National and International Energy Policy

Winter/Summer Energy School

2nd of February 2016

Czech Technical University in Prague

MINISTERSTVO PRŮMYSLU A OBCHODU

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Ministry of Industry and Trade

Content

i. Energy policy – introduction/overview.
ii. Energy modeling.
iii. Climate-energy Policy, Energy Union.
iv. Long term vision of EU energy sector
v. Energy only market, capacity market.
vi. Decentralized energy sector.

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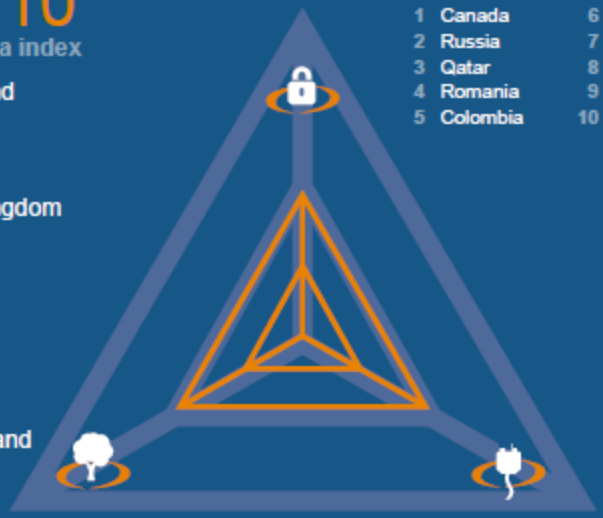
Top 10 Energy Trilemma Index performers overall and per dimension

Source: WEC/Oliver Wyman, 2014

TOP 10

2014 Trilemma index

1 Switzerland
2 Sweden
3 Norway
4 United Kingdom
5 Denmark
6 Canada
7 Austria
8 Finland
9 France
10 New Zealand



Energy Security

1	Canada	6	Denmark
2	Russia	7	Bolivia
3	Qatar	8	United States
4	Romania	9	United Kingdom
5	Colombia	10	Australia

Environmental Sustainability

1	Switzerland	6	Sweden
2	Costa Rica	7	Uruguay
3	Albania	8	Austria
4	Colombia	9	Denmark
5	Norway	10	France

Energy Equity

1	United States	6	Qatar
2	Canada	7	Saudi Arabia
3	Australia	8	United Arab Emirates
4	Luxembourg	9	Hong Kong, China
5	Switzerland	10	Austria

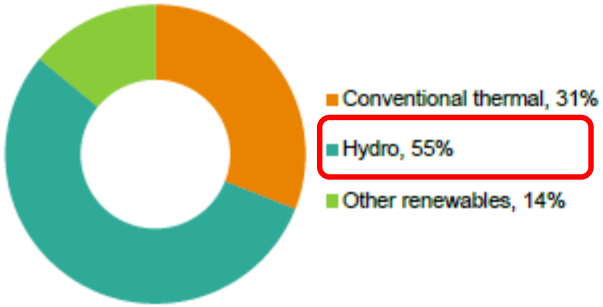
AAB SCORE **AUSTRIA** RANK 7

TRILEMMA BALANCE

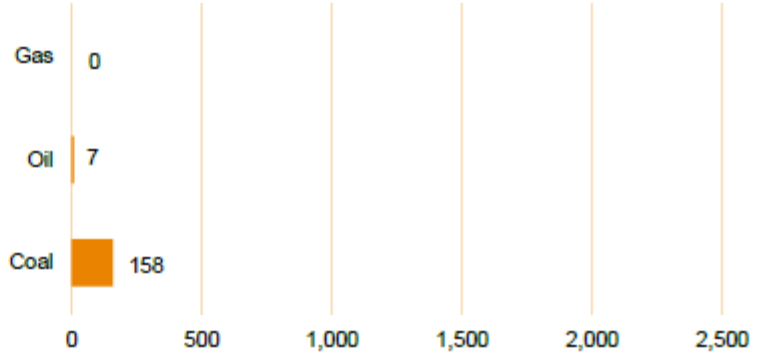
INDEX RANKINGS AND BALANCE SCORE

	2012	2013	2014	Trend	Score
Energy performance	3	5	5	→	
Energy security	30	33	44	↓	B
Energy equity	7	7	10	→	A
Environmental sustainability	7	7	8	→	A
Contextual performance	12	12	13	→	
Political strength	9	12	12	→	
Societal strength	16	16	13	→	
Economic strength	28	27	19	↑	
Overall rank and balance score	**4**	**4**	**7**	→	**AAB**

