EUROPEAN ENERGY FORUM
FORUM EUROPÉEN DE L'ENERGIE

European Energy Forum

Meet

Get informed

Debate

EEF Assistants Briefing

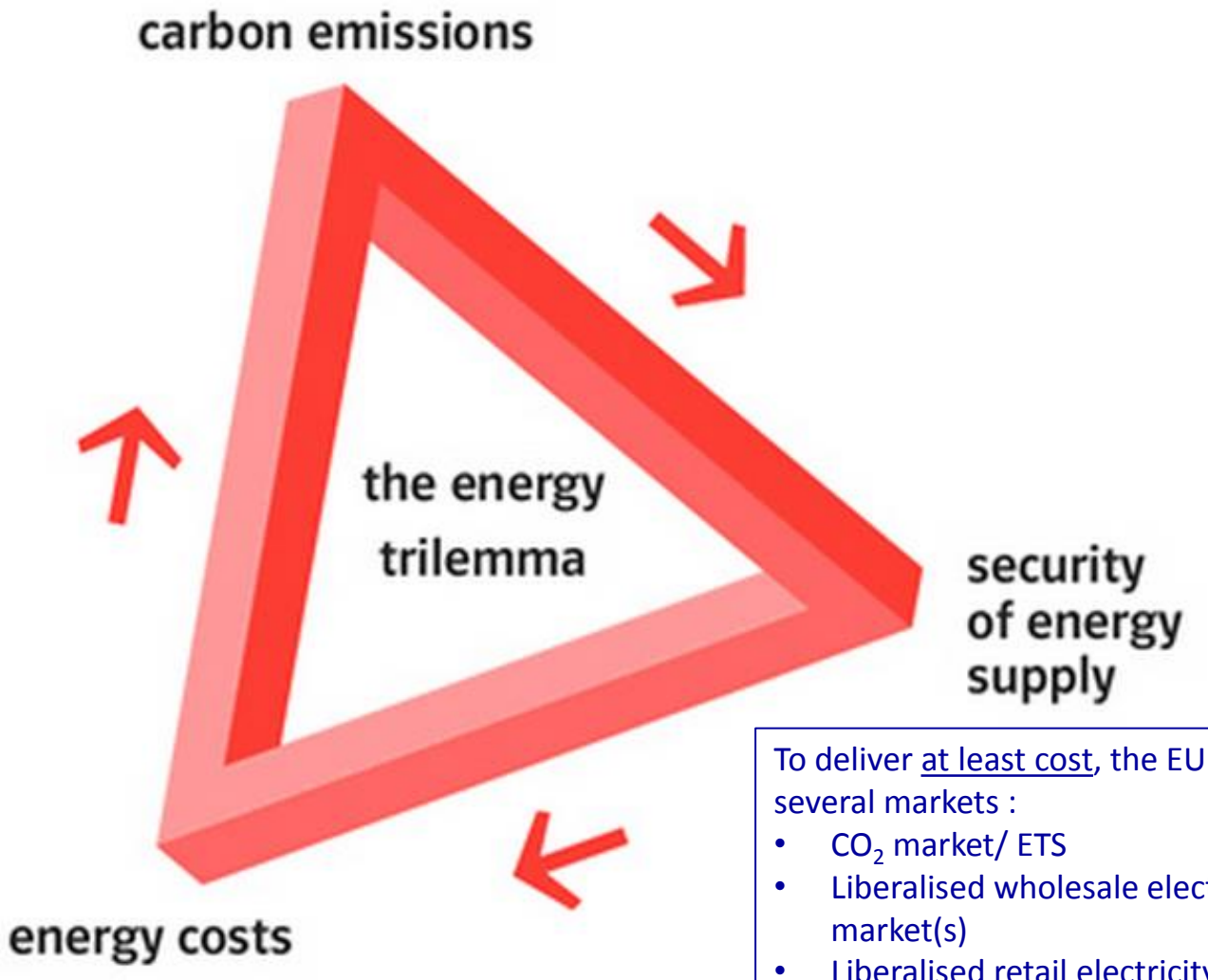
European Parliament, 2 July 2015

Session 2

Integrating larger shares of RES to the power system: Market perspectives

Part 1
Market basics

The overall objective: reach balance



To deliver <u>at least cost</u>, the EU set up several markets :

- CO_2 market/ ETS
- Liberalised wholesale electricity market(s)
- Liberalised retail electricity market(s)

Source: Eurelectric

The wholesale electricity market(s)

	Energy	*Flexibility*	*Capacity*
Goal	Efficient dispatch Product: kWh	Short-term system adequacy Product: kWh	Long-term system adequacy Product: kW
What it does	Delivers energy in the most cost-efficient way by having the market define operations	Enables the system to respond to short-term variations in the supply/demand balance	Ensures long-term system adequacy (e.g. in case of extreme load peaks or backup intermittent renewable generation)
Instruments	Forward, day-ahead and intraday markets	Day-ahead, intraday and balancing markets, ancillary services	Market-based capacity remuneration mechanisms
Where we are today	Ongoing energy market integration with market coupling & cross-border intra-day markets (though taking long)	Energy market integration & cross-border balancing ongoing, grid related services to be developed	Rather separate CRM national initiatives, with increasing discussion on cross-border participation

"Energy-only market" **"Capacity markets"**

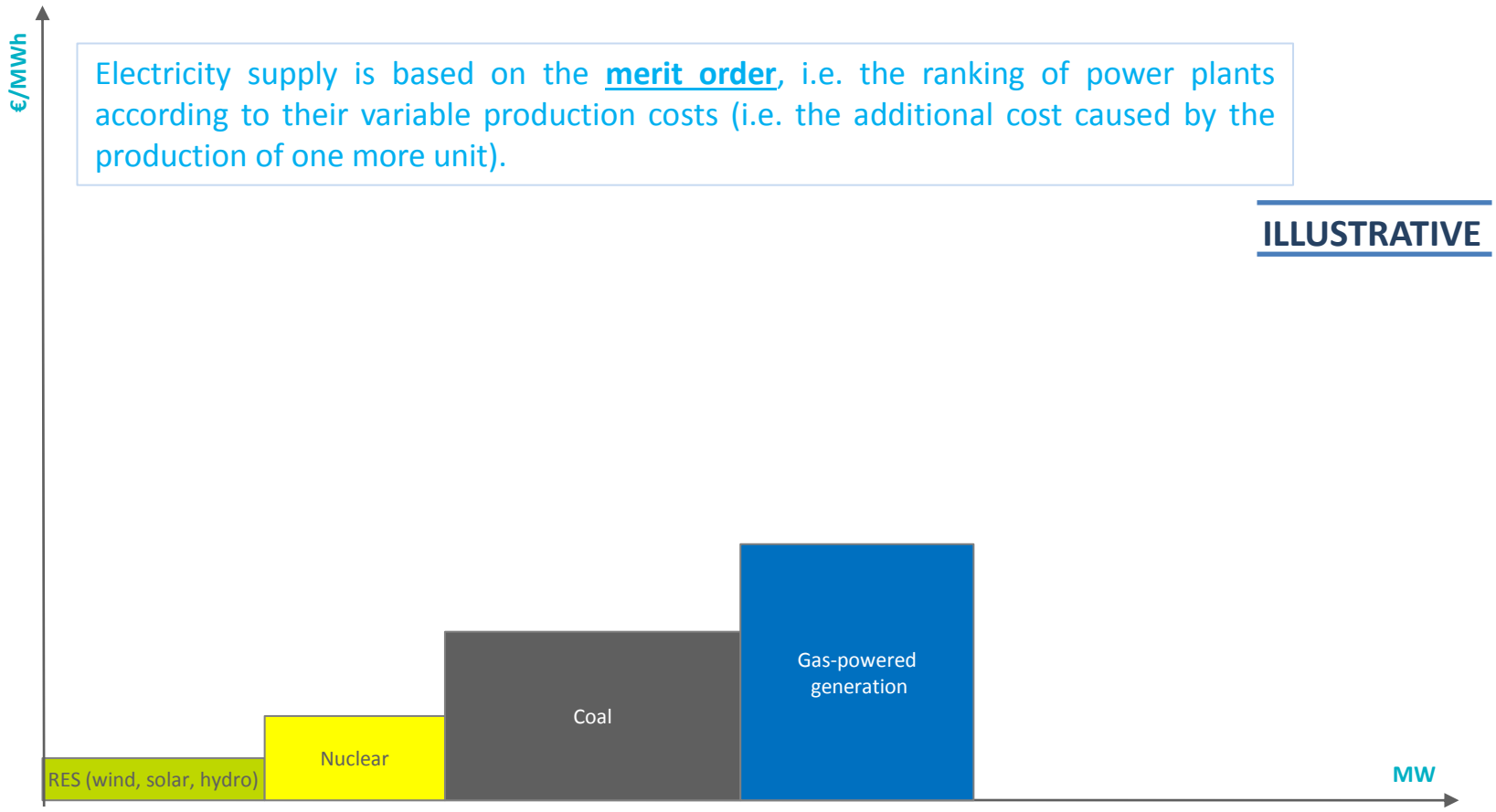
Source: Eurelectric

Energy market: on which basis are plants operated?

Variable cost

Electricity supply is based on the **merit order**, i.e. the ranking of power plants according to their variable production costs (i.e. the additional cost caused by the production of one more unit).

ILLUSTRATIVE



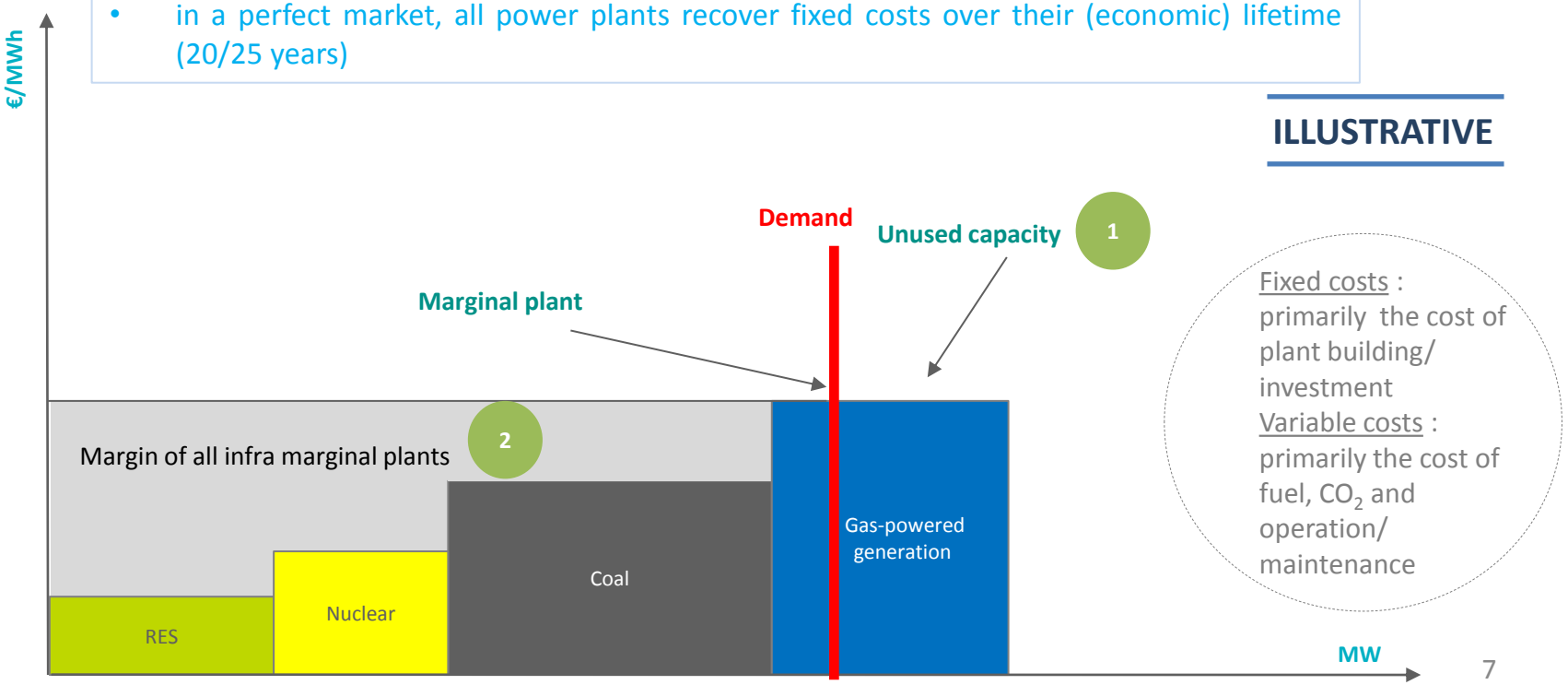
Source: Eurelectric

Energy market: how is the wholesale price set?

