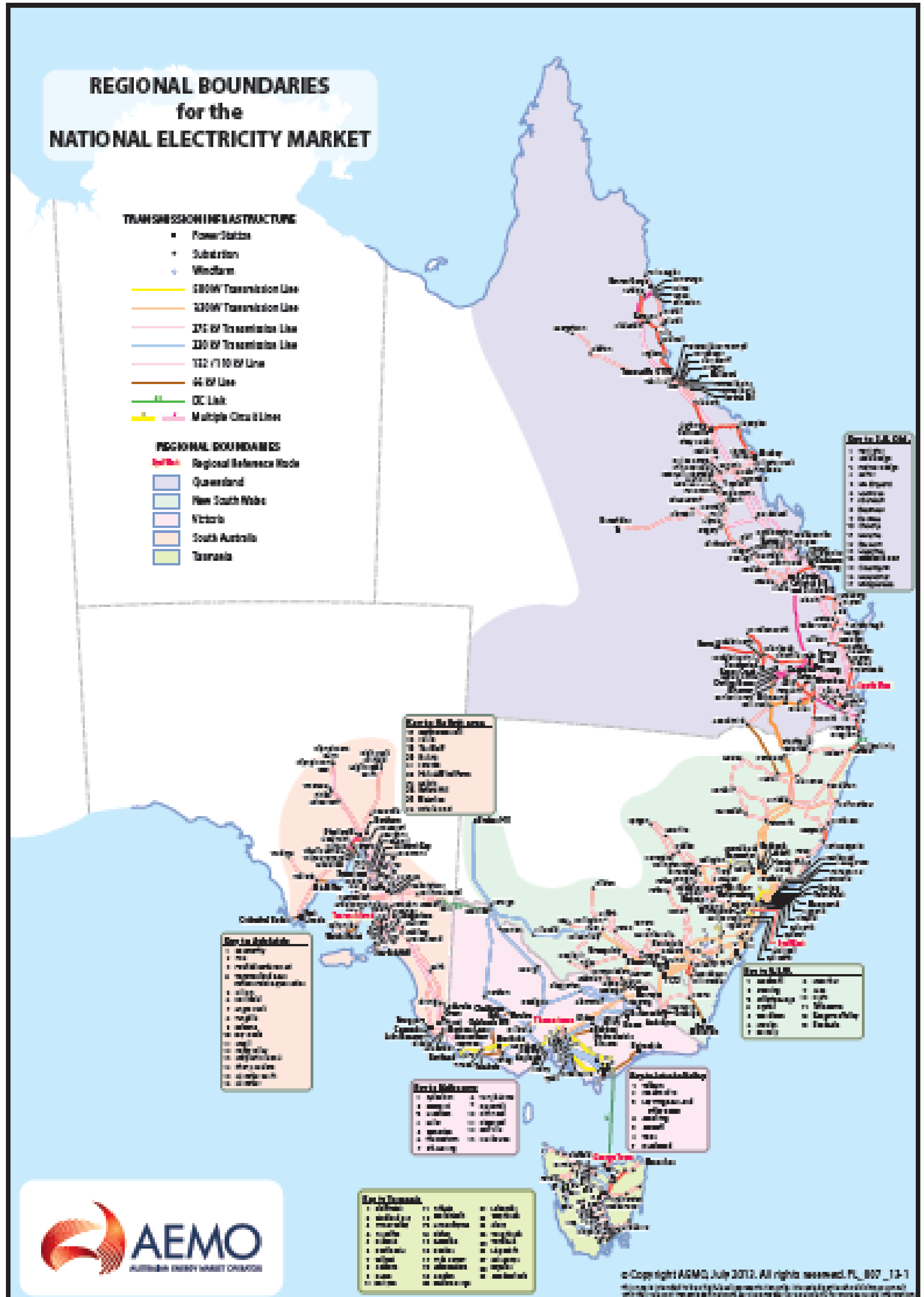
EUROMED

20 GW by 2020
(~5 GW exports to EU)

DESERTEC INDUSTRIAL INITIATIVE

500 GW by 2050
(100 GW exports to EU)

The Australian National Electricity Market



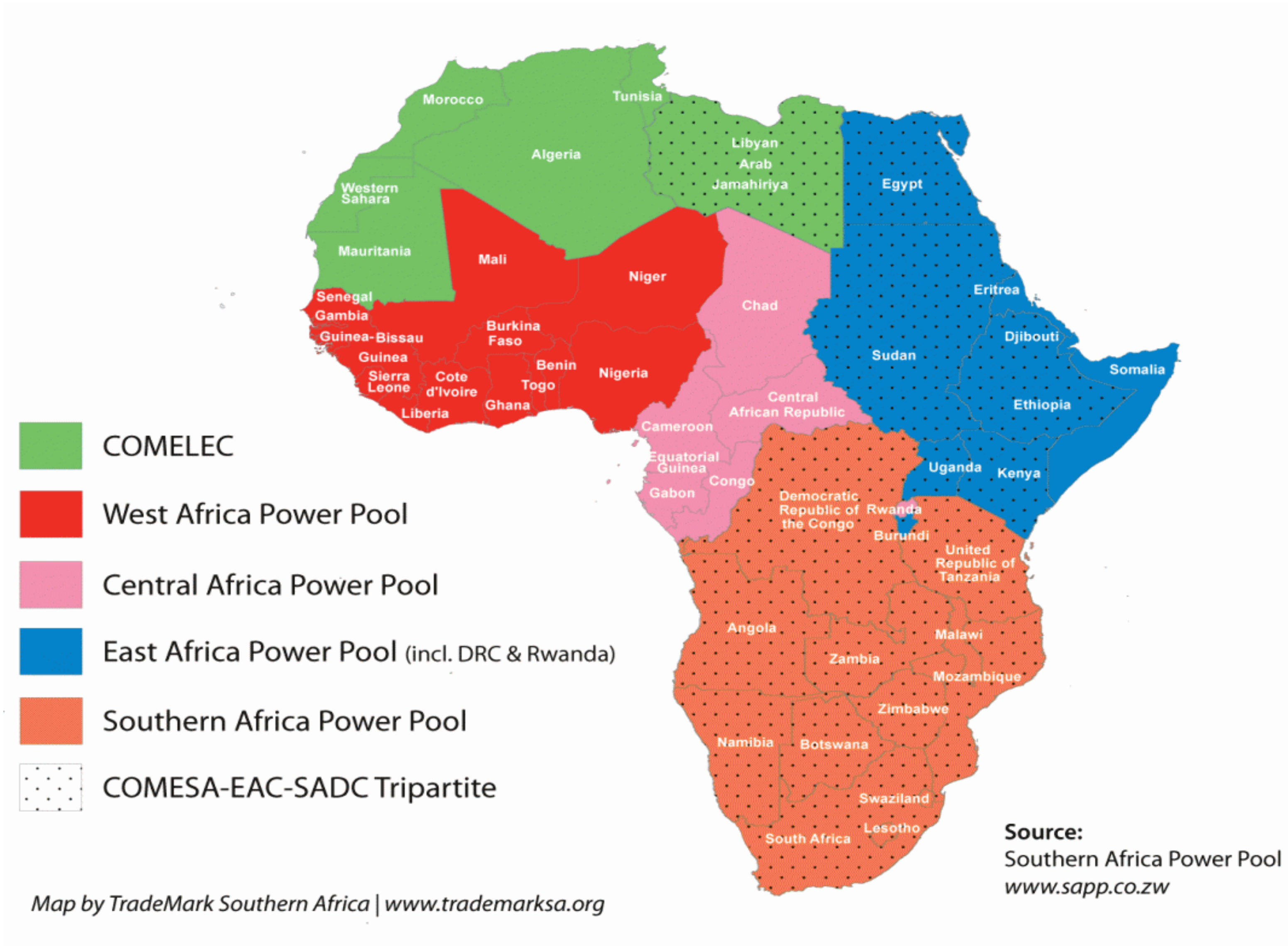
MER: A highly integrated regional market

Proyecto SIEPAC

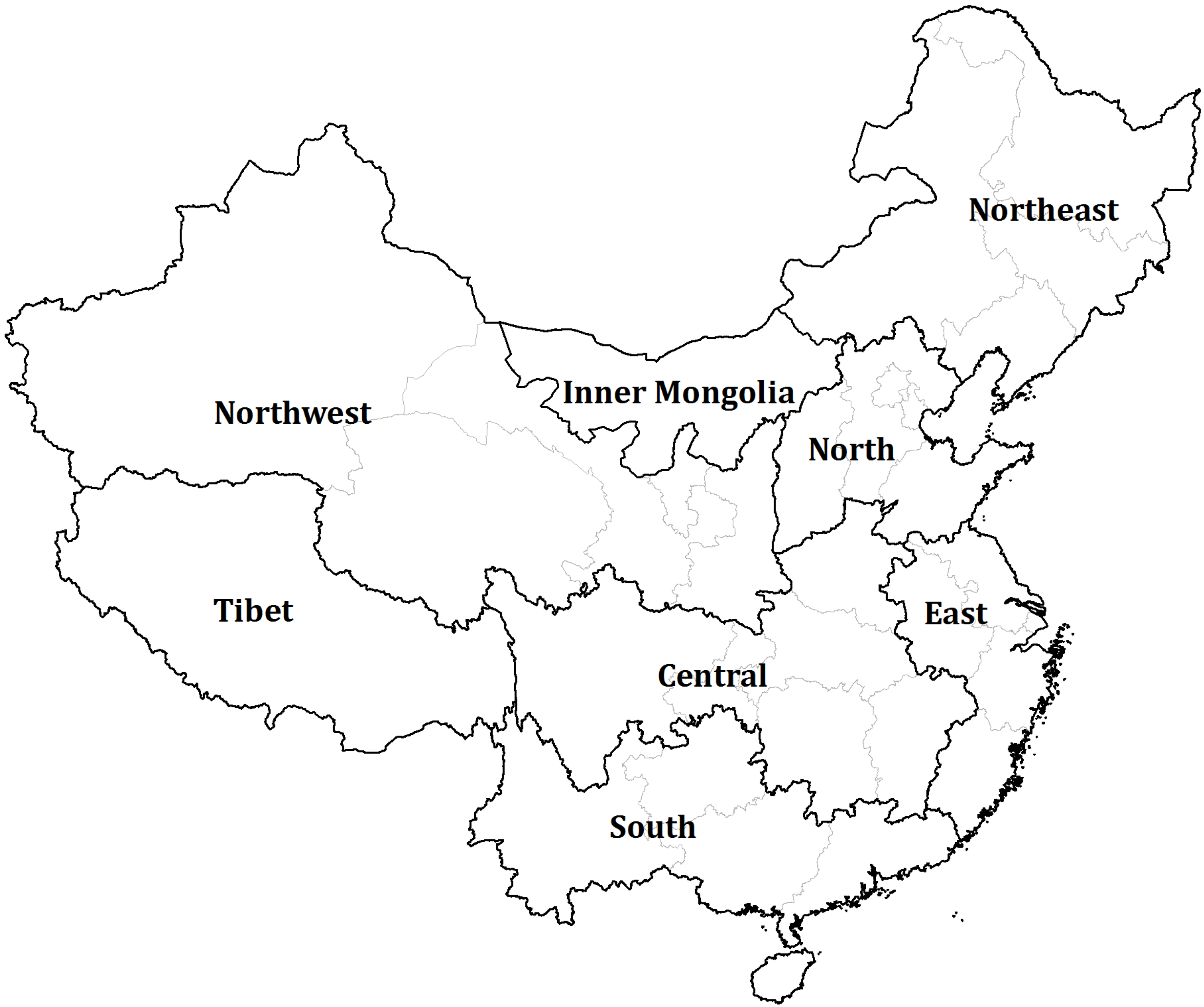
230 Kv LINE

COUNTRY	LENGTH (km)	%
Guatemala	242	13.4
El Salvador	260	14.4
Honduras	266	20.3
Nicaragua	284	15.8
Costa Rica	515	28.6
Panamá	135	7.5
TOTAL	1 802	100.0

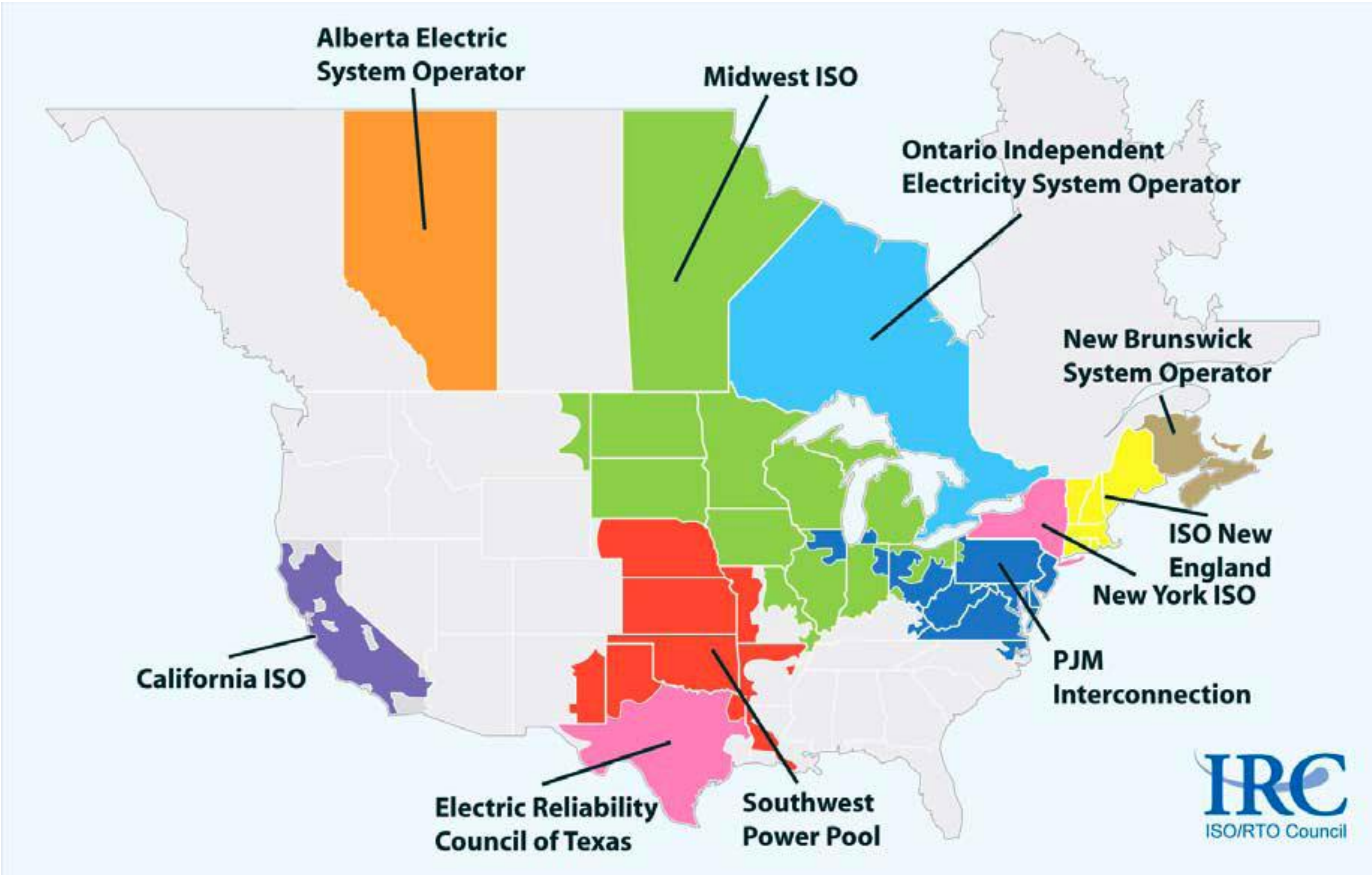
Power Pools under construction in Africa



CHINA

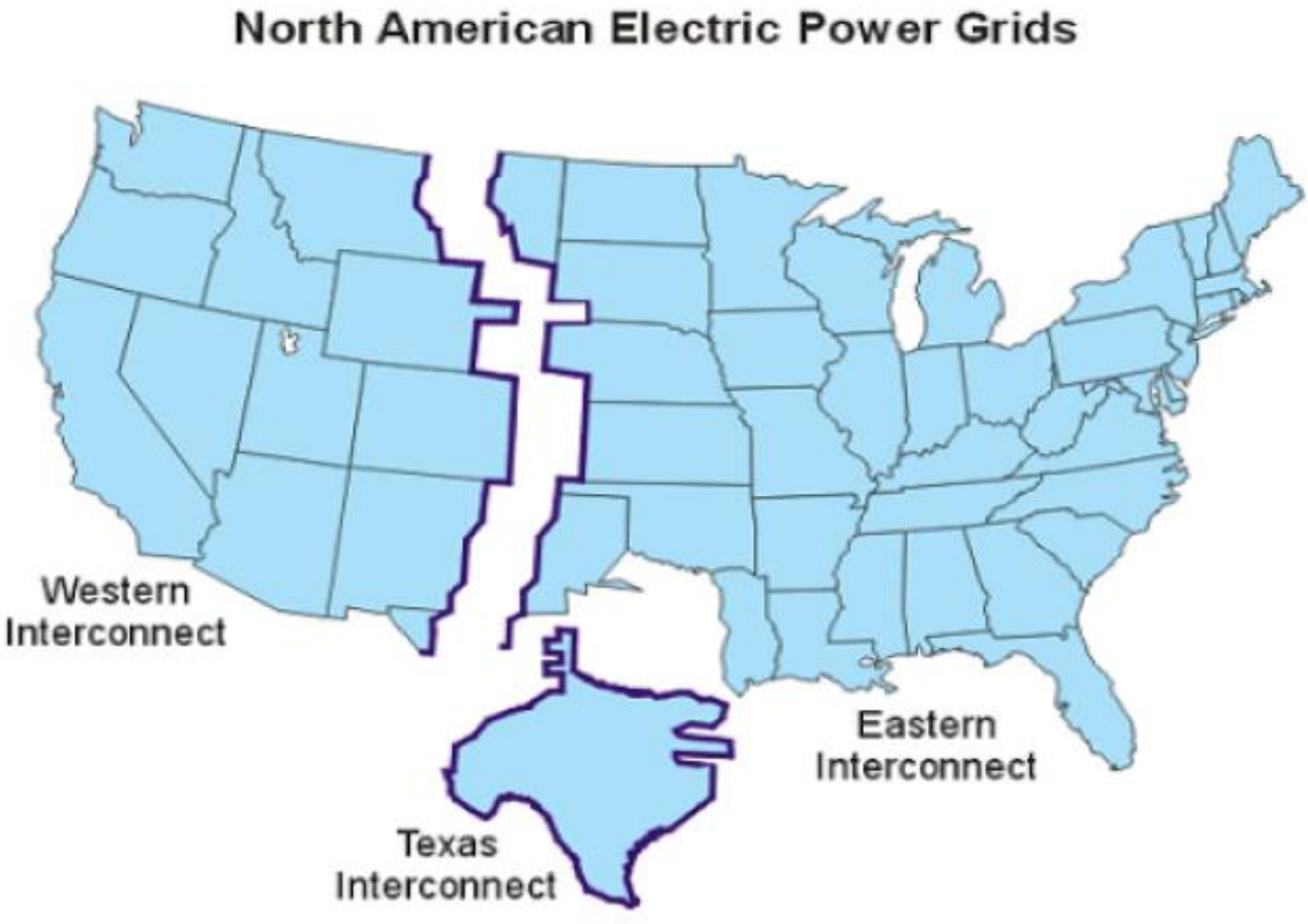

Northeast
Inner Mongolia
Northwest
North
Tibet
East
Central
South

Power pools were invented in US-Canada in the 1970's & later became markets...



Footprint of the North American ISOs and RTOs Source: http:// www.iso-rto.org

...but they still have a long way to go in terms of integration



Background
EU & US
Information for a comparison

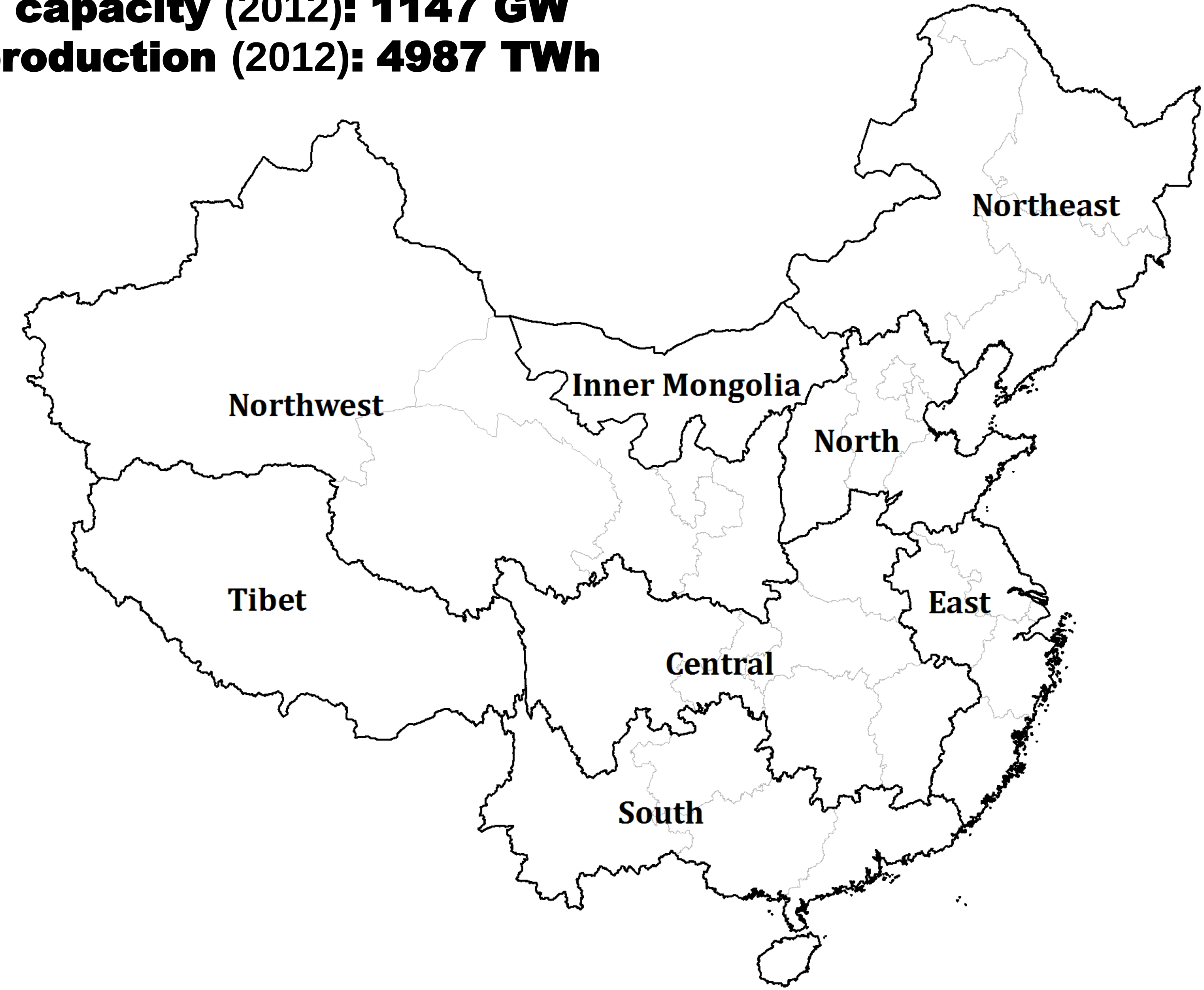
Size matters: Comparative analysis

	Area (1 000 km²)	Population (million)	Per capita gross domestic product (PPS (1))
The 27 European Union countries together	4 234	503.7	25 700
India	3 287	1 205.4	2 800 (2)
China	9 327	1 343.3	6 400 (2)
Japan	365	127.4	28 000 (2)
Russia	16 889	142.5	12 900 (2)
United States	9 159	313.8	37 100 (2)

US & EU: a basic comparison (2014)

- EU-28 & IEM
  - 4,3 Mkm2, 503 Mhab, 12945 b€ GDP
  - 1253 GW installed capacity
  - 2883 TWh/year
- *(Installed capacity, annual production)*
  - Germany (160 GW, 538 TWh)
  - France (130 GW, 447 TWh)
  - UK (93 GW, 321 TWh)
  - Italy (118 GW, 311 TWh)
  - Spain (102 GW, 244 TWh)
- USA
  - 9,8 Mkm2, 314 Mhab, 15.68b$ GDP
  - 1053 GW installed capacity
  - 3883 TWh/year
- *(Installed capacity, annual production)*
  - PJM (184GW, 794 TWh)
  - MISO (175 GW, 526 TWh)
  - ERCOT (74 GW, 331 TWh)
  - California (51 GW, 232 TWh)
  - NY-ISO (40 GW, 163 TWh)
  - NE-ISO (32 GW, 112 TWh)

CHINA
Installed capacity (2012)**: 1147 GW**
Annual production (2012)**: 4987 TWh**



Major issues in markets integration *(from experience)*

- INSTITUTIONS AND GOVERNANCE
  - PROTOCOL OF AGREEMENT, REGIONAL INSTITUTIONS
- ORGANIZATION OF DISPATCH
  - MARKET DESIGN, CONTRACTING FORMATS
- TRANSMISSION
  - GOVERNANCE, ALLOCATION OF TRANSMISSION COSTS, CONGESTION MANAGEMENT
- GENERATION CAPACITY EXPANSION
  - SECURITY OF SUPPLY
- FINANCING THE INFRASTRUCTURES

An appraisal of the EU IEM

- Characteristic traits of the EU electricity & gas markets
  - How do they differ from designs of regional markets in the US? Pros & cons?
    - Energy policy requirements & Governance
    - Market structure & Level of integration
    - Transmission network representation: Planning & Cost allocation
    - Design of market pricing rules
    - Harmonization of network tariffs & instruments for capacity remuneration or promotion of renewables
  - Any major improvements to be made?

Governance

Are EU Member States more "docile" than US states?

Governance of energy markets in the EU & US

- EU **Directives** vs. **Energy Acts**
- ACER **Framework Guidelines** & ENTSO-E/G **Network Codes** vs **FERC Orders**
- The EU 2014 **Target model** for a seamless IEM vs the 2002 US **Standard Market Design**
- ENTSO-E/G **10 year transmission planning**, e-Highway **2050** & Inter-TSO **compensation** scheme vs **FERC Order 1000**

Governance of the IEM

A complex process

Consultation!

Consultation!

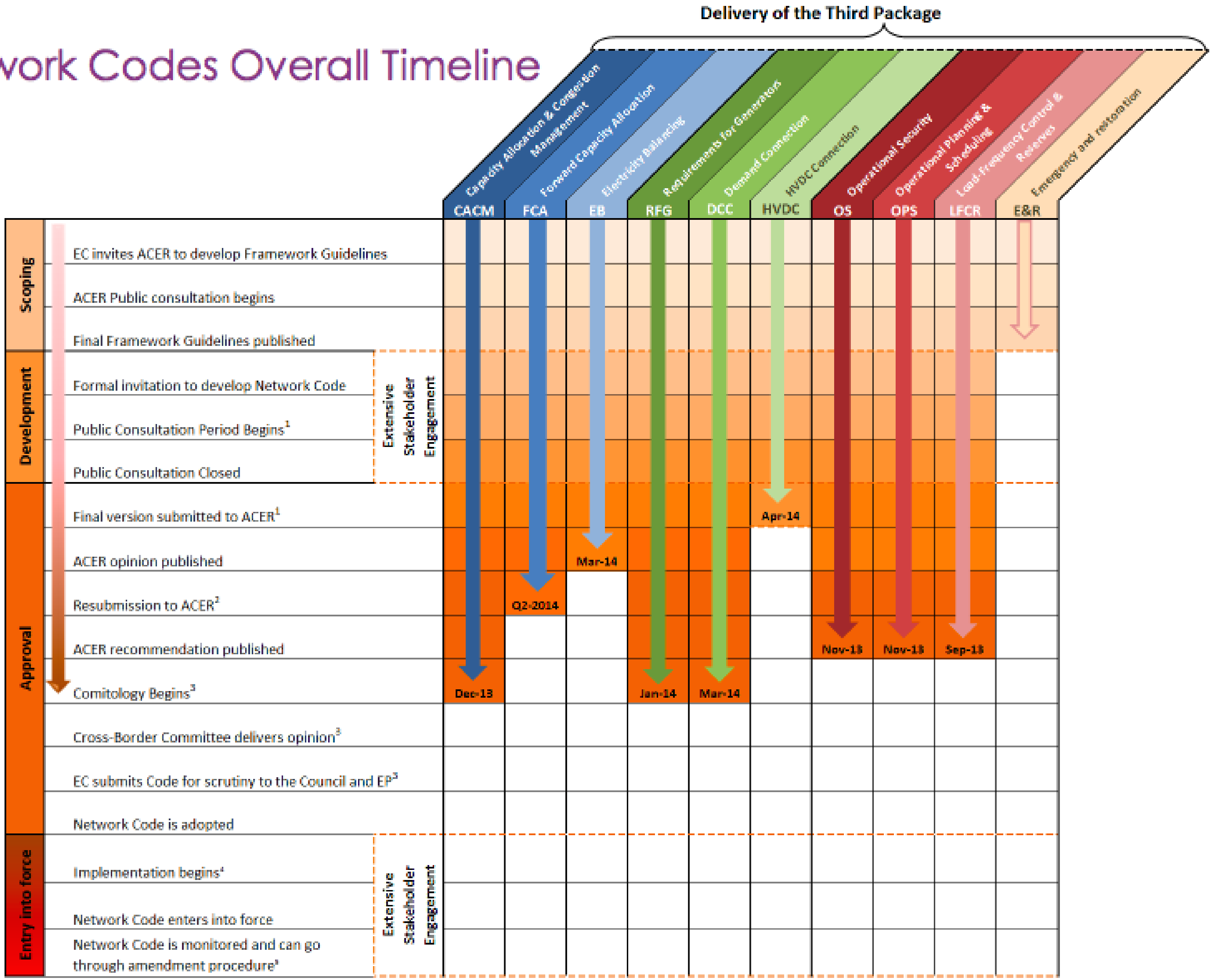
Consultation!