DIVERSITY OF ELECTRICITY GENERATION



FOSSIL FUEL RESERVES (IN MTOE)



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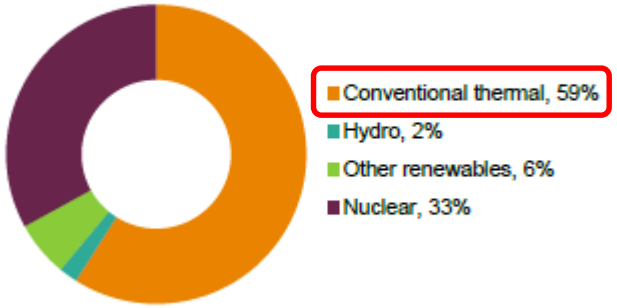
28 RANK **CZECH REPUBLIC** SCORE **ABC**

TRILEMMA BALANCE

INDEX RANKINGS AND BALANCE SCORE

	2012	2013	2014	Trend	Score
Energy performance	38	32	31	↑	
Energy security	16	16	12	↑	A
Energy equity	37	32	38	→	B
Environmental sustainability	90	90	87	→	C
Contextual performance	39	38	38	→	
Political strength	21	18	25	↓	
Societal strength	40	40	35	↑	
Economic strength	70	72	68	→	
Overall rank and balance score	**35**	**32**	**28**	↑	**ABC**

DIVERSITY OF ELECTRICITY GENERATION



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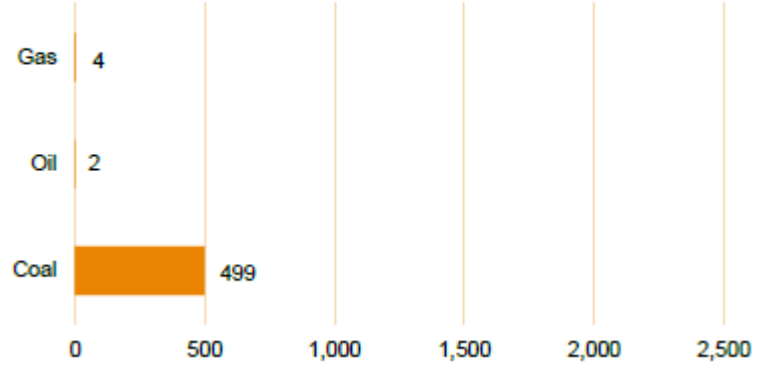

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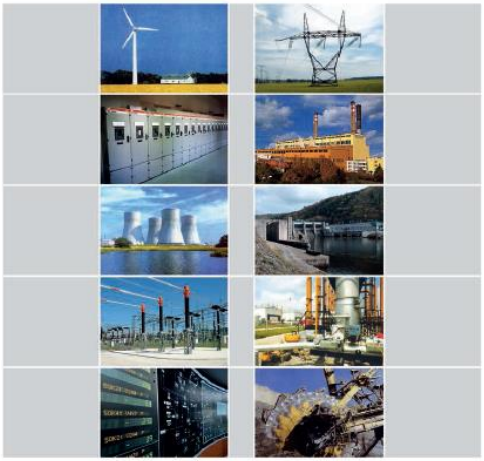
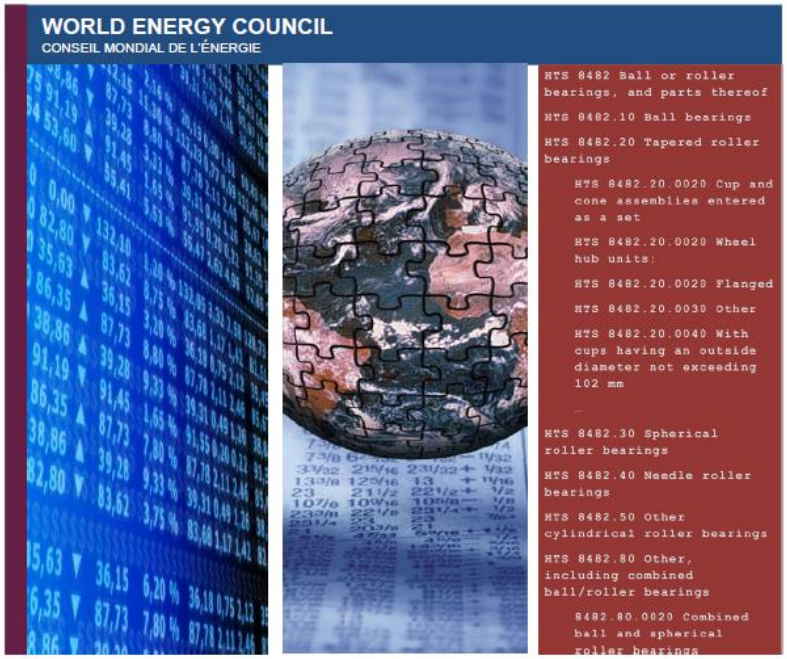