Wholesale price = intersection of supply & demand curves.

When there is enough capacity to meet demand:

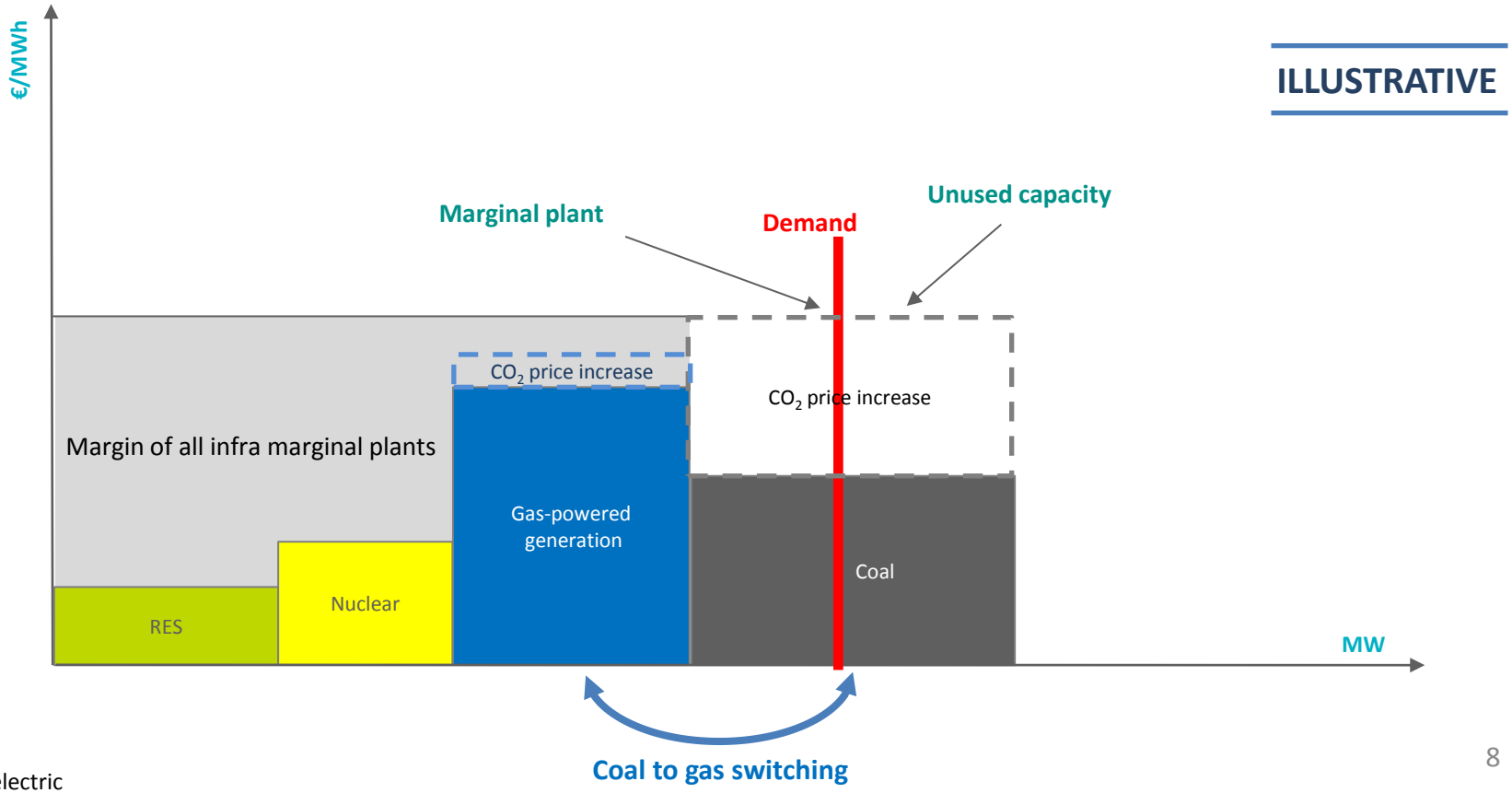
- **generation capacity is not fully used** (1)
- the **wholesale price equals the variable cost of the marginal unit** (i.e. last unit dispatched in the merit order)
- **dispatched capacity receives an infra-marginal rent** (2) which partly covers fixed costs
- in a perfect market, all power plants recover fixed costs over their (economic) lifetime (20/25 years)



Source: Eurelectric

Energy market: impact of a higher CO_2 price

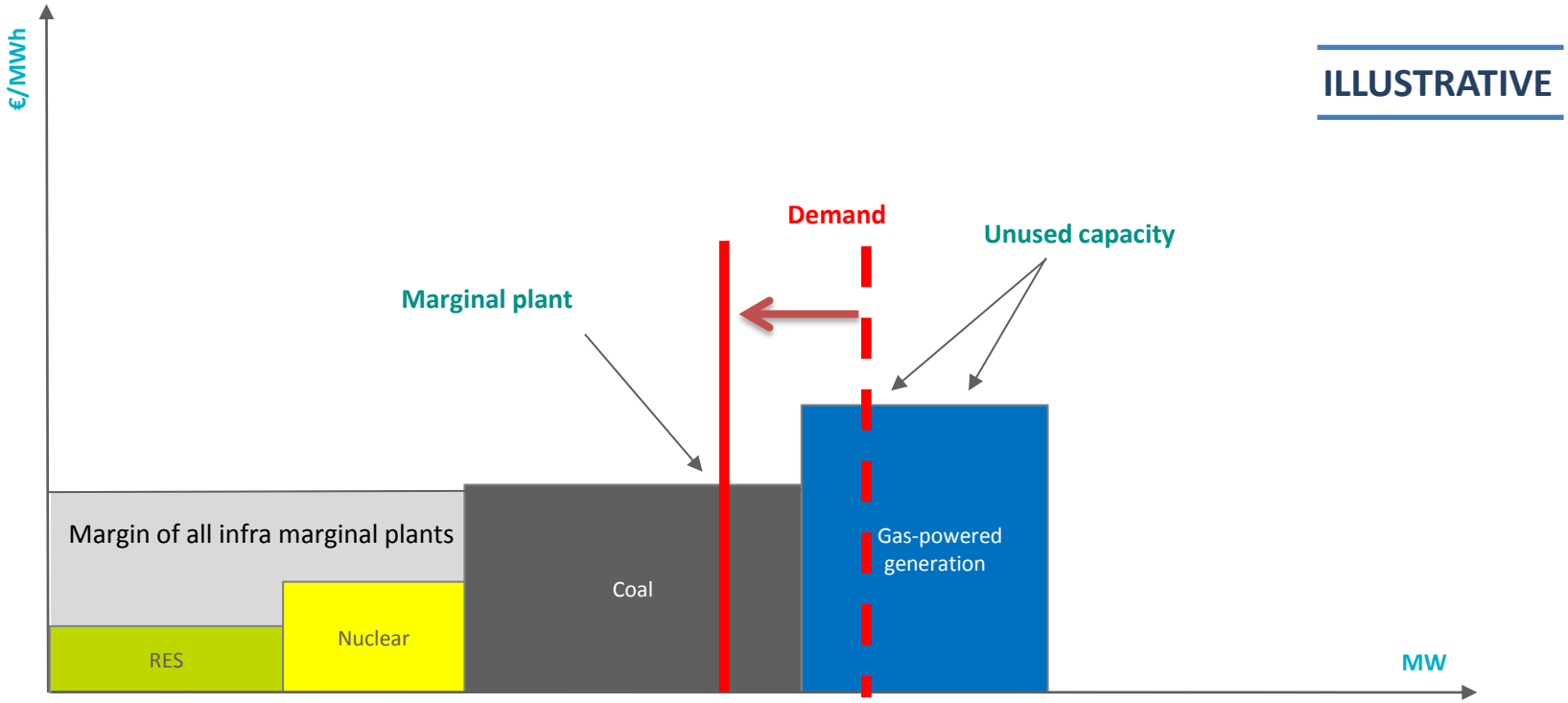
A sufficiently high CO_2 price can provoke a reversal in the merit order. Gas can become more competitive than coal due to its lower emissions. The system then emits less since coal becomes more marginal and generates less.



Source: Eurelectric

Energy market: impact of lower demand

For a given generation mix, **a lower electricity demand lowers the wholesale price** as the marginal unit is lower in the merit order, more plants are left idle and the margin earned by infra-marginal plants decreases.