Member States

- Catalogue of topics included in third package
- Commission sets priorities
- ACER adopts Framework Guidelines (FGs)
- ENTSOs develop FGs into Network Codes (NCs)
- Commission adopts NCs through Comitology procedures
- EU Network Codes are legally binding

Based on deep stakeholder engagement

Network Codes Overall Timeline



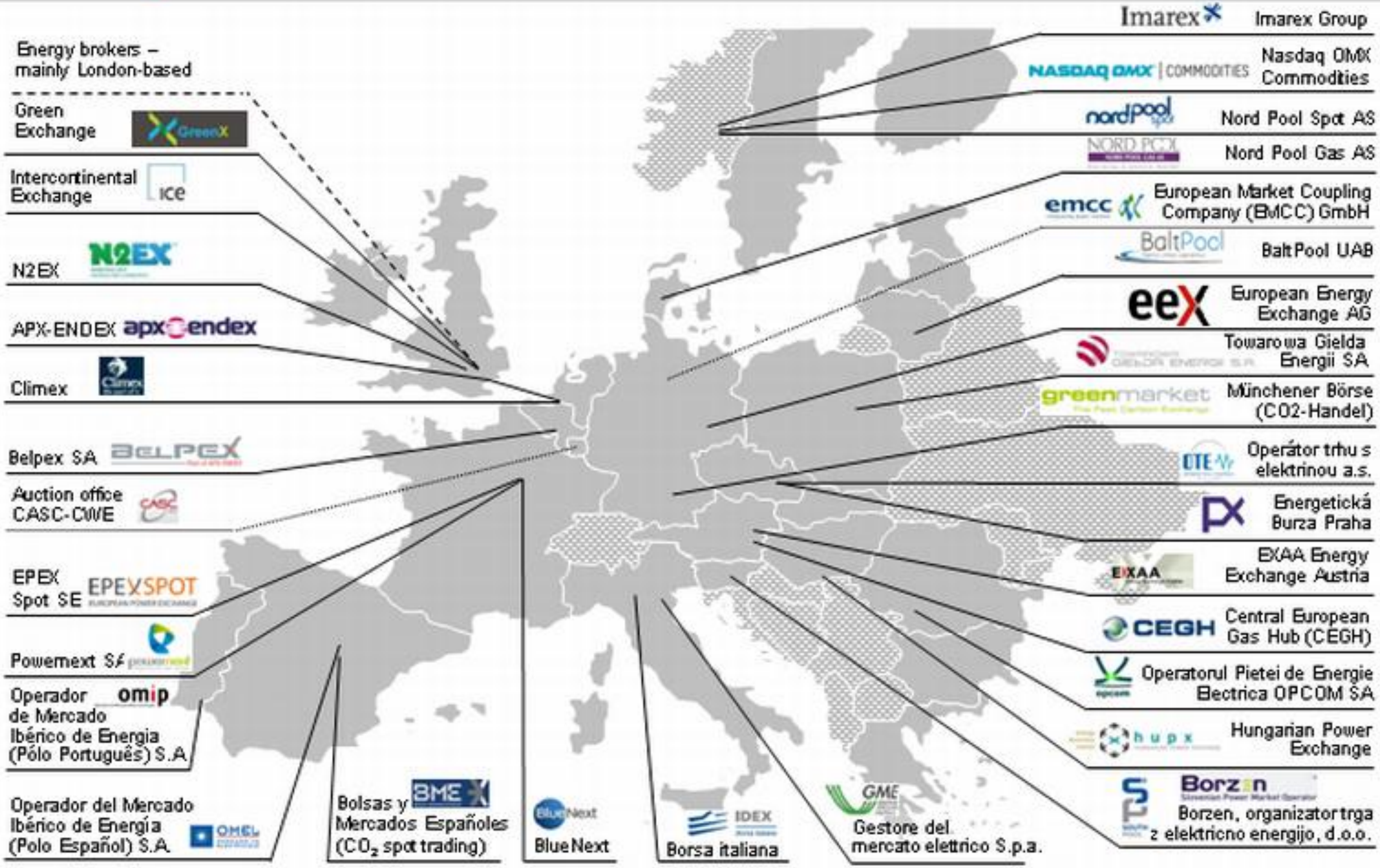
The “target model”

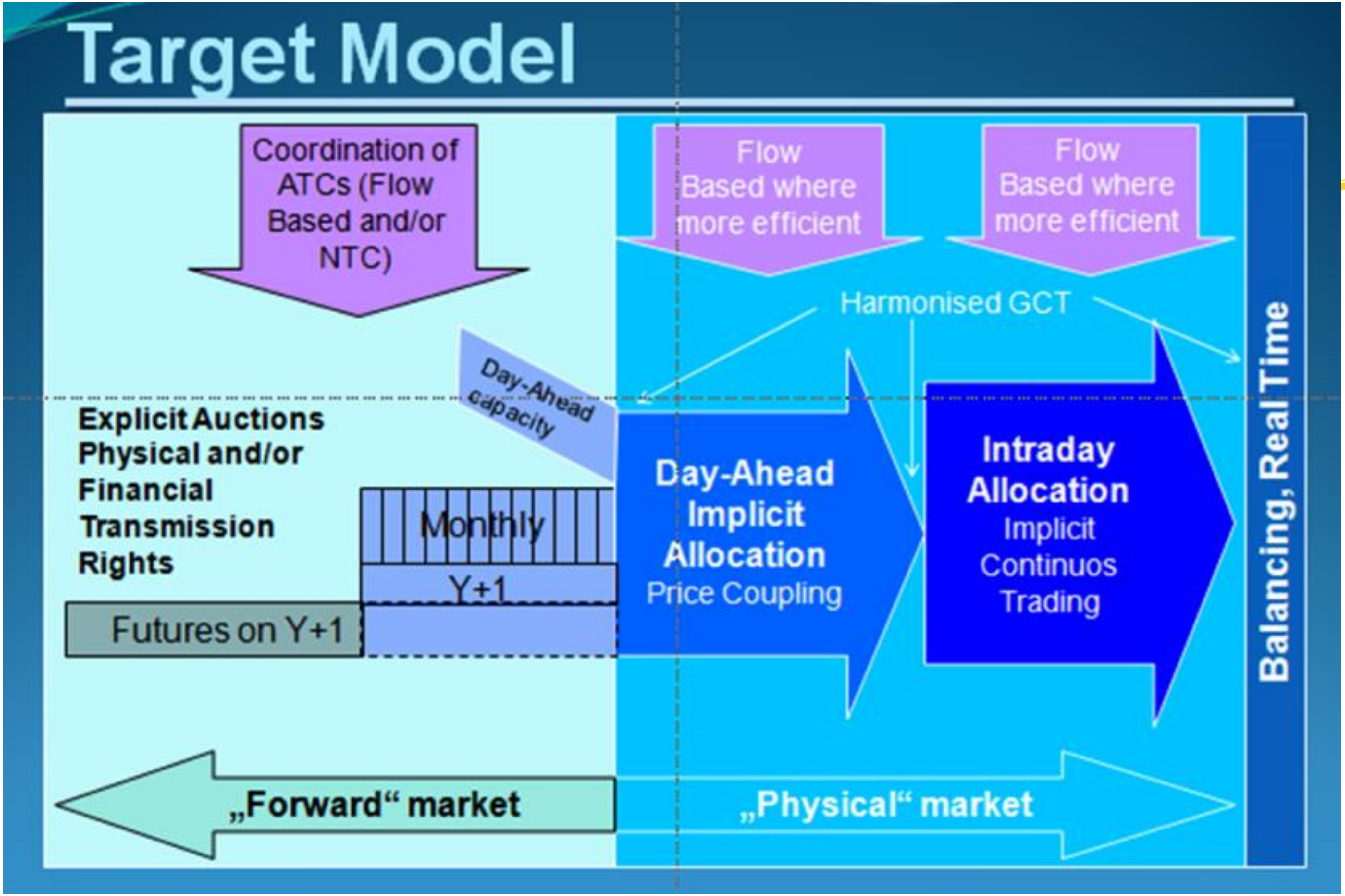
Towards a seamless EU electricity trading platform?

The EU Electricity Target Model
PCR: Price Coupling of the Regions

- Goal: A single algorithm to determine electricity prices throughout the EU. Three main principles:
  - One single algorithm
  - Decentralized operation
  - Individual accountability of each Power Exchange
- The EU Target Model is based on four elements:
  - A day-ahead market
  - Intra-day markets
  - The definition of a series of bidding zones
  - A coordinated approach to capacity calculation between bidding zones

Energy Exchanges and other market places in Europe in 2011




Target Model
Coordination of ATCs (Flow Based and/or NTC)
Flow Based where more efficient
Flow Based where more efficient
Harmonised GCT
Day-Ahead capacity
Explicit Auctions Physical and/or Financial Transmission Rights
Monthly
Y+1
Futures on Y+1
Day-Ahead Implicit Allocation
Price Coupling
Intraday Allocation
Implicit Continuos Trading
Balancing, Real Time
„Forward“ market
„Physical“ market

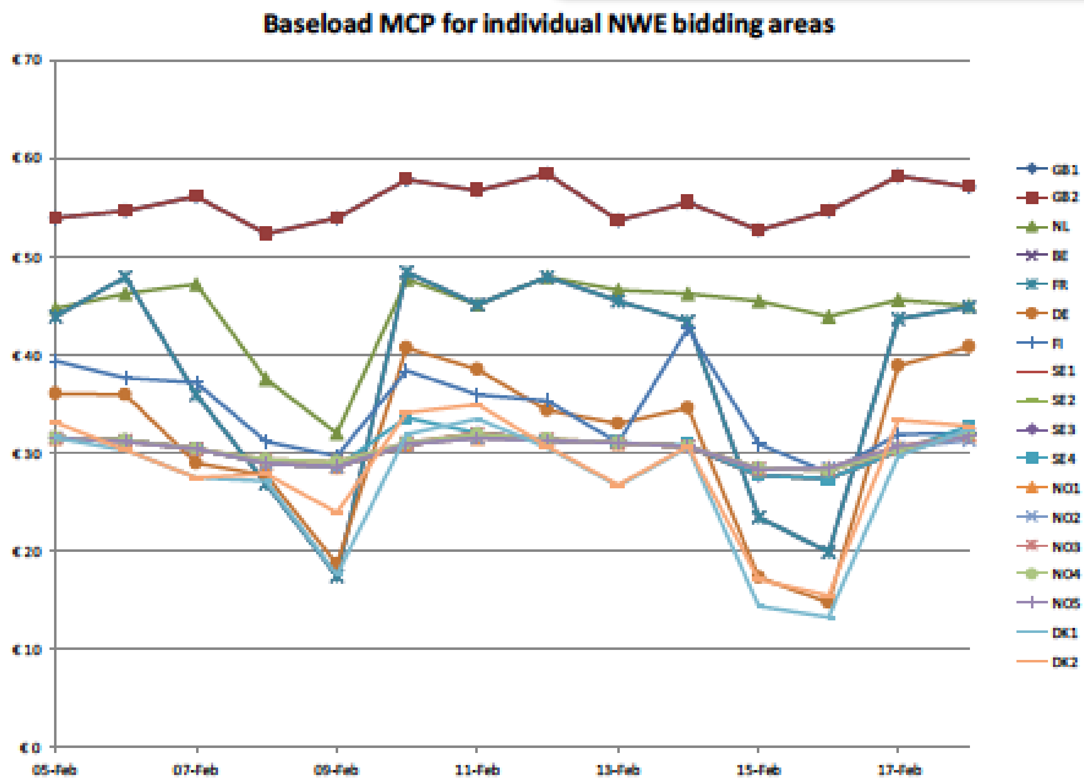
Grid operators and power exchanges from 14 EU Member States (Belgium, Denmark, Estonia, Finland, France, Germany, Austria, UK, Latvia, Lithuania, Luxembourg, the Netherlands, Poland and Sweden) plus Norway inaugurated on February 4 a pilot project for joint electricity trading, so-called day-ahead market coupling. The project, which is a milestone on the way towards a European Electricity Market, had been jointly initiated by the EU Commission, regulators, grid operators and power exchanges in North-Western Europe (NWE). NWE market coupling combines all bids and offers in a region and creates a large integrated electricity market in the area concerned, combining 75% of today's electricity consumption in the EU. The Commission prepares an EU Regulation that will make market coupling binding in the entire EU, leading to important costs savings for the benefit of European customers. Read more: http://europa.eu/rapid/press-release_MEX-14-0204_en.htm

NWE Market Coupling Launch First Results

***Launched** on 04/02/2014*

***Operations** went on smoothly, prices were published on time except a delay of 4 minutes on the launch day*

*Starting in 2009, the project has involved **over 200 people** from the participating Power Exchanges across Europe*

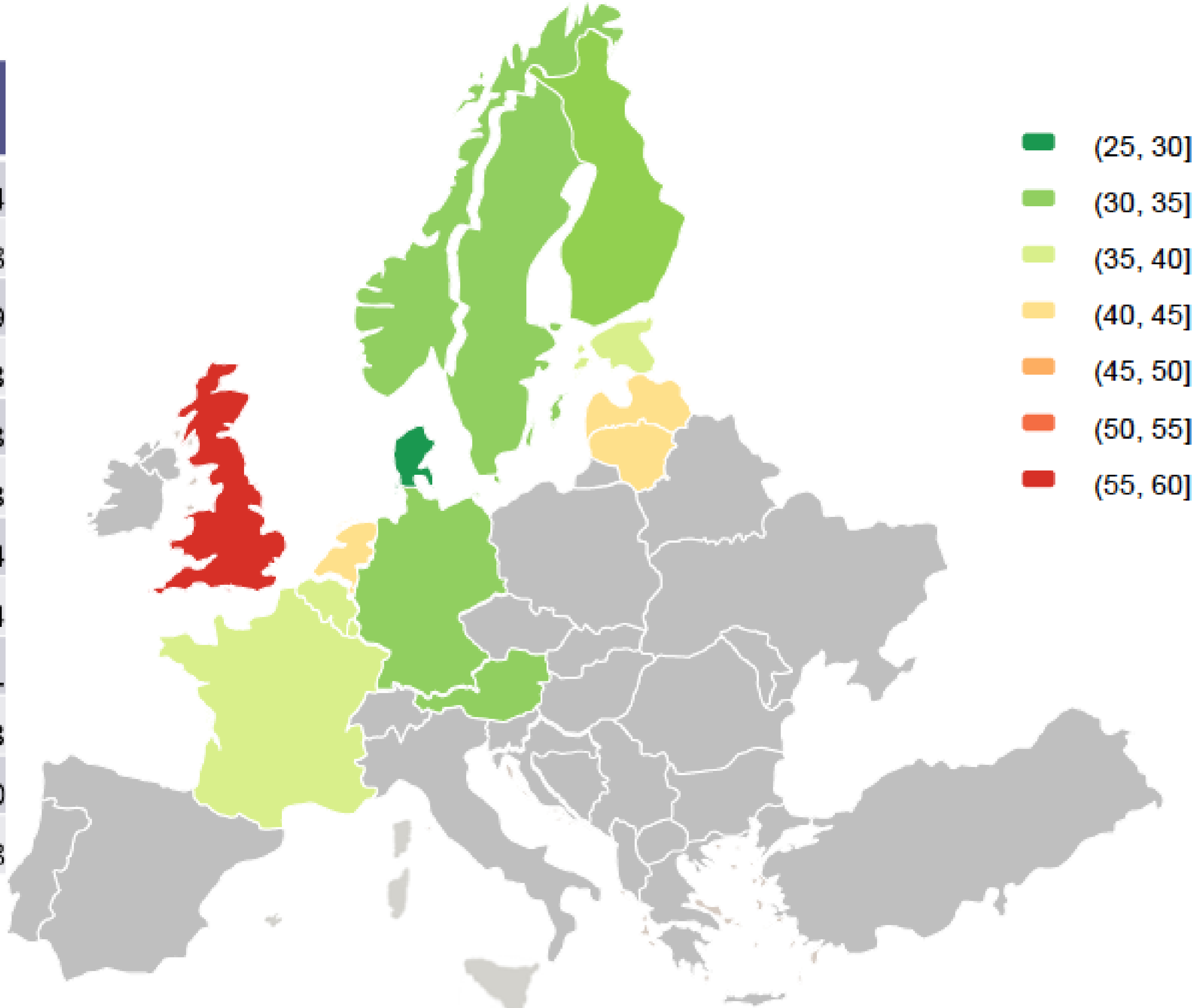


Prices and net transfers are determined in a **single calculation** using the PCR Matcher-Broker (PMB) with its embedded algorithm "Euphemia", based on the order books and available transmission capacities from the NWE and SWE regions.

NWE – Results of the first month

(2014-02-05 to 2014-02-21 for illustration)

Area	Average MCP
Denmark	€ 28.64
Norway	€ 30.58
Sweden	€ 30.69
Germany	€ 32.53
Finland	€ 34.53
Estonia	€ 35.63
Belgium	€ 38.64
France	€ 38.64
Latvia	€ 43.91
Lithuania	€ 43.93
Netherlands	€ 44.30
Great Britain	€ 55.08



***Note**: arithmetic mean of MCPs for first 17 days of NWE Market Coupling; for Denmark, Norway and Sweden. First an aggregation on country level was performed (again arithmic mean of concerned area prices)*

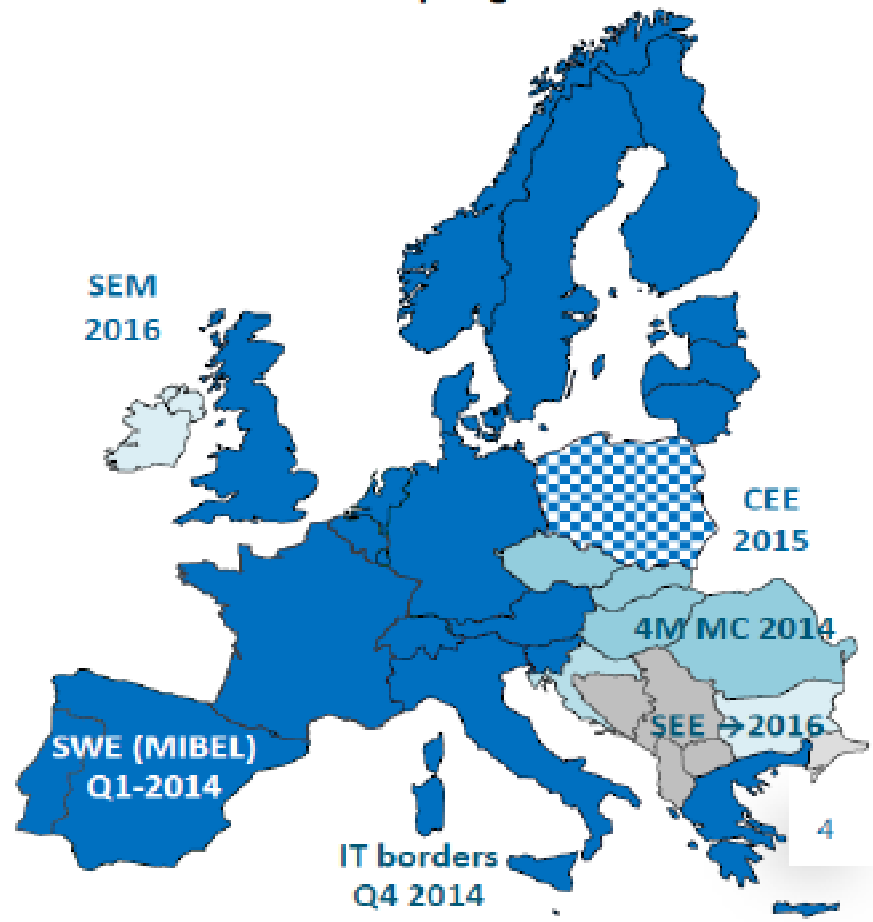
Source: EPEX calculation based on data from APX, Belpex, EPEX SPOT, N2EX and Nord Pool Spot

Next steps on the Day-Ahead in 2014

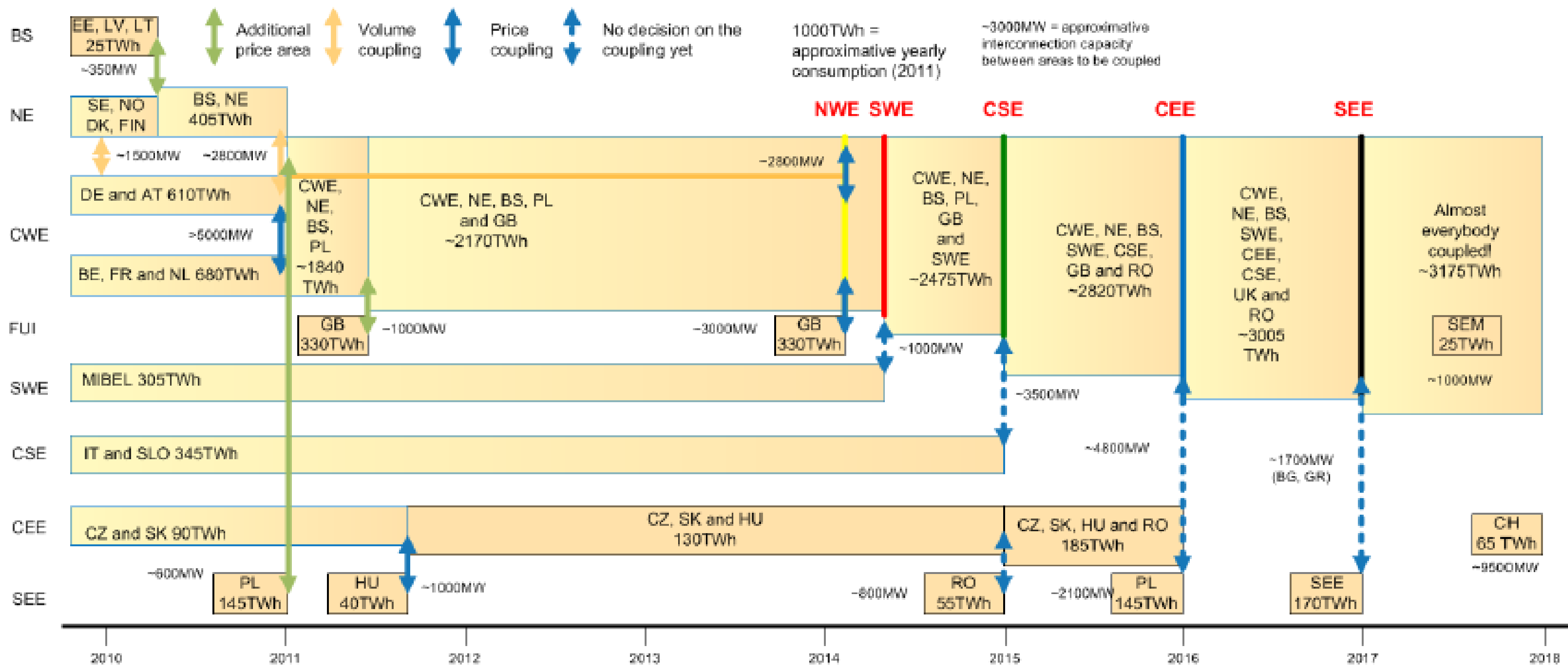
2014 as target for most Europe to be coupled

- **Goals for 2014**
  - Consolidation of NWE
  - Full coupling SWE-NWE (with implicit allocation on FR-ES border)
  - IT borders project implementation and go-live
  - Implementation of the basis for the pan-European governance framework, covering the coupled areas
  - Preparation of coupling of northern Swiss borders and reaching readiness for go-live
  - 4M MC implementation and go-live using PCR
  - CEE Flow Based MC project design
  - CWE Flow Based MC go-live
- **Next steps**
  - CEE FB MC implementation and go-live
  - Evolution of markets towards MC compatible models in Ireland & Northern Ireland, Bulgaria, Greece and the Balkan States

- **End 2014 market coupling outlook**



Market coupling timetable

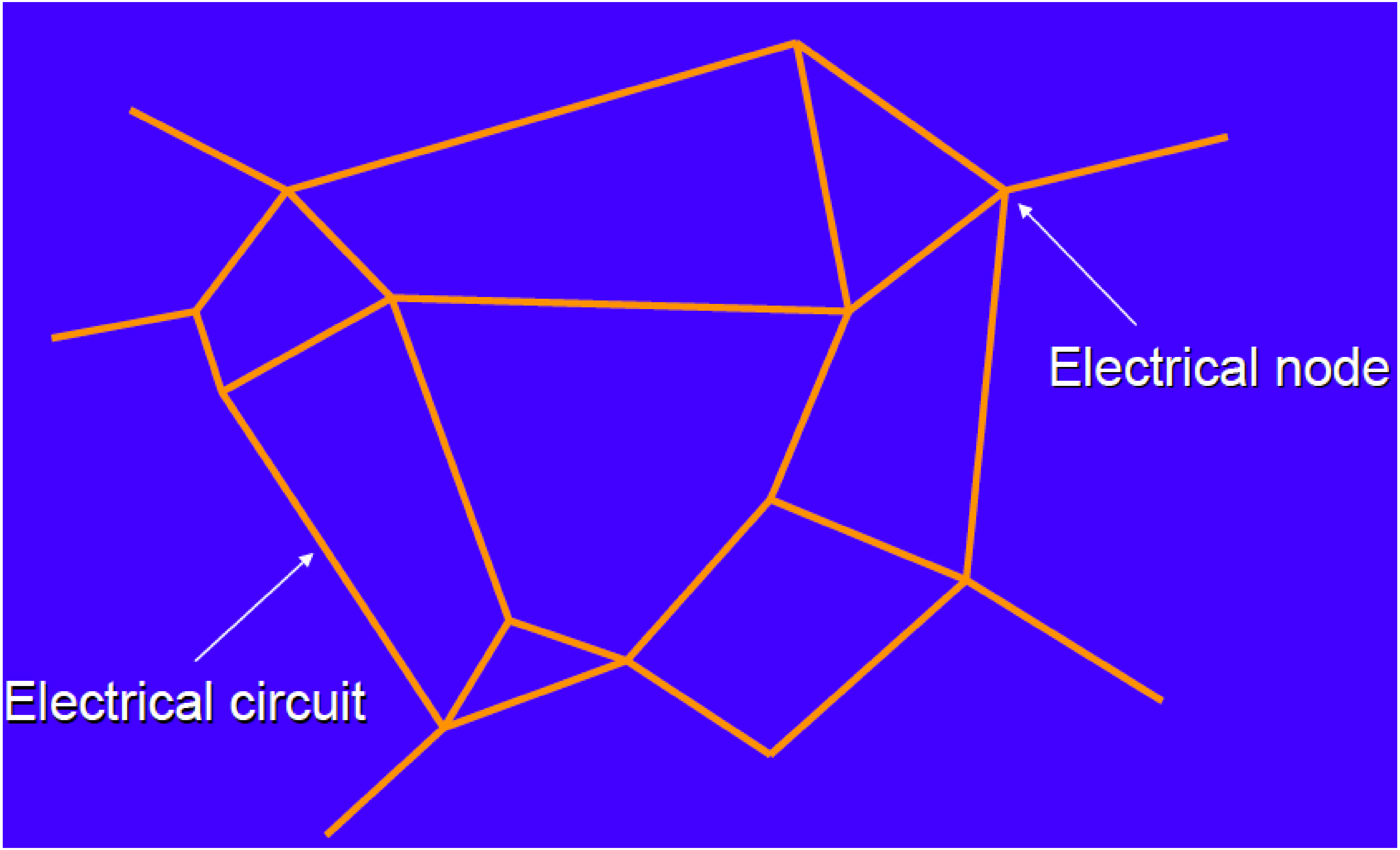


Transmission issues

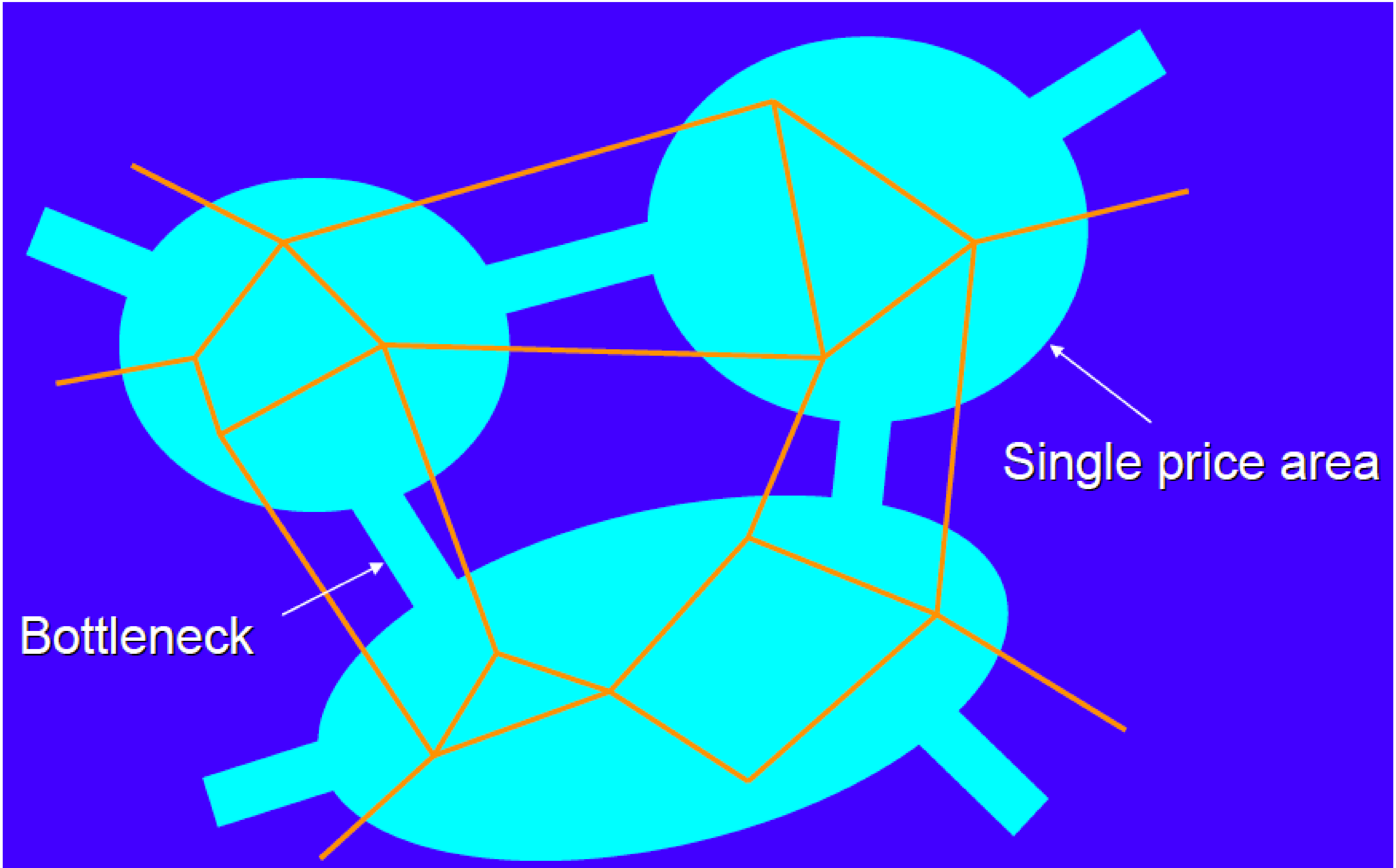
Network representation in electricity trade: Nodal vs zonal vs single price