WEC/CME
Energetický komitét České republiky
Praha, červen 2013



World Energy Council -
https://www.worldenergy.org/

Energetický komitét ČR
http://www.wec.cz/

Characteristics of energy sector

- Electricity and heat still treated as a **public goods** despite the liberalization proces (more below).
- **Long investment cycle**, uncertainties (risk mark-up) are crucial for profitability of long term investments (nuclear power plants => 60 years operational period).
- Tightly connected with **geopolitical politics**, „battle for dominancy of world resources“.
- Strong **dependency on policy/regulatory environment**.
- **High market concentration**, natural monopoly, strong regulation.
- Still highly **centralized on the side of production**.
- **Market specifics** – real time balancing of supply and demand.
- Global markets with still **highly regulated state owned companies** (ex: oil and OPEC influence).
- Liberalized global market – quick **transmission of global events through markets** (floods in Australia => coal price in Europe).

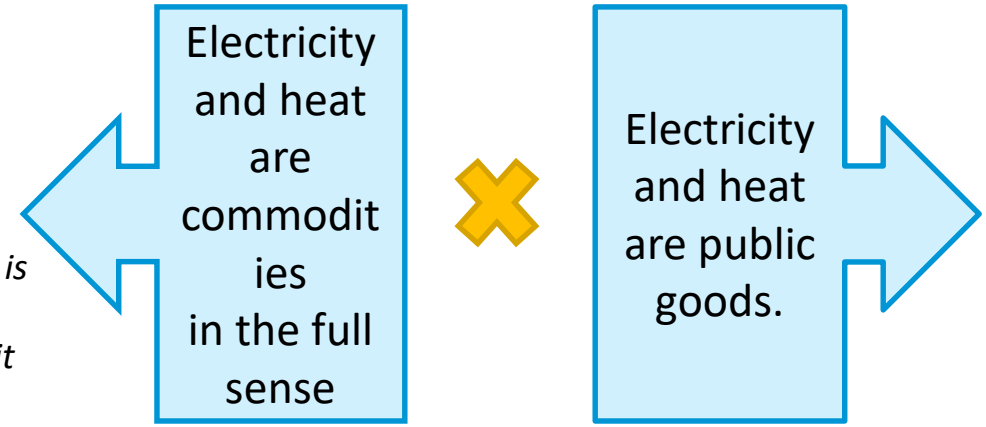
The role of energy policy

Public good is a good that is both non-excludable and non-rivalrous in that individuals cannot be effectively excluded from use and where use by one individual does not reduce availability to others.

Electricity and heat are divisible goods - it is possible to exclude certain entities from consumption. These goods **do not therefore meet the definition of public goods** and can be seen as a purely private goods (these goods have long been seen as public goods due to natural monopoly in the sector of transmission and distribution).