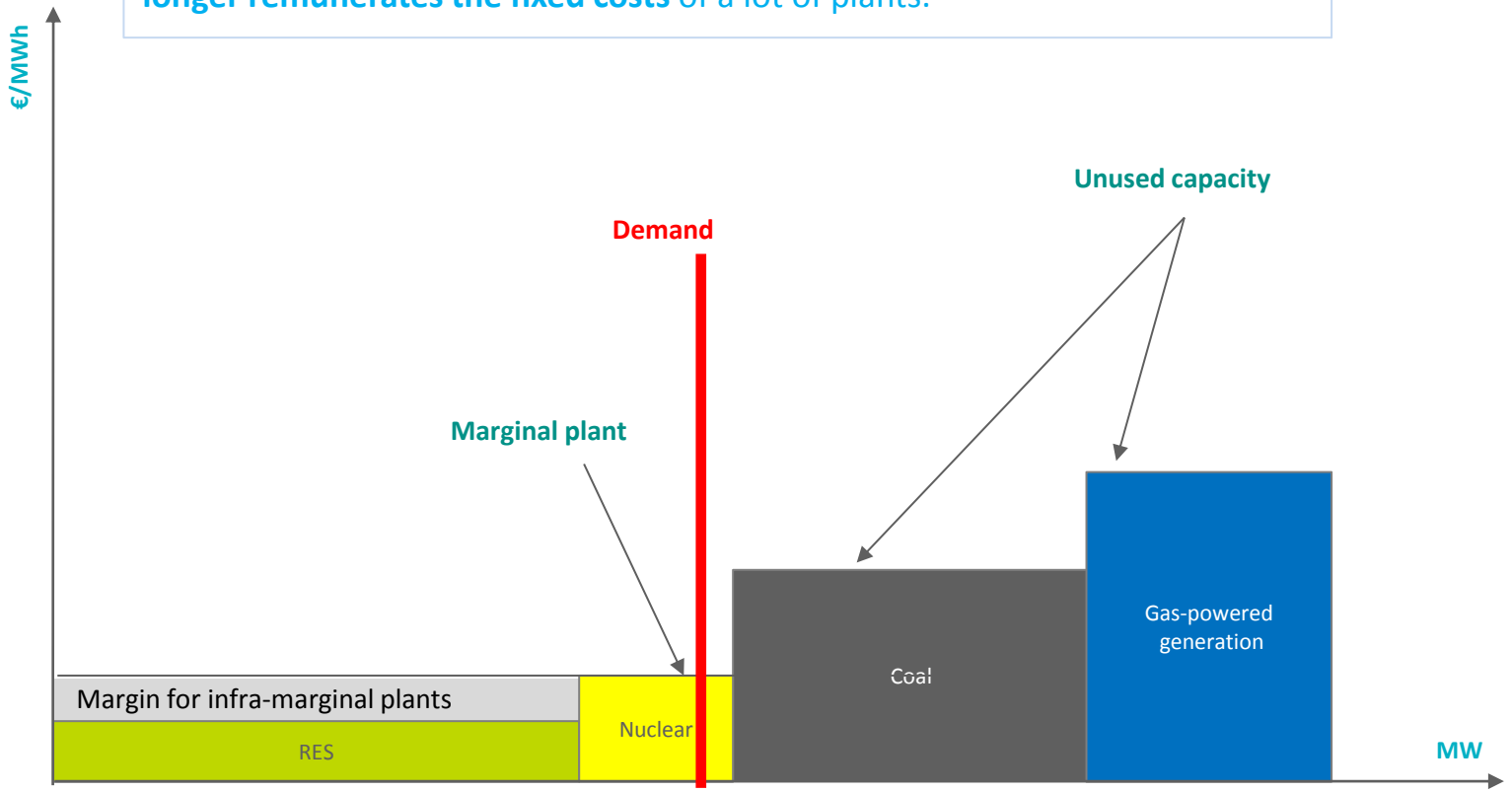


Source: Eurelectric

Energy market: impact of increasing low-carbon generation

Important volumes of low-carbon generation considerably lower the wholesale price as the marginal unit is lower in the merit order. As a consequence, **the margin earned by infra-marginal plants decreases and no longer remunerates the fixed costs** of a lot of plants.

ILLUSTRATIVE

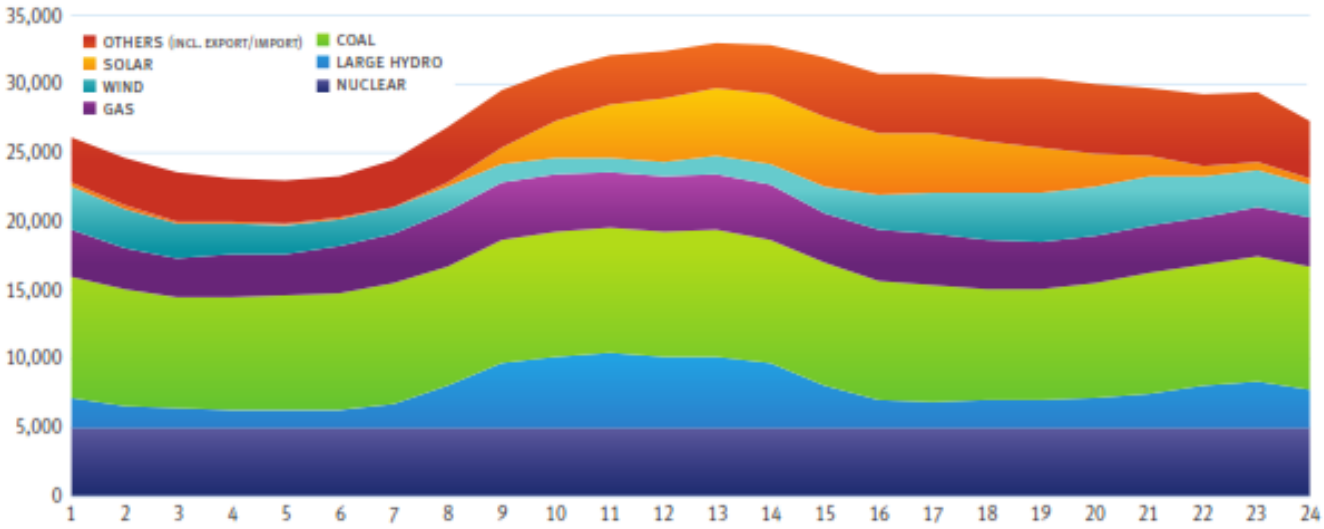


Source: Eurelectric

Energy market & RES: which impact on the balancing needs?

The Spanish example

FIGURE 8 – ELECTRICITY BALANCE IN SPAIN, MWh, 20/06/2014



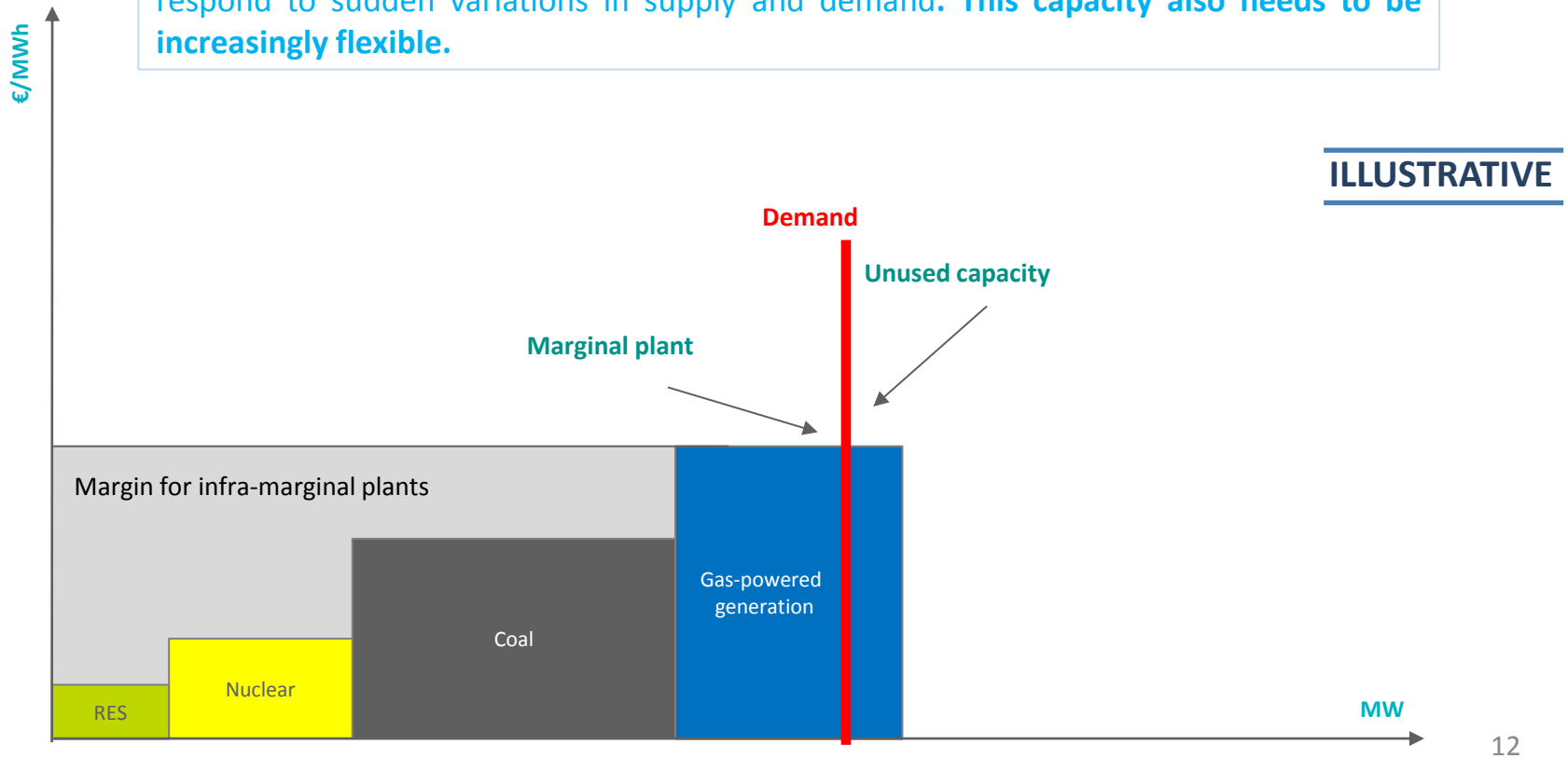
Source: REE

A large portion of the RES are variable sources of electricity generation, depending on weather (solar & wind). As a result, the kWh dispatched on the market vary continuously. In order to ensure a constant matching of generation and demand, **continuous balancing of supply and demand through balancing markets is absolutely needed**.

Source: Eurelectric

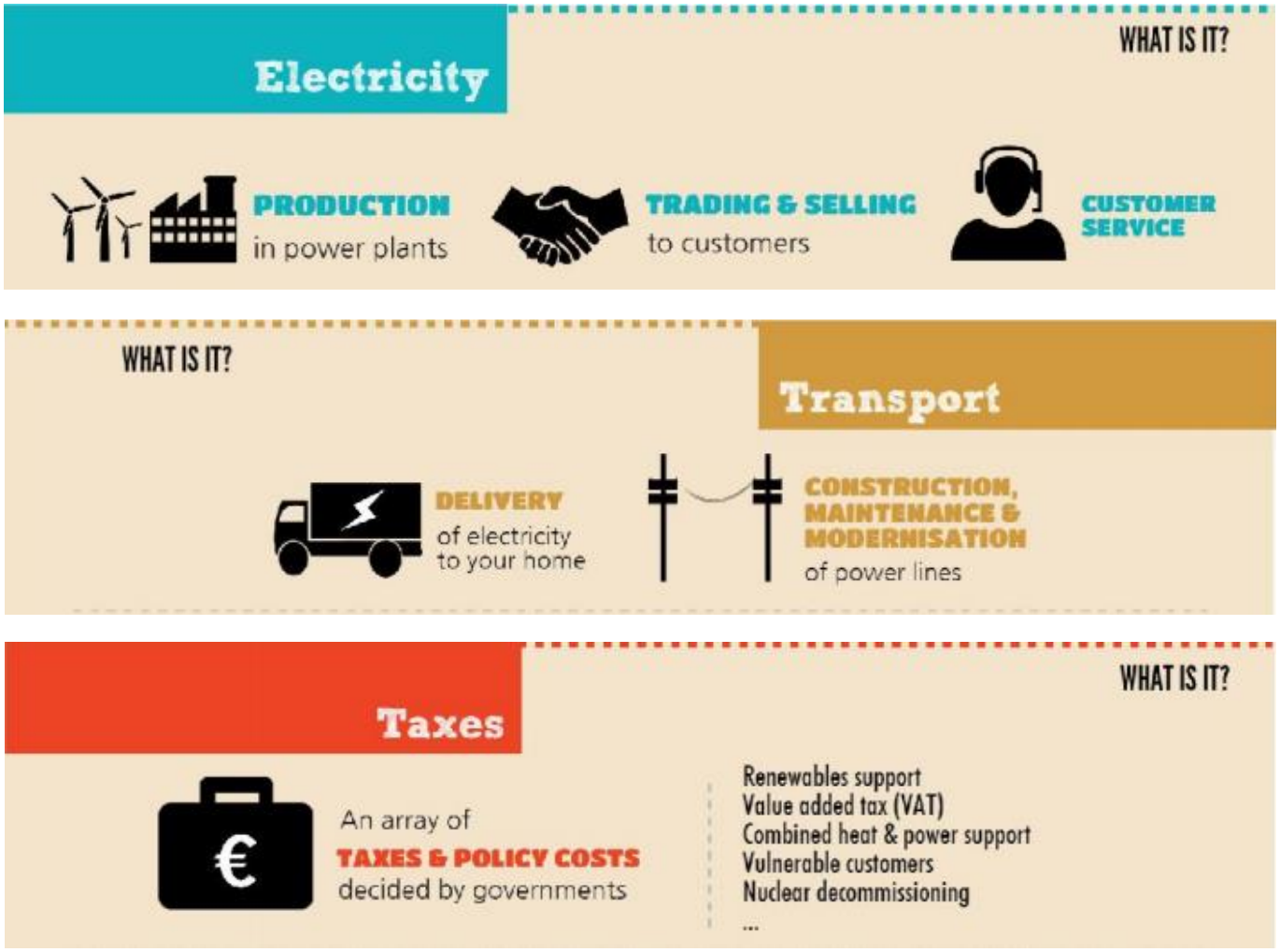
Energy market: increased intermittency raises the need for back-up and flexibility