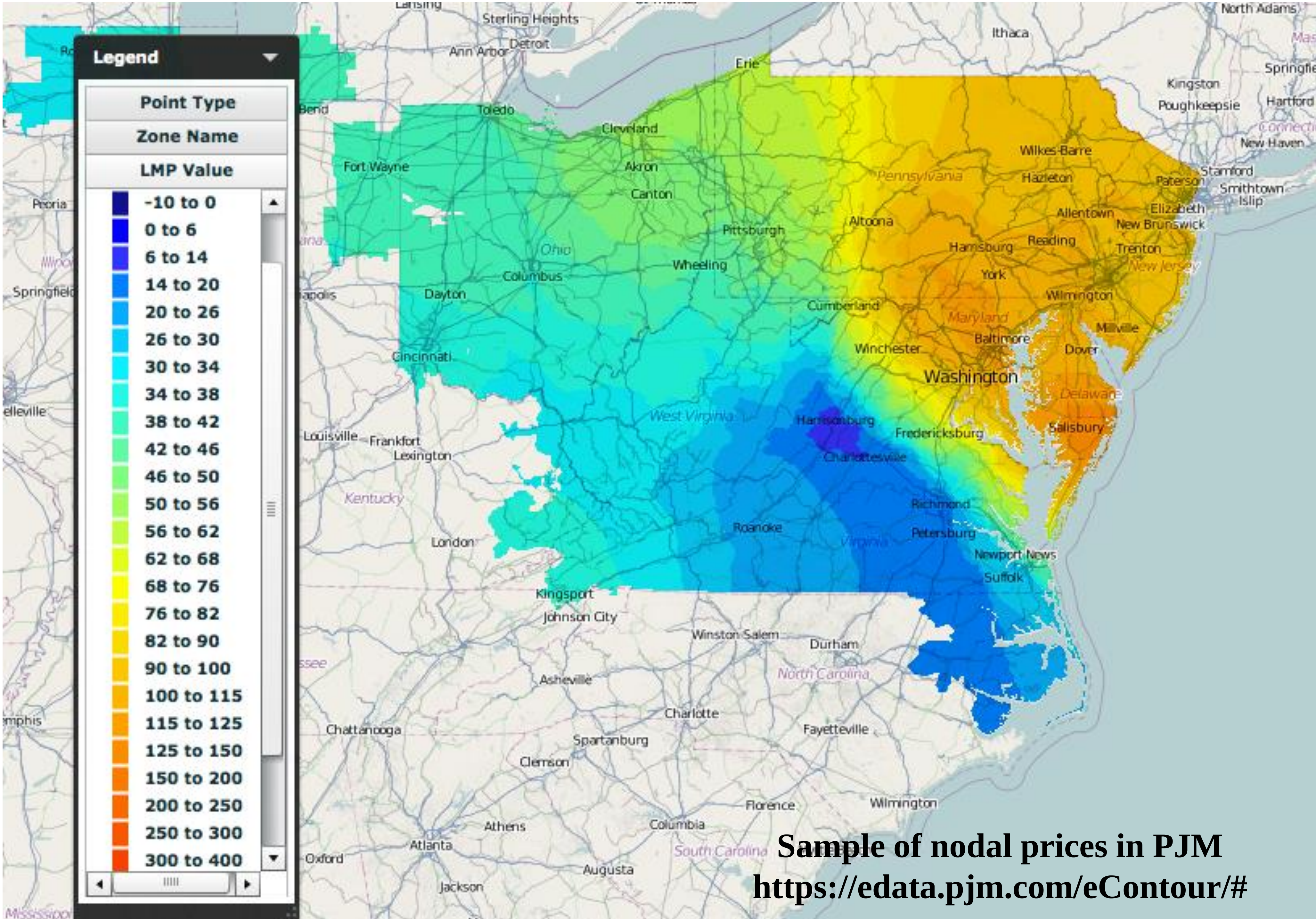
Interconnected
network of
ENTSO-E
NORTH SEA
BALTIC SEA
ATLANTIC OCEAN
BLACK SEA
MEDITERRANEAN SEA

Operational network model



Simplified network model for PCR





Sample of nodal prices in PJM

https://edata.pjm.com/eContour/#

Seamless interconnections
Two very different approaches

- **USA**:
  - LMP (locational or nodal energy pricing) at ISO/RTO level
  - LMP is ideal to integrate generation & network, but difficult to combine with neighboring systems & preserving identity
  - Once implemented has many advantages
- **EU**:
  - Power Exchanges with single energy prices. Their outcomes are passed to TSOs to check grid compatibility
  - Easy for Power Exchanges to integrate. But underlying network compatibility only becomes worse & locational signals have to be found elsewhere

Seamless interconnections
The way ahead

- Conceptually, LMP, locational marginal pricing *(nodal energy pricing)* would the ideal solution
  - It is widely used in the USA, but only at ISO/RTO level, not at a wider interconnection level
  - Generalized LMP does not seem to be a viable solution in the EU in the short or medium term

The EU gas market

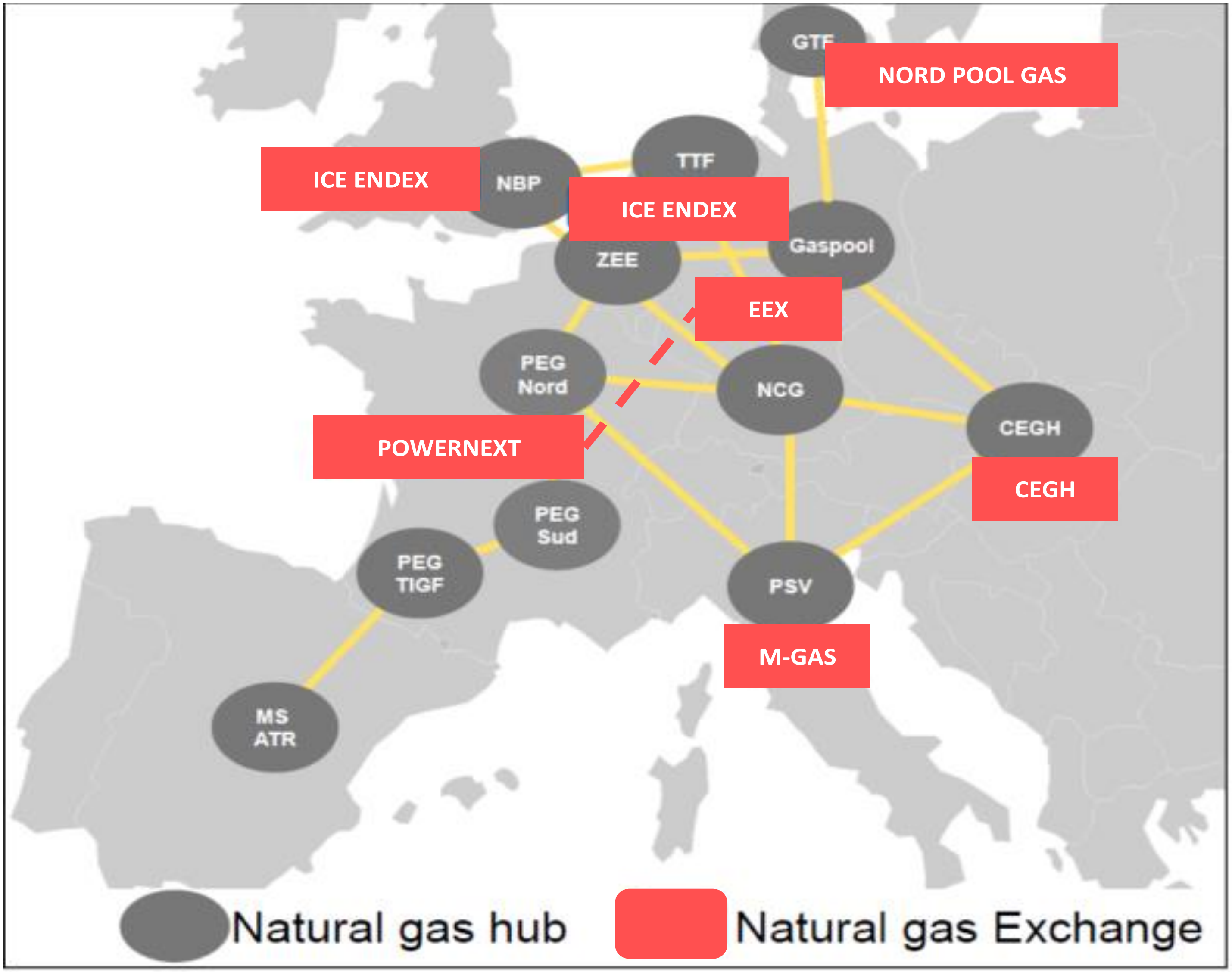
Is a good idea to copy the EU electricity market format?

The process under European regulation

- Objective: **Gas target model** to integrate national energy markets by 2014 *(hub to hub gas trading)*
- Align national markets currently in development via **network codes**:
  - Congestion management procedures
  - Capacity allocation mechanisms
  - Market based balancing and harmonized nominations
  - Harmonization of tariffs
  - Interoperability improvements
- **Network charges** based on the **entry-exit** approach

Natural gas transmission system operators in Europe

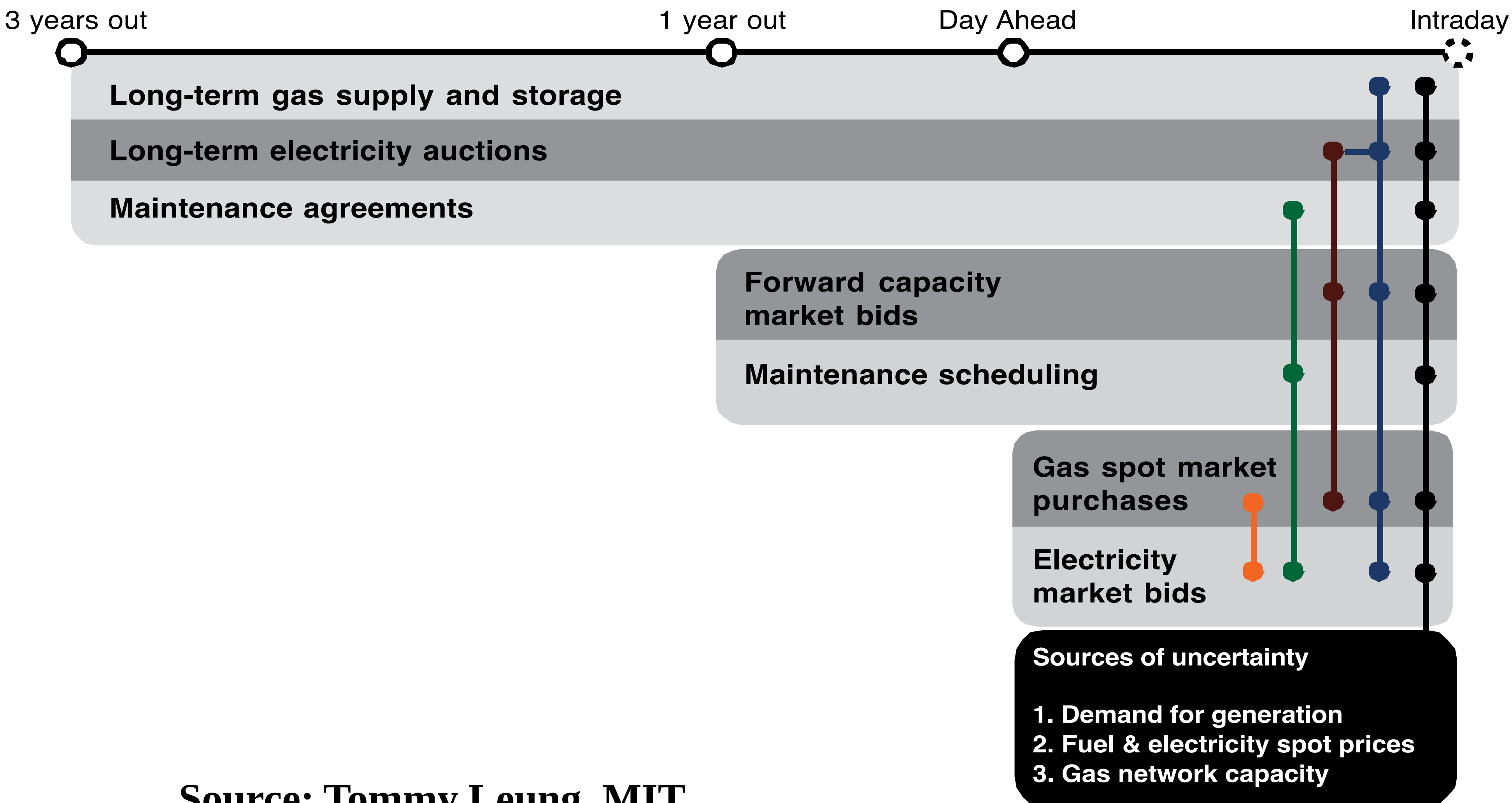
Natural gas hubs and natural gas exchanges in Europe



Sources: IberiangasHUB and P. Heather, "Continental European gas hubs: Are they fit for purpose?", OIES NG 63, June 2012.


RED DE GASODUCTOS RUSIA - EUROPA
Gasoductos
Grandes proyectos de conducción
Países cuyo consumo depende en más del 25% de la importación de gas natural ruso.
FINLANDIA
Nord Stream
SUECIA
ESTONIA
Yamal
LETONIA
DINAMARCA
LITUANIA
IRLANDA
REINO UNIDO
HOLANDA
POLONIA
RUSIA
BÉLGICA
Soyuz
ALEMANIA
R. CHECA
ESLOVAQUIA
UCRANIA
AUSTRIA
HUNGRÍA
RUMANÍA
FRANCIA
ESLOV.
CROACIA
South Stream
PORTUGAL
BULGARIA
ESPAÑA
ITALIA
Nabucco (descartado)
GRECIA

Coupling of gas & electricity markets in multiple time ranges



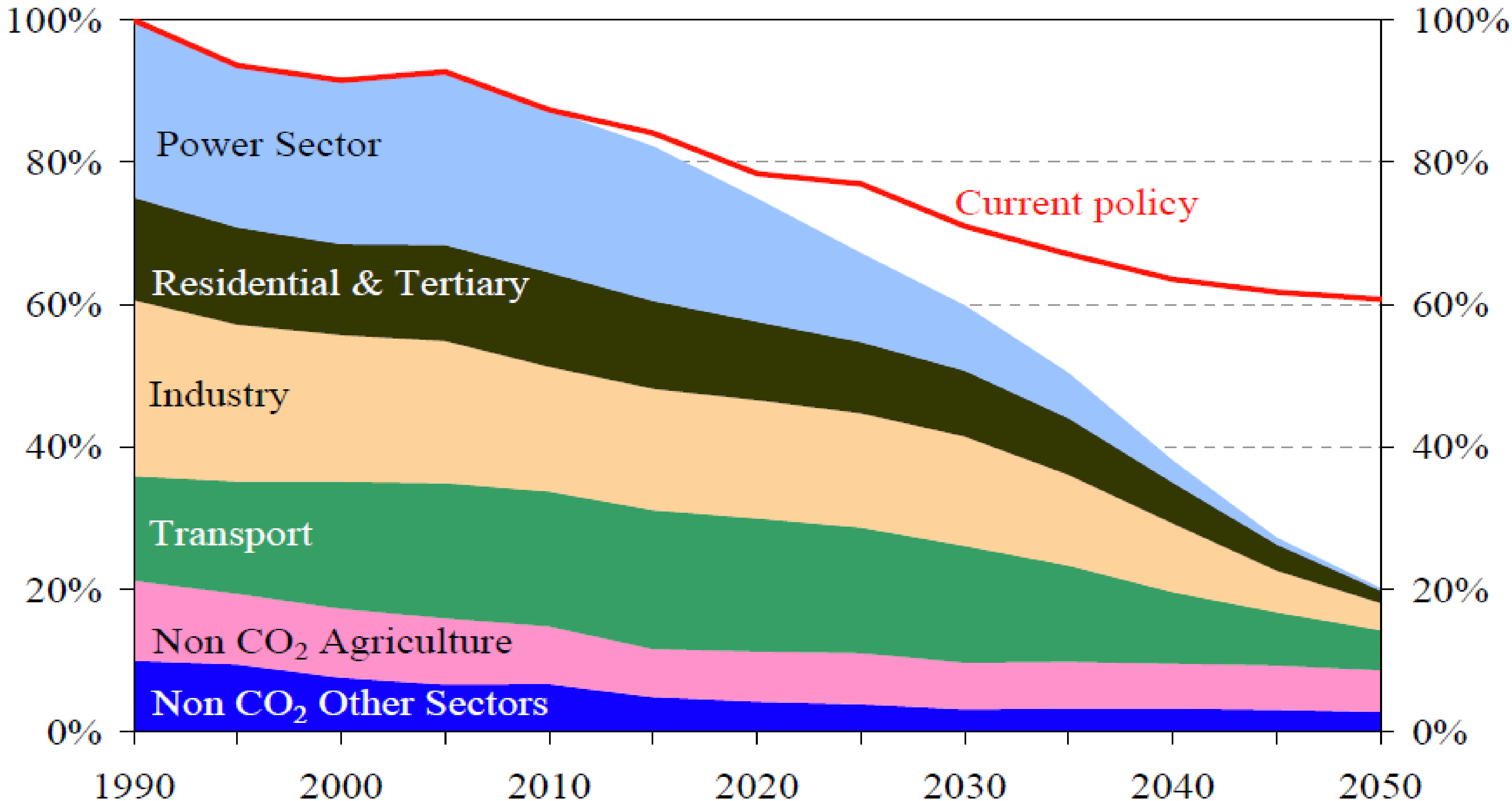
Source: Tommy Leung, MIT

Coordination of balancing zones in electricity & gas

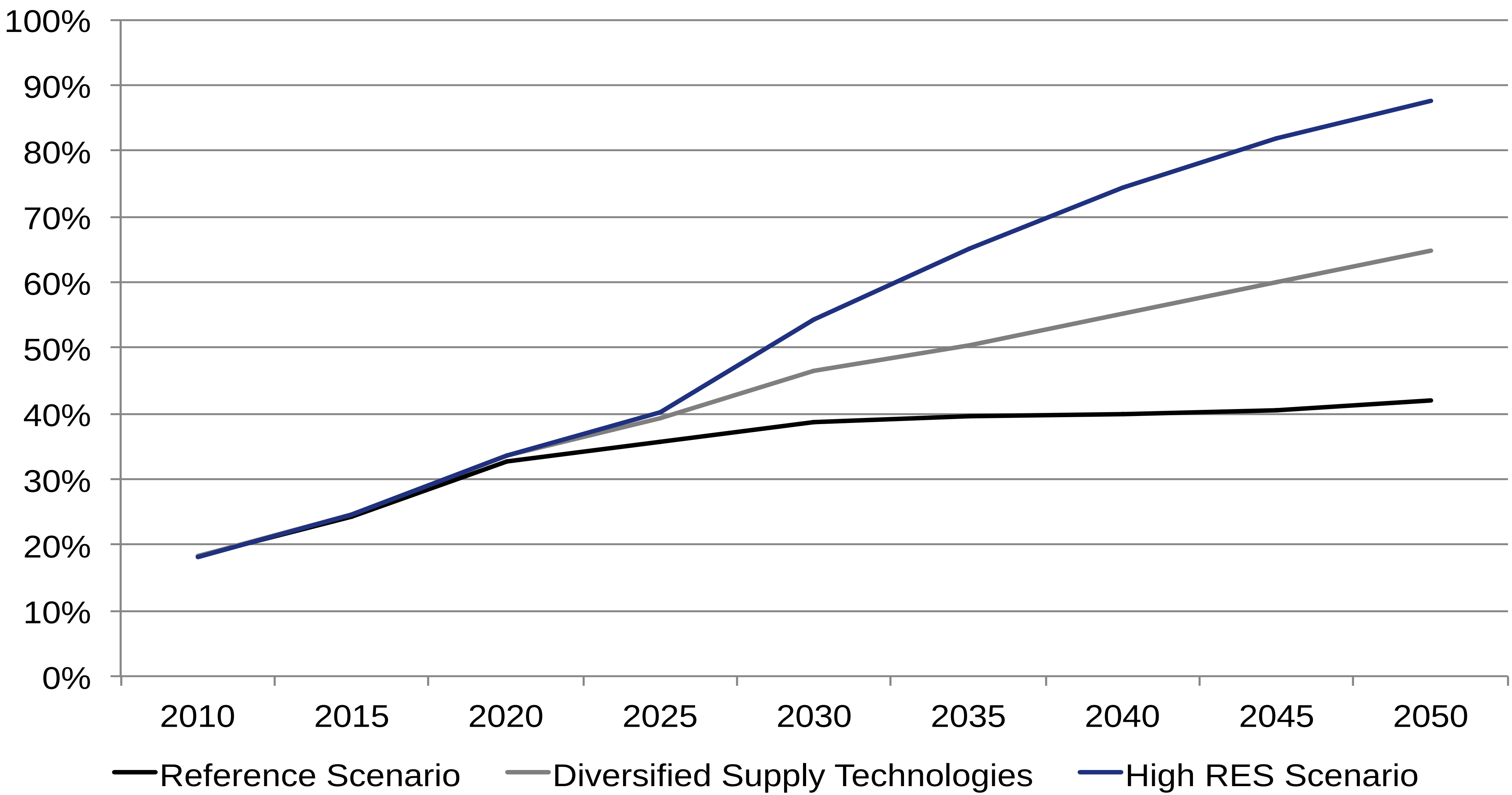
- **Balancing** is necessary in both markets
- EU regulation wants **market-based solutions**, led by agents, without TSO intervention, except for emergencies
- Balance zones hide strong **network simplifications** both in electricity & gas
- **Time dimension** in gas must get closer to real time without adding much complexity
- Poorly designed **cross-border network charges** may hamper trade
- **Intermittency** in electricity generation amplifies existing shortcomings in operation rules

Role of gas in a decarbonized power sector

The EU Low-Carbon Energy Roadmap 2050



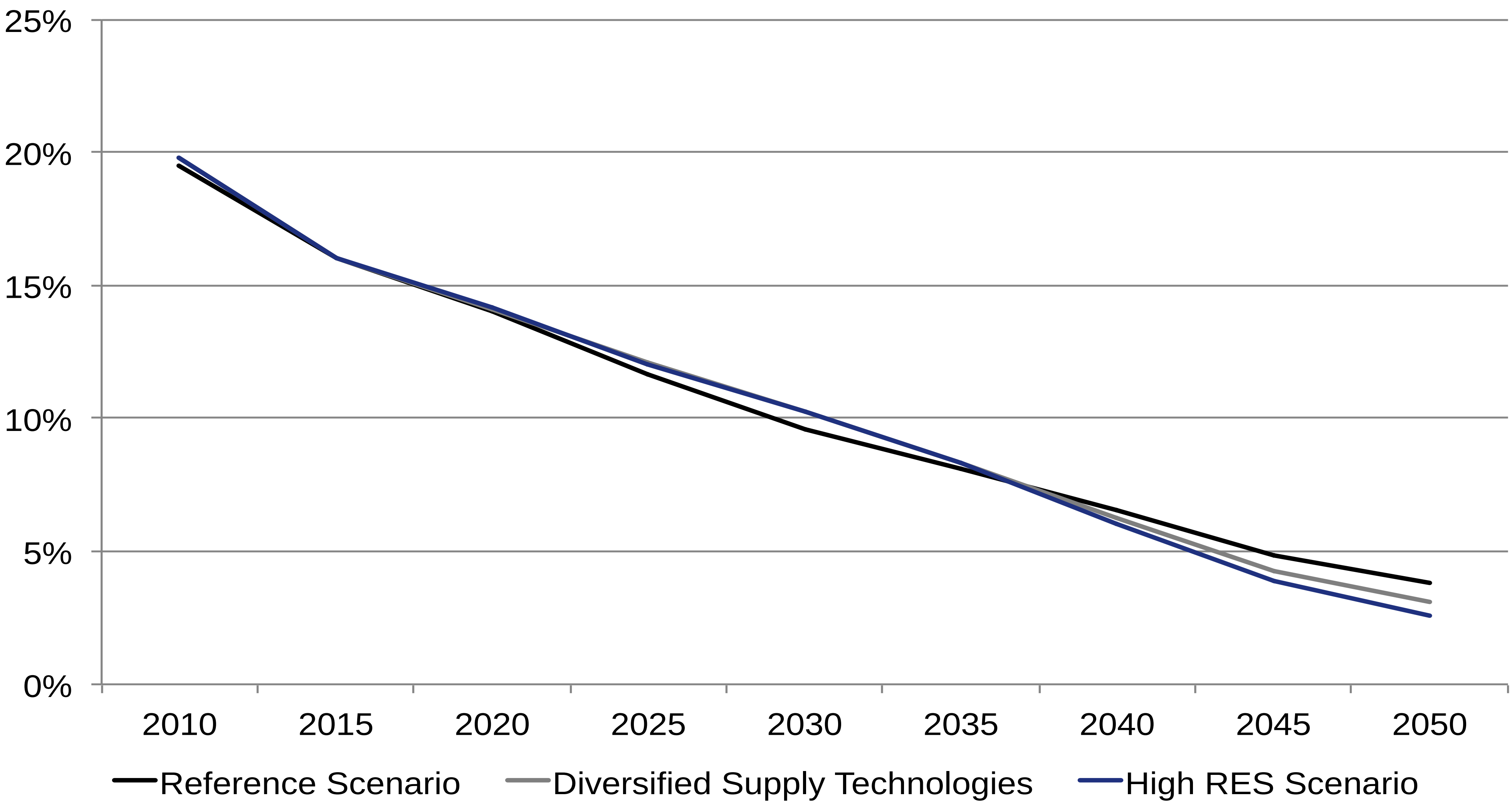
Share of Renewables in Electricity Production in the EU scenarios



Source: EU Energy Roadmap

Source: Prof. Christian von Hirschhausen

Share of Gas in Electricity Production in the EU scenarios



Source: EU Energy Roadmap

Source: Prof. Christian von Hirschhausen

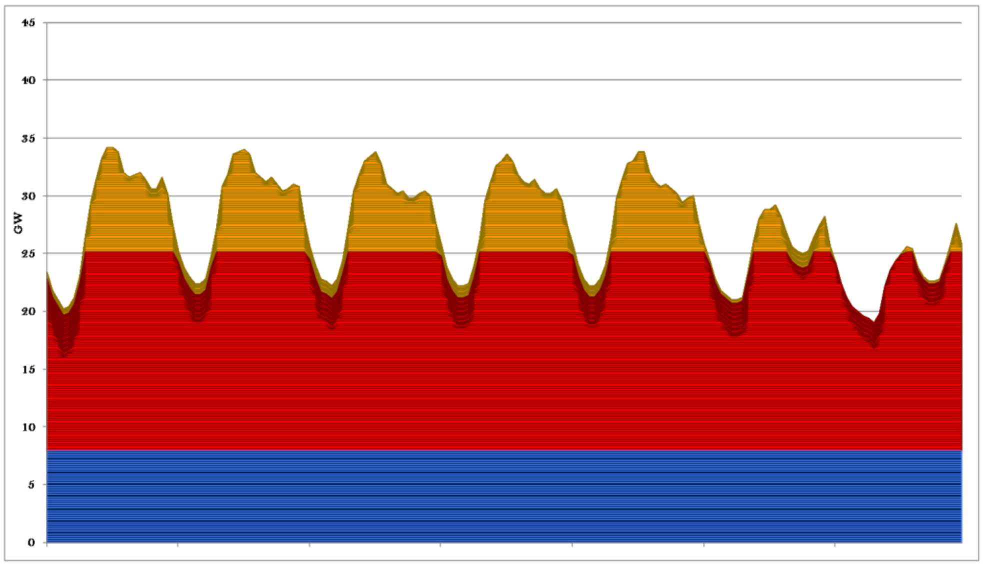
A case example

- How do solar & wind output affect generation dispatch & investment *(& for gas-fired plants, in particular)* in a specific power system?
- How do solar & wind penetration affect the optimal generation mix *(horizon 2030, starting from some existing mix in 2012)*?
- **Case example**:
  - 2 representative weeks in a system of the size & demand pattern of the Spanish power system, but with just nuclear, coal & CCGT
  - Different levels of penetration of wind and solar
  - Nuclear is frozen; only coal & CCGT respond

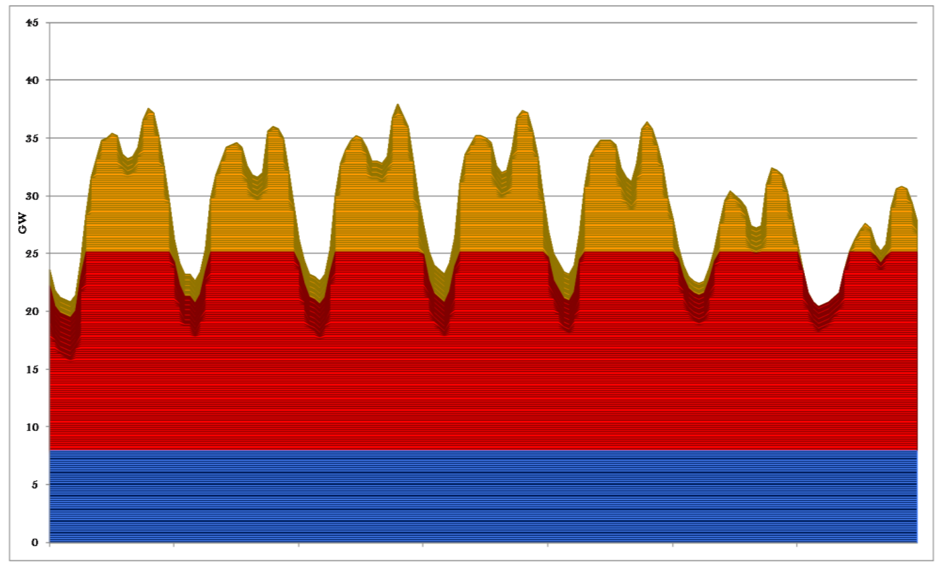
Results obtained with the LEEMA computer model, Institute for Research in Technology, Comillas University (Madrid, Spain). Collaboration Comillas-MIT Energy Initiative. Researchers: Carlos Batlle, Pablo Rodilla & Andrea Veiga.

