European Energy Forum

EEF Briefing for MEP Assistants

Ensuring EU's Security of Supply

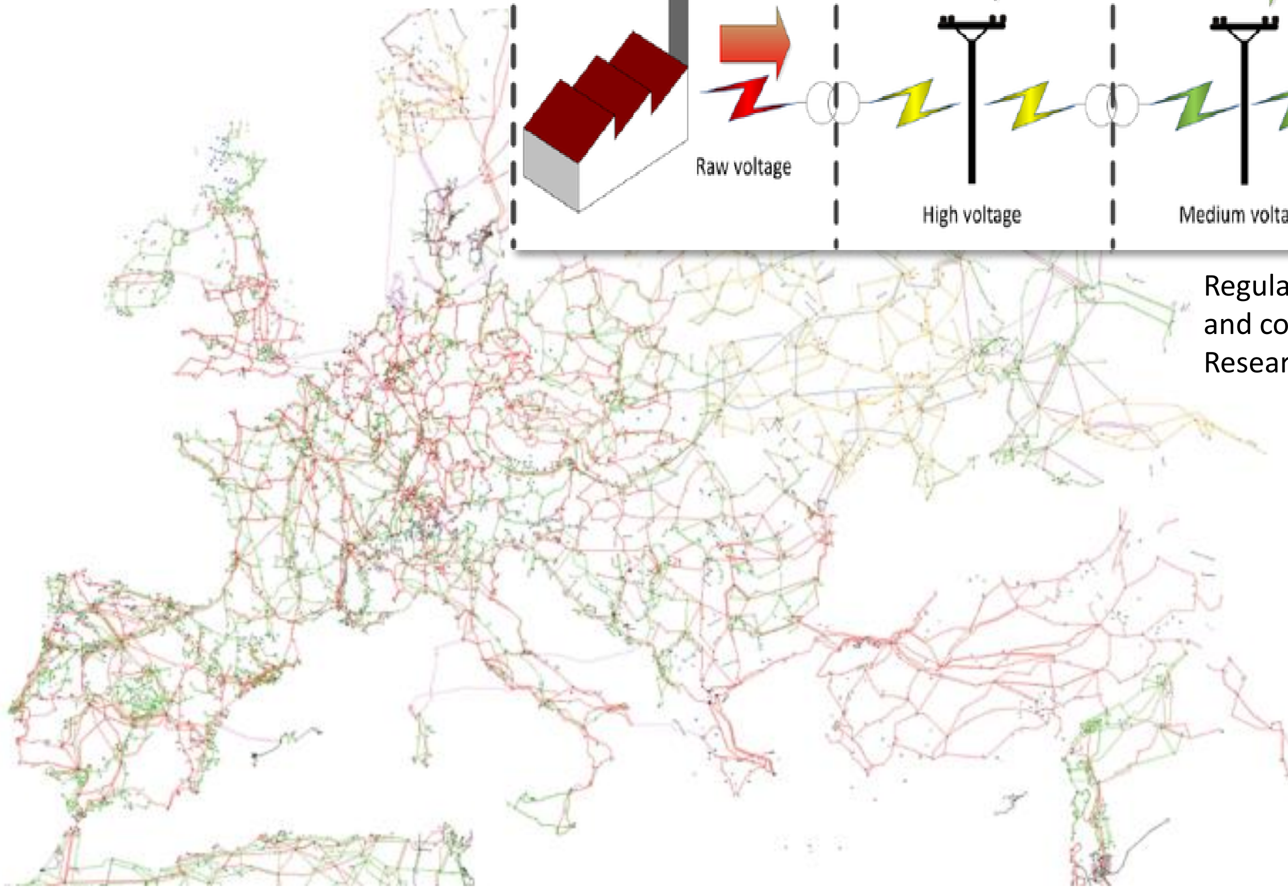
Session two: electricity

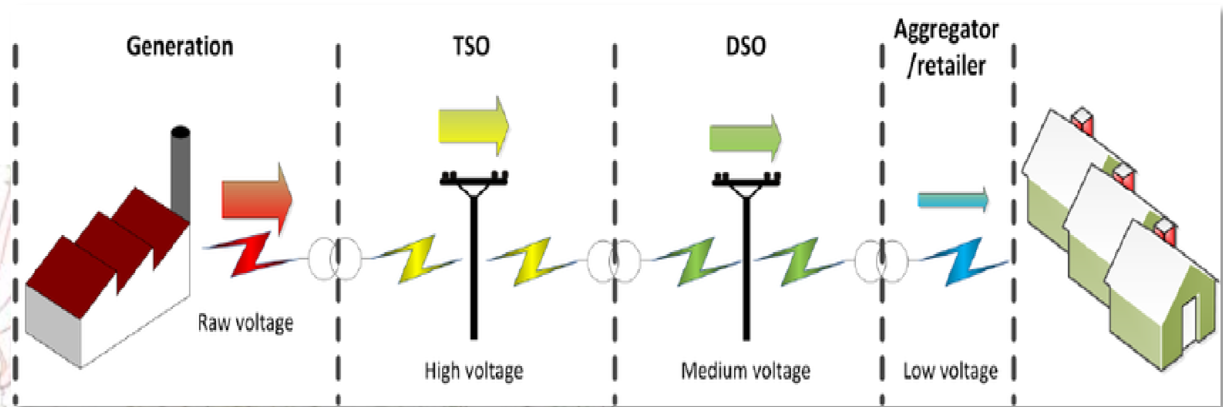
European Energy Forum

Overall picture:
Production and transmission

Speaker: Michael Mieszczanski,
Communication Advisor of the European Network for Transmission Systems Operators of Electricity (ENTSO-E)

The power system value chain





Regular electricity production, distribution and consumption value chain. Source: Researchgate.net

The relationship between gas and electricity SoS?