Intermittent RES are not always available to produce (the sun doesn't always shine and the wind doesn't always blow). Thus, **backup available capacity is increasingly needed** to respond to sudden variations in supply and demand**. This capacity also needs to be increasingly flexible.**



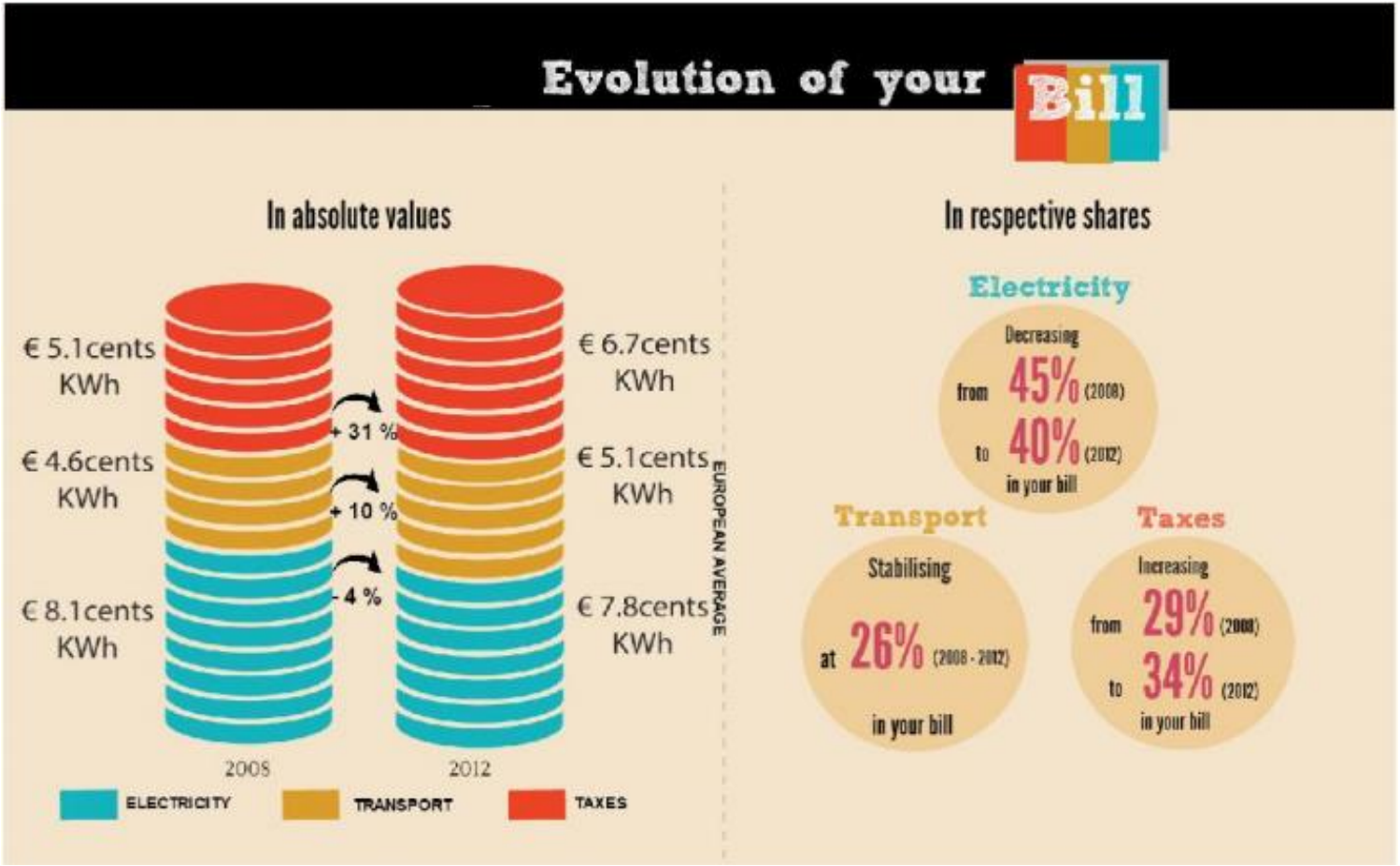
Source: Eurelectric

Another market: the retail electricity market



Source: Eurelectric

How does the energy wholesale price show up on the customer bill?



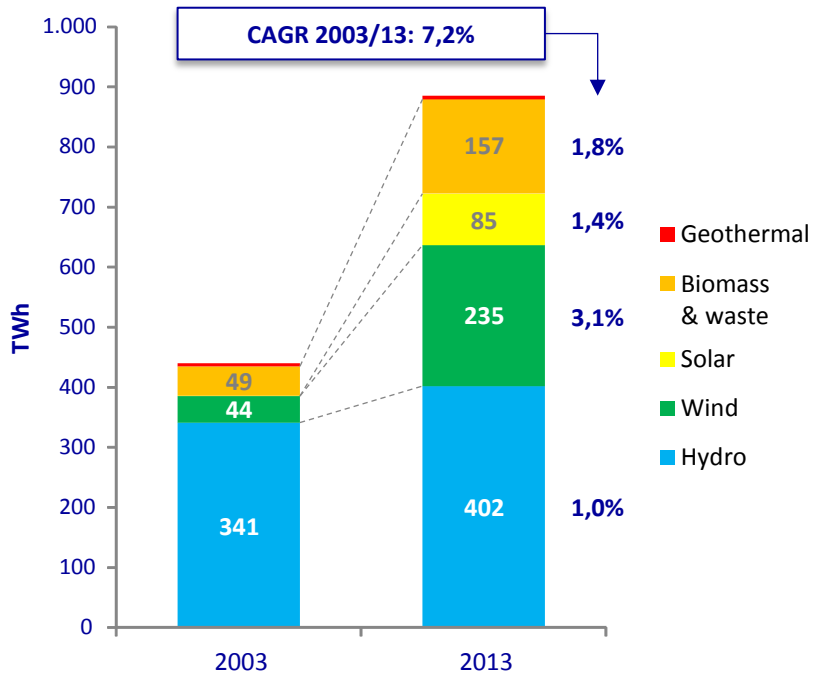
Source: Eurelectric

Part 2
Challenges

RES evolution and prospects

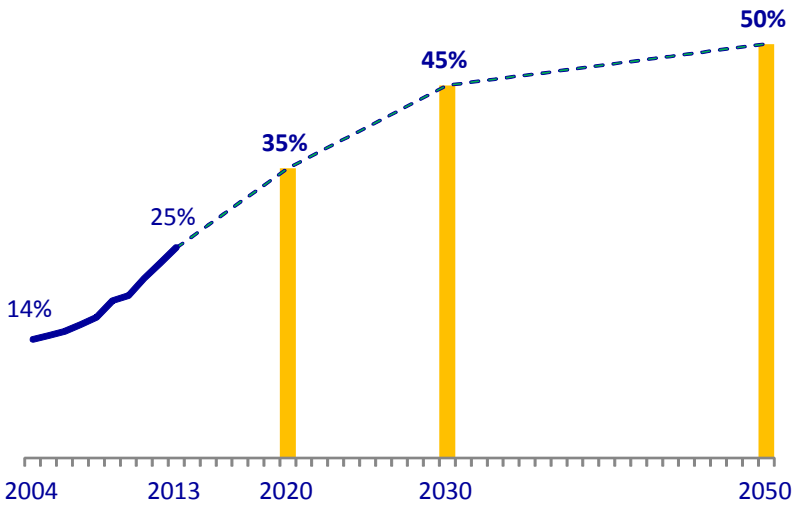
Deployment so far…

Electricity generated from RES in EU28



…and more to come!

Translation of EU RES targets into RES share in the EU 28 electricity production



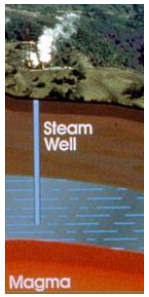
More RES to come: need to adapt the market design

Source: Iberdrola

Operation and economic impacts of different RES

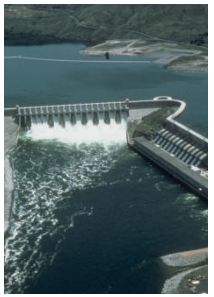
"Dispatchable" RES

- Large hydro with reservoir, geothermal, biomass
- Output can be modified to meet system needs
- Marginal cost (i.e., short-term market bids) different from zero

"Variable" RES

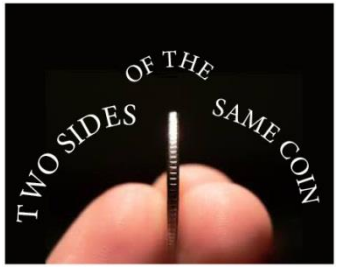
- Run-of-river Hydro, wind, solar, tidal, etc.
- Output depends on the availability of the natural resource
- Marginal cost (i.e., short-term market bids) close to zero



Variable RES (VRES) are the most prominent technologies in terms of deployment

Source: Iberdrola

VRES and back-up are the two sides of the same coin



VRES

- Produces when wind or sun is available only – for example, in Spain on-shore wind capacity utilisation is 25%
- VRES' production patterns do not depend on demand
- VRES' main function is decarbonisation

Back-up

- Back-up contributes to the electricity system certainty and flexibility
- Back-up is able to produce whenever required – for example, availability of CCGTs is about 90%
- Back-up's main function is to make up for the uncertain availability of RES