Base case escenario: No PV

14-20 June



8-14 November

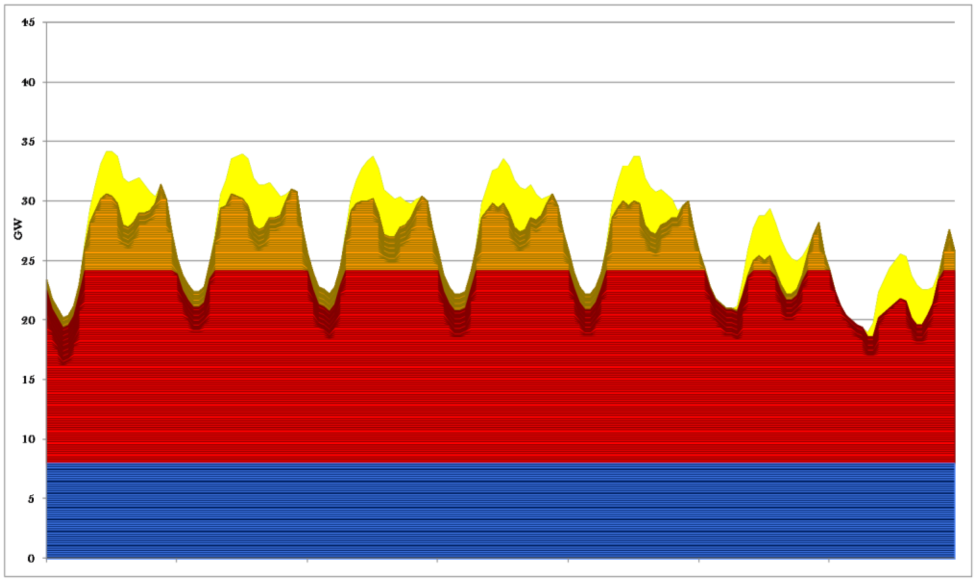


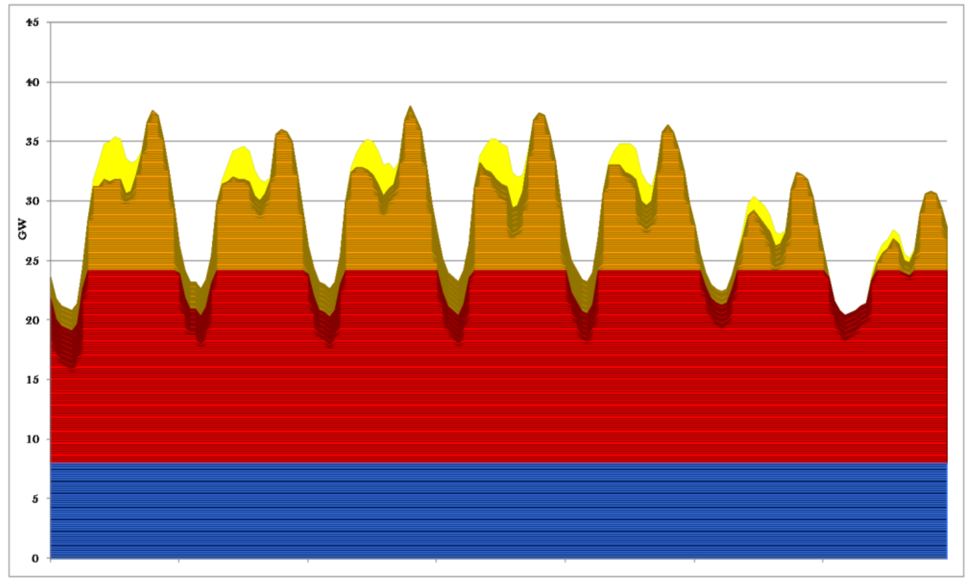
CCGT Coal Nuclear

5 GW non dispatchable solar PV

14-20 June

8-14 November



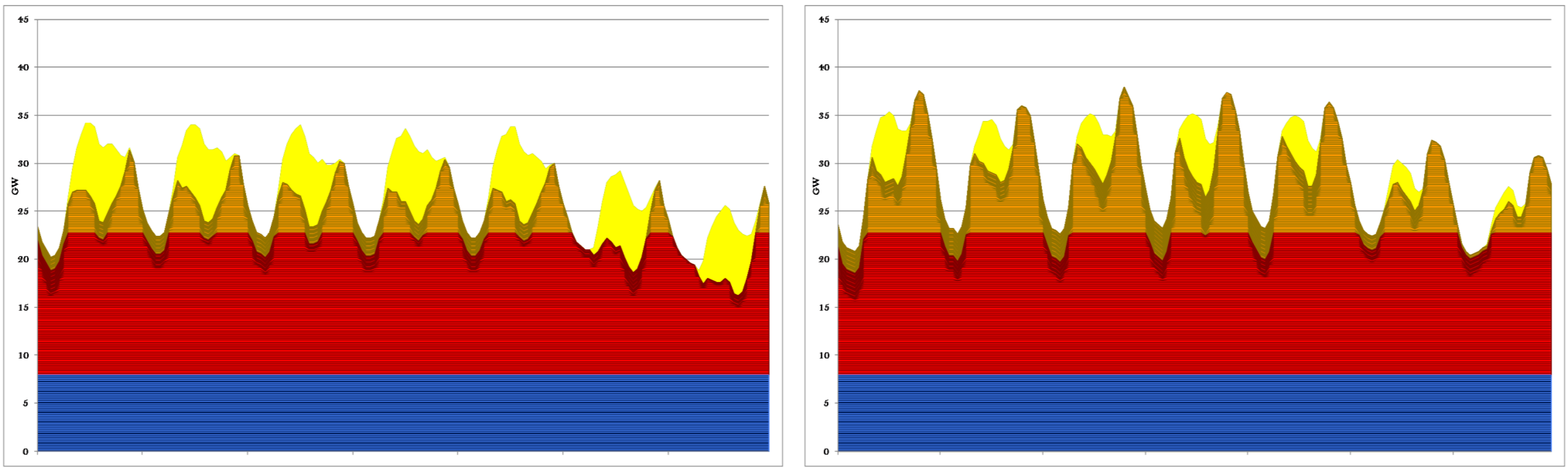


CCGT   Coal   Nuclear

10 GW non dispatchable solar PV

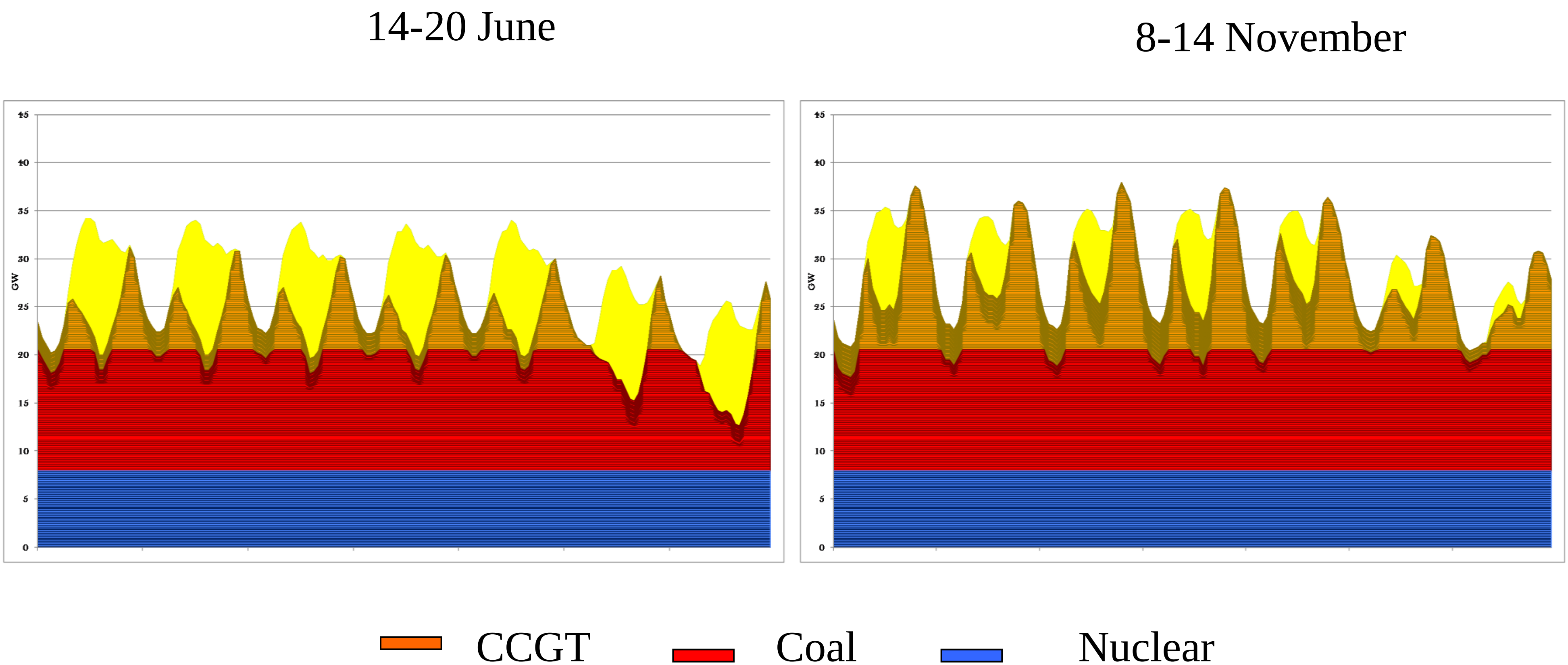
14-20 June

8-14 November



CCGT Coal Nuclear

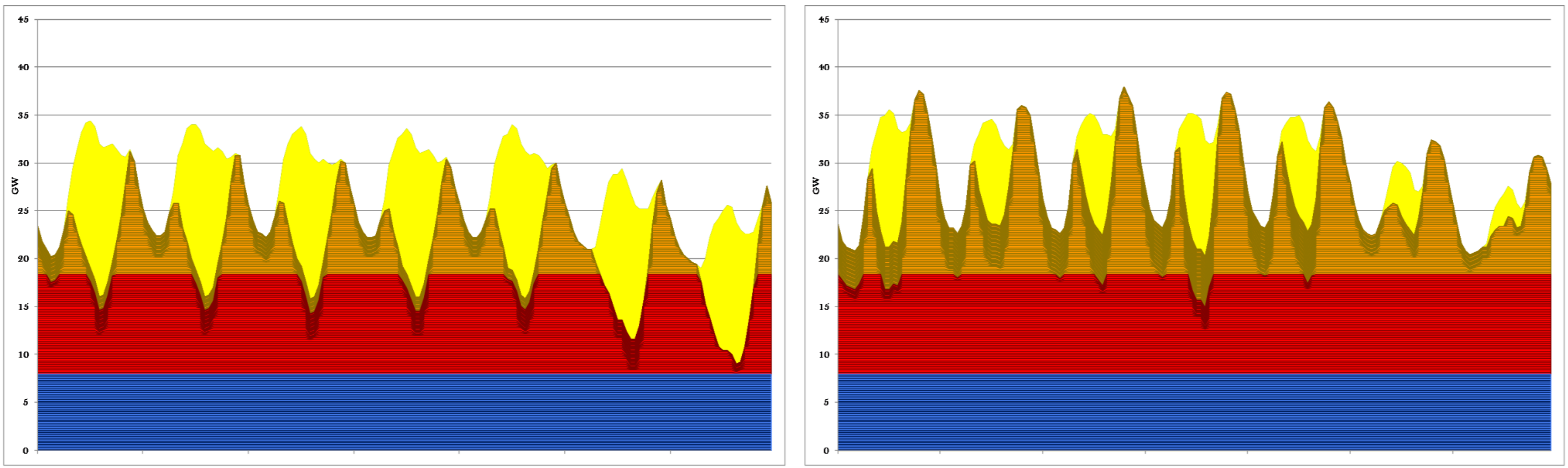
15 GW non dispatchable solar PV



20 GW non dispatchable solar PV

14-20 June

8-14 November

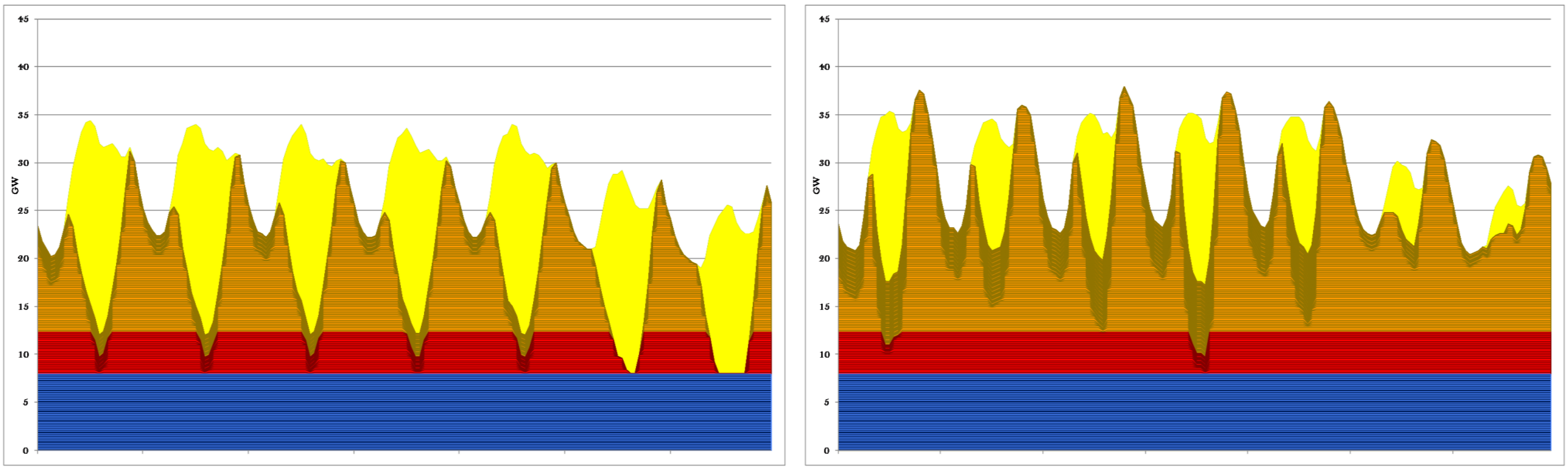


CCGT Coal Nuclear

25 GW non dispatchable solar PV

14-20 June

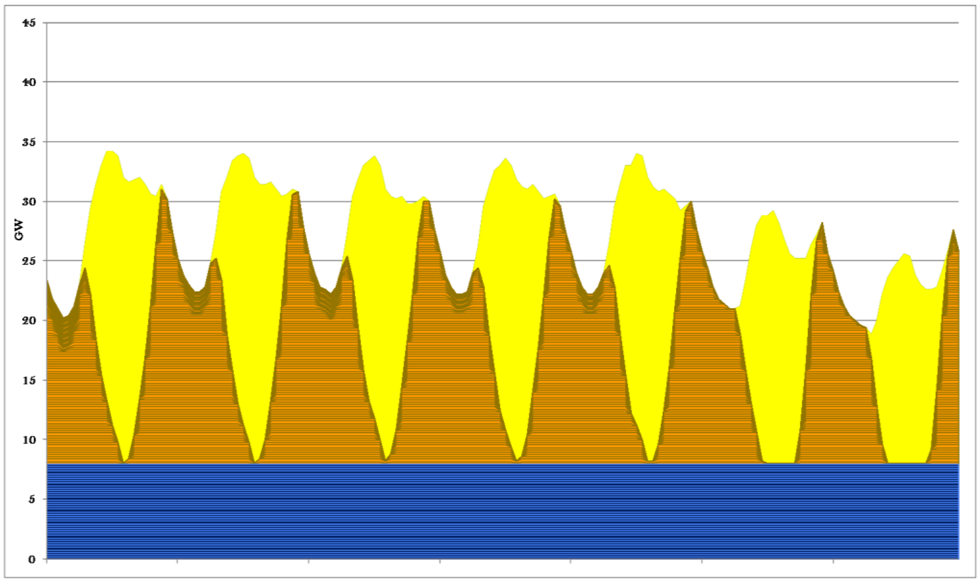
8-14 November



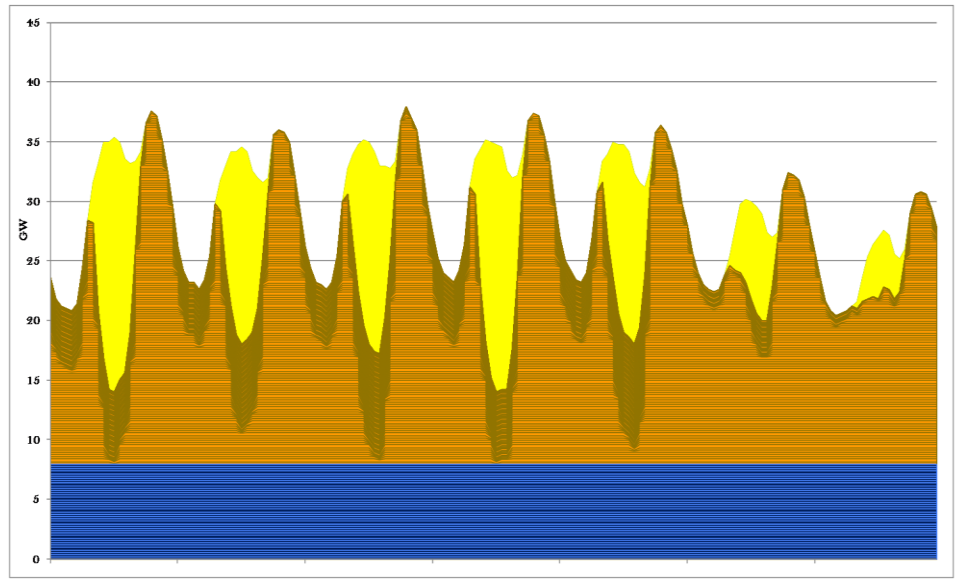
CCGT Coal Nuclear

30 GW non dispatchable solar PV

14-20 June



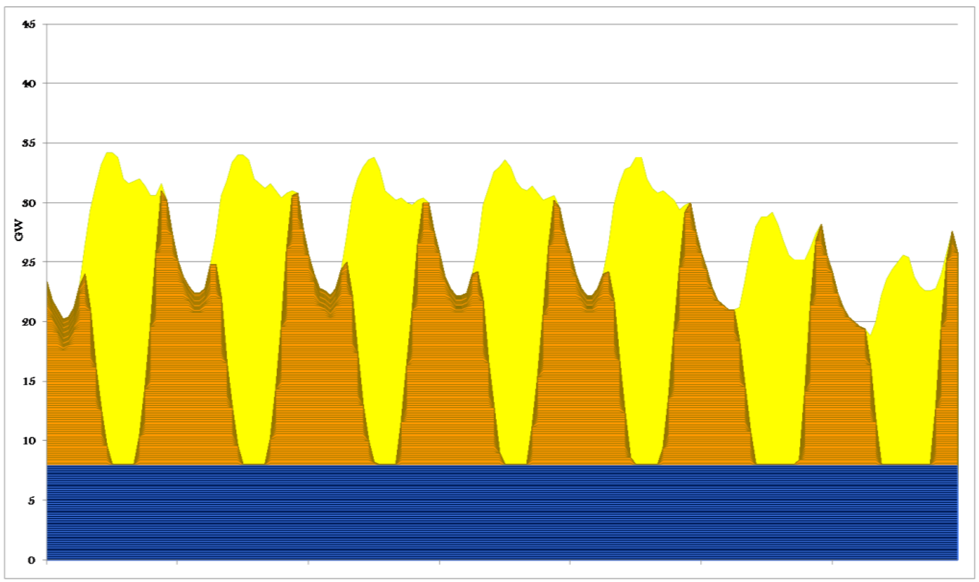
8-14 November



CCGT Coal Nuclear

35 GW non dispatchable solar PV

14-20 June



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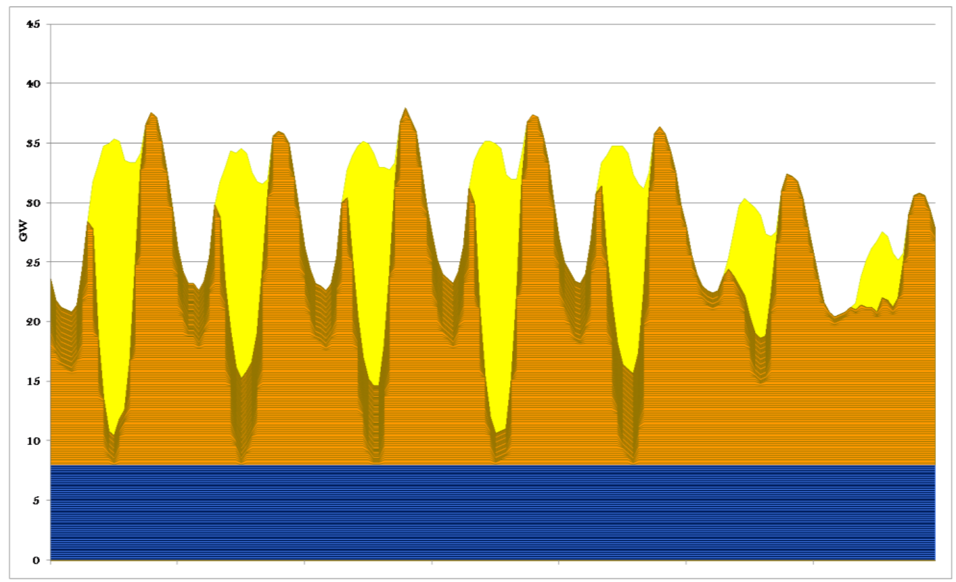

CCGT Coal Nuclear

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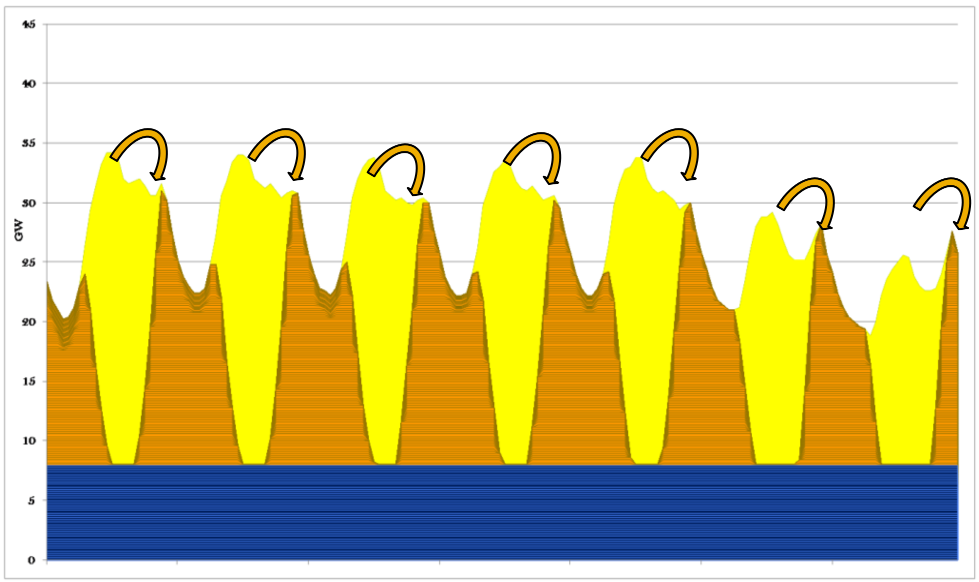

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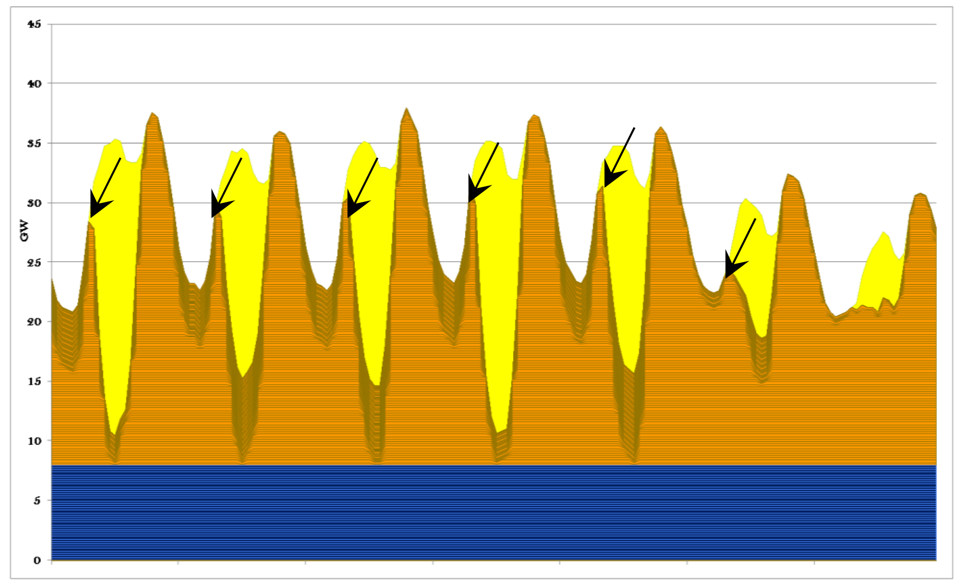
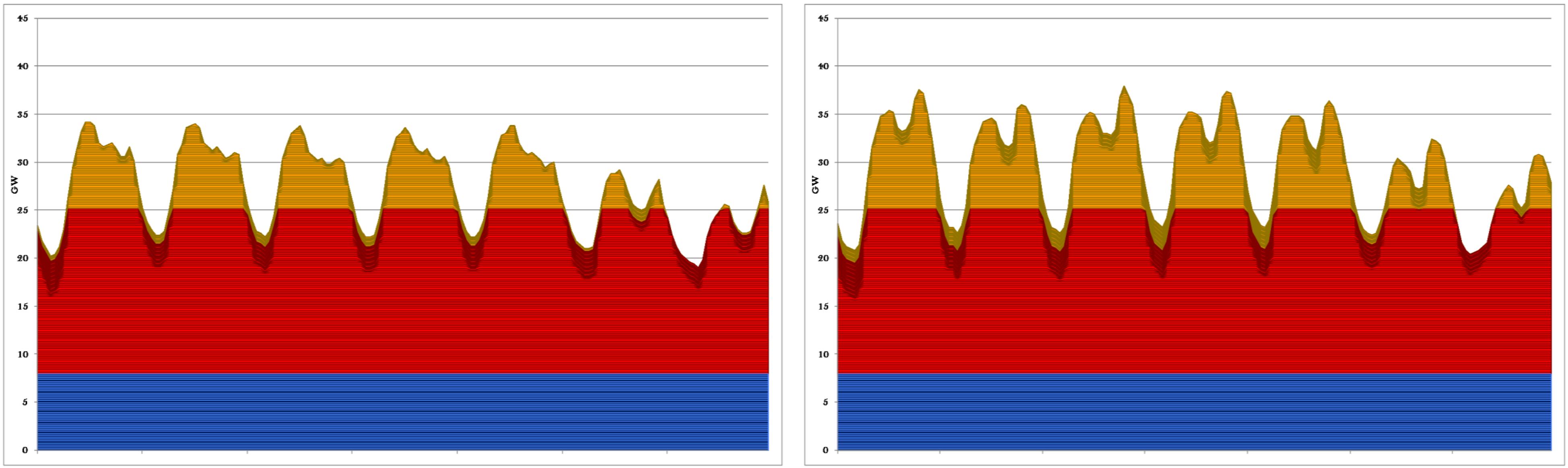