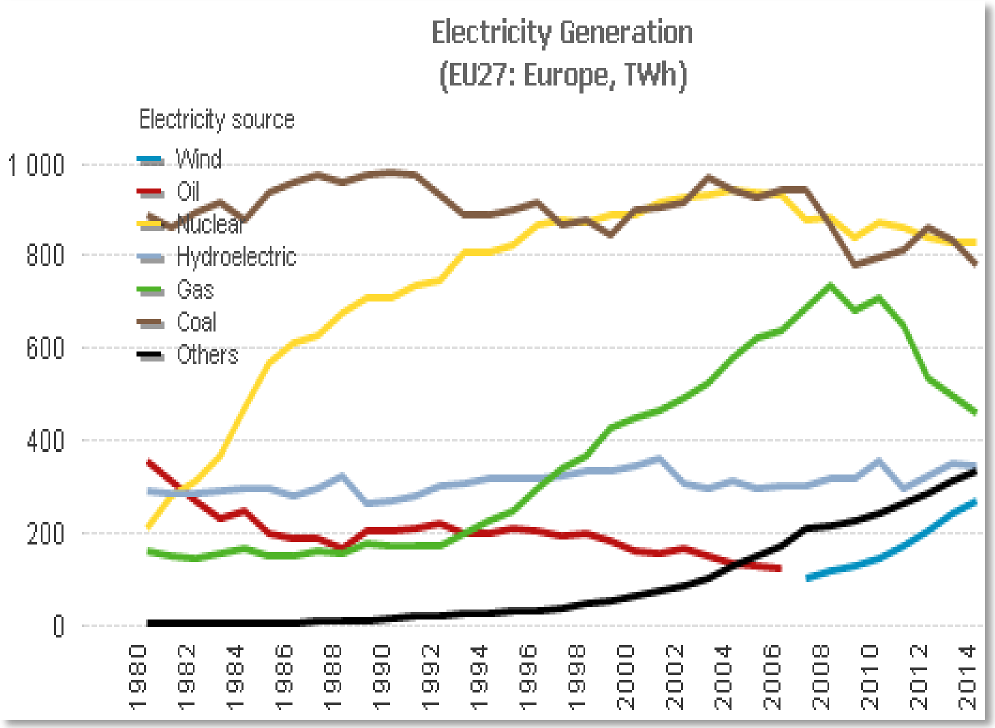
16,5% of electricity is generated from gas in Europe*

Import dependency on natural gas is 65%**

BUT

SoS risks from gas shortages are assessed twice a year

Electricity SoS is substantially different to gas SoS



Declining share of gas in electricity production. Source: TSP Data portal

*Source European Environment Agency, 2013
** Source: European Commission, 2015

How is security of supply in electricity characterised?

Electricity generation is largely domestic

Broad range of supplies & generation technologies

Energy storage is a challenge / It can provide local, secure supply

Electricity is European, but accountability is national

Balance of demand & supply impact volatge and frequency

➔ SoS = avoiding blackouts, brown-outs, disruptions or disturbances; ensuring generation adequacy

➔ n-1 = the system remains safe even if any element of the system fails

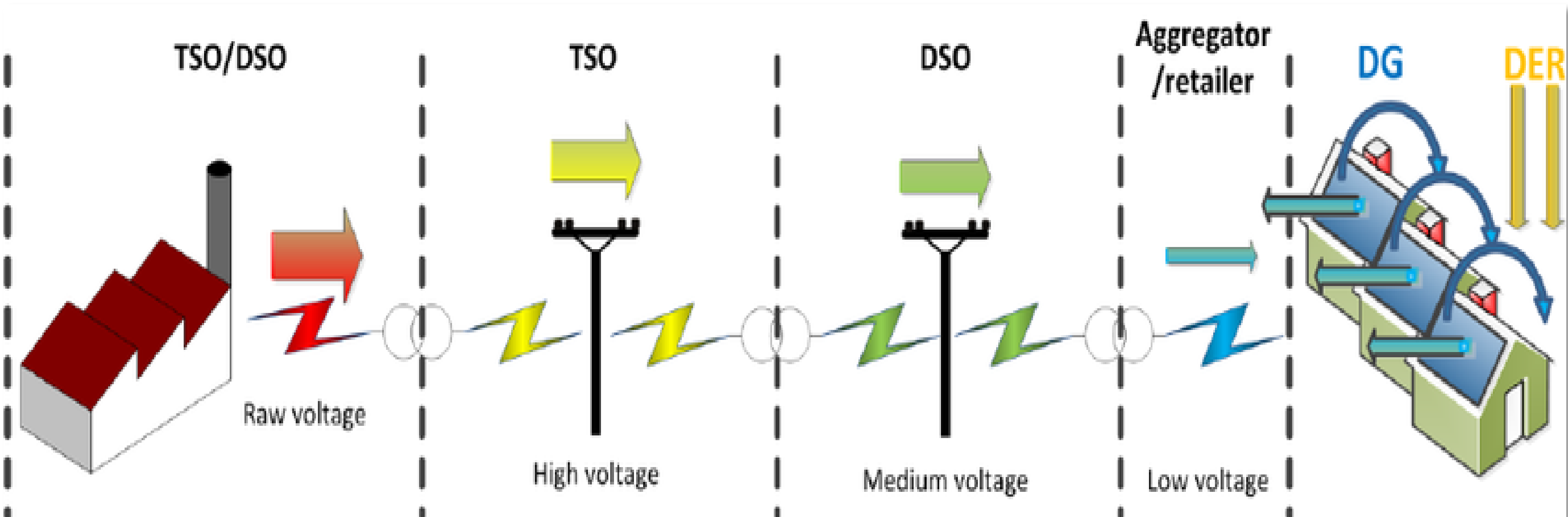
➔ 24/7 balancing of demand and supply

➔ Long-term system adequacy (capacity, flexibility, system services)

➔ Very close cooperation across borders is required

What are the challenges today?

Significant rise in variable RES (wind solar PV), since 2009



Can be addressed through policy

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Overall picture:
Distribution

Speaker: Johannes Vollmer,
Policy Manager at GEODE (independent local energy distributors across Europe)

90% of RES connected to the distribution level

Decentralised generation makes Europe less dependent from energy imports

→ Contributing to Security of Supply

Variable RES require system flexibility

- → Demand Side Management
- → Active Consumers through Smart Metering
- → Smart Grids
- → Storage
- → New Technologies such as P2G and others

European Commission

Electricity: 17 Member States with Large-Scale Roll-out by 2020

<u>Countries with highest roll-out at present</u>

Sweden: 100% roll-out
Finland: 97% roll-out
Italy: 96% roll-out

Mandated: Decision taken by Ministry or National Regulatory Authority

Original ref. COM(2014) 356; SWD(2014) 189; updated

Electricity Smart Meters Roll-Out Timelines in MS (at least 80% coverage)

Sweden		2003 → 2009	Completed
Italy		2001 → 2011	Completed (ENEL: 2001-2006)
Finland	Mandated	2009 → 2013	
Malta	Mandated	2009 → 2014	
Spain	Mandated	2011 → 2018	
Austria	Mandated	2012 → 2019	
Poland	Under Discussion	2012 → 2020	
UK	Mandated	2012 → 2020	
Estonia	Mandated	2013 → 2017	
Romania	Under Discussion	2013 → 2020	
Greece	Mandated	2014 → 2020	
Netherlands	Mandated (timetable TBC)	2014 → 2020	
Denmark	Mandated (>1.5mn SM already installed)	2014 → 2020	
Latvia	DSO decision	2014 → 2020	
France	Mandated	2015 → 2020	
Luxembourg	Mandated	2015 → 2018	
Ireland	Mandated	2016 → 2019	

Altogether: roll-outs in 19 MS => 72% EU electricity consumers with a smart meter by 2020