„Energy dilemma“

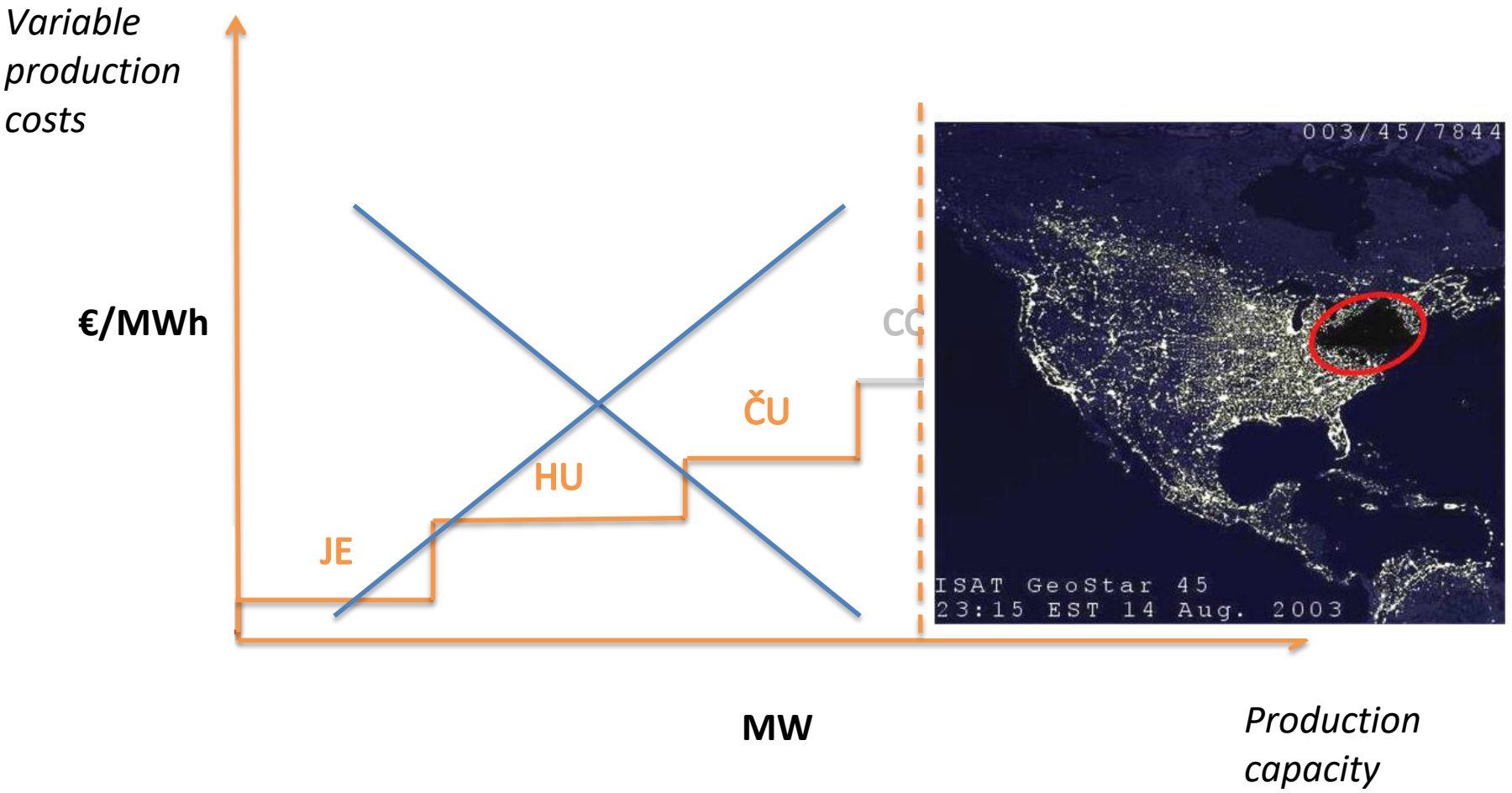
The State does not care about the adequacy of production capacity. Due to the long investment cycle the situation might occur in which consumer is willing to pay an „appropriate“ price, but it is not possible due to insufficient capacity.



The State reflects the fact that everyone has the right to connect to a source of electricity and heat. The state arrogates to itself the right to intervene in the free market in order to keep production adequacy. Regulation of supply side of power market.

Energy only market, capacity markets, price spikes energy poverty.

On „classical“ markets the falling of the edge of supply is impossible due to elasticity (price), „closing of the business“ is experienced only by the last buyer.