CCGT Coal Nuclear

Base case scenario: no wind

14-20 June

8-14 November

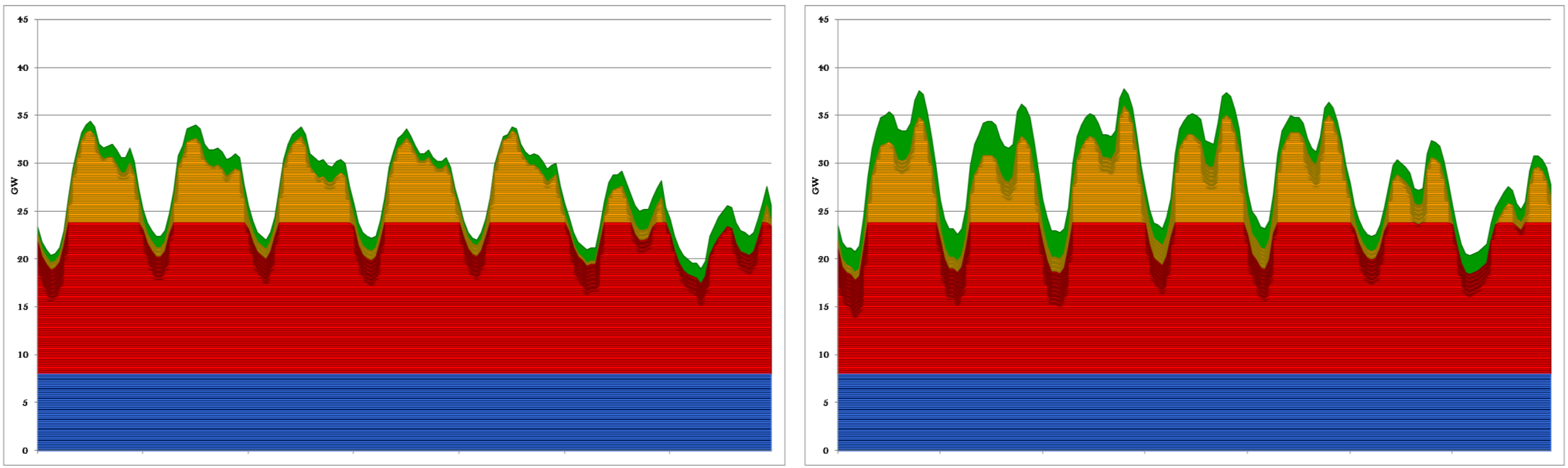


CCGT Coal Nuclear

5 GW wind

14-20 June

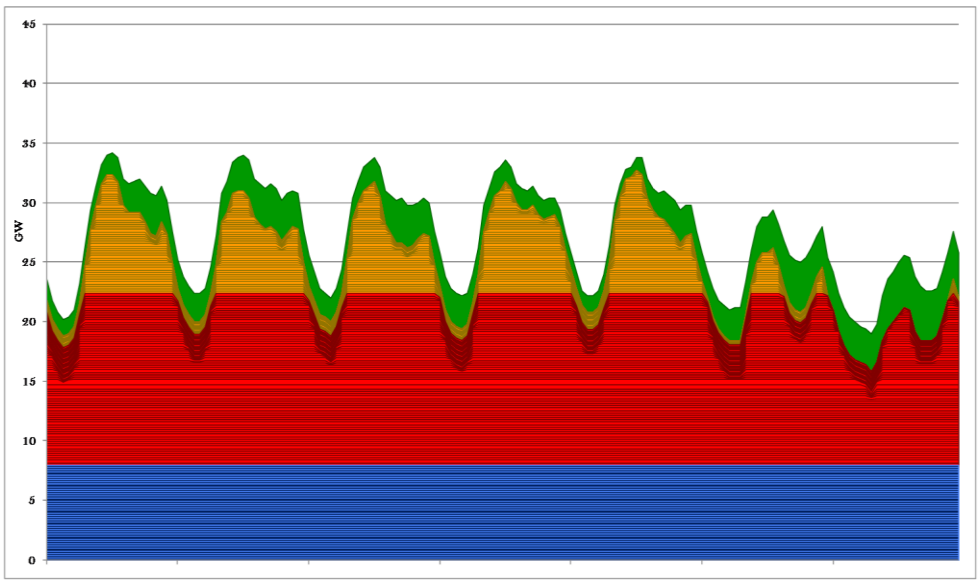
8-14 November



CCGT Coal Nuclear

10 GW wind

14-20 June



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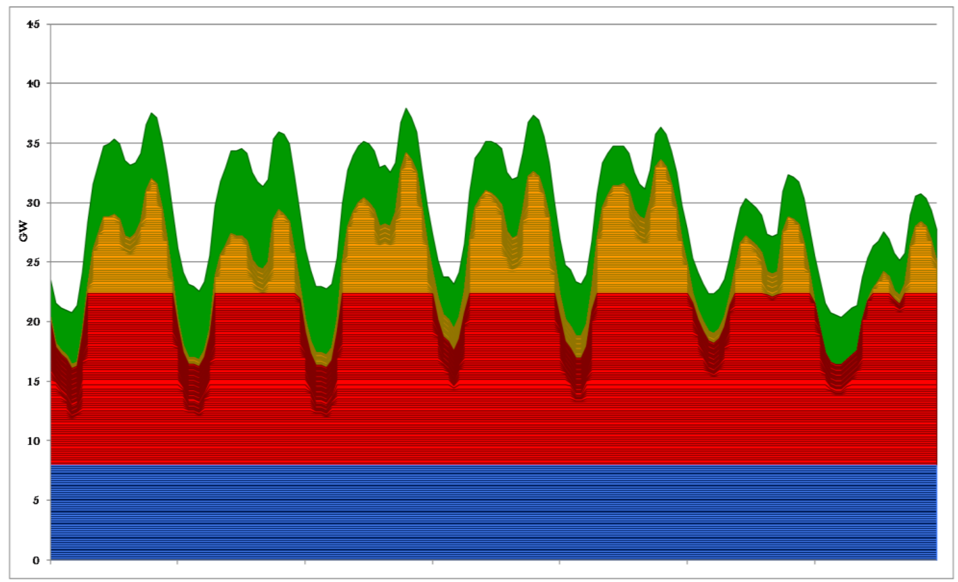
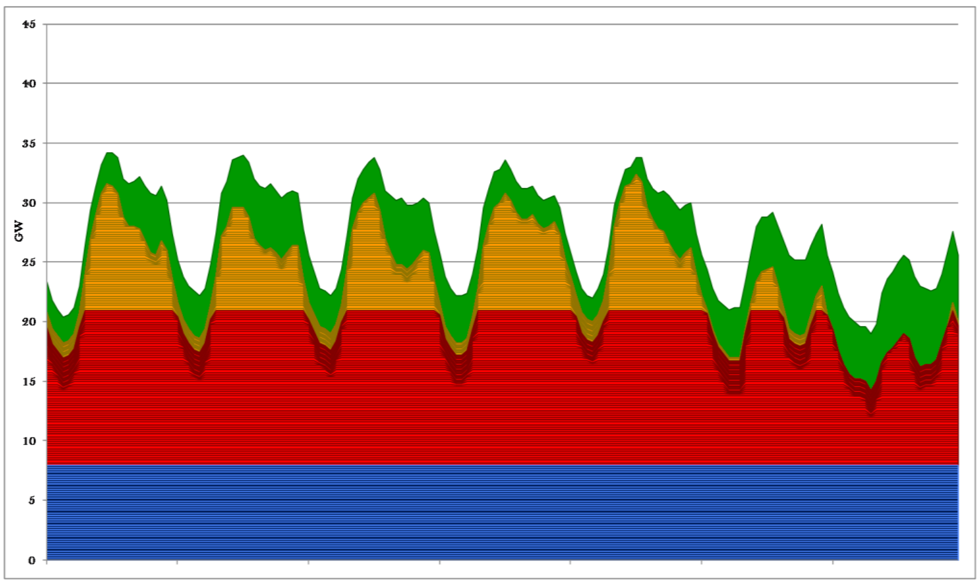


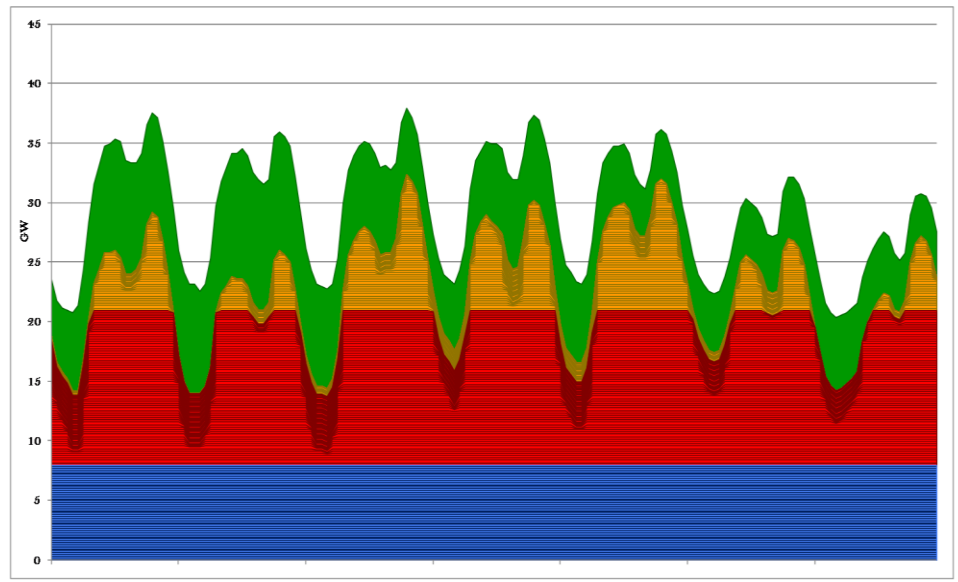
CCGT Coal Nuclear

15 GW wind

14-20 June



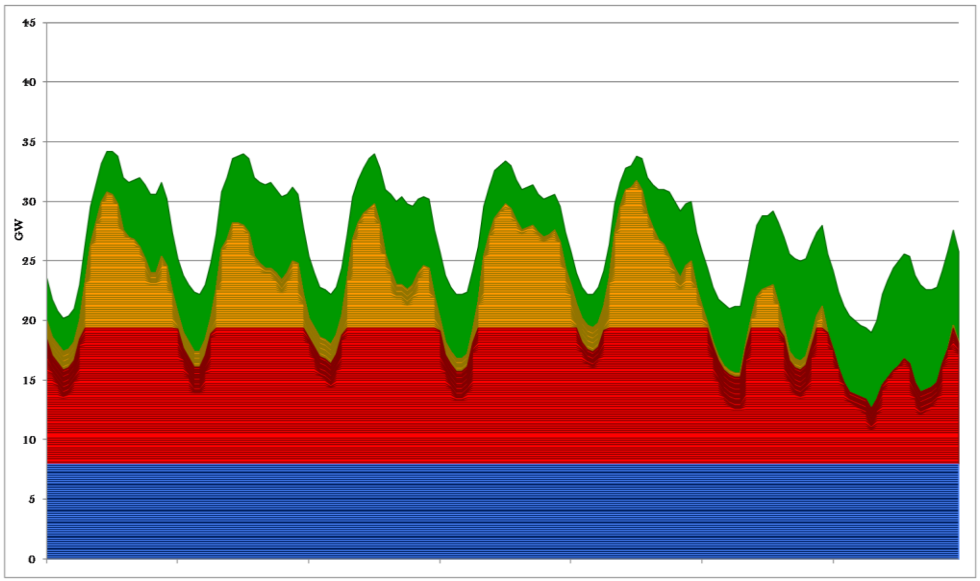
8-14 November



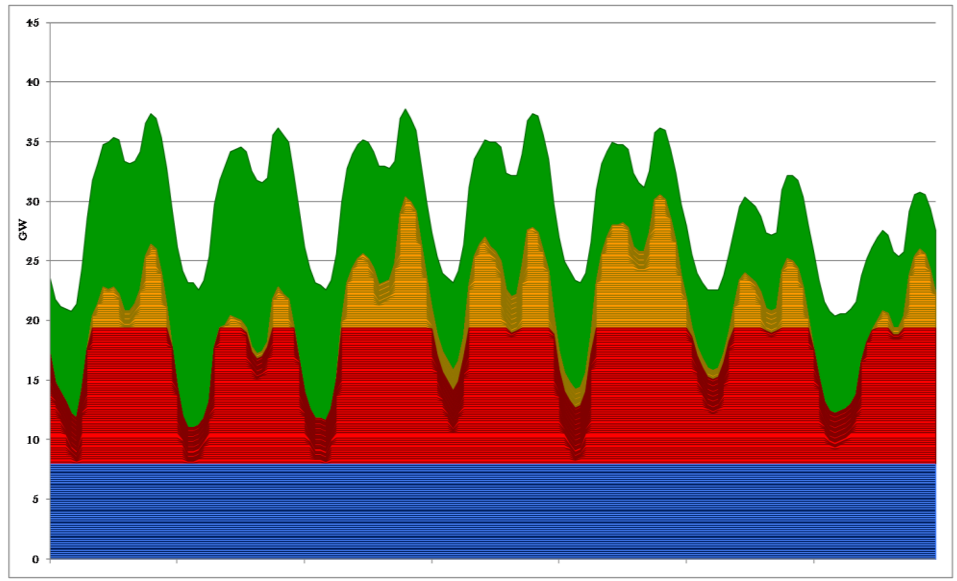
CCGT Coal Nuclear

20 GW wind

14-20 June



8-14 November

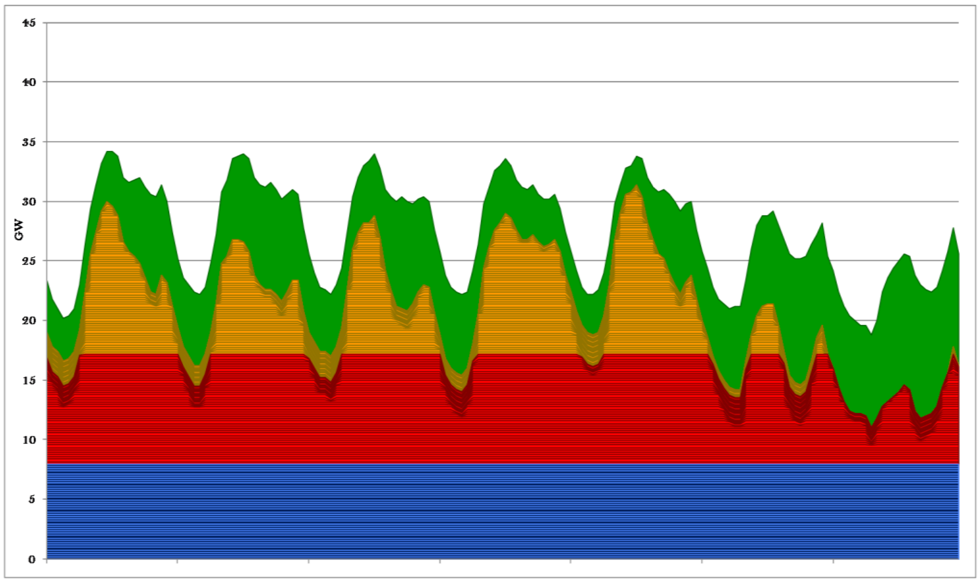


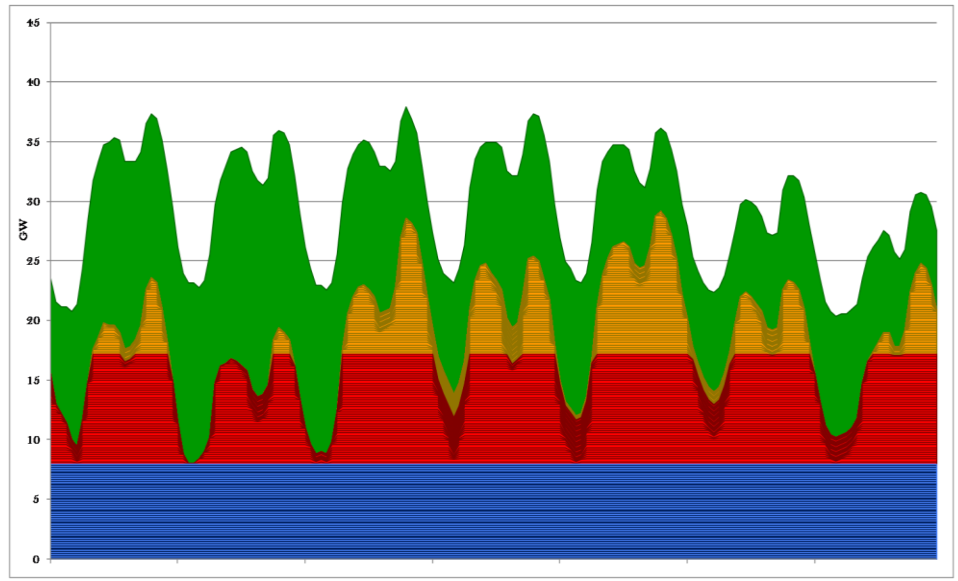
CCGT Coal Nuclear

25 GW wind

14-20 June

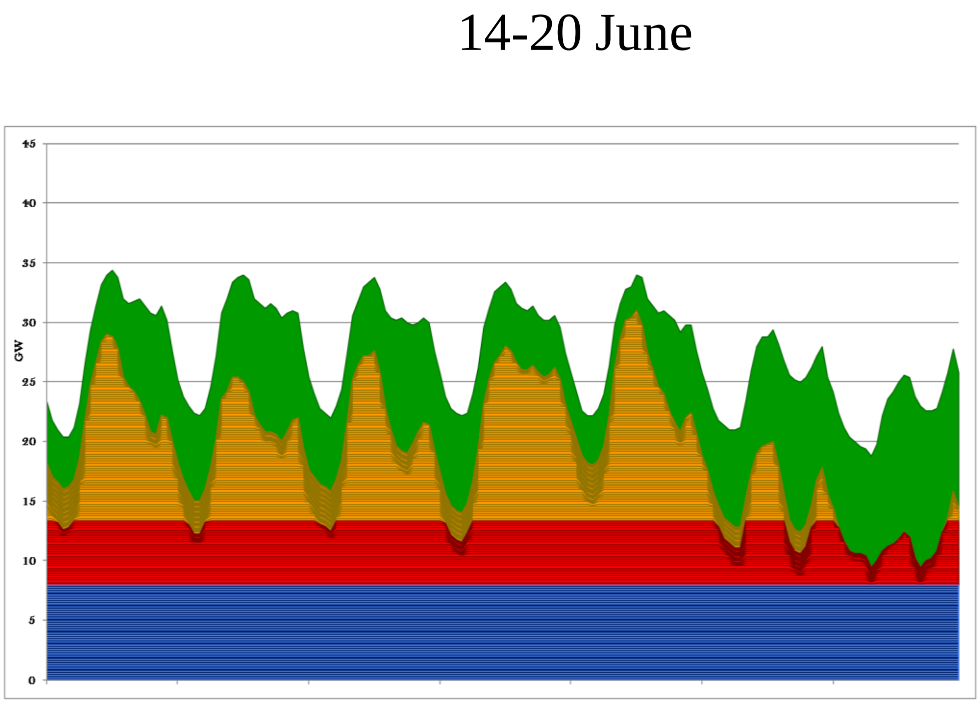
8-14 November

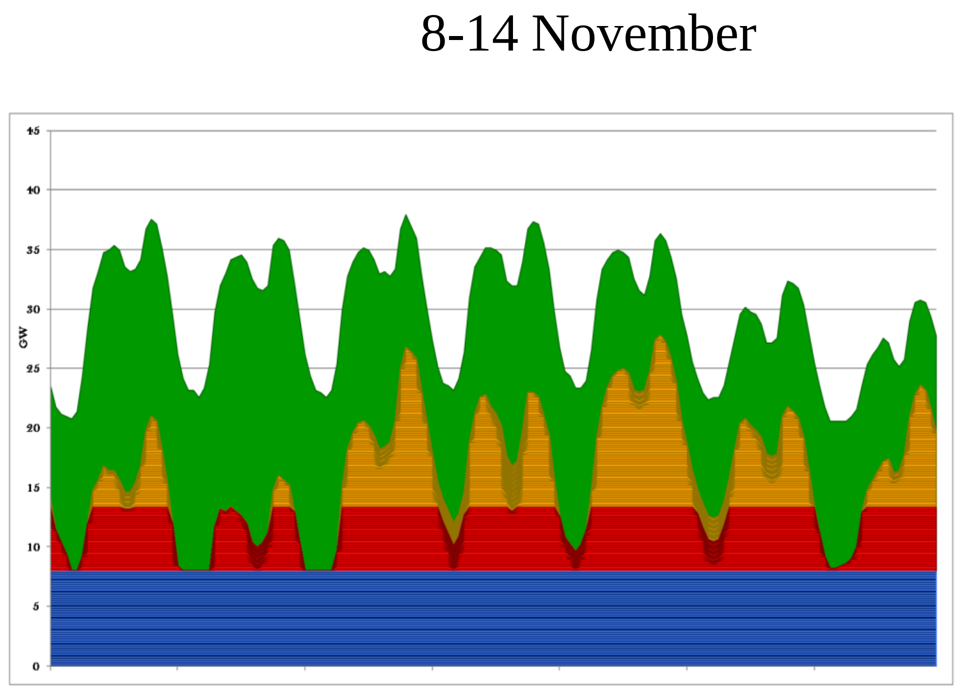




CCGT Coal Nuclear

30 GW wind

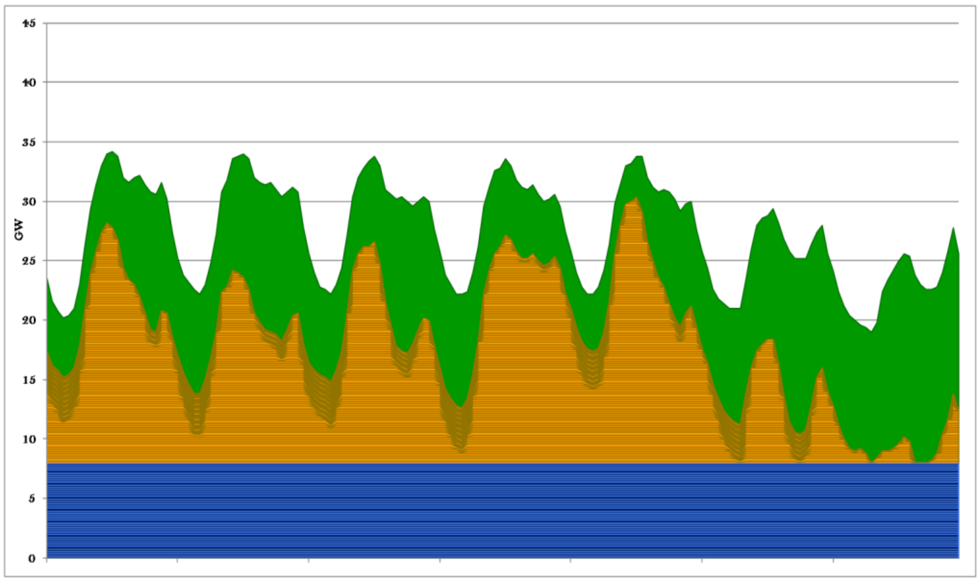




CCGT Coal Nuclear

35 GW wind

14-20 June



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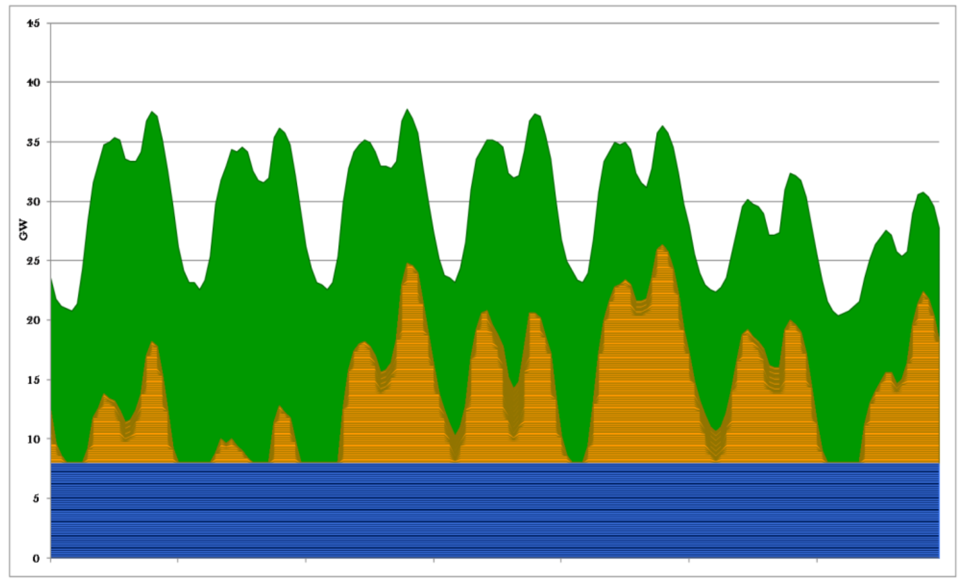
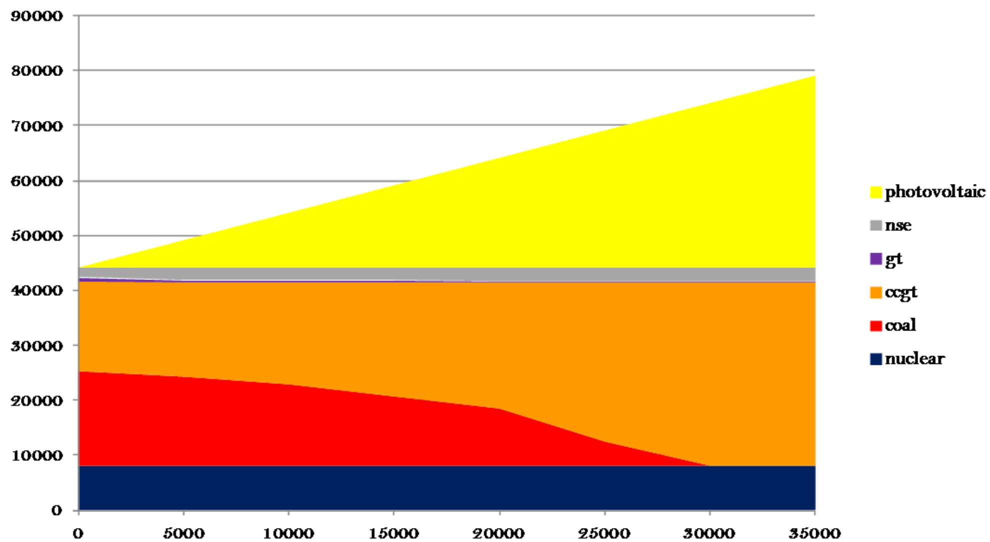
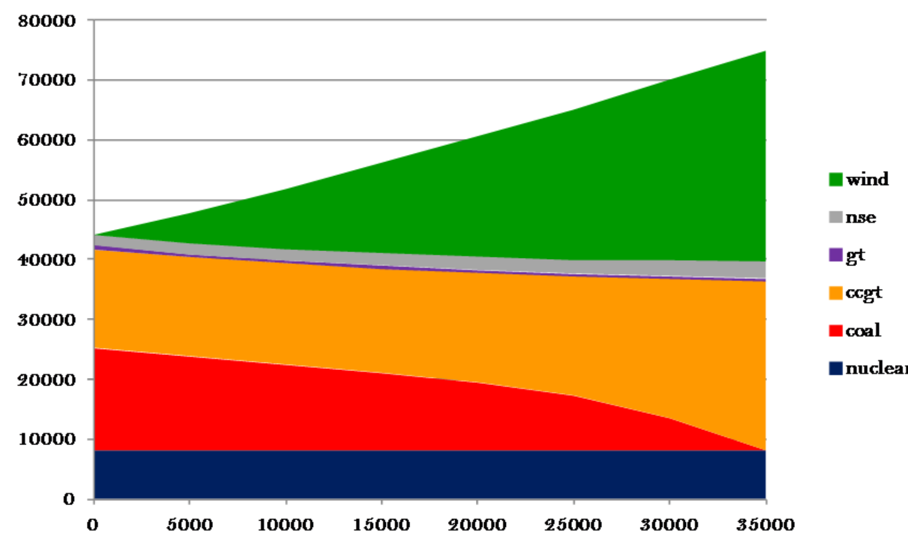


CCGT Coal Nuclear

Optimal generation capacity mix
as a function of PV & wind penetration levels



Increasing PV penetration level (MW)



Increasing wind penetration level (MW)

A thought for debate

- The presence of economically viable storage
  - will **facilitate** the deployment of more **intermittent renewable** generation
  - but it will also **decrease the pressure on less flexible** generation to disappear

The “target model”

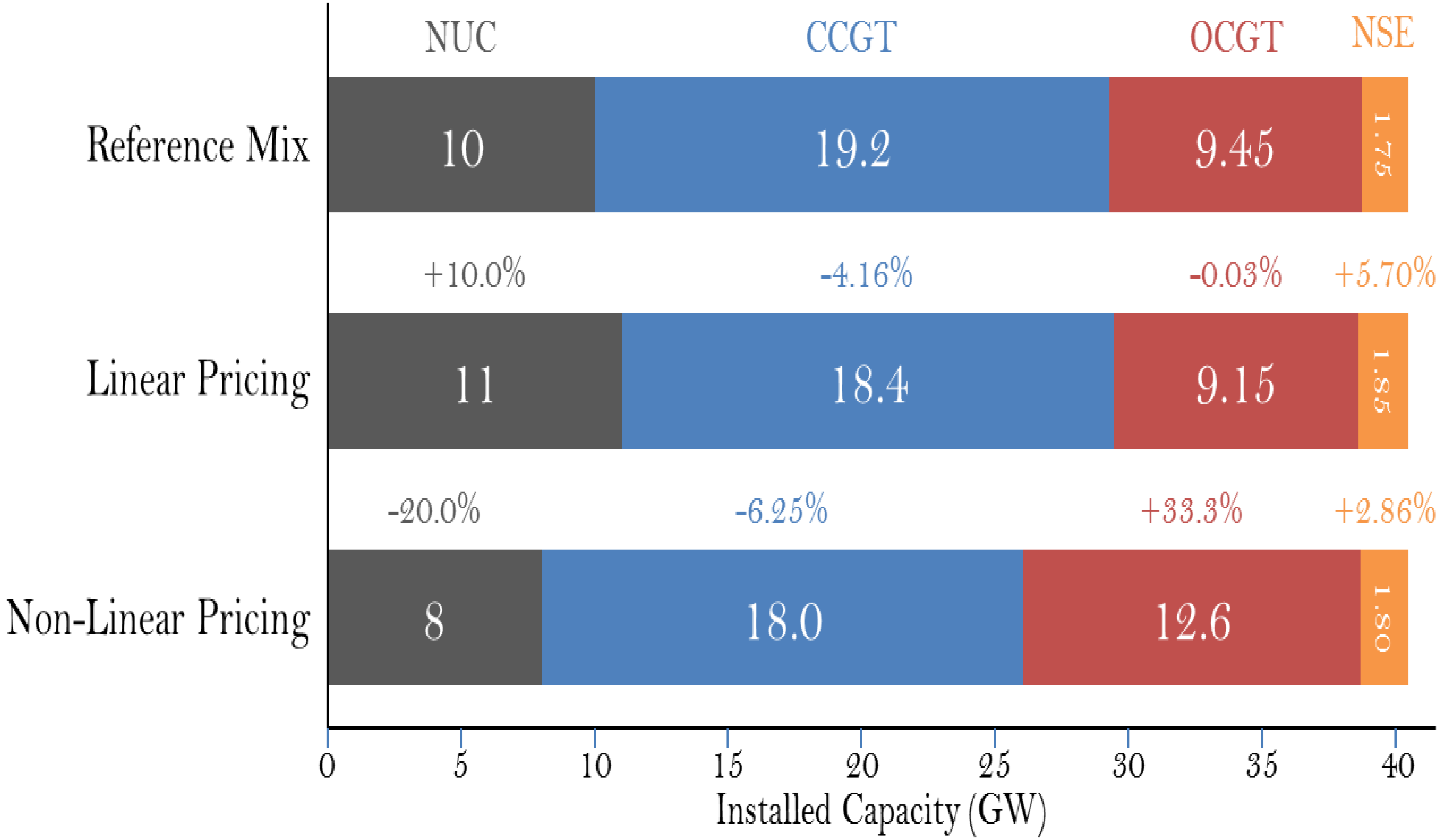
Market pricing rules do matter

Examining the future with advanced market simulation models

- Increased penetration of wind & solar **amplifies the differences** in market prices resulting from different market rules *(e.g. PJM & most US ISOs, Ireland or Spain & most EU PEXs),* as well as the impact on the corresponding well adapted generation mix
  - "**Nonlinear pricing**" seems to under-remunerate base-loaded plants, since the non-linear costs are only used for side payments to generators incurring them.
  - "**Linear pricing**" seems to over-remunerate base-loaded plants, by introducing the non-linear costs into the marginal price that applies to the energy produced by all plants

Source: "Intermittent RES-E, spot prices and investment incentives: The role of pricing rules", I. Herrero, C. Batlle, P. Rodilla. Submitted to Energy Economics, April 2014.