Energy ENER Smart Grids © European Commission 2016

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Questions and comments

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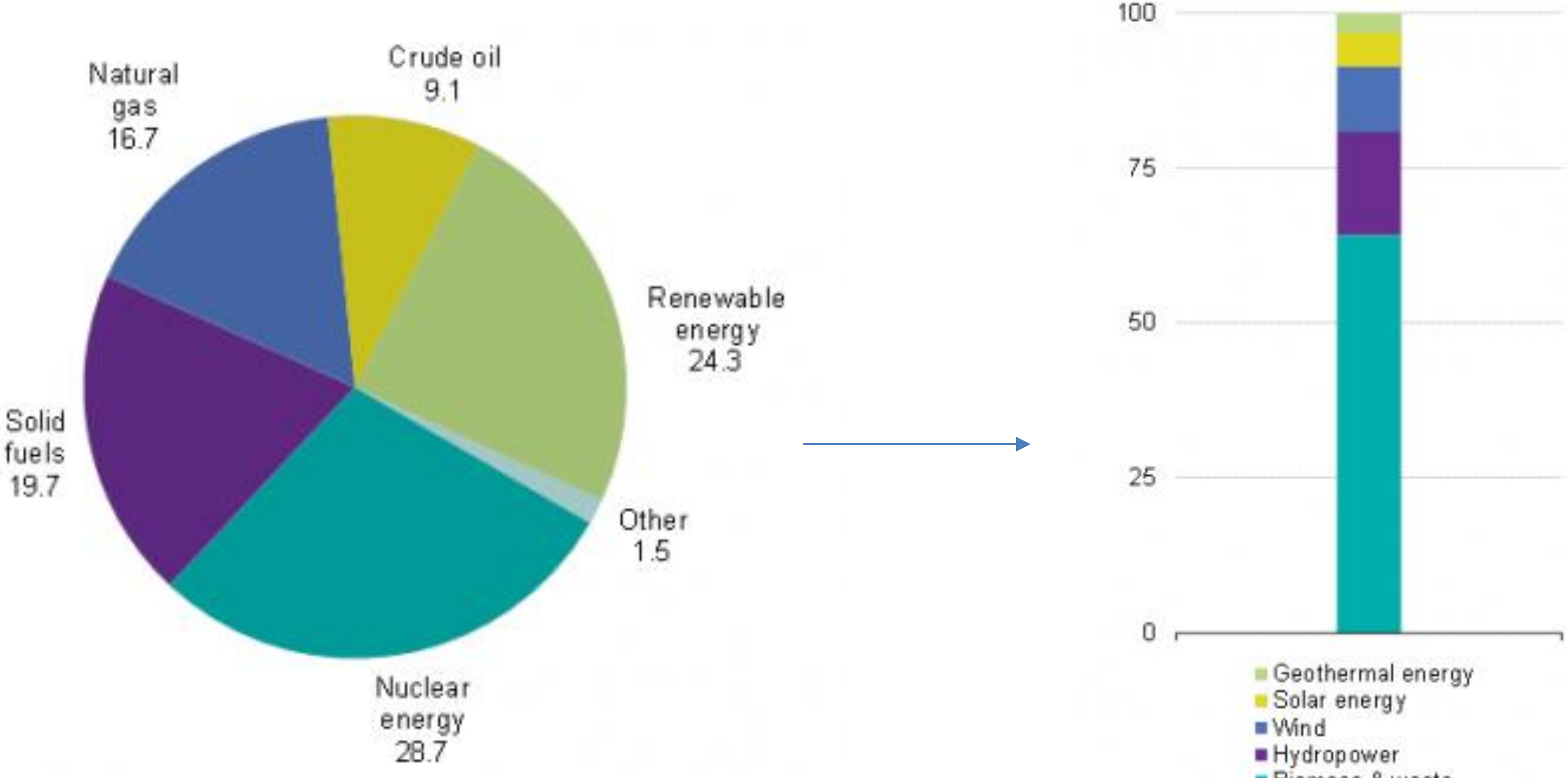
Technology aspects

Speaker: François Paquet,
Policy Officer at the European Power Plant Suppliers Association (EPPSA)

Technology Solutions Ensuring The Security of Electricity Supply

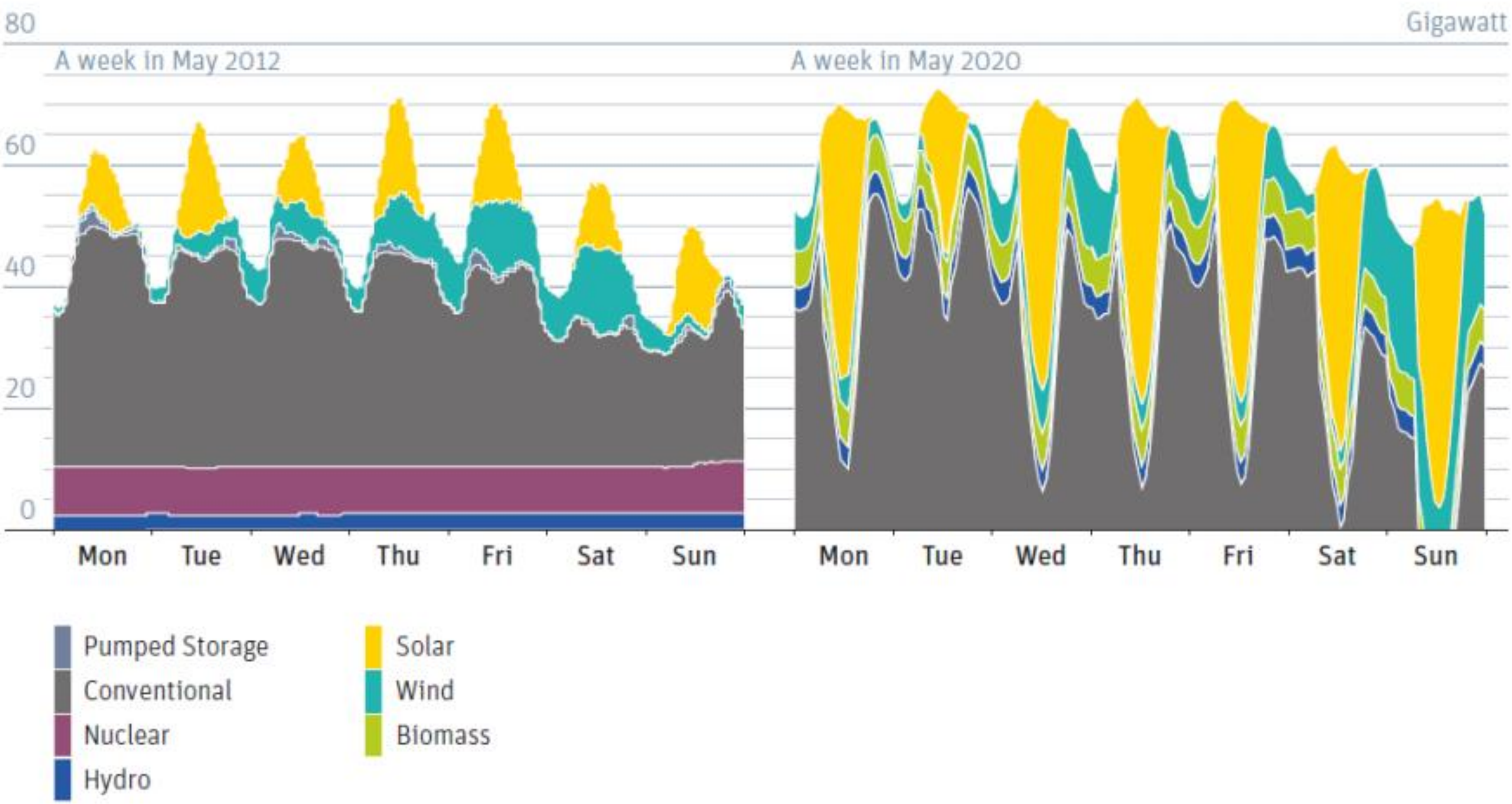
1. A balanced energy mix
2. Energy storage
3. Grid interconnections
4. Demand Side Management (DSM)