VRES + Back-up = Decarbonising preserving the required Security of Supply

Source: Iberdrola

VRES provide the electricity system with…

Achieve EU's RES targets

YES

Security of Supply

Cover peak demand

NO

Need for firm capacities – able to produce whenever required

Maintain the balance between supply and demand permanently

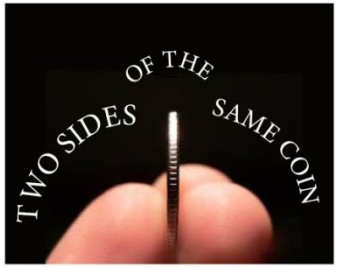
NO

Need for flexible capacities – able to adjust their output

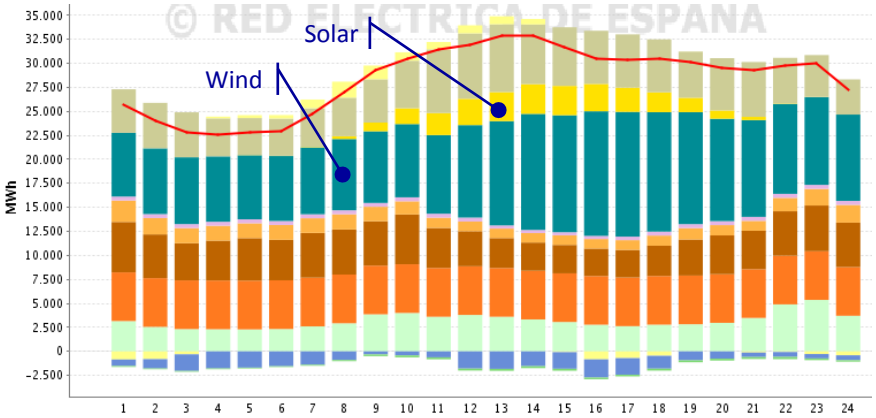
Need for back-up capacity

Source: Iberdrola

VRES and back-up are the two sides of the same coin

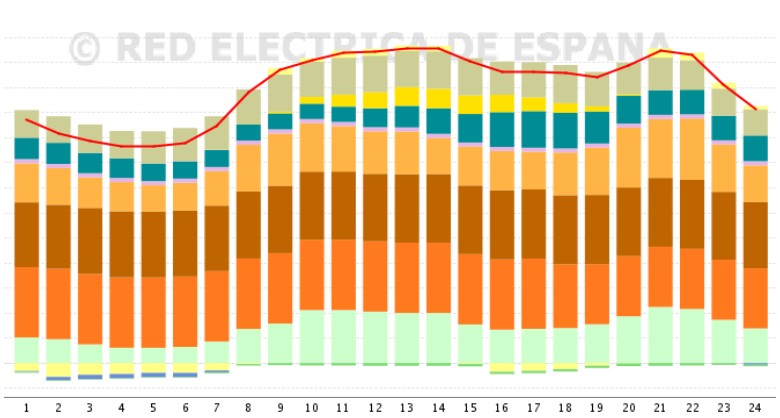


Spain, Friday, 6-Jun-2014



681	Demand	672
45	Solar	39
221	Wind	41
33	CCGT	93
97	Coal	187
122	Nuclear	168
60	Hydro	60

Spain, Friday, 3-Oct-2014

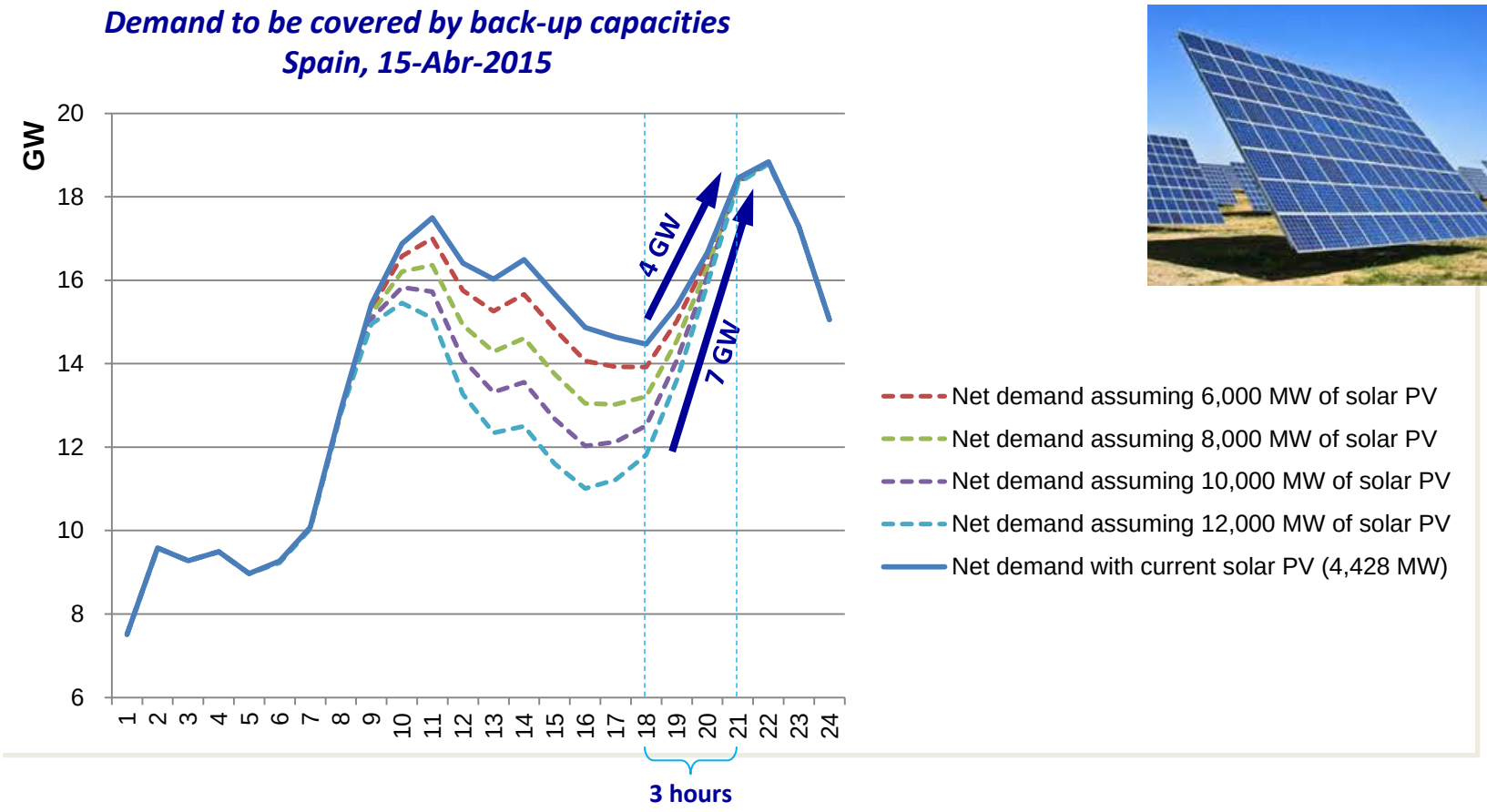


The firm back-up needed is basically the same with or without RES

RES do not bring savings in CAPEX (same investment in back-up), but just in OPEX (avoided consumption of fossil fuels and CO2 emissions)

Source: Iberdrola

VRES is a game changer

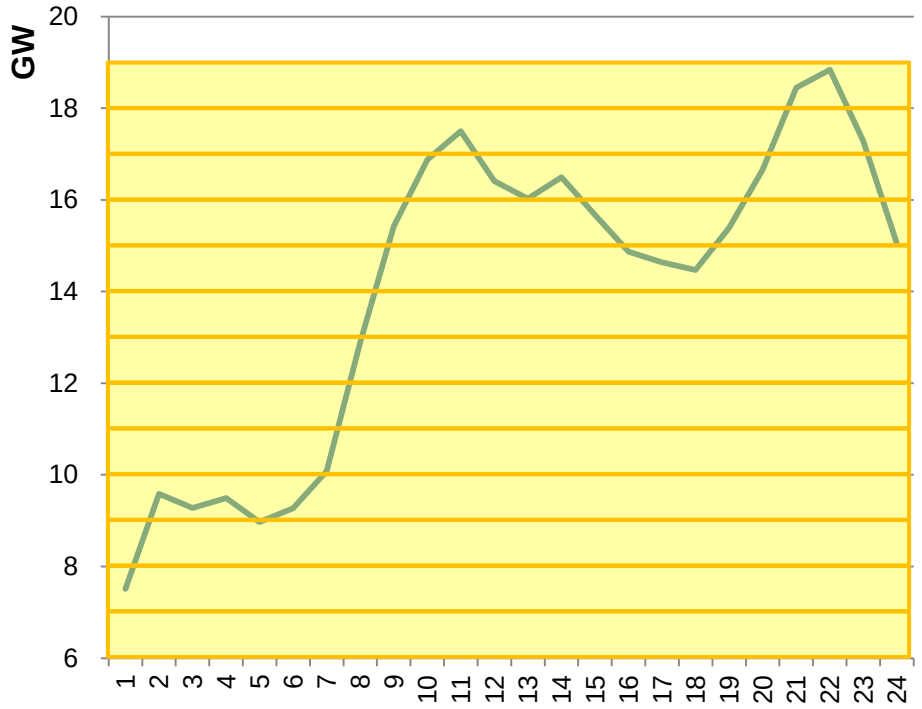


It is not about having a firm back-up only, but a <u>firm and flexible</u> back-up

Source: Iberdrola

VRES is a game changer

Demand to be covered by conventional capacities
Spain, 15-Abr-2015

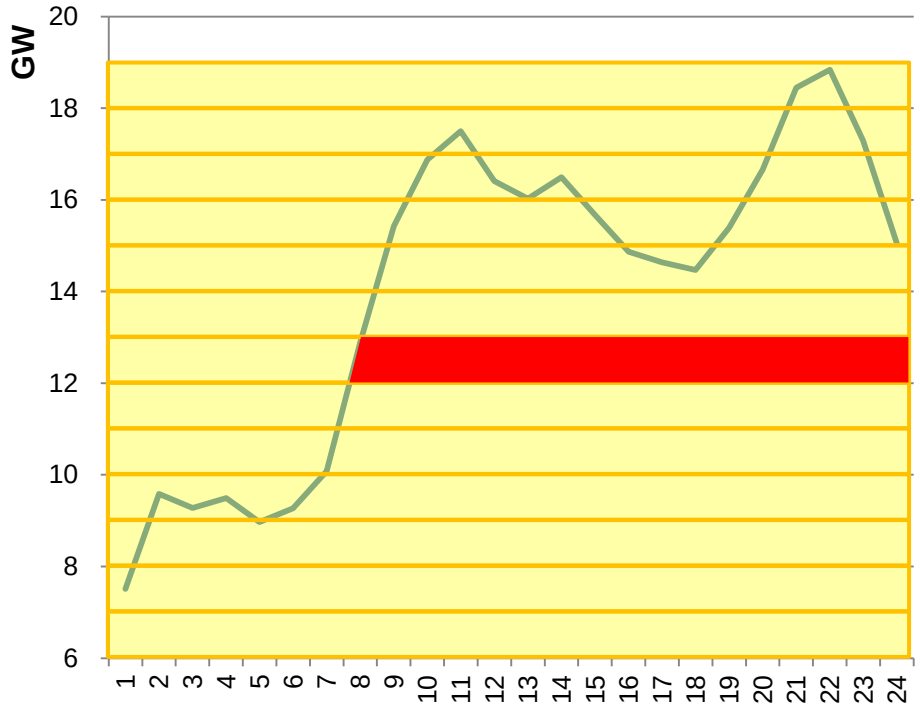


It is not about having a firm back-up only, but a <u>firm and flexible</u> back-up

Source: Iberdrola

VRES is a game changer

Demand to be covered by conventional capacities
Spain, 15-Abr-2015

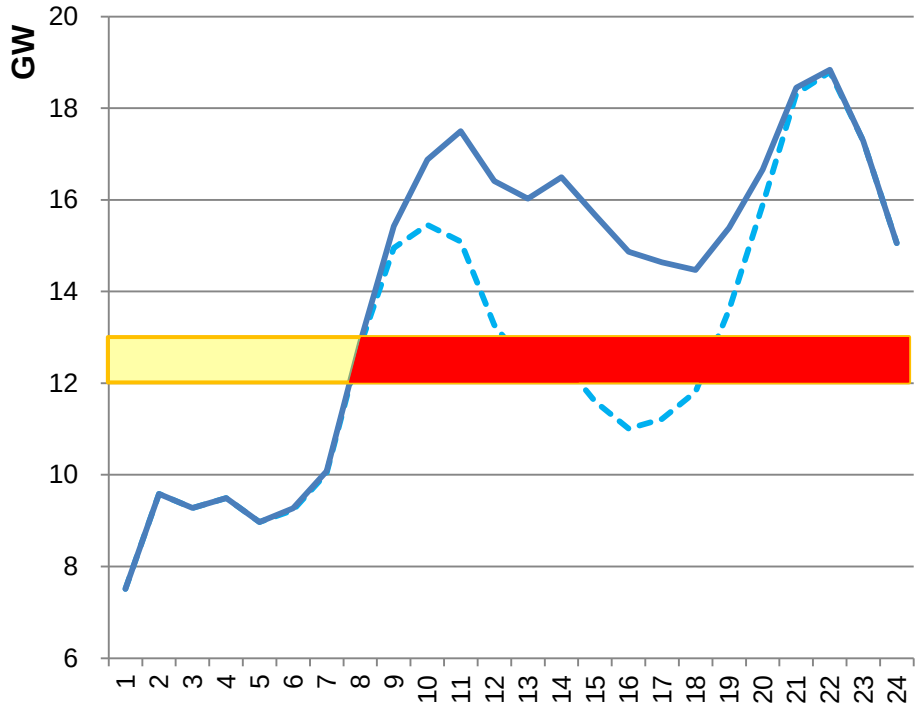


It is not about having a firm back-up only, but a <u>firm and flexible</u> back-up