Impact of pricing rules with strong renewable penetration on the well-adapted generation mix

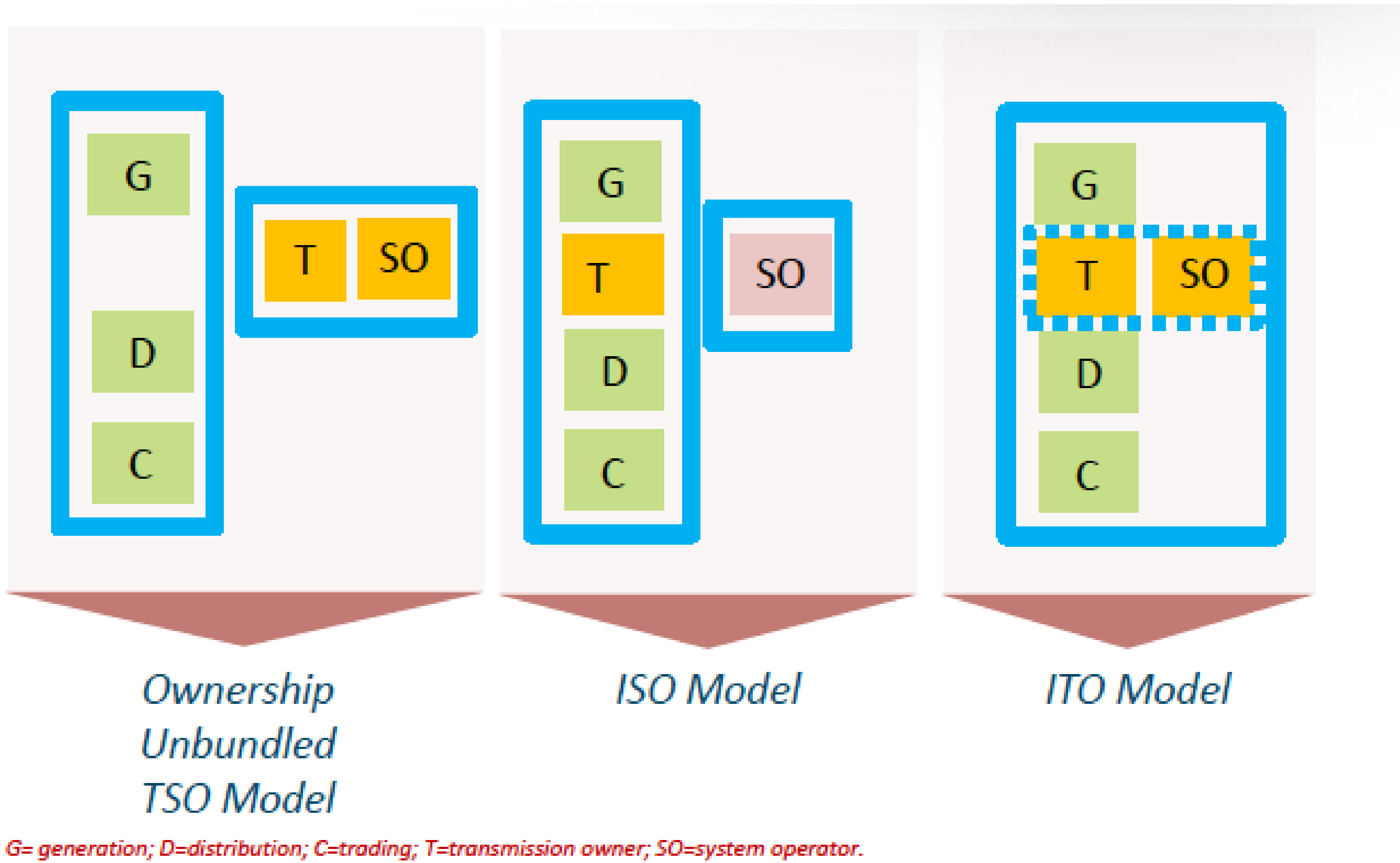


Source: "Intermittent RES-E, spot prices and investment incentives: The role of pricing rules", I. Herrero, C. Batlle, P. Rodilla. Submitted to Energy Economics, April 2014.

Electricity transmission planning

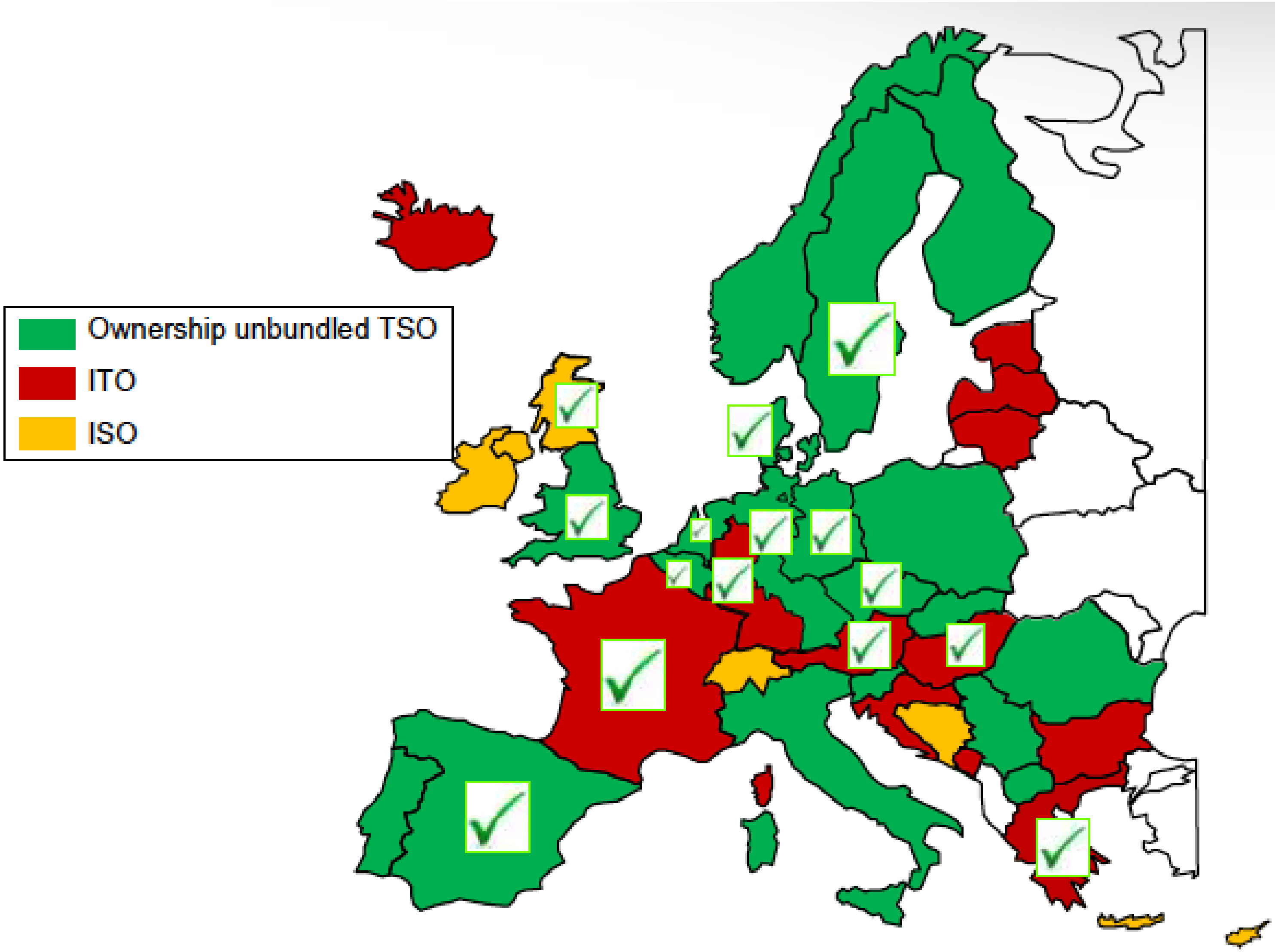
How to balance a global vision & respect for local jurisdiction?

Unbundling *(Directive 2009/72/CE)*



Source: José Luis Mata, Red Eléctrica de España

Unbundling *(Directive 2009/72/CE)*

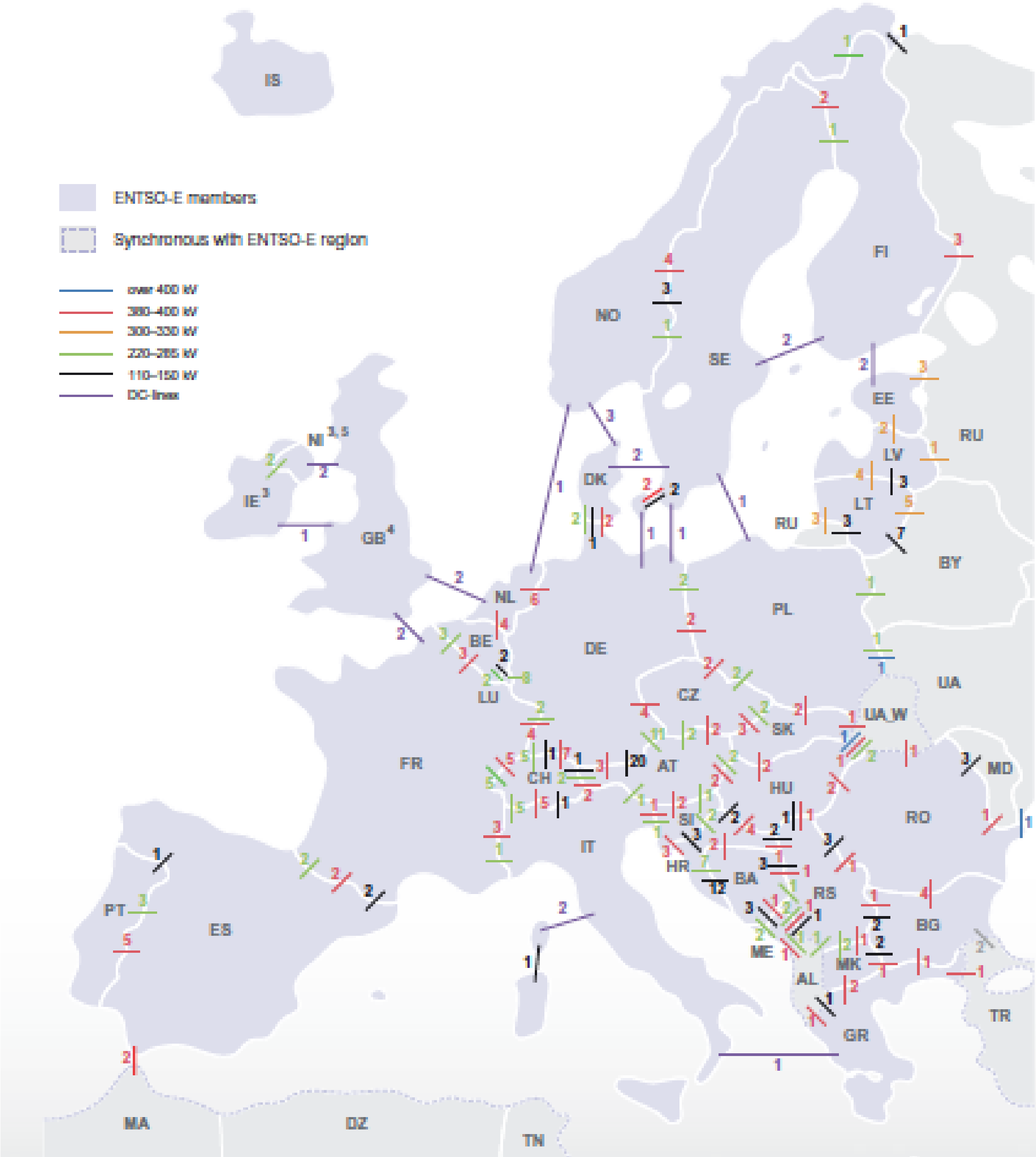


Source: Red Eléctrica (own elaboration based on public information from TSOs, ENTSO-E and European Commission as of March 12, 2013).

The challenge…

- Despite the large geographical dimension of the EU IEM & open transmission access, there are **not very significant transfers of electricity** between regions
  - The interconnections between regions are frequently weak
  - Typically there are no major surpluses / deficits
  - Generation technologies at the margin are frequently similar
- **This situation will probably change** with massive deployment of renewable generation, either internal or external
- A comprehensive approach to **transmission expansion has been lacking**, as well as the institutional capability for an effective implementation

Grid information



Number of circuits on cross-frontier transmission lines as of 31 December 2013 in the ENTSO-E area[1, 2]

ENTSO-E Overview circuit length in km

	Length of AC circuits	of which AC cable	Sum of DC cable
220 – 285 kV	141 359	3 230	
330 kV	9 141	14	
380 / 400 kV	151 272	1 512	
750 kV	471	0	
Sum	302 243	4 756	5 260

Number of cross frontier lines in the ENTSO-E area

	AC	DC
Over 400 kV	7	7
380–400 kV	116	4
300–330 kV	18	
200–285 kV	89	10
110–150 kV	88	1
Under 110 kV	1	
Sum	319	22

[1] Non geographic location of lines.

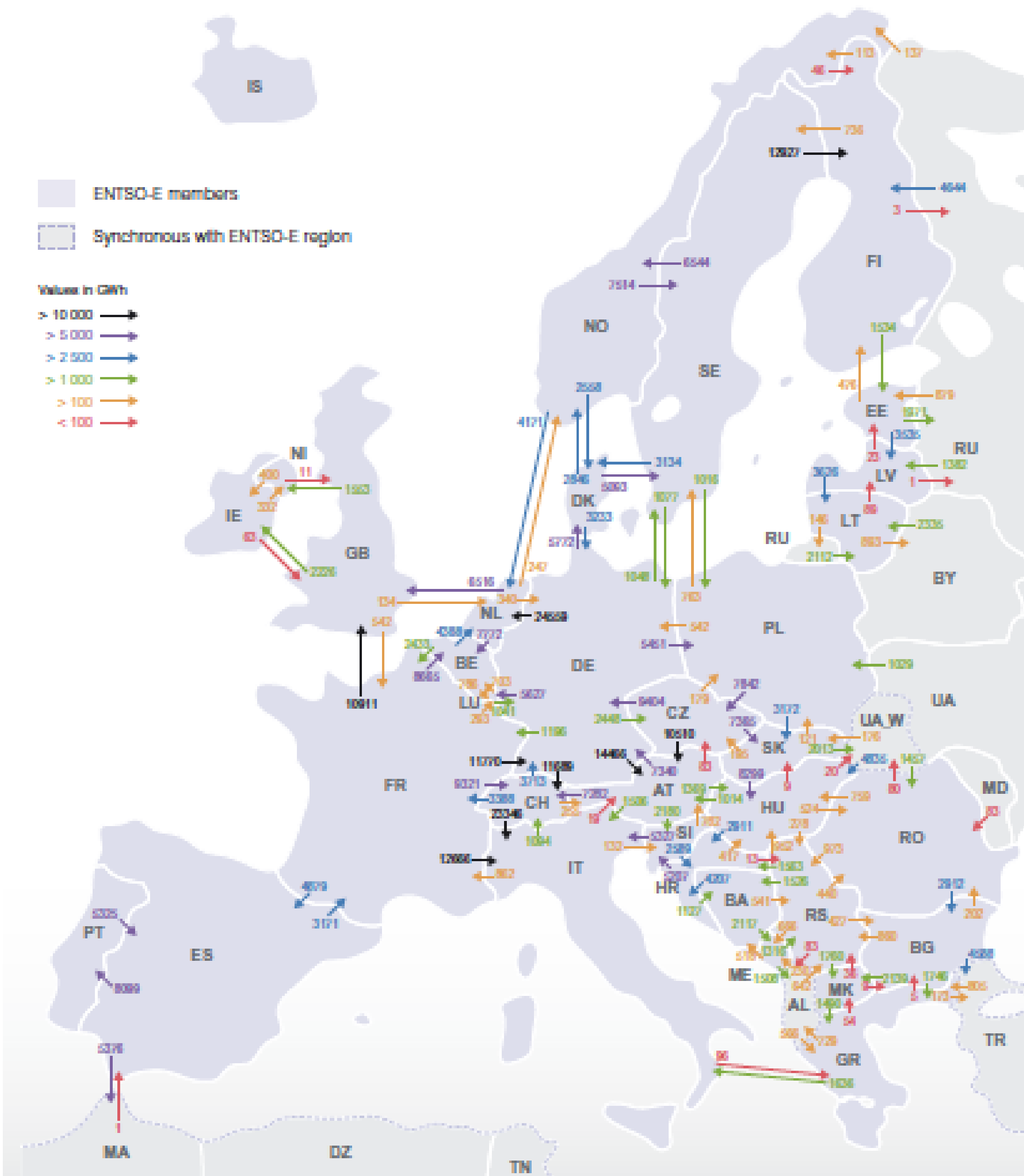
[2] Between IE and NI 275 kV instead 220 kV.

[3] Only lines operated by TSOs are taken into account.

[4] All data with the country code GB represents monthly statistical data as sum of England, Scotland and Wales.

[5] All data with the country code NI represents the monthly statistical data GB Northern Ireland.

Physical energy flows



	Sum of imports[1]	Sum of exports[1]	Balance (imp - exp)
AT	27 046	19 760	7 286
BA	3 171	6 865	-3 694
BE[4]	17 140	7 607	9 533
BG	3 353	9 535	-6 182
CH	29 386	30 702	-1 316
CY[2]	—	—	—
CZ	10 568	27 458	-16 890
DE	38 460	72 256	-33 796
DK	11 464	11 172	292
EE	2 436	5 982	-3 546
ES	10 205	16 646	-6 441
FI	18 093	2 386	15 707
FR[4]	11 592	58 212	-46 618
GB[3]	17 501	4 455	13 046
GR	4 703	2 597	2 106
HR	11 270	6 764	4 506
HU[4]	16 631	4 756	11 875
IE	2 626	395	2 231
IS[2]	—	—	—
IT	44 481	2 203	42 278
LT	8 073	1 128	6 945
LU[4]	6 706	1 744	4 962
LV	5 006	3 650	1 356
ME	3 013	3 342	-329
MK	3 953	1 535	2 418
NI[5]	1 885	411	1 474
NL	33 252	14 875	18 377
NO	9 887	14 289	-4 402
PL	7 801	12 323	-4 521
PT	8 099	5 325	2 774
RO	2 706	4 724	-2 018
RS	4 659	7 417	-2 758
SE[4]	15 154	24 698	-9 544
SI	7 519	8 698	-1 179
SK	10 722	10 628	94
ENTSO-E	**408 558**	**404 534**	**4 024**

Physical flow values in GWh

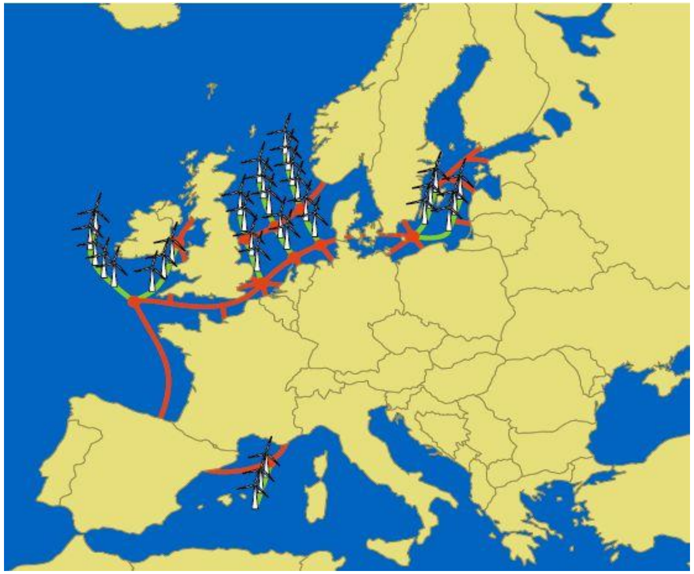
[1] Consolidated yearly values might differ from detailed flow data from the ENTSO-E database due to ex-post consolidation taking into account national statistical resources.

[2] Isolated system; therefore no exchange data.

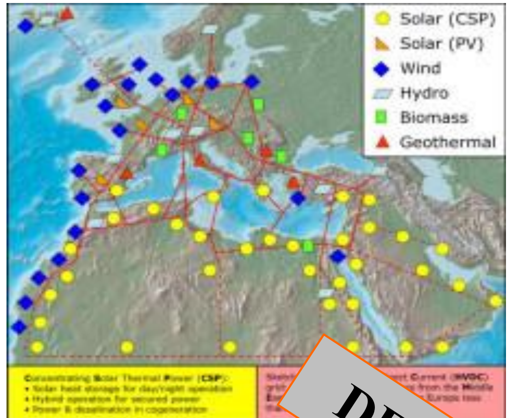
[3] All data with the country code GB represents monthly statistical data as sum of England, Scotland and Wales.

[4] The reported exchange data are not complete.

[5] All data with the country code NI represents the monthly statistical data of GB Northern Ireland.

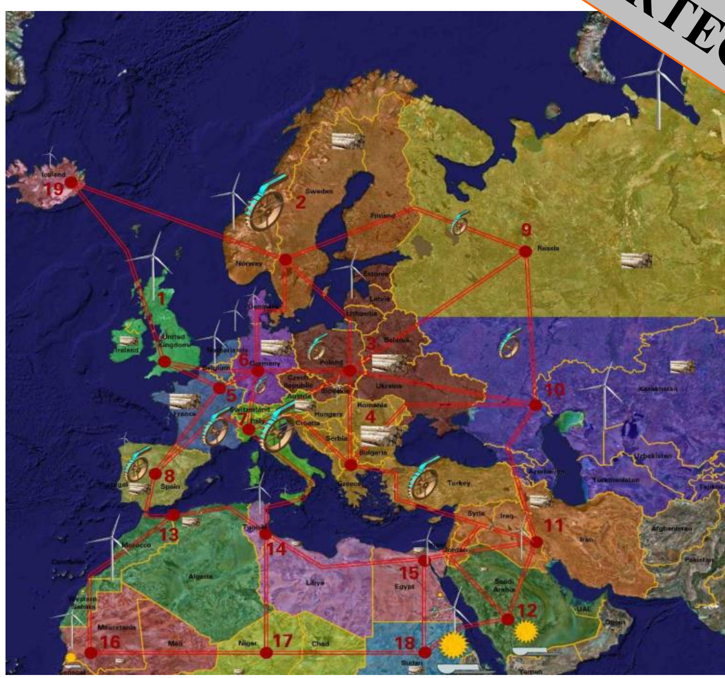


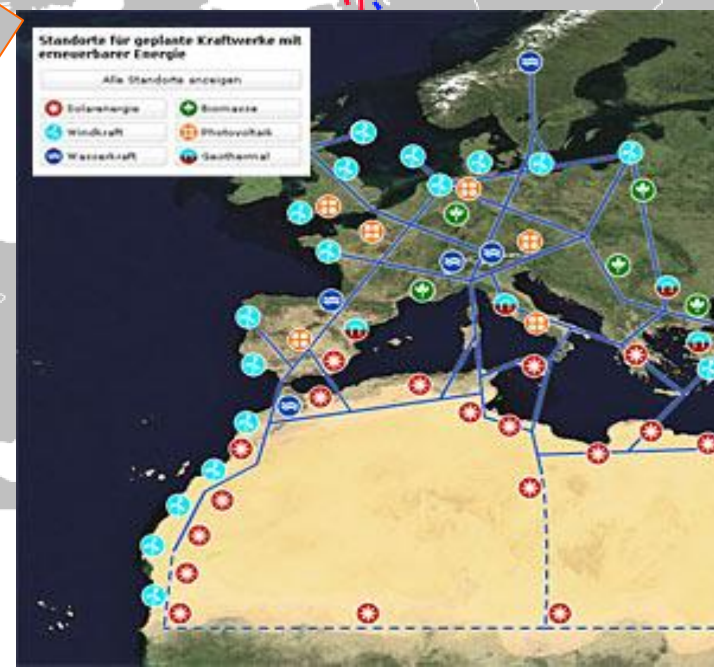
EU Offshore Super grid



DESERTEC

HVDC Links



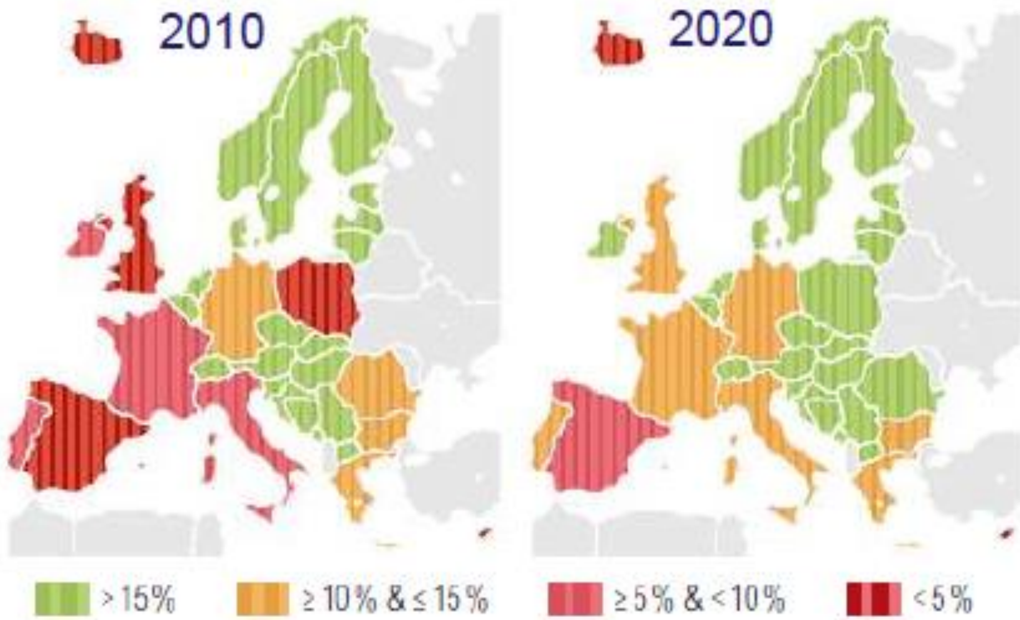


Which one to choose?