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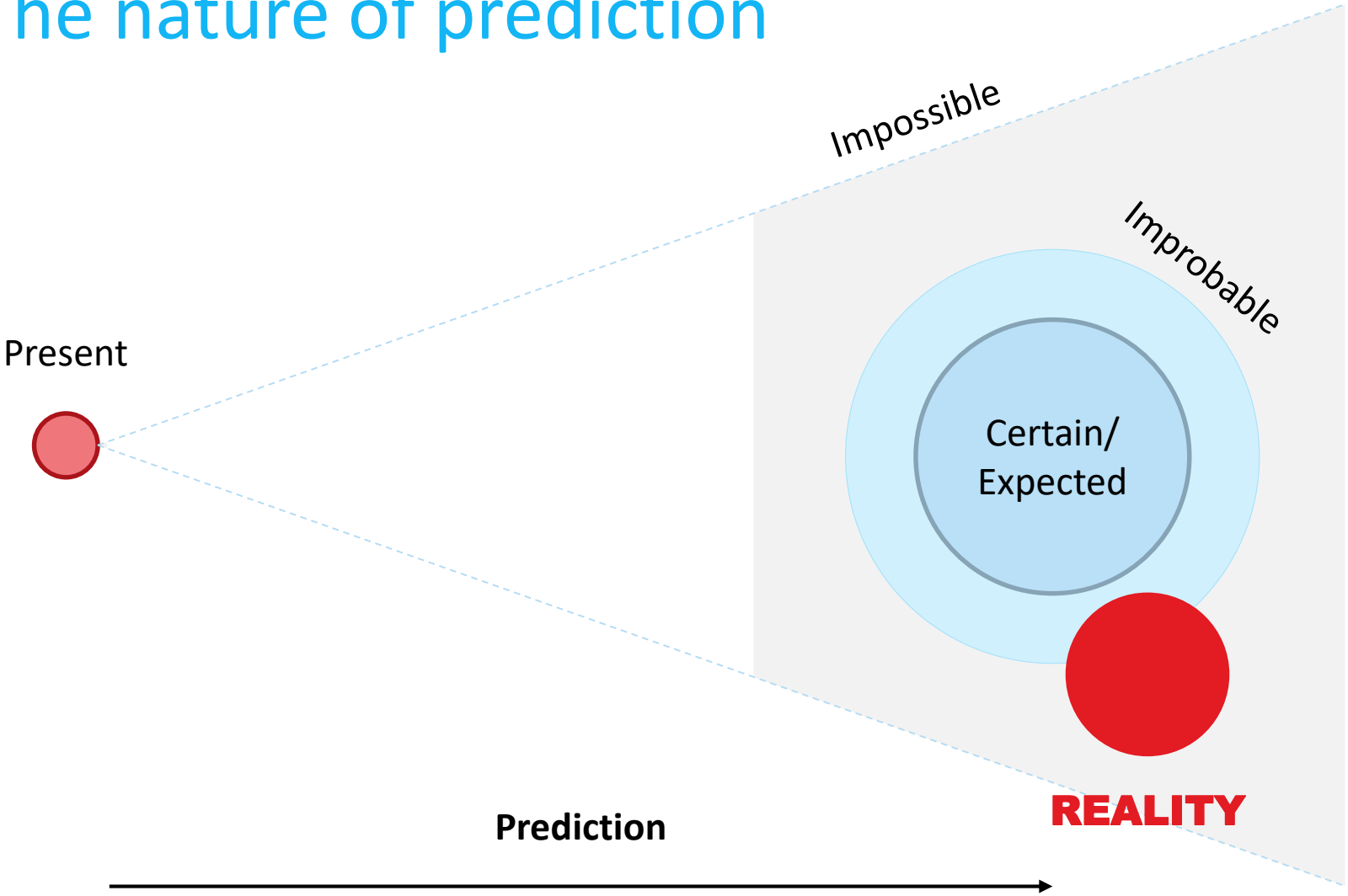
The nature of prediction