Source: Iberdrola

VRES is a game changer

Demand to be covered by conventional capacities
Spain, 15-Abr-2015



It is not about having a firm back-up only, but a <u>firm and flexible</u> back-up

Source: Iberdrola

VRES is a game changer

Technical integration challenge – need for specific Control Centres for RES

Spanish TSO (REE) has a control centre (CECRE) specific for VRES (CECRE):

- Target: integrate as much VRES production as possible without compromising system security
- Interface with VRES producers' control centres (RESCC)

An example of a RESCC is IBERDROLA's CORE:

- Production forecast
- SCADA for VRES facilities with telemetry
- Control of real and reactive production

Source: Iberdrola

VRES is a game changer

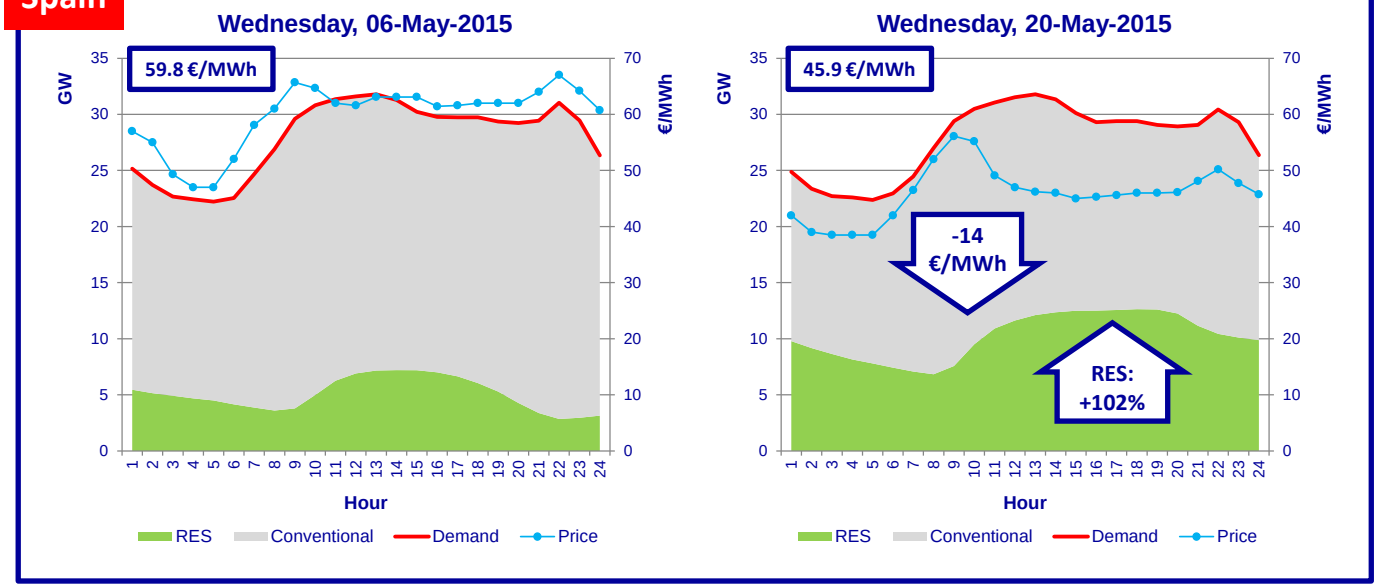
Flexible back-up challenge – a number of options available

- At present, **hydro with reservoir, pumped storage and gas-powered generation**
- In the future:
  - **Interconnections: need for efficient development**
    - •Create larger markets, which dilute VRES volatility
    - •Allow the access to firm and flexible capacities located in neighbor markets
    - •How much interconnection capacity? Cost-benefit analysis
    - •Which projects to develop? Opt for the most cost-efficient alternatives
  - **Storage**
  - **Demand side response**
    - •Need for further technological progress
    - •Remove barriers and avoid inefficient subsidies
  - **Further develop flexible generation**

Source: Iberdrola

VRES is a game changer

Spain



What does RES penetration means for back-up capacity?

1

Lower average production and lower average price

More difficult to cover fixed costs with market spreads

2

Higher variability of production and price

More stressful operation (higher cost) and higher business risk

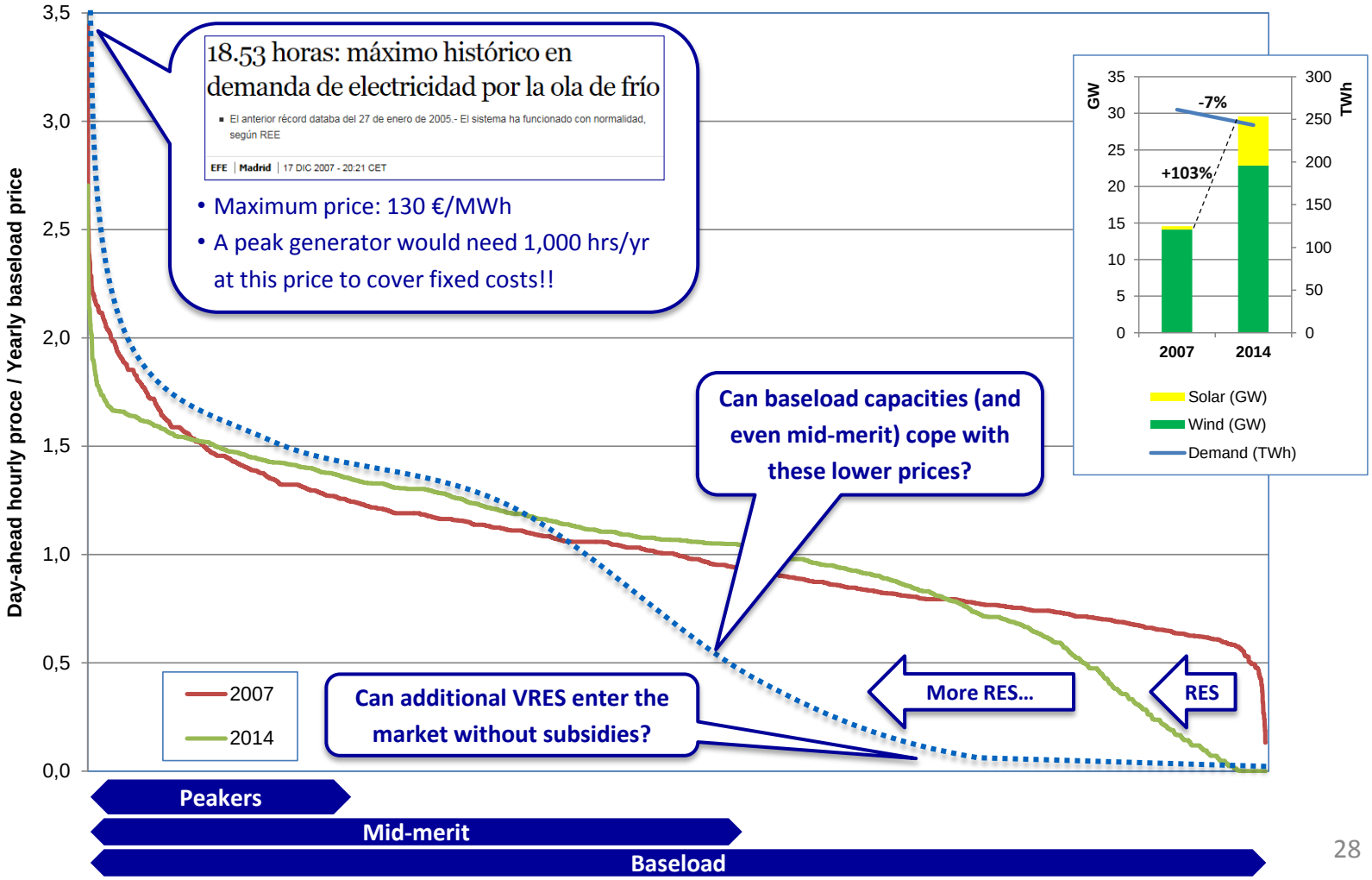
Investment case for back-up capacity deteriorates drastically – Security of Supply?

Source: Iberdrola

VRES is a game changer

Price duration curve in Spain, 2007 vs. 2014

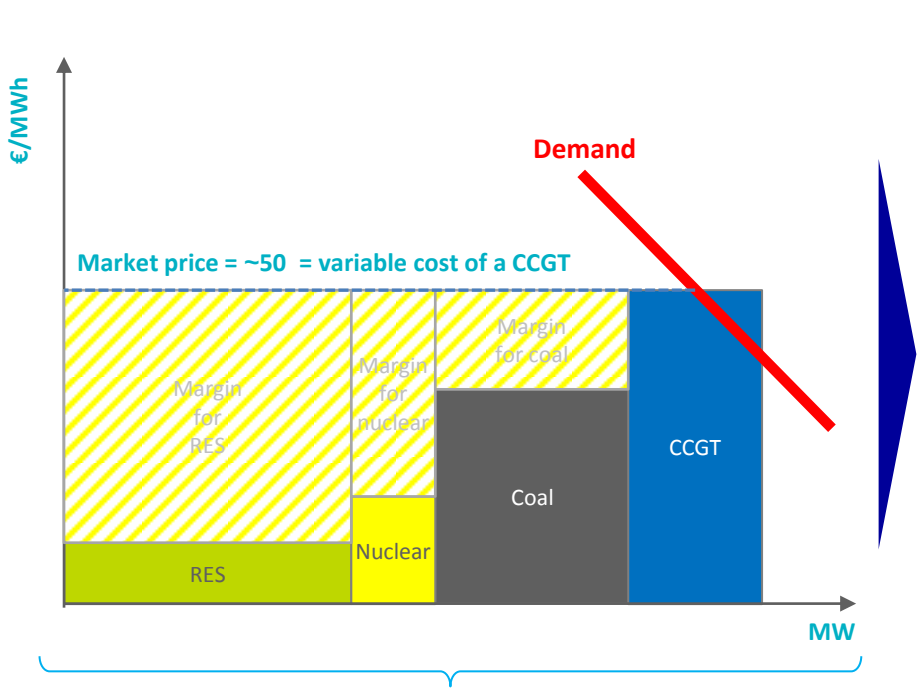
Hourly day-ahead prices observed in a year ordered from highest to lowest

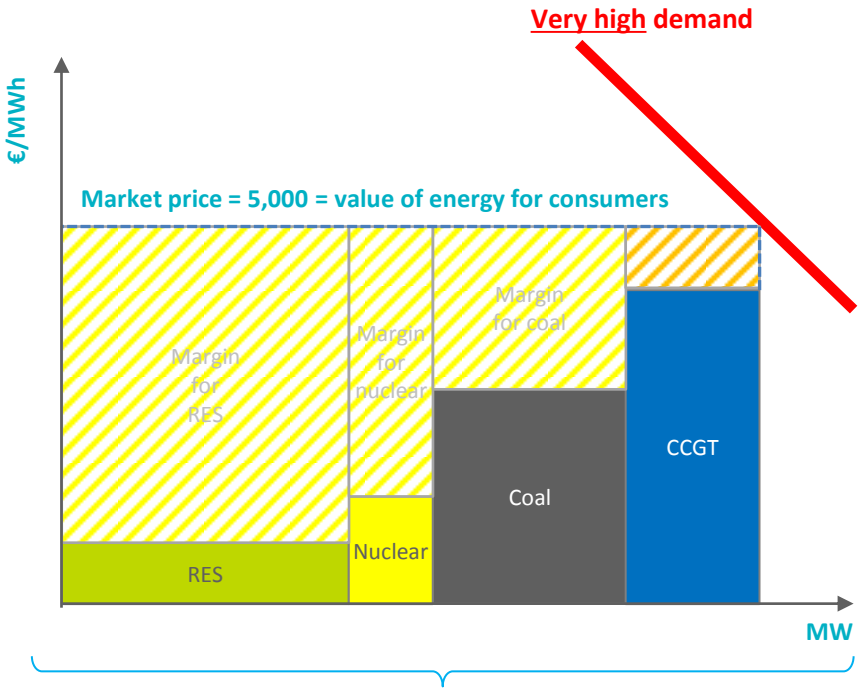


Source: Iberdrola

The Energy-only Market paradigm: scarcity pricing

ILLUSTRATIVE





Unsustainable situation as back-up does not have any expectation of covering their fixed costs!!