1. A Balanced Energy Mix…



Production of primary energy, EU-28, 2013 (% of total, based on tonnes of oil equivalent)
Source: [EUROSTAT]

…with varying flexibility potentials to meet the future energy system needs



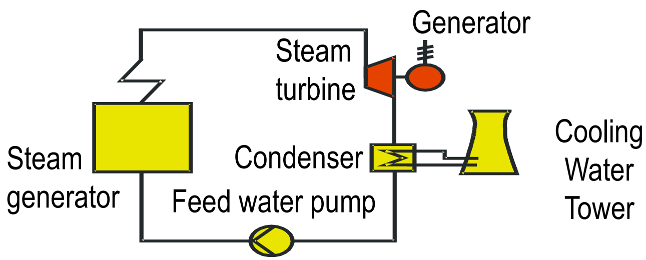
Source: Volker Quaschning, HTW Berlin

1. A Balanced Energy Mix
Thermal power

Large combustion power plants and smaller units

Steam power plant

Principle: apply steam turbine technology for electricity generation
Fuel: Coal, lignite, gas, oil, biomass, waste

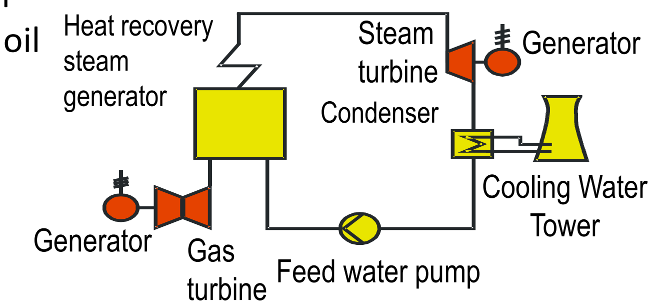


Example of large combustion plants: Lippendorf coal-fired power plant in Germany

Output up to **1000 MWe** per unit and efficiency up to 47% (>than 90% with CHP)

Combined cycle (CCGT) power plant

Principle: apply mainly gas turbine technology and subsequent heat recovery steam generator for electricity generation
Fuel: Gas, oil



Example of combined cycle power plant in Bouchain, France

Output: **605 MWe** unit and efficiency of up to 62.22%

1. A Balanced Energy Mix

Thermal power

Fuel: Mainly natural gas
Others: biogas, sewage gas, biodiesel, diesel, etc.

Engine power plants

- Energy generated by **'internal combustion engines'**
- Up to **21 MWe** output per engine, **tens of engines** in a power plant
- Engines can start-up and ramp-up to **full output within 5 minutes** (high flexibility)
- Applications: emergency reserve, cogeneration, back-up for V-RES and bioenergy

Back-up engines at a hospital

Back-up engines for variable renewables

1. A Balanced Energy Mix

Thermal power

Benefits

- ➢ 24/7 dispatchable capacity for baseload generation and back-up generation (e.g. to compensate intermittent RES and stabilise the system or emergency reserve (e.g. in hospitals, airports))

- ➢ Increasing fuel flexibility:
  - traditionally based on conventional energy sources (coal, lignite, gas, oil),
  - thermal power is more and more using RES (e.g. bioenergy (biomass, Bio-gas), Concentrated Solar Power, Waste to Energy …),
  ➔ which improves the security of electricity supply and reduces the dependency on fossil fuel imports

- ➢ Increasing resource efficiency:
  - more electricity generated with less fuel,
  - plants suitable for district heating through combined heat and power (CHP),

- ➢ Increasing descentralisation of electricity generation

Challenges

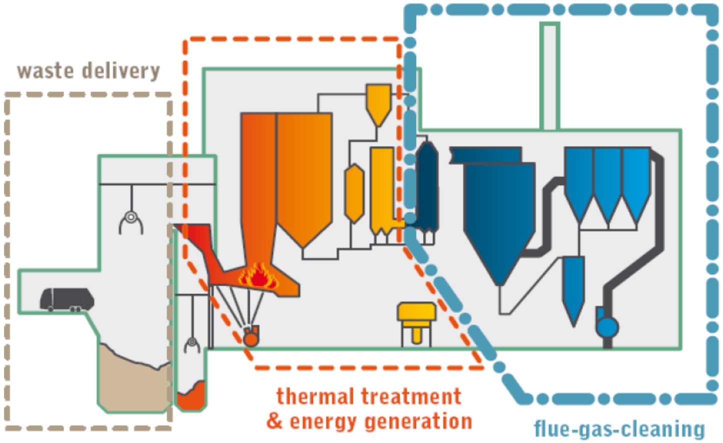
- ➢ Emissions of Co2 and some pollutants, especially ageing installations
  - Flue-gas-cleaning technologies allow mitigating pollutant emissions regulated under BREF
  - Carbon Capture and Storage and Utilisation technologies allow capturing CO2 emissions

- ➢ Declining political support for fossil fuel based installations while the need for ensuring the security of electricity supply increases

1. A Balanced Energy Mix

Waste to energy (another thermal process)

<u>Basic principle</u>: thermally treat residual household and similar waste that cannot otherwise be reused or recycled in an environmentally sound way to produce heat and electricity.



Benefits

- Can be used for baseload generation (substituting fossil fuels (gas, oil, hard coal and lignite)
- Is around 50% renewable. Waste is a local, reliable and affordable energy source
- In Europe, around 60% of WtE plants are recovering both electricity and heat (CHP) from the energy content of residual waste.