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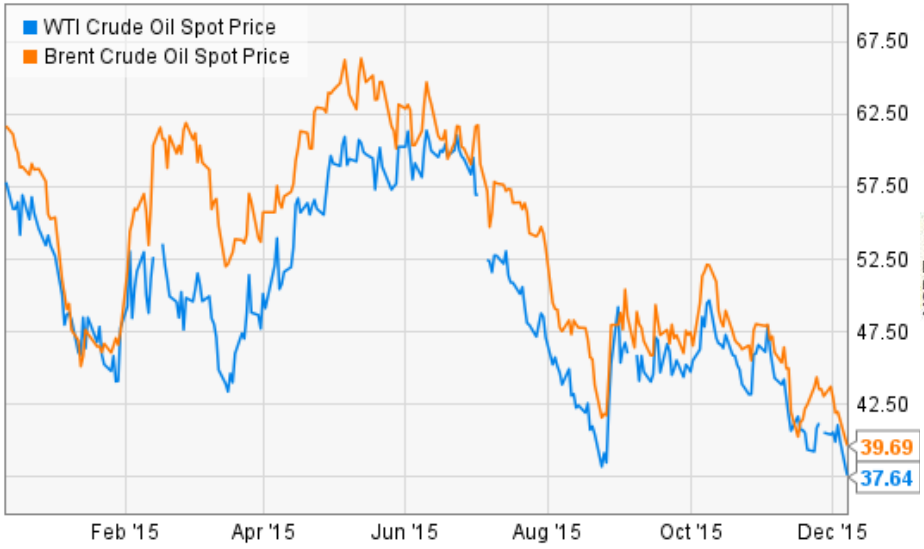
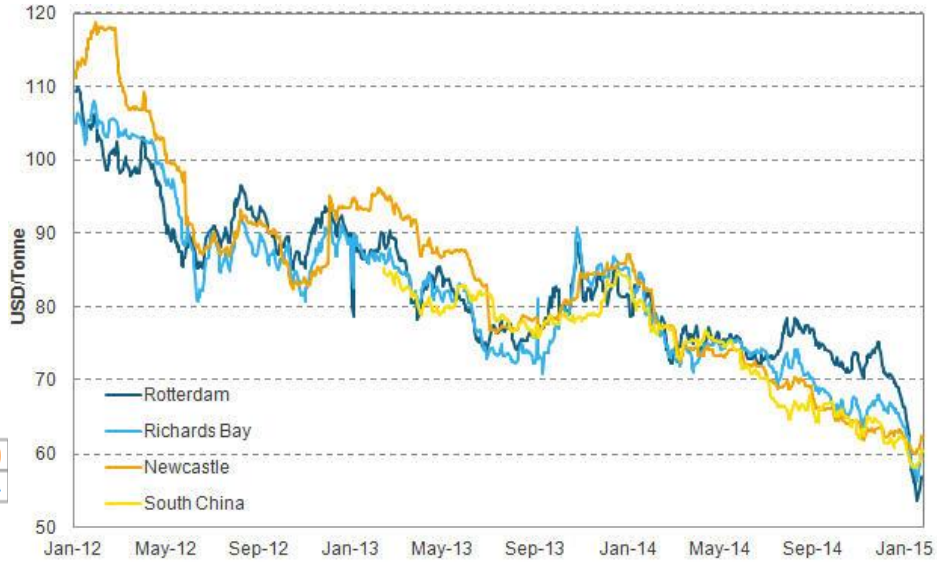
Energy sector got „crazy“