If Price = 5,000 €/MWh and fixed costs of CCGT = 100,000 €/MW/year, then the market would tend to show such a scarcity situation 20 hours/year

Source: Iberdrola

The Energy-only Market paradigm: scarcity pricing

Is it acceptable to have during 20 hours/year a price of 5,000 €/MWh when normally it is no more than 50 €/MWh?

So far, **it has not been acceptable**:

- For the sake of consumer protection regulators introduce **price caps**
  - For example, 180 €/MWh in Spain
- For the sake of Security of Supply regulators introduce **exit barriers**
  - Back-up capacities not allowed to close / mothball even with negative results
  - This means to artificially extend overcapacity situations / depressed prices episodes
- High prices episodes lead to **different forms of price controls / interventions**

How to guarantee these interventions will not be repeated in the future?

Source: Iberdrola

Distributed Generation

Distributed Generation is a fact

- It is necessary to take advantage of technology developments **– distributed generation is good news**
- As any other energy source, **should be developed efficiently**

- "Grid parity" concept is a good example in this sense:
  - Charges for the use of the system should reflect the costs caused to the system, both fixed and variable – **avoid giving the wrong signals in terms of potential savings**
  - Costs not related to the electricity supply should be removed from final prices – **avoid giving wrong signals for investment decisions**

Need to efficiently allocate the costs related to utility services

Source: Iberdrola

In summary…

The firm back-up needed is basically the same with or without RES

It is not about having a firm back-up only, but firm and flexible

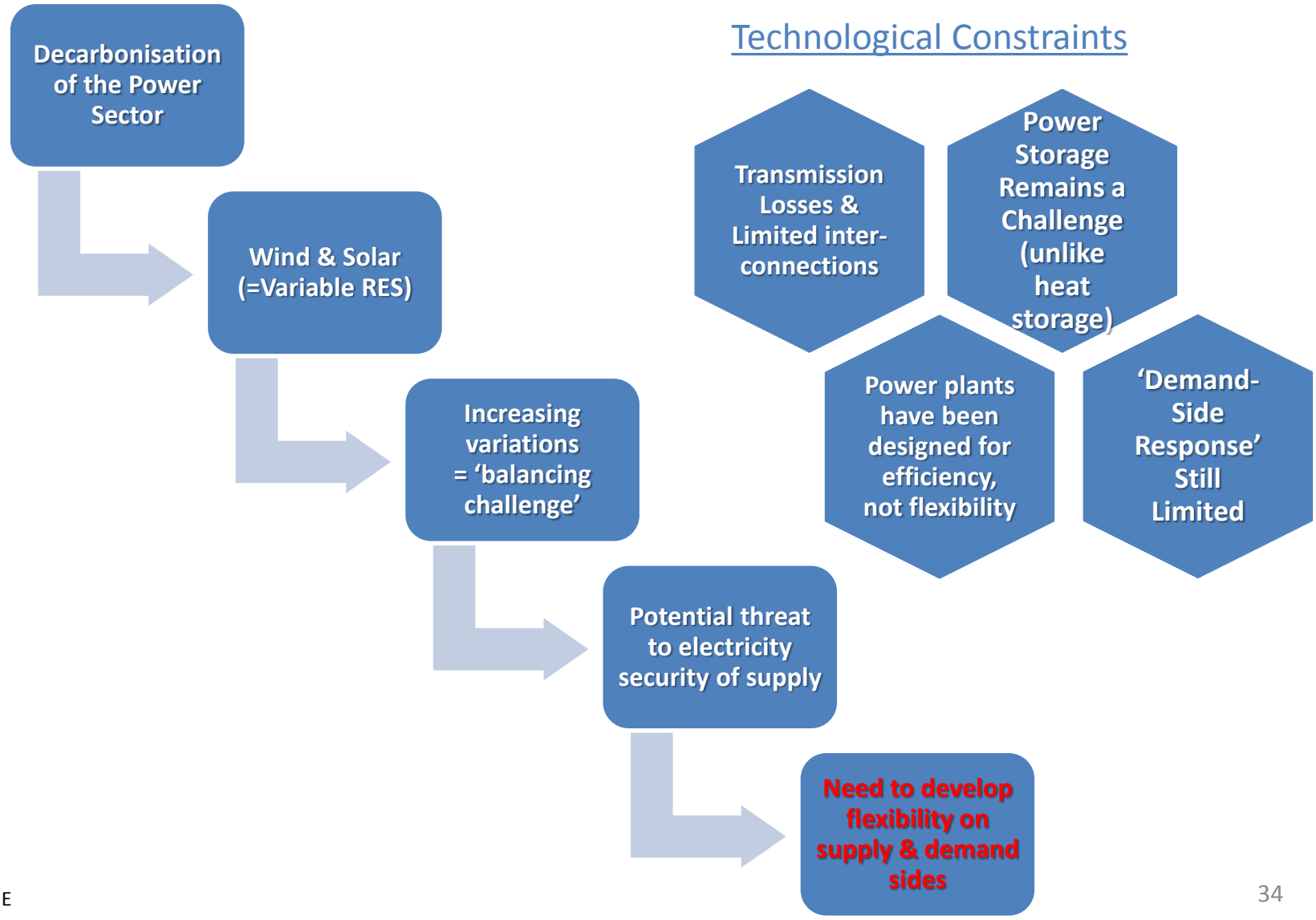
RES penetration reduces the incentives to invest in back-up

Distributed Generation is a fact –
need to efficiently allocate the costs related to utility services

Source: Iberdrola

Part 3
Options

Technological challenges



Source: EUGINE

Solutions for RES integration

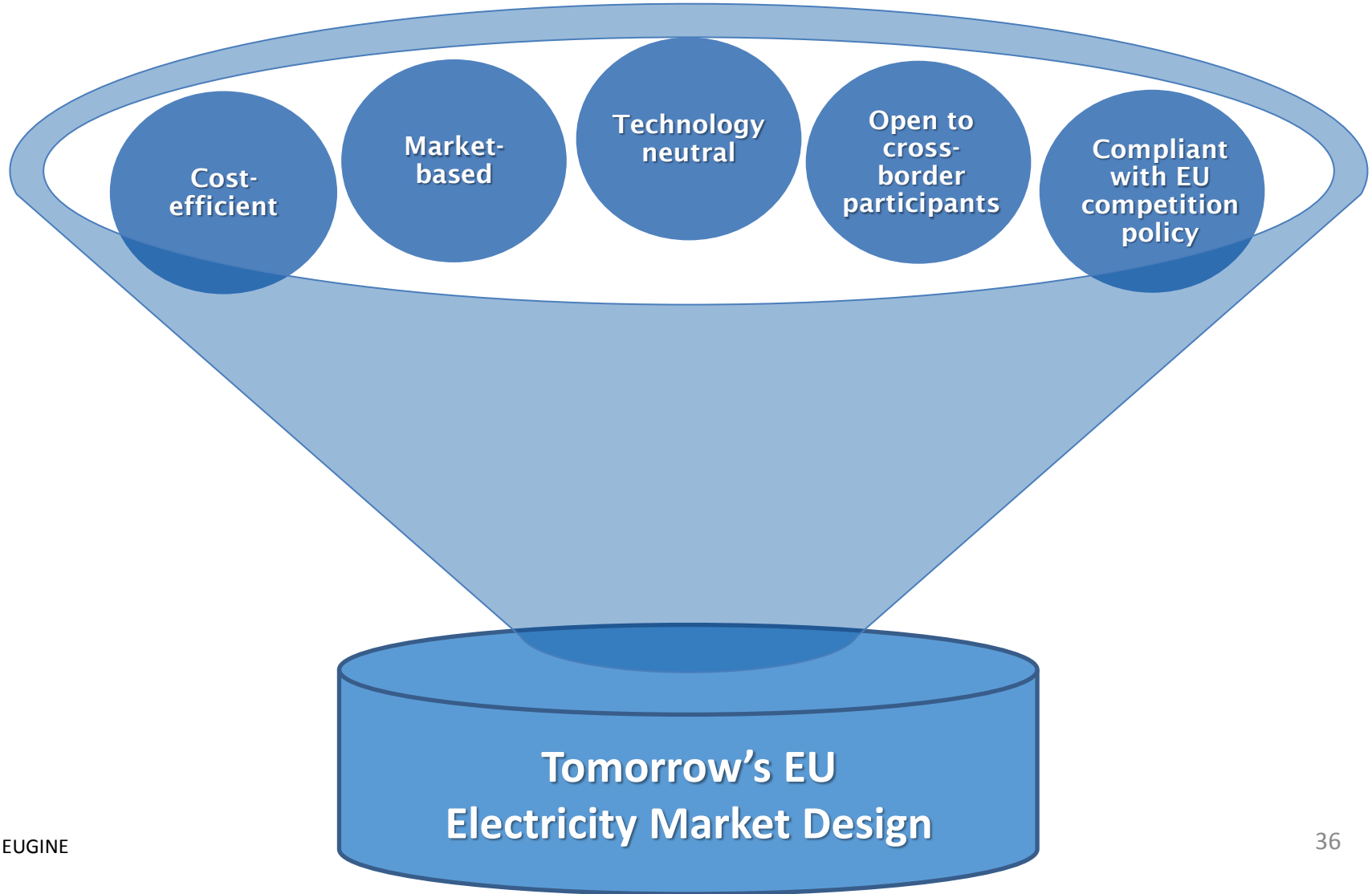
=> How to improve the electricity market design?