Challenges

- Investments in available technologies
- Emissions of Co2 and pollutants: Waste-to-Energy is regulated by stringent environmental legislation, achieving very low, strictly controlled and well-monitored emissions.
- Improve infrastructures and connections between the energy providers and district heating networks with appropriate investments, the contribution to district heating networks from WtE could raise up to 200 TWh in 2050 (around 50 TWh provided in 2010)

1. A Balanced Energy Mix

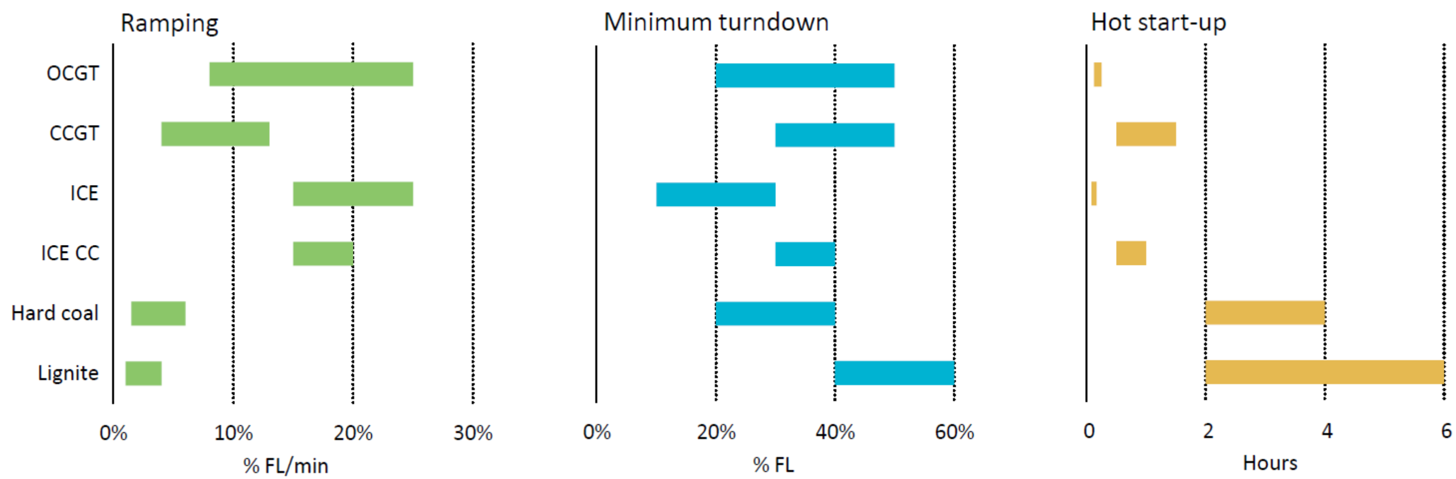
Nuclear power (also thermal power)

- **Benefits**
  - 24/7 capacity. However latest reactor designs allow running on load-follow mode with modulations greater than 50 percent of their capacity. This provides a two-fold benefit:
    - essential baseload availability
    - flexibility to meet market fluctuations
  - Low carbon source of energy (Nuclear accounts for the largest amount of avoidance of carbon – as a percentage of actual electricity produced)
  - Limited investment required in the grid nor in any backup capacity
- **Challenges**
  - Nuclear waste management (Cost of nuclear generation is fully accounted in that final waste and decommissioning costs are included in the tariff)
  - Ageing capacity, which will need to be replaced in the next 10 years to meet nuclear security and decarbonisation commitments
  - Capital intensive although negligible operating costs

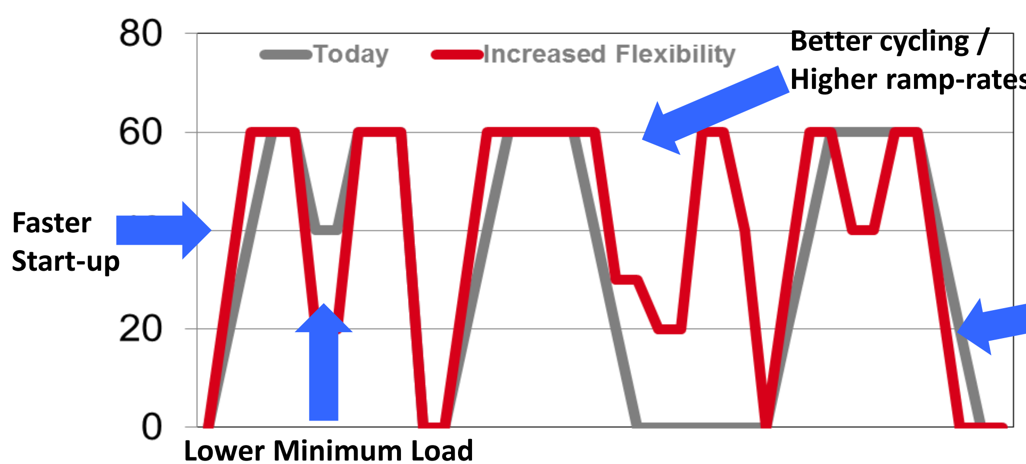
Flexibility of Power Generation

Research needed

The start-up and ramp-up times as well as the minimum turndown ratio are key to define the ability of the various technologies to respond cost-efficiently to flexibility challenges and to ensure the security of electricity supply.

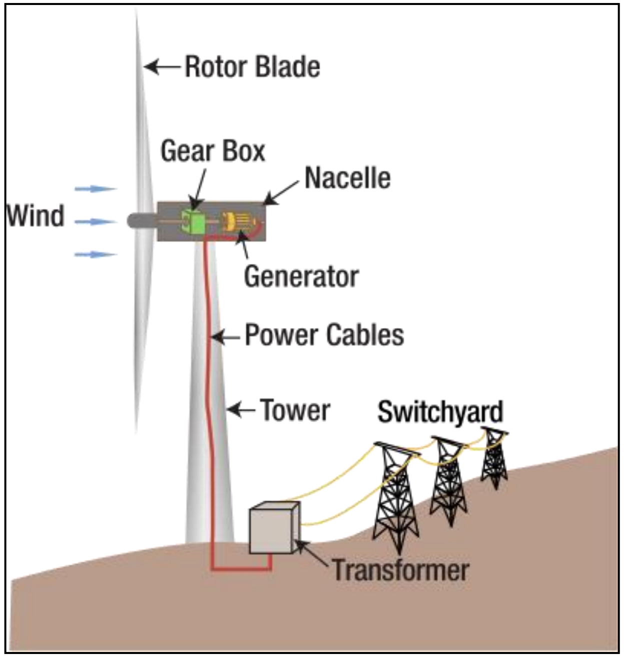


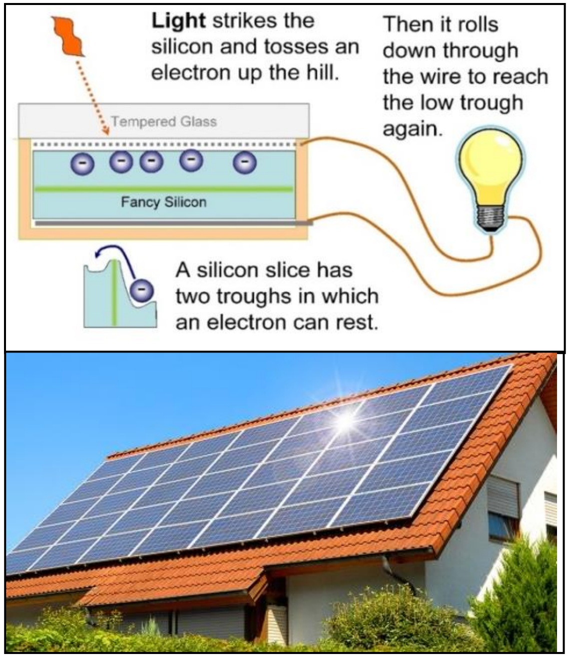
More research, development and demonstration is needed to increase the flexibility of available technologies