TYNDP 2012

Transmission adequacy

Interconnection ratio 2010-2020



INTERCONNECTION RATIO:
Exchange capacity (import) vs. Total installed generation capacity (%)

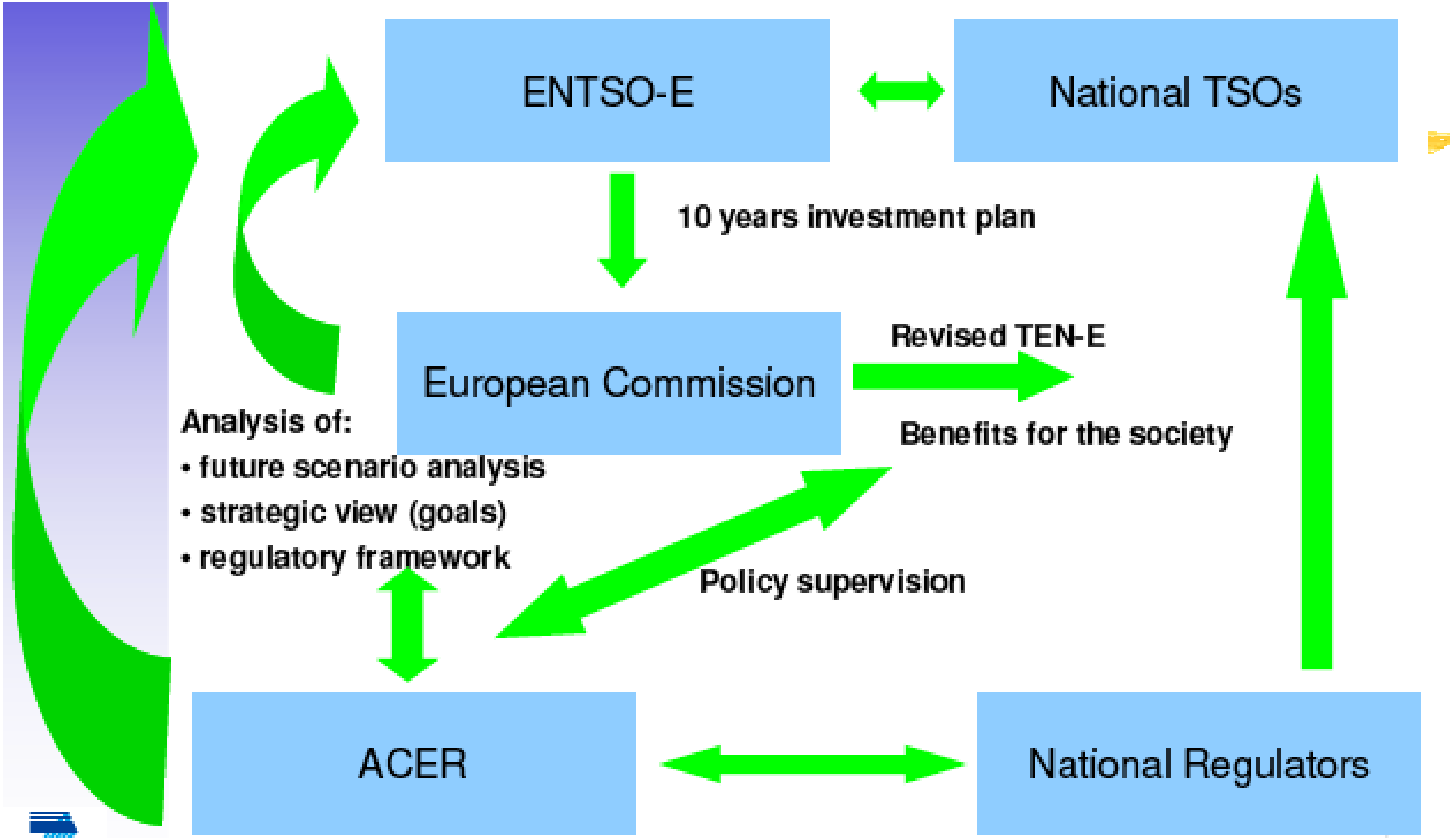
Objective value = 10%

100 main bottlenecks in Europe in 2020

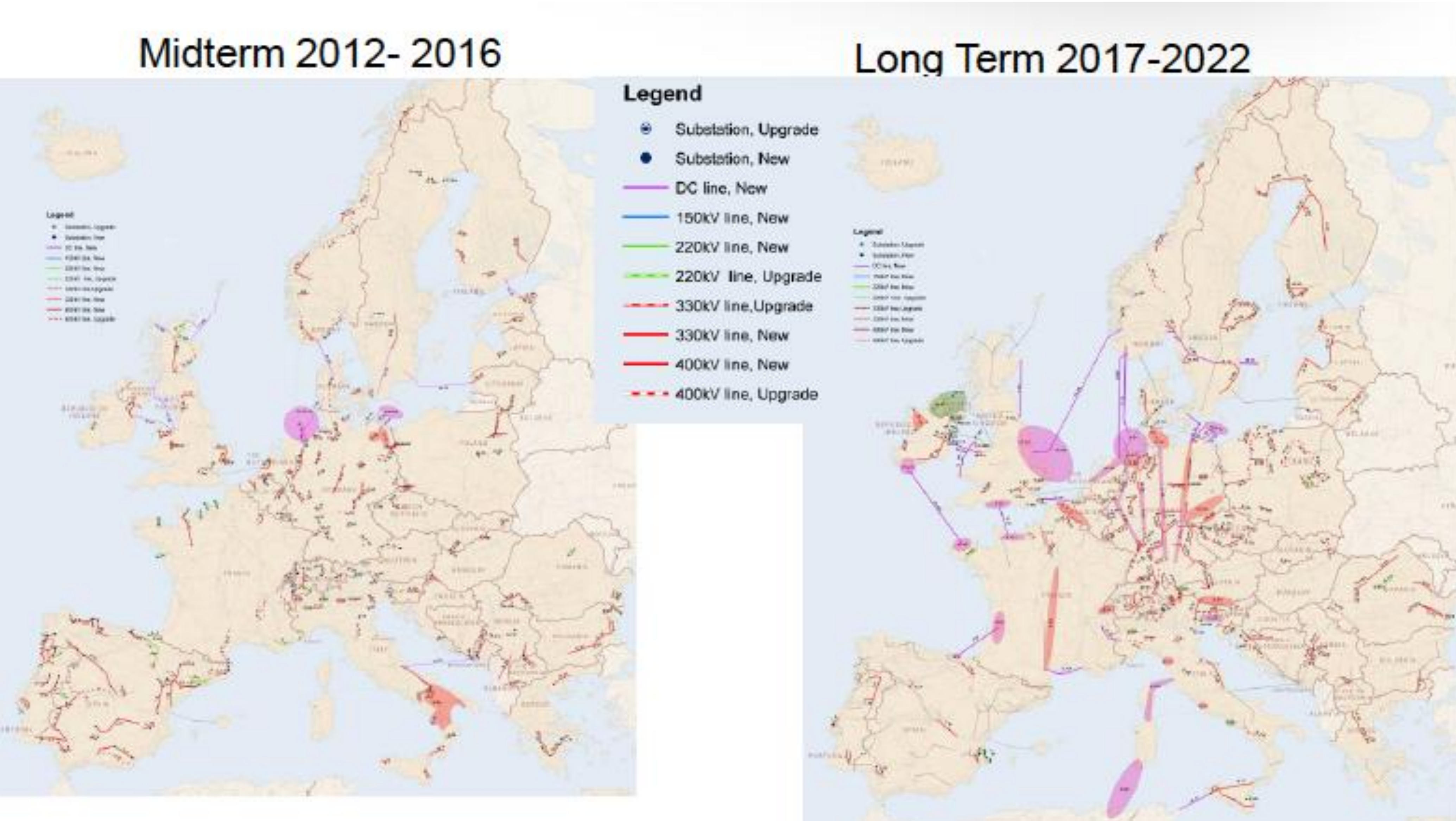
Source: José Luis Mata, Red Eléctrica de España

… and the EU regulatory response

- Electricity Directive & Regulation, July 2009
  - Establish the participation of TSOs, collectively (ENTSO) & individually, the regulatory authorities, collectively (ACER) & individually, the Member States & the concerned stakeholders
- **Non mandatory EU-wide** 10-year ahead transmission expansion plan prepared by ENTSO-E every other year *(European Network of Transmission System Operators for Electricity)*
  - First plan published March 2010, second (draft) March 2012
- **Mandatory national** transmission expansion plans *(prepared by national TSOs & approved & enforced by national regulators)*
- Final decisions are left to national regulators & TSOs with **ACER supervising compliance** with EU-wide plan


ENTSO-E
National TSOs
10 years investment plan
European Commission
Revised TEN-E
Benefits for the society
Analysis of:
• future scenario analysis
• strategic view (goals)
• regulatory framework
Policy supervision
ACER
National Regulators

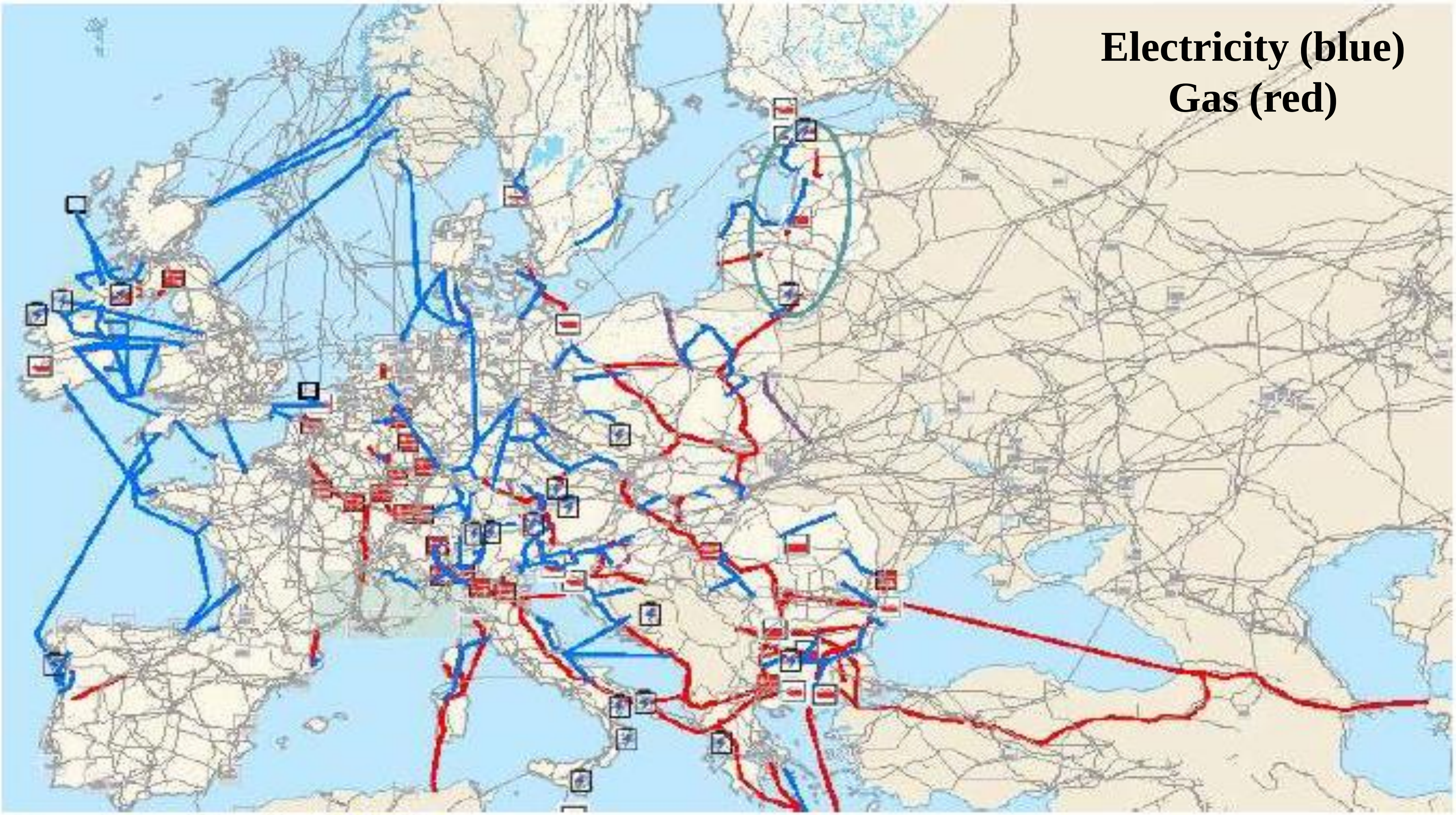
TYNDP 2012 *(Projects of EU significance)*



Source: José Luis Mata, Red Eléctrica de España

EU legislation on Energy Infrastructure

- **Projects of common interest (PCI)**



Source: European Commission – DG ENER

Source: http://ec.europa.eu/energy/infrastructure/transparency_platform/map-viewer/

Is this response enough?

- Institutions of European dimension *(ENTSO & ACER)* are responsible for developing *(non mandatory)* EU-wide transmission expansion plans
  - However, final decisions are left to national regulators & TSOs
- Critical issues (authorizations, siting, remuneration *(Art. 22.7 & 22.8 of Regulation)*) are still open & **cost allocation** implicitly results from the Inter-TSO payment mechanism but the current method *(not its underlying rationale)* needs a thorough review

Electricity transmission cost allocation

The three fundamental principles

Abandon this mental model…

… & follow the Single System Paradigm

The EU hierarchical cost allocation method

- The basic principle behind the current "inter-TSO compensation scheme" ***(payment of the "modified" transmission charges in your country gives you access to the entire regional market)*** should be the basis for a future EU-wide transmission cost allocation method, since
  - reduces the dimensionality problem
  - simplifies much the process
  - does not require harmonization at Member State / TSO level of the internal transmission cost allocation procedures

Inter-TSO payments
Computation

- **Step 1.** Determine the **compensation** that is due to each country/TSO on the basis of the external use of its network & standard network & energy costs
- **Step 2.** Determine the **charges** to be applied to each country/TSO because of its responsibility in the extra costs of other countries
- **Step 3.** Application of the **net balance** of compensation & charges of a country/TSO to its internal network users

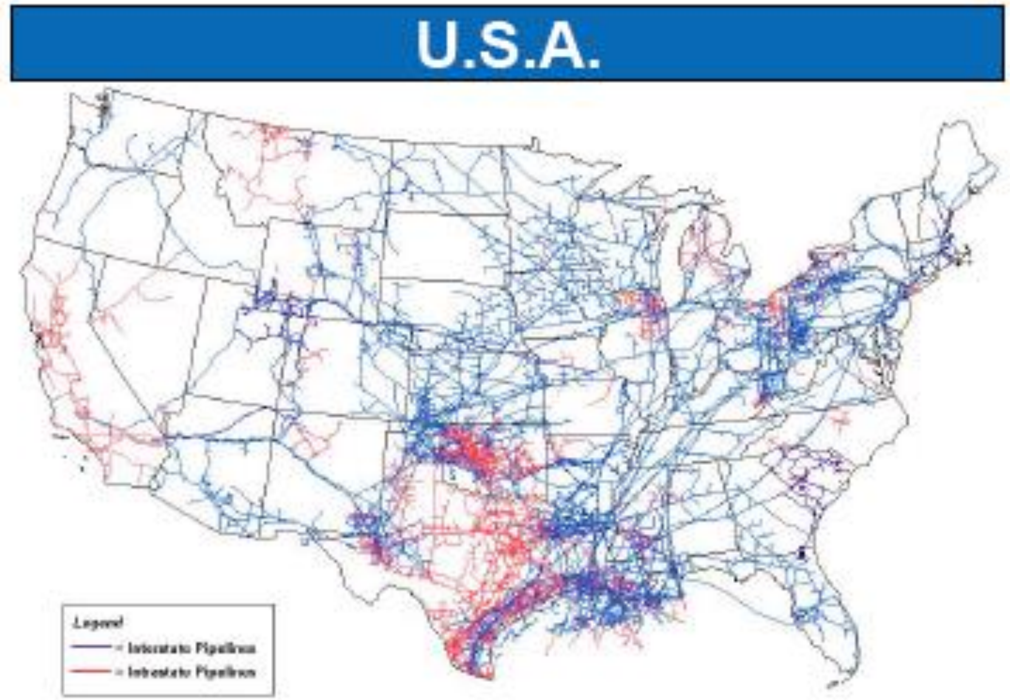
Still a long way for application of basic cost allocation principles

- **Beneficiary pays** *(i.e.* ***responsibility in network investment****)* ↓
- Transmission network charges **should not depend on commercial transactions** ↑
- Transmission network charges should be determined **ex ante and not updated** *(at least for a reasonably long time)* ↓

Gas transmission

The EU & US approaches

Approaches to investment in gas pipelines: How much does regulation matter?



Source: Energy Information Administration, Office of Oil & Gas, Natural Gas Division, Gas Transportation Information System

The success of each regime does not depend on physical differences, but on regulatory differences

Approaches to investment in gas pipelines *(1 of 2)*

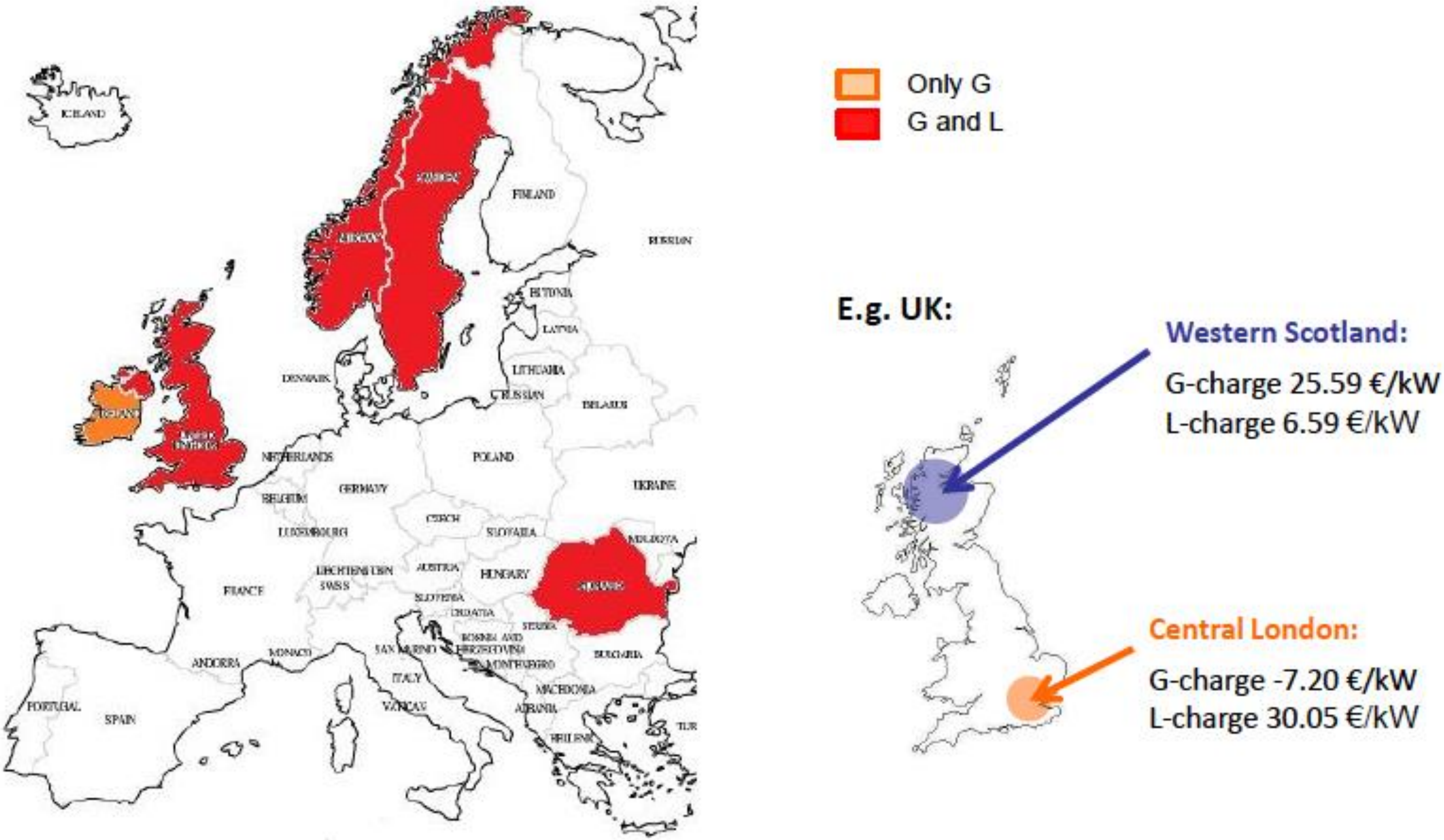
- The **European approach** is based on two complementary mechanisms
  - A. **National expansion plans** that ACER verifies are consistent with the non-mandatory EU-wide plan prepared by ENTSO-G and costs are recovered via regulated entry-exit tariffs
  - B. “Exempted” **merchant pipelines**, whose costs are covered by bilateral contracts between investors & users
- The traditional approach (B) to finance large projects faces considerable **financial uncertainties** & the regulated approach (A) meets **political difficulties** on decision making & cost allocation

Approaches to investment in gas pipelines *(2 of 2)*

- The **US approach** is based on **open access** subject to a well-defined & stable **regulatory compact**
  - Very liquid & competitive gas market
  - Point-to-point lines are built by numerous independent private investors under long term contracts with gas distribution companies that pass the cost to regulated gas tariffs
  - Open seasons and obligation of existing pipelines to provide taps
  - Economic value of lines is passed (somehow?) to consumers at the expiration of the contracts

Harmonization

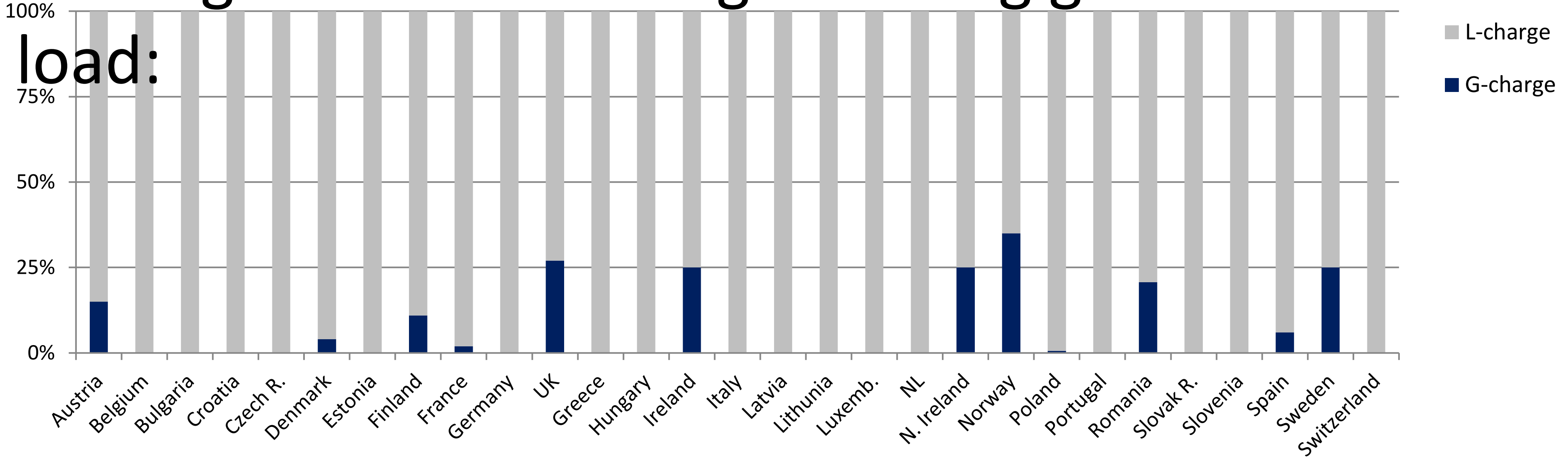
Of gas & electricity transmission tariffs?



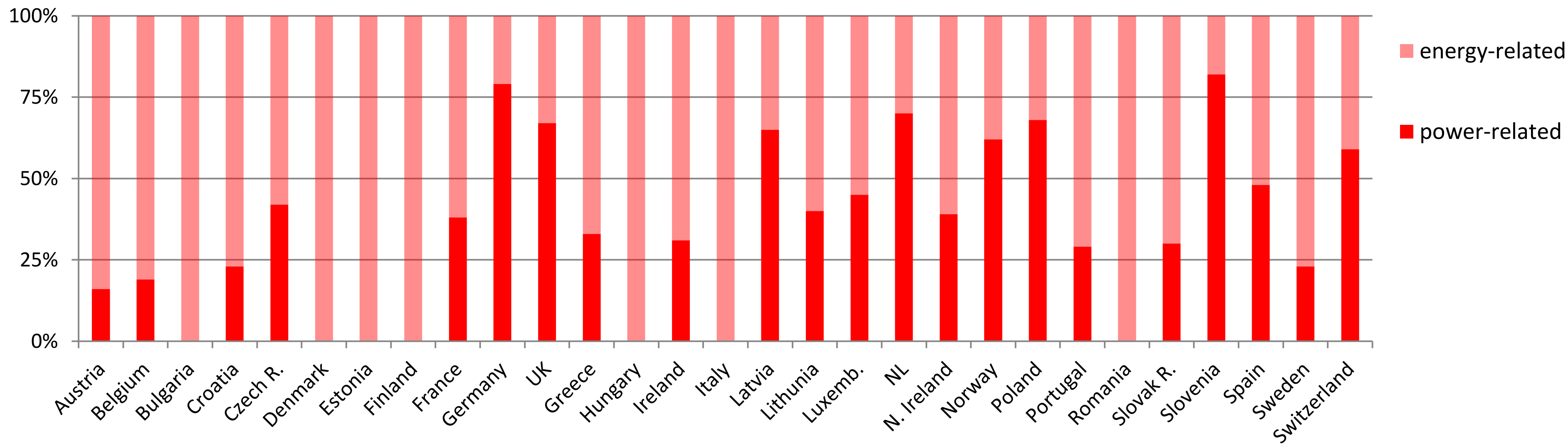
Source: Project THINK, Florence School of Regulation

Data source: ENTSO-E (2011)

Sharing of network charges among generation and load:



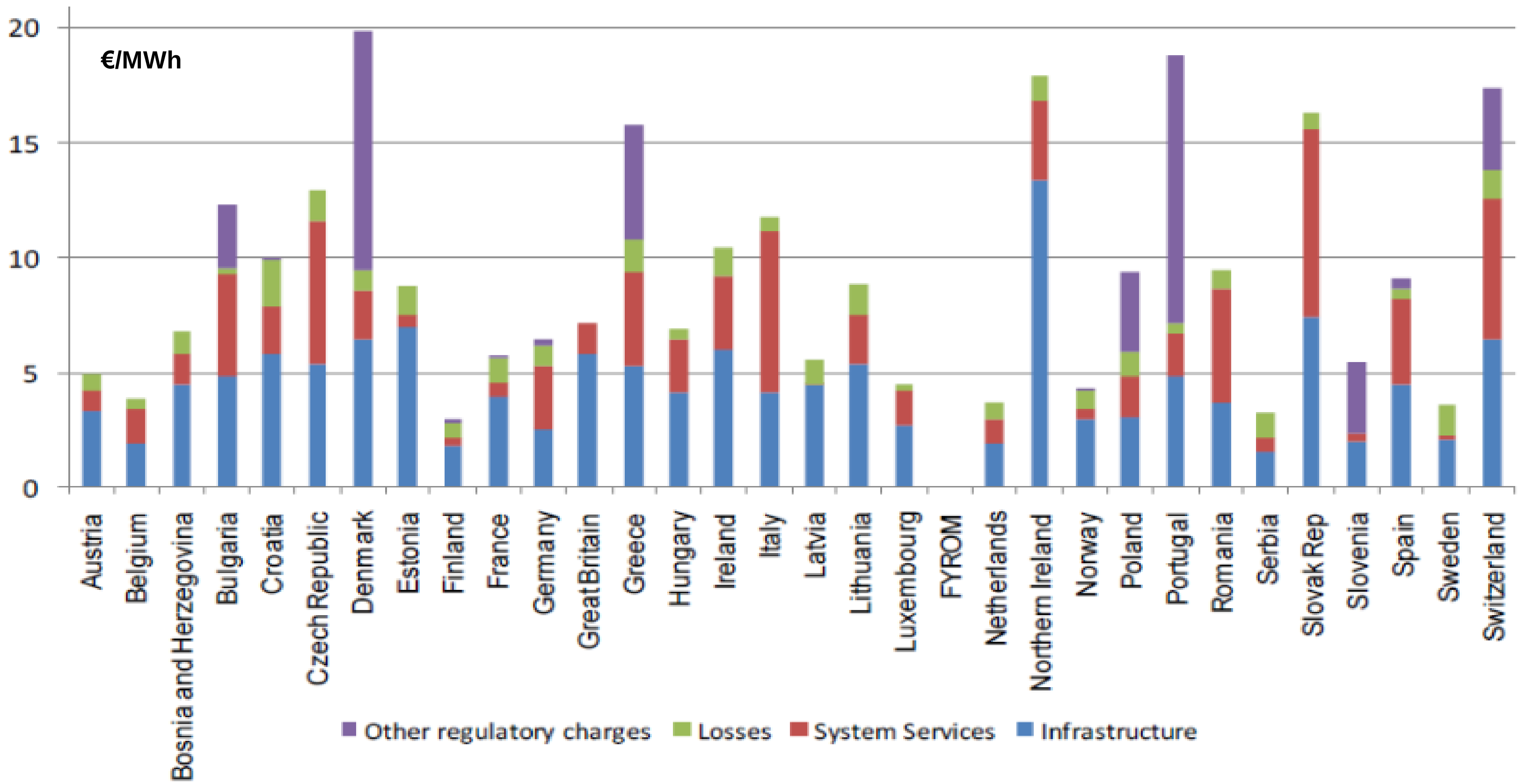
Form of tariff components:



Experience from the EU electricity sector

Diversity regarding components included in tariff

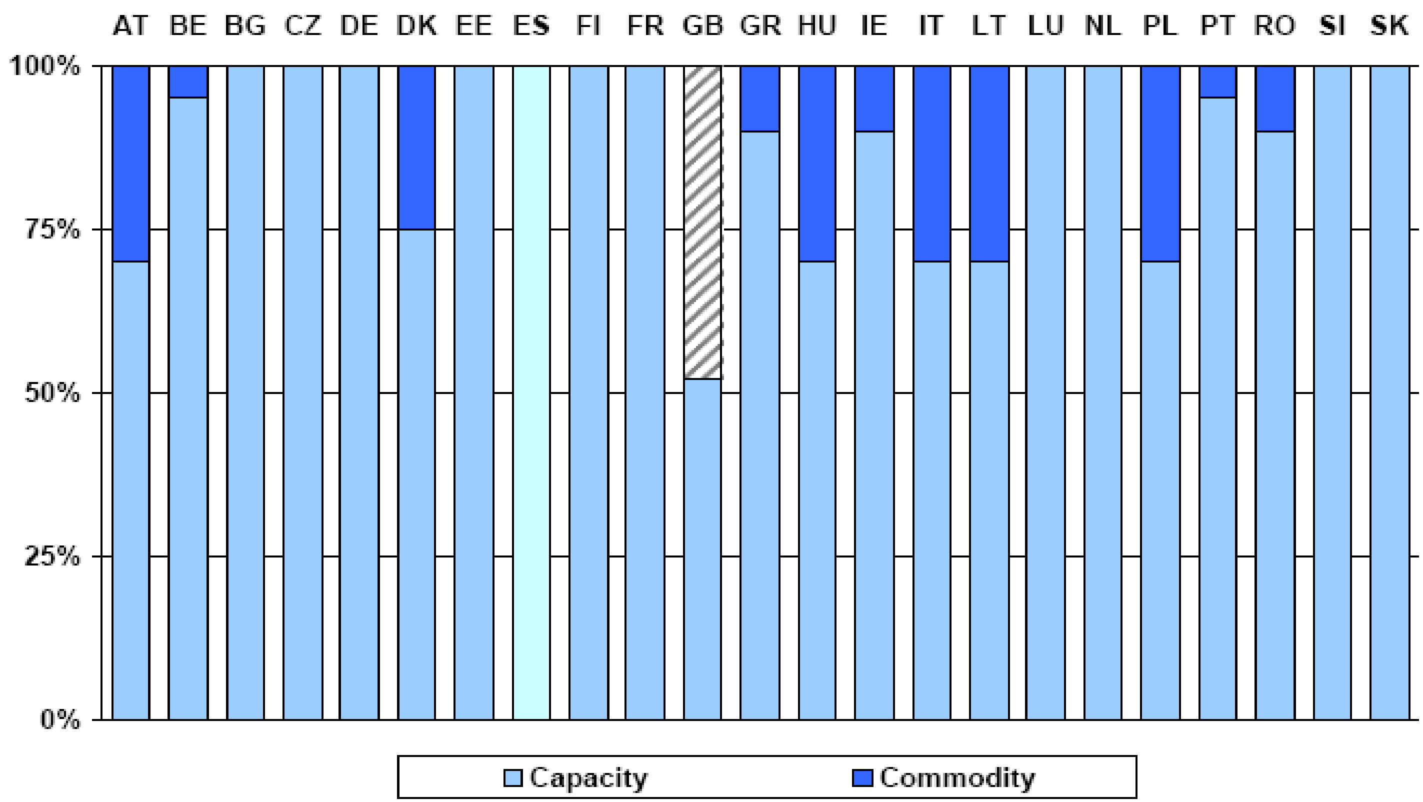
- Tariffs do not cover the same cost components in all countries (Costs from losses and/or system services might be included in the tariffs or not, etc.)
- In the following discussion, we will focus on <u>network costs</u> (i.e. building and operating grids)



Experience from the natural gas sector

Heterogeneity in form of tariff components

- Tariff mainly based on contracted capacity, with some countries also applying an energy-related component



[Furthermore, not obvious which cost components included in commodity charge]

Source: KEMA (2009)

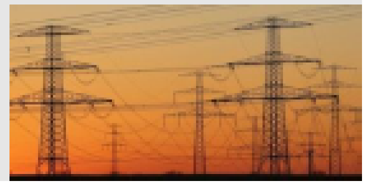
Does heterogeneity matter?