Oil prices



Coal prices



Electricity prices

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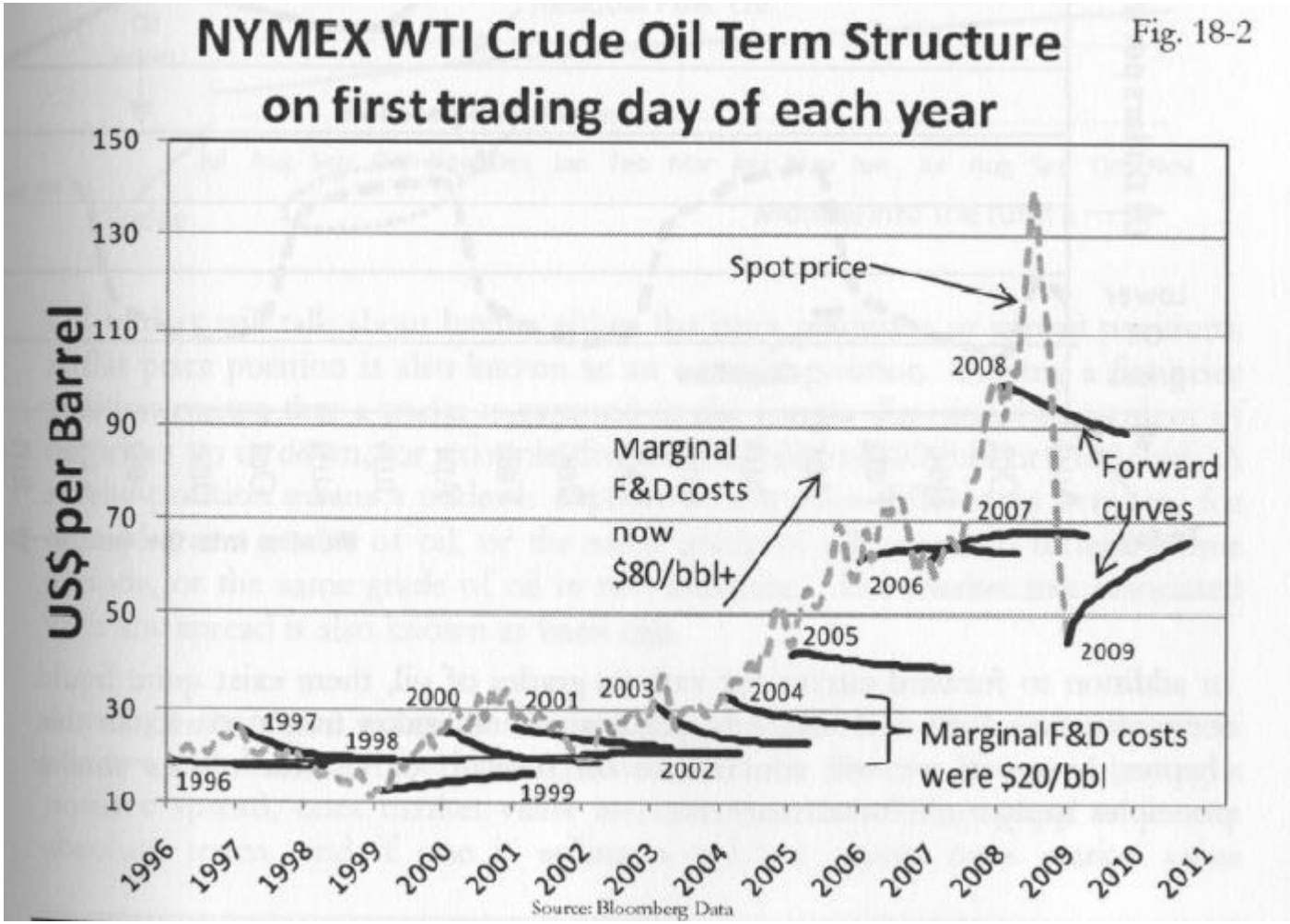

➡ Repercussions for measures/tools for energy policy

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The role of energy policy

Snaha o využití systematických nástrojů:

Guaranteed demand of „green“ electricity/

No license for „micro-sources“ (< 10 kW).

Feed-in-tariffs/green bonuses.

European union emission trading scheme (EU ETS).

Target for renewable sources of 27 % in 2030.

Green energy development policies

- **Low carbon policies** - fossil fuel taxation, EU Emission trading scheme.
- **Renewable energy policies.**

- **Non-financial support** (priority access to the grid, tax exceptions, no responsibility for intermittency, low administrative burden).
- **Investment support schemes** (Czech state budget, EU structural funds).
- **Feed in tariffs and premiums** (payment for generated kWh) – quoted every year for new sources, different for different sources

- **Feed in tariff**- guaranteed market purchaser, all generation sold, fixed price (not fixed to the market price), 15 year payback period.
- **Feed in premium (green bonus)** – nonguaranteed market purchaser, fixed bonus to market price, payment for own consumption, green bonus + market price > fixed tariff.

➡ Different motivations!