1. Basic conditions
2. Policy options
    1. Capacity remuneration mechanisms (CRMs)
    2. Improved Energy Only Market (EOM)
3. Point of view of the European Commission
4. Market design - Next steps

Source: EUGINE

Basic conditions

Any policy option must be:

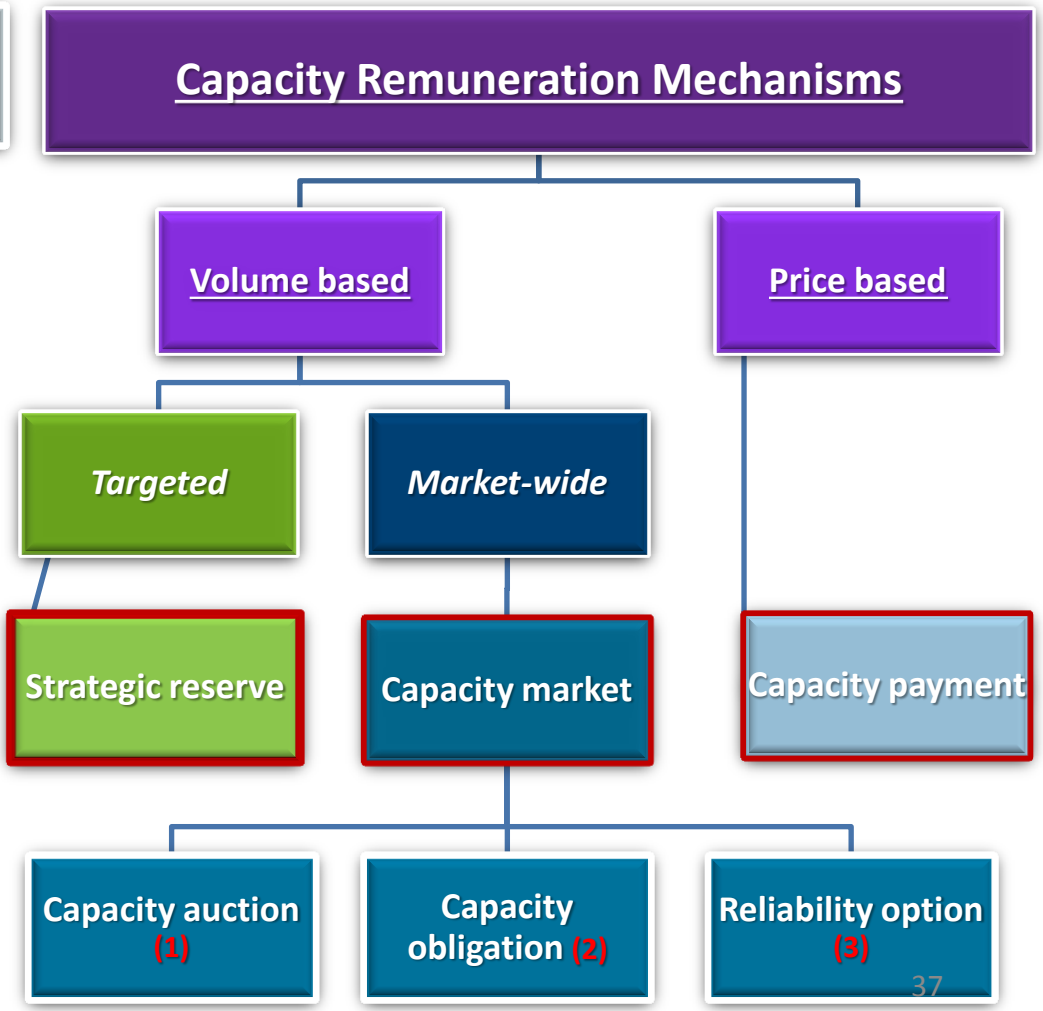


Source: EUGINE

Policy option 1: capacity mechanisms

= remuneration for the availability of capacity, in addition to revenues from the energy-only market, if deemed necessary for security of supply

Source: EUGINE



Aims of CRMs

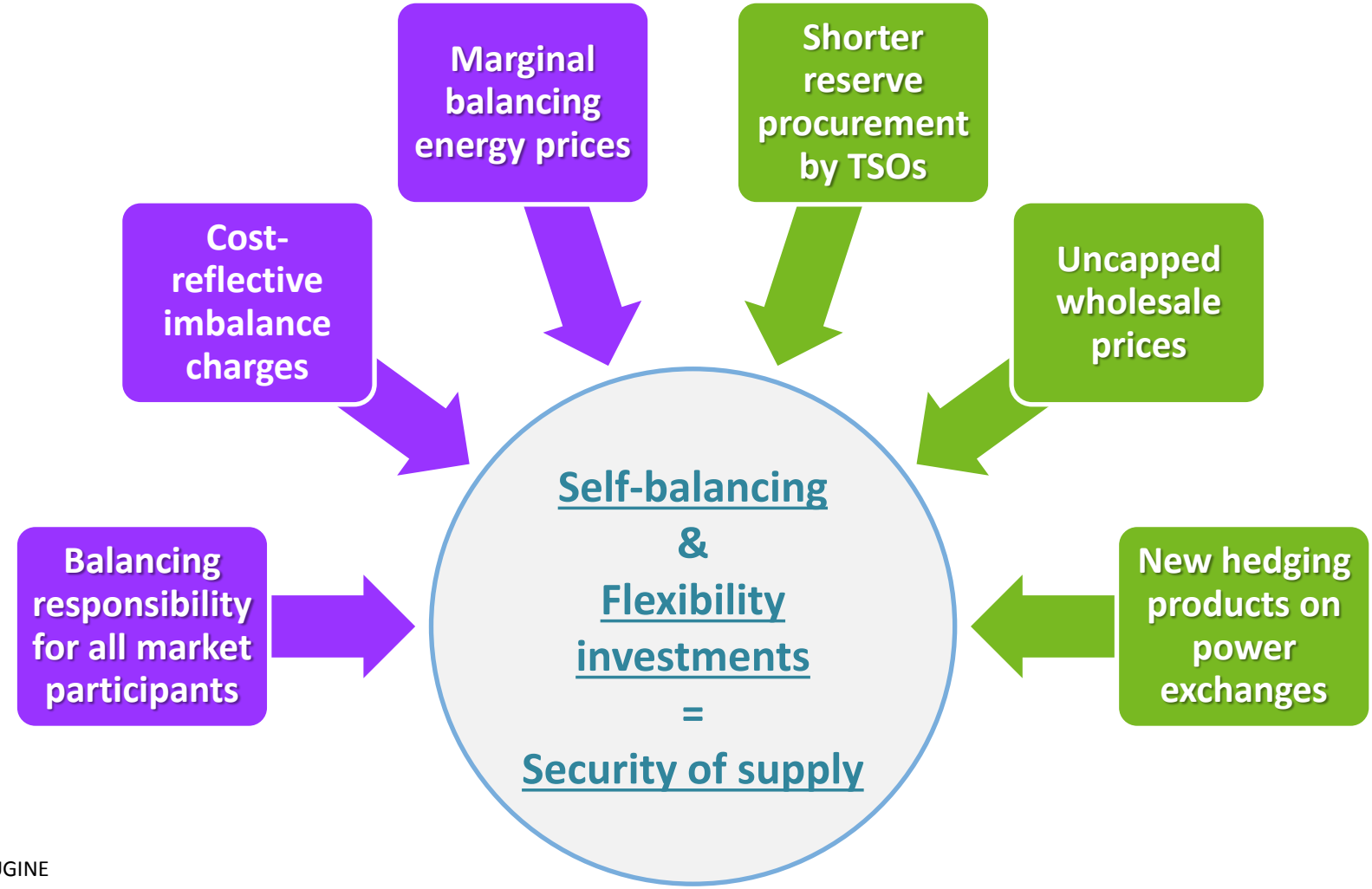
	Belgium	Finland	France	Germany	Greece	Great Britain	Hungary	Ireland	Italy	Portugal	Spain	Sweden
Adequacy	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑
Flexibility										☑	☑	
Reduced risk and price volatility								☑	☑	☑	☑	

Source: National Regulatory Authorities (2013). *Note:* In this table "Adequacy" refers to CRMs which aim at ensuring sufficient generation capacity in the electricity system to meet demand at all times, including at peak load periods; "Flexibility" (or reliability) refers to CRMs which aim at maintaining sufficient system flexibility to balance the electricity system notably in response to (sudden) demand variations or unexpected outages; and "Reduced risk and price volatility" refers to CRMs which aim at de-risking new investment and avoiding the price volatility associated with generators that run only periodically recovering their fixed costs over a short period of time.

Source: EUGINE (ACER)

Policy option 2: improved EOM

= set of measures fostering self-balancing and rewarding flexibility investments



Source: EUGINE

Policy options: comparison

	CRMs	Improved EOM
Advantages	- Capacity offered with a high-level of certainty; - Various types, adjustable to specific situations;	- Market-based measures, reduced costs; - Technology neutral, incentives for flexibility;
Usual criticism	If badly designed (e.g. overestimation of the required capacity, strictly national intervention): higher costs, market distortion, keeps old and less efficient plants running;	If badly implemented and the market does not work properly (e.g. in case of a possible reintroduction of price caps), no security that costs will be recovered and supply will be sufficient;

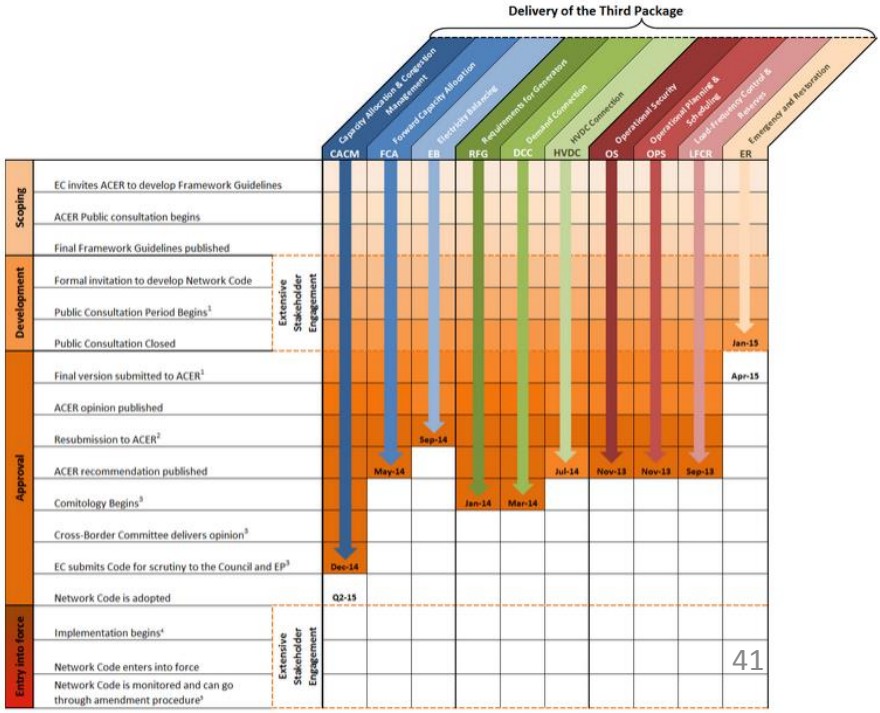
=> Possibility to combine both options?

Source: EUGINE

Point of view of the Commission

- **Competition policy:**
  - Communication “making the most of public intervention” (2013)
  - Guidelines on “state aids for environmental protection and energy” (2014)
  - 2014: GB “contract for difference”
  - Sector inquiry into capacity mechanisms: Belgium, Croatia, Denmark, France, Germany, Ireland, Italy, Poland, Portugal, Spain and Sweden

- **Energy policy:**
  - System adequacy assessment
  - Strengthening of the internal energy market through the development of Network Codes
    - “Sets of rules applying to one or more parts of the energy sector”
    - NC on electricity balancing (now on hold)
  - Market design initiative (2015/2016)



Source: EUGINE

Market design – Next steps

- 15 July: ‘Summer Package’ by the EC with consultative communication
- 2016: legislative proposals on:
  - Market design
  - Electricity security of supply

- Important evolutions in parallel:
  - National measures (e.g. GB, F, DE, PL, IT, etc.)
  - Regional initiatives (e.g. Political declarations of the “Pentalateral Energy Forum”)
  - New flexibility products on power exchanges
  - Innovations to further improve flexibility technologies

Source: EUGINE

Thank you for your attention!