EU involvement in electricity and natural gas transmission grid tarification

Regulation of TSO revenues

- No need for an EU-wide harmonization
- Benchmarking of national practices through ACER
- Consideration of innovative solutions to trigger investment

Electricity transmission tariffs



- Definition of cost components to be included
- Allocation based on principle of cost-causality
- Minimum G-charge
- Limit charging in €/MWh

Natural gas transmission tariffs

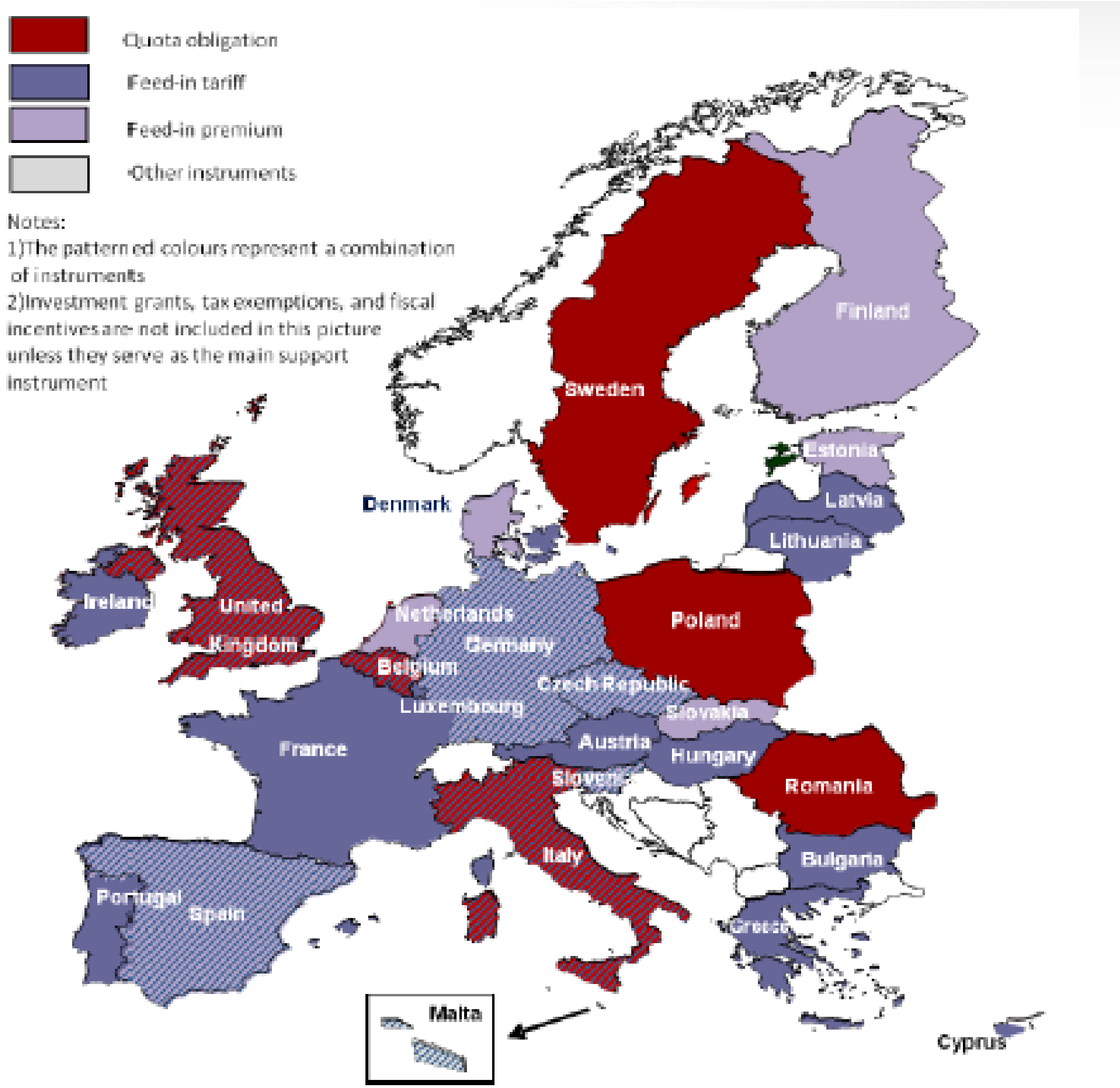
- Principles for determining ideal size of market areas
- Breakdown of costs among (a) grid users and (b) entry-/exit points in cost-reflective way
- Good-practice guidelines

Source: Project THINK, Florence School of Regulation

Harmonization

Of renewables promotion instruments?

RES support schemes in Europe as of 2012



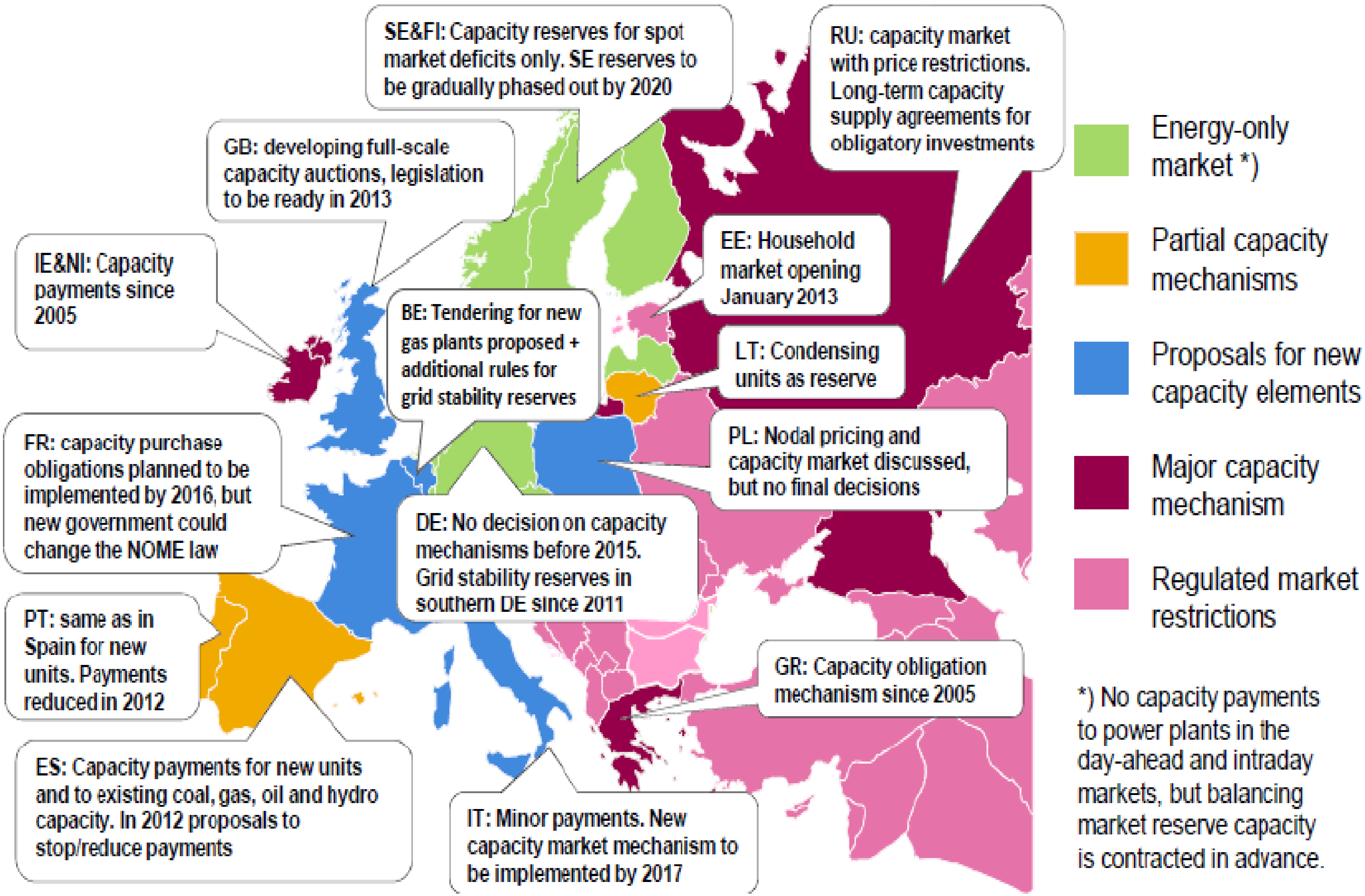
Source: José Luis Mata, Red Eléctrica de España

Harmonization

Of capacity mechanisms?

Capacity mechanisms in the EU Member States

(Eurelectric, March 2013)



Significant issues when integrating capacity mechanisms in a regional market

- A "regional" market should imply that there is some sort of **joint approach to reliability** *(& not only a concern that the proliferation of local capacity mechanisms may distort the energy market)*
  - A **minimum requirement** in a regional market should be that all agents in the regional market must be **allowed to participate** in whatever capacity mechanism is established by any local authority *(e.g. other member state in the EU)*
  - … in other words, that **a commitment** of a generator located in system A to contribute to the capacity mechanism in system B, **cannot be cancelled** by the regulator in A **because the capacity committed** to B **is also needed** in system A

Significant issues when integrating capacity mechanisms in a regional market

- A diversity of *(well-designed)* capacity mechanisms **will not distort the short-term efficiency** of a regional market **IFF**
  - The rule in the previous slide *(which amounts to **Article 4.3 of the Security of Supply Directive**)* is applied
    - with firm nominations of cross-border bilateral contracts *(only applied in case of emergency)*
    - without need for cross-border capacity reservations
    - & limited by the actual interconnection capacity limits
  - However, this diversity will result in **loss of efficiency in the deployment of installed capacity**

Significant issues when integrating capacity mechanisms in a regional market

- It is to be expected *(still a hypothesis)* that application of Article 4.3 of the Security of Supply Directive will
  - significantly reduce any possible distortion of the local capacity mechanisms in the EU-wide electricity energy market
  - & will (subtly) reduce the proliferation of disparate capacity mechanisms & converge towards the dominant (preferable) ones
- **Demand response** has to play a crucial role ➔ TSOs have to open grid codes to take advantage of this potential

EU-wide energy policy

Lack of consistency?

Targets vs CO2 prices

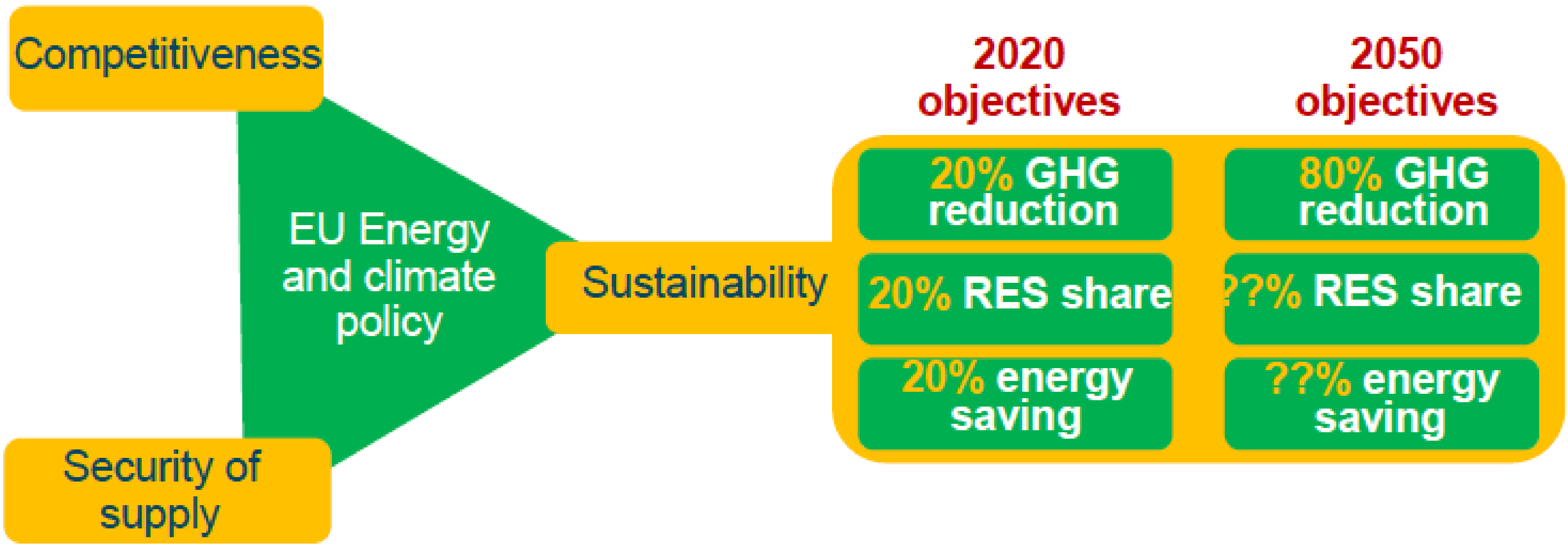
The struggle to establish an UE Energy Policy

Towards a EU energy policy

- After much indecision, the EU was able to establish in the early 2000s important regulation:
  - Inspired by sustainability & with the classical objectives of security, economy & environmental concern
  - Reduction 2020/1990 of CO2 emissions by 20% *(30% if international consensus)*
  - Improvement of 20% of efficiency in consumption
  - Target of 20% of renewables in final energy consumption *(approx. 35 to 40% of electricity production)*
  - Plus: Implementation of the GHG Emission Trading Scheme, more than 10 Directives & Regulations approved in 2009 & 2010, standards for appliances, sustainability criteria for biofuels, instruments to support clean technologies, infrastructures, 2050 Energy Roadmap, etc.

EU Energy Policy

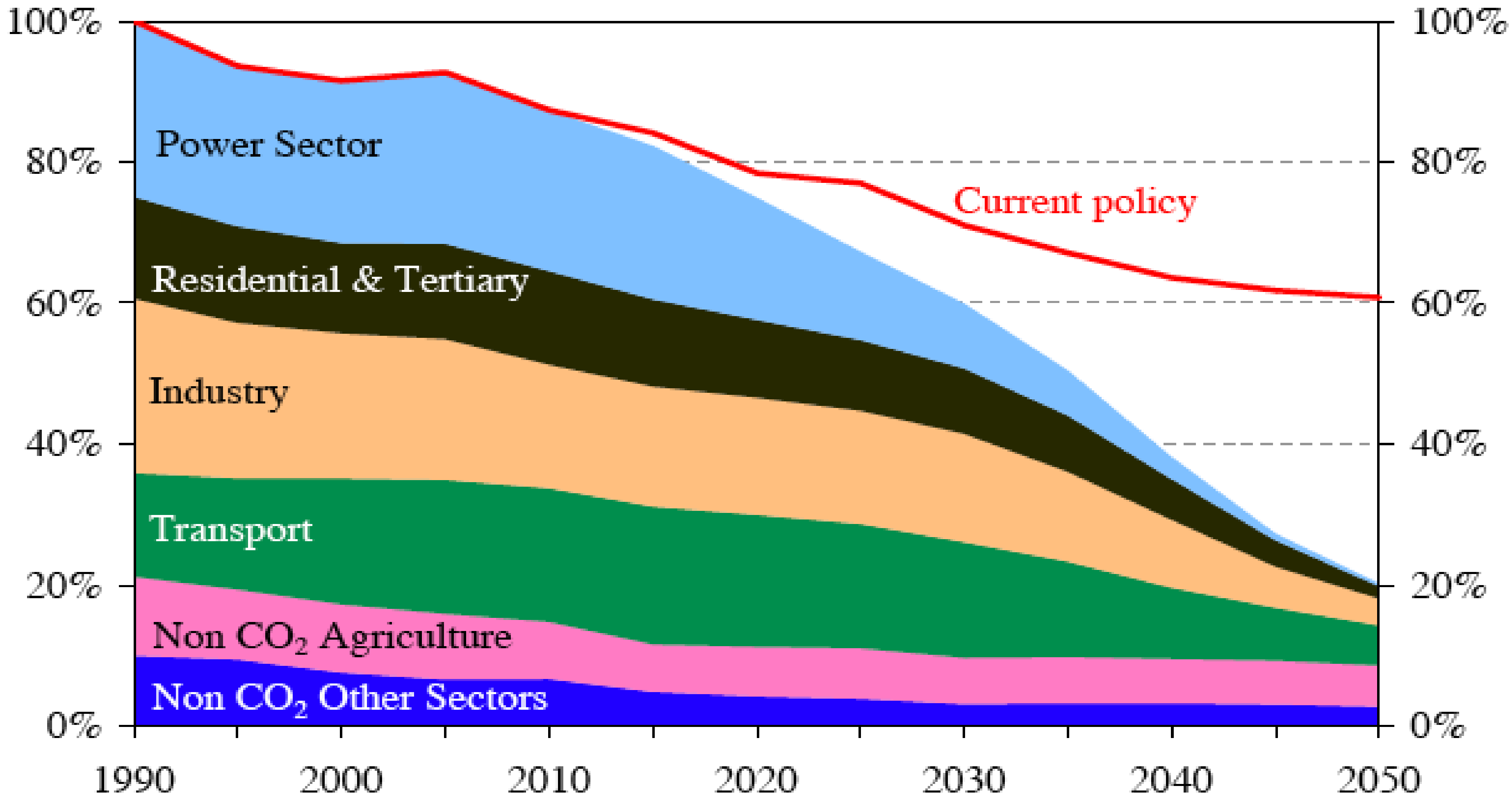
- EU Energy and Climate policy objectives envisage a largely decarbonised energy system, which will need higher percentages of electricity supply from Renewable Energy Sources (RES):



Source: José Luis Mata, Red Eléctrica de España

The EU 2050 Climate Change Roadmap

Figure 1: EU GHG emissions towards an 80% domestic reduction (100% =1990)

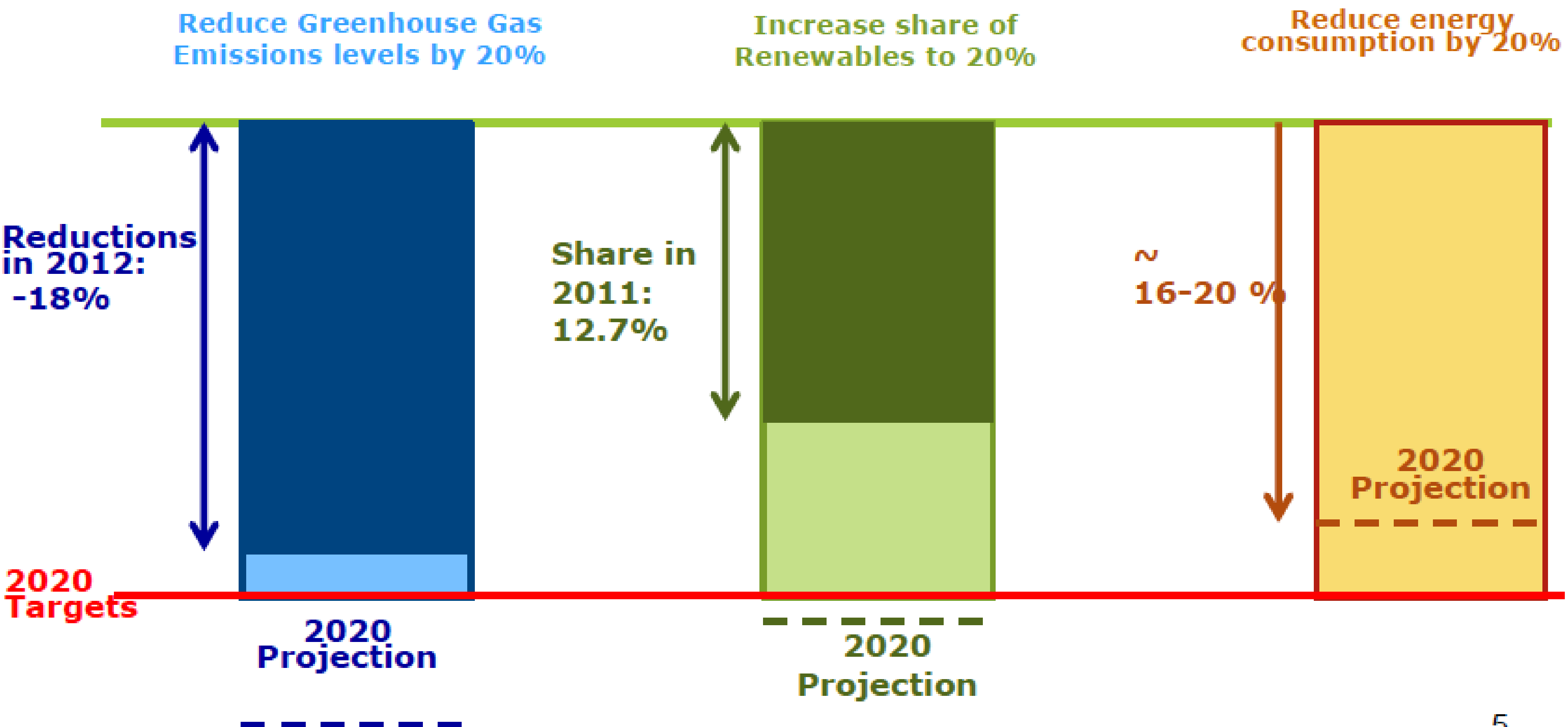


Source: "A Roadmap for moving to a competitive low carbon economy in 2050", EU Commission (DG Climate), COM(2011) 112 final, March-8-2011

Towards a EU energy policy

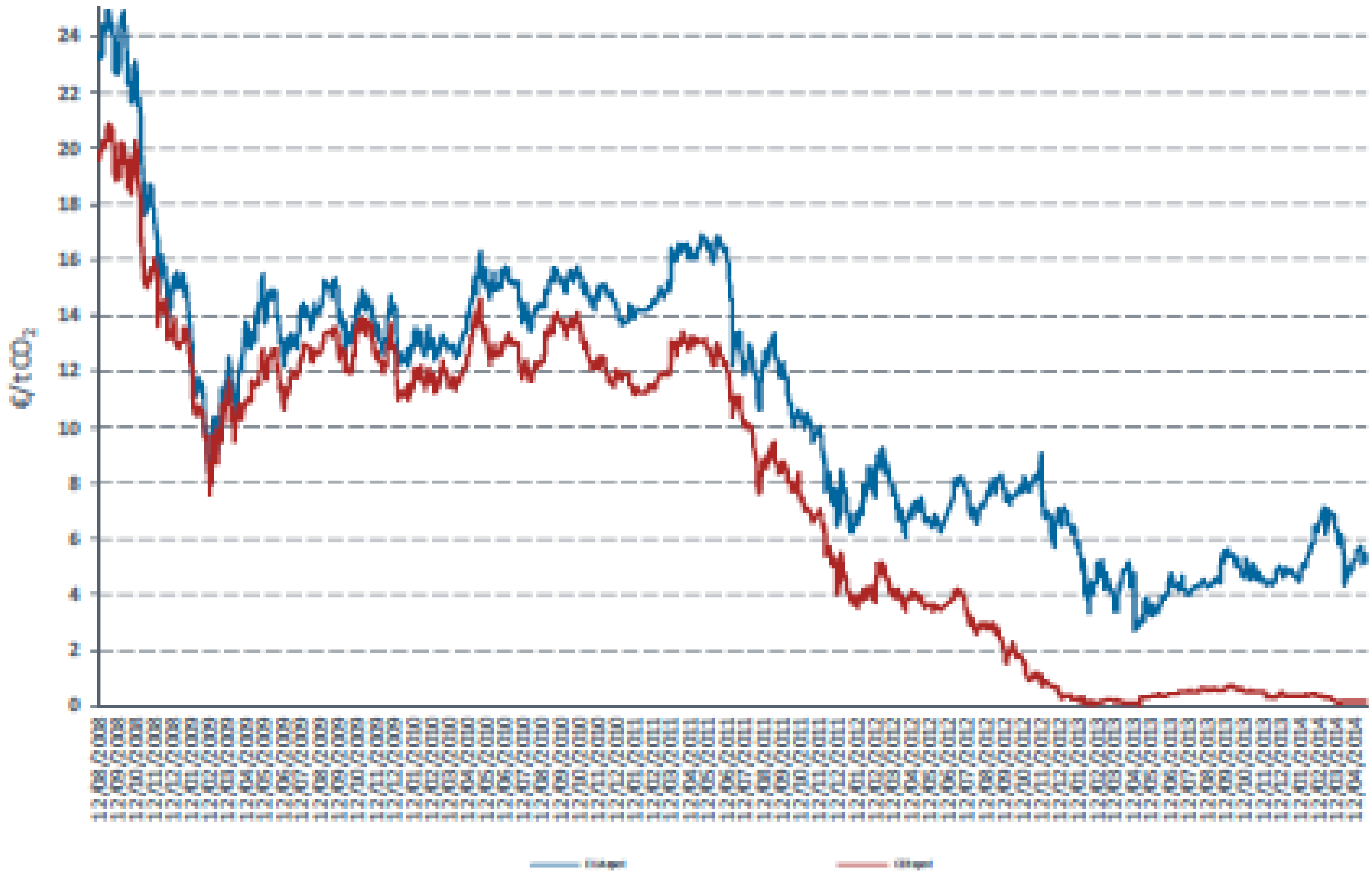
- These targets have been updated in January 2014, setting values for 2030:
  - Reduction 2030/1990 of CO_2 emissions by 40% & only with domestic measures
  - Efforts in improvement of efficiency, but no targets
  - EU-wide target of 27% of renewables in final energy consumption
  - Plus some reforms in the EU Emission Trading Scheme

Climate and energy: where do we stand?



Prices of the European Trading Scheme (ETS)

EUA (blue) & CER (red), €/ton



Period: August 2008-April 2014

Policy needs to be "loud, long & legal"

- **Loud**
  - Policy instruments make a difference, so that investments in clean energy become commercially attractive
- **Long**
  - Policy instruments are sustained for a period that is consistent with the financial characteristics of the project
- **Legal**
  - Policy instruments are based on a clear, stable & well-established regulatory framework

Based on "Unlocking finance for clean energy", www.chathamhouse.org.uk, 2009

Should technology targets be set for 2030? Of course, NOT

- Deployment *(energy)* targets for renewables:
  - make it more expensive to meet the carbon targets
  - waste resources that could be better used to stimulate low-carbon innovation
  - disrupt markets discovery processes
  - undermine the European Trading Scheme (ETS)

Source: Dr. Simon Less, Policy Exchange, London. Eurelectric Conference, Jan-2011.

Should technology targets be set for 2030? Of course, NOT

- Instead, energy policy after 2020 should:
  - keep it simple
  - focus on carbon price as "the" instrument & avoid technology-specific deployment targets
  - focus *(politically)* on achieving a long-term, credible carbon pricing framework
  - focus any subsidies on stimulating most valuable innovation, while balancing R&D & learning-by-doing
  - & overcome behavioral barriers to energy efficiency

Should technology targets be set for 2030? YES, of course

- Carbon price, for the time being, is not loud *(too low to make an impact)*, long *(no agreement after 2012)* or legal *(credible)* enough
  - Any progress in this direction is very welcome
- Investment in subsidized technologies needs an adequate & credible regulatory framework
  - Clear targets & strong enough economic signals by 2030 for renewables & efficiency
  - Adequate support instruments for R&D & deployment for each technology
  - But avoid picking winners as much as possible

Still work in progress...

Source: Jean-François Conil-Lacoste. Chairman of EPEX SPOT.
4th OMIE International Workshop. Madrid 29 April 2014

Thank you for your attention