1. A Balanced Energy Mix

Solar and Wind Power

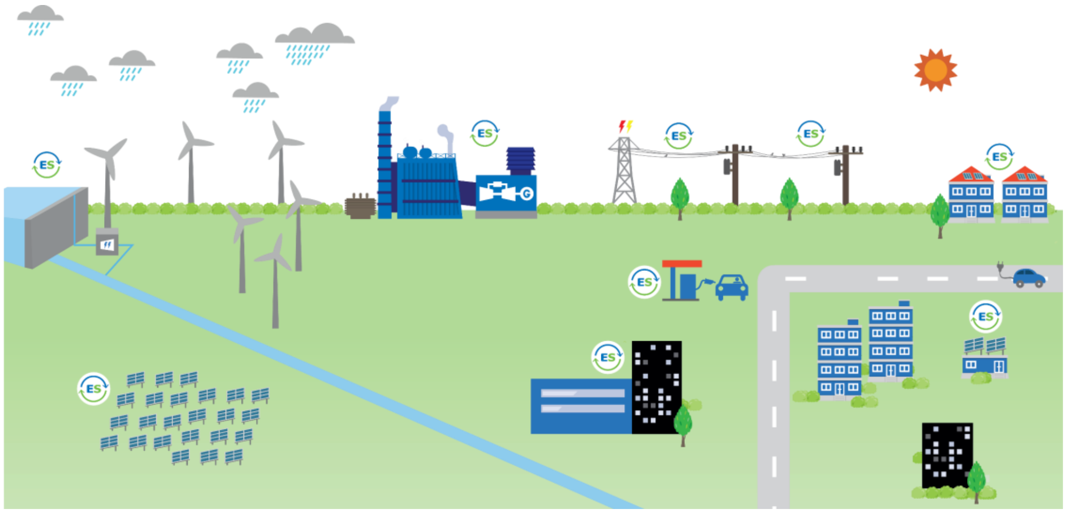




- **Benefits**:
  - ➢ CO_2 free electricity generation that can replace or complete other sources of electricity supply to meet electricity demand

- **Challenges**:
  - ➢ Intermittent generation - Wind and solar power generation depends on the changing weather conditions, which poses challenges in terms of securing the electricity supply
  - ➢ Feed in tariff - Public financial support needed to make it economical

2. Energy Storage



What is it? Energy Storage is the act of deferring an amount of the energy that was generated to the moment of use, either as final energy or converted into another energy carrier.

Benefits

- Energy can be stored through a myriad of technologies , such as pumped hydro, batteries, flywheels, capacitors, compressed air
- Energy storage can add value to the grid when deployed at various levels, for example:
  - At transmission level, it allows optimised dispatching (peak shaving, curtailment minimisation) for renewable energy sources
  - At distribution level, it provides incremental capacity to address grid congestion (peak shifting), allowing investment deferral
  - At 'prosumer' level, it enables deferred and optimised self-consumption

Challenges

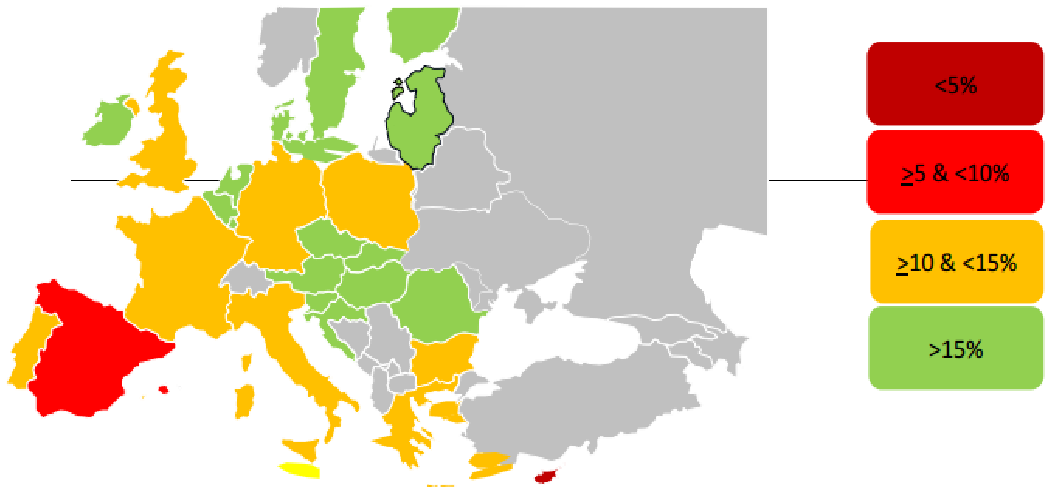
- Energy storage is already economical but large-scale deployment is hampered by regulatory barriers
- Coordinated action by policy makers, regulators and industry needed to capture its full value

3. Grid Interconnection

Benefits

- Can help balance loads and facilitate power trading
- Integration of remote renewables and transmission to distant load centres (e.g. hydro, wind, offshore wind, large scale solar etc.)

Map of interconnection levels in 2020 after implementation of current PCIs



Challenges

- Interconnections not as good as they should be
- Next development step - DC Grids? High-voltage DC?
- 10% electricity interconnection target for 2020 -> proposal to extend this to 15% by 2030.
- The targets will be reached through the implementation of Projects of Common Interest. An Expert Group will provide technical advice on how to break down the 15% electricity interconnection target by 2030 into regional, country and/or border interconnection target

4. Demand Side Management (DSM)

Principle:

Balancing supply and demand sides e.g. by deferring or advancing consumption, with promising potential in industrial processes (already used today) or energy storage or a changed consumer behaviour

Benefits

- Can significantly reduce peak prices and overall price volatility for all users
- May reduce the need for expensive new generation, transmission and distribution facilities to meet peaks in demand
- May facilitate a smart and cost efficient operation of distribution grids (e.g. by mitigating local load peaks and overvoltage in the distribution grid (e.g. in low and medium voltage grid))

Challenges

- Peak demand tends to grow. Countries face growing challenges to balance supply and demand. How to ensure the best coordination between DSOs, TSOs, BRPs, aggregators, …?
- Consumers involvement – should we move toward floating consumer prices?
- Ensuring data privacy and cyber security
- Interoperability of all "smart" devices required – standards to be developed at EU level
- Smart meters with minimum requirements
- Huge investments needed in smart grids

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Questions and comments

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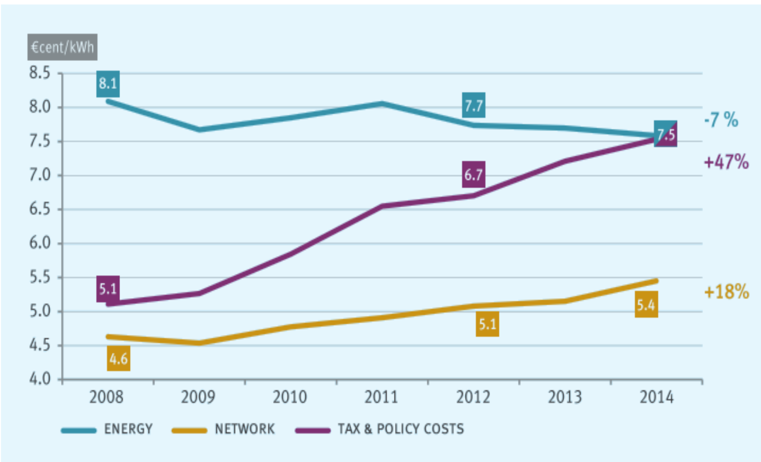
Economic aspects:
Point of view of electricity producers and suppliers

Speaker: Hans ten Berge, Secretary General of Eurelectric

The reality of today's markets

Consumers don't benefit from decreasing wholesale prices

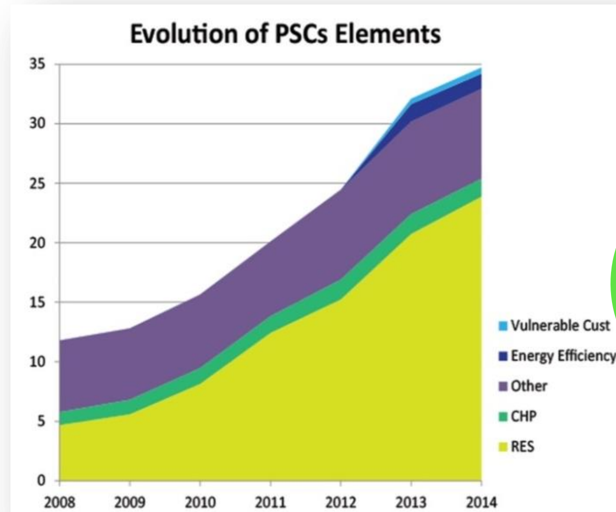


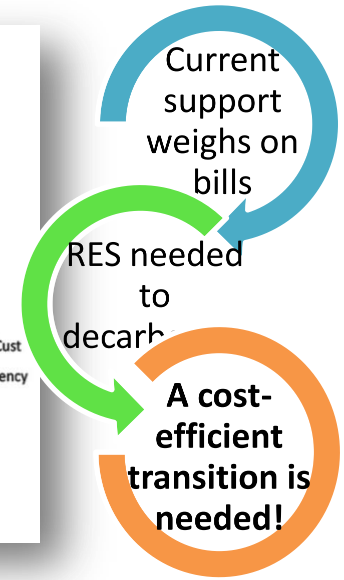
Source: EURELECTRIC infographic "Making sense of your electricity bill", February 2016

What is needed:

- Demand response enabled
- Level playing field for prosumers, demand response, storage etc.
- Timely roll out of smart meters & grids

RES are not integrated in the market

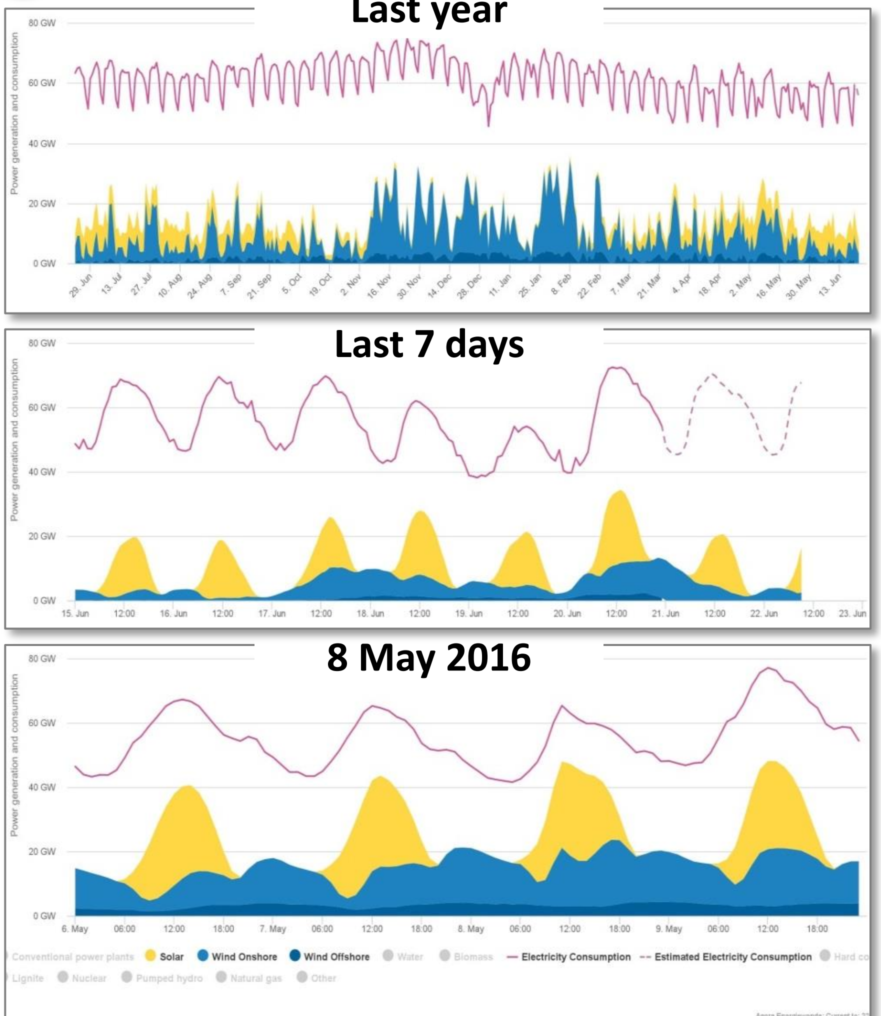




What is needed:

- Balance responsibility for all
- A strengthened ETS
- Possible RES support to be market-based & cost-efficient

Power systems with broad generation variations need both firm capacity & flexibility



RES load factors vary greatly

Germany has around 90 GW of wind and solar installed capacity, while peak demand ranges 75 – 80 GW

Normal **range of variation** in a few days/intraday is around 30 GW: production can be “virtually” zero and in some hours higher than 30 GW.

On 8 May, wind and solar reached a peak production value higher than 40 GW

Security of supply = Variable RES + Flexible resources + Back-up capacity

A future-proof market design

ENERGY

Sells KWh

PROVIDED THROUGH

Forward, day-ahead, intraday markets

FLEXIBILITY

Adjusts to short-term variations

PROVIDED THROUGH

Day-ahead, intraday, balancing markets & ancillary services

NEEDED

Market integration, interconnections used at their best, shorter gate closures…

CAPACITY

Delivers firm capacity

PROVIDED THROUGH

Market-based capacity mechanisms, where relevant

NEEDED

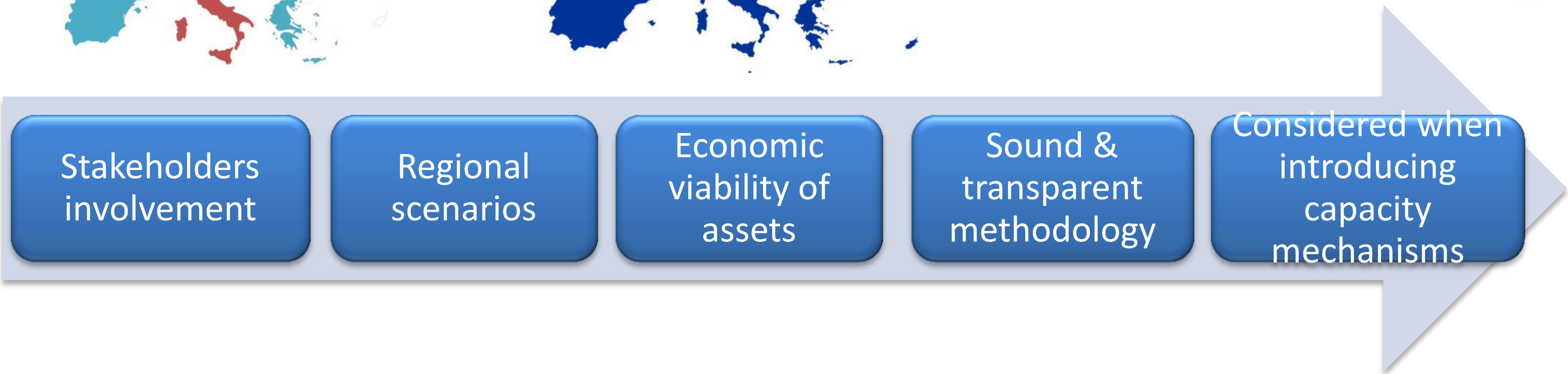
Open to all technologies (generation/ demand response/ storage), new & existing assets and cross-border participants.

Complete the internal market - go regional/European on all, including capacity markets

Scarcity prices are rare & uncertain:

- Are governments really ready to accept risks of brownout?
- Huge market interventions mean that investment signals are lacking for all technologies

WHERE THEY EXIST, WELL-DESIGNED CAPACITY MARKETS ARE A TOOL FOR ADEQUACY ASSESSMENTS



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Economic aspects:
Point of view of technology producers

Speaker: Ralf Wezel, Secretary General of EUGINE

Context

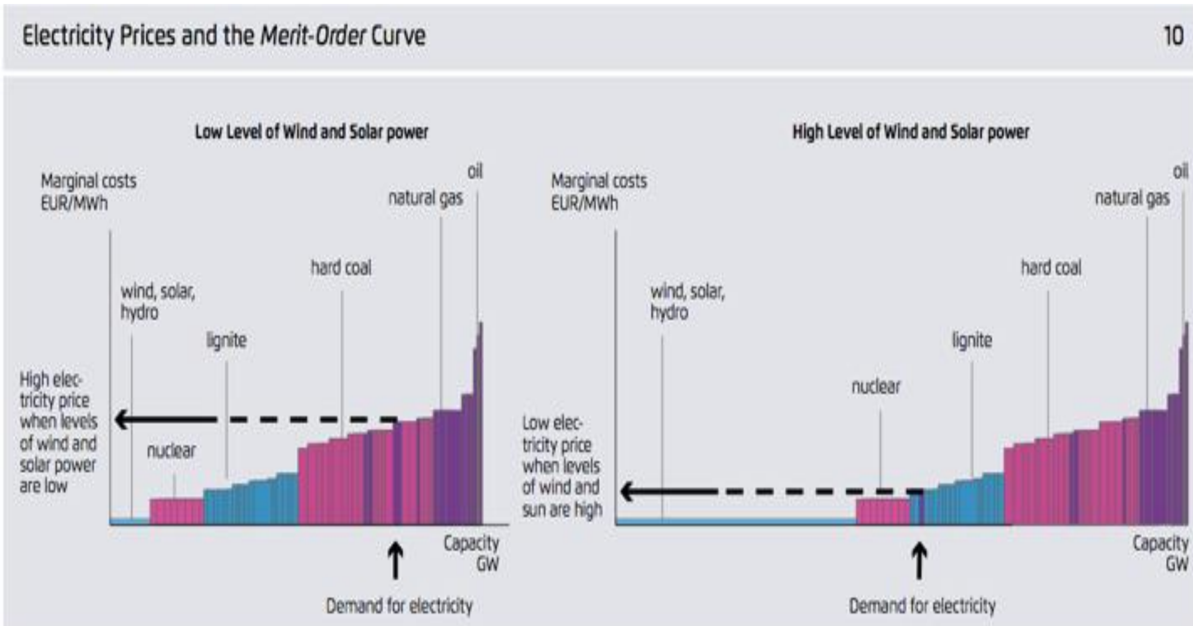
- Challenge of the past:
  Ensure sufficient supply

- Challenge of Today:
  Overcapacities in Europe, but uneven distribution and growing share of volatile sources

Supply Today: No market for flexibility

<u>RES</u>: Subsidies + priority dispatch + almost zero variable costs

- Pricing: "over-the-counter" (off-exchange) & power exchange: wholesale price equals the variable cost of the marginal unit



- Balancing today: TSOs procure capacities on a separate balancing market (3 different reserves with different activation time)
  -> income for flexibility solutions
  -> costs partly charged to source of imbalance

Source: Agora Energiewende

Flexibility solutions challenges

Running less hours but still recovering the investment costs

- Balancing contracts with TSOs
- Increase efficiency
- Additional income by eg cogeneration

How to ensure that investments in flexibility are made?

- ETS: Ensure that carbon-intensive unflexible generation is less competitive
- Pay additional income while not running to ensure availability of flexibility
- Ensure sufficiently high income to recover costs during (lower) operating hours

Payments even if not running – Capacity markets

- OK, if not distorting the energy-only market and limiting internal European market
- OK, if it really focuses on flexibility solutions
  -> Today often tool to help utilities with existing assets, not aiming at flexibility
- DG COMP enquiry shows the difficulty of designing a suitable framework

Ensure sufficient income while running

- No price caps
  Allow very high wholesale market prices when most suppliers cannot deliver -> most flexible solutions would earn highest income
- Balancing responsibility for all
  Make everybody who causes short-term imbalances pay the full marginal costs for balancing
  -> this creates incentives to look for own cheaper backup solutions or hedging products
- Crossborder markets
  Allow flexibility solutions to have a larger market

Questions and comments

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Thank you for your attention!