Cost burden of RES support
- state budget (tax payers).
- within regulated component of final price.

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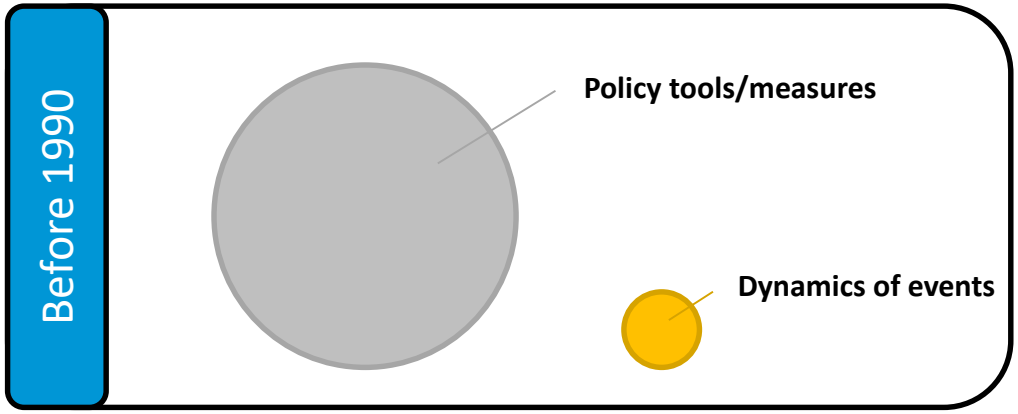
Lesson learned – „solar boom“

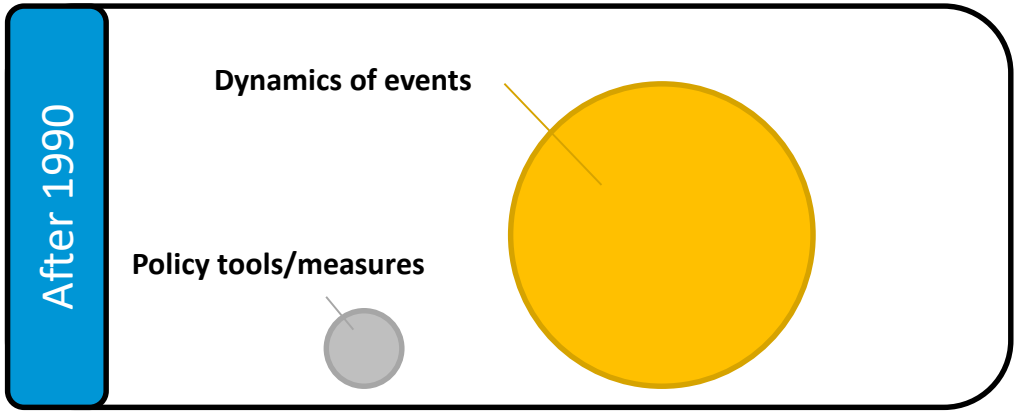
- Feed in tariffs – fixed for 20 year, guaranteeing 15 years payback time.
- Decision – feed in tariffs can decrease by max. 5% annually (motivated by ensuring the stability for the investors).
- „Unexpected“ fall of PV costs – approx. 50% decrease.
- Feed in tariffs could not change accordingly => wind fall profit.
- Investment boom in 2009 and 2010 => second largest capacity per capacity in the world (2010).
- Major increase in power consumer fee for RES – 6.9 => 23.9 USD/MWh (2010/2011) => 11.2% increase in consumer prices.
- State reaction solar tax => law suits, stop & go policy.

The role of energy policy



- Fully regulated price of electricity.
- Fully regulated supply of power and heat.
- Regulated prices of energy commodities.
- Investment based on long-term plans.
- Limited cross boarder exchange.
- Raw materials fully in state control.
- Possibility to use expropriation institute.
- Research and development planned by state.

Energy Policy



- Unbundling + privatization (ex. Net4Gas)
- Separation of regulated and non-regulated price of electricity.
- Common market– market coupling.
- Energy market only.
- Global markets – oil, gas, coal.
- Climate & Energy Framework of EU
- Investment based on market signals.
- Competitiveness assessed on global market.
- International transfers of capital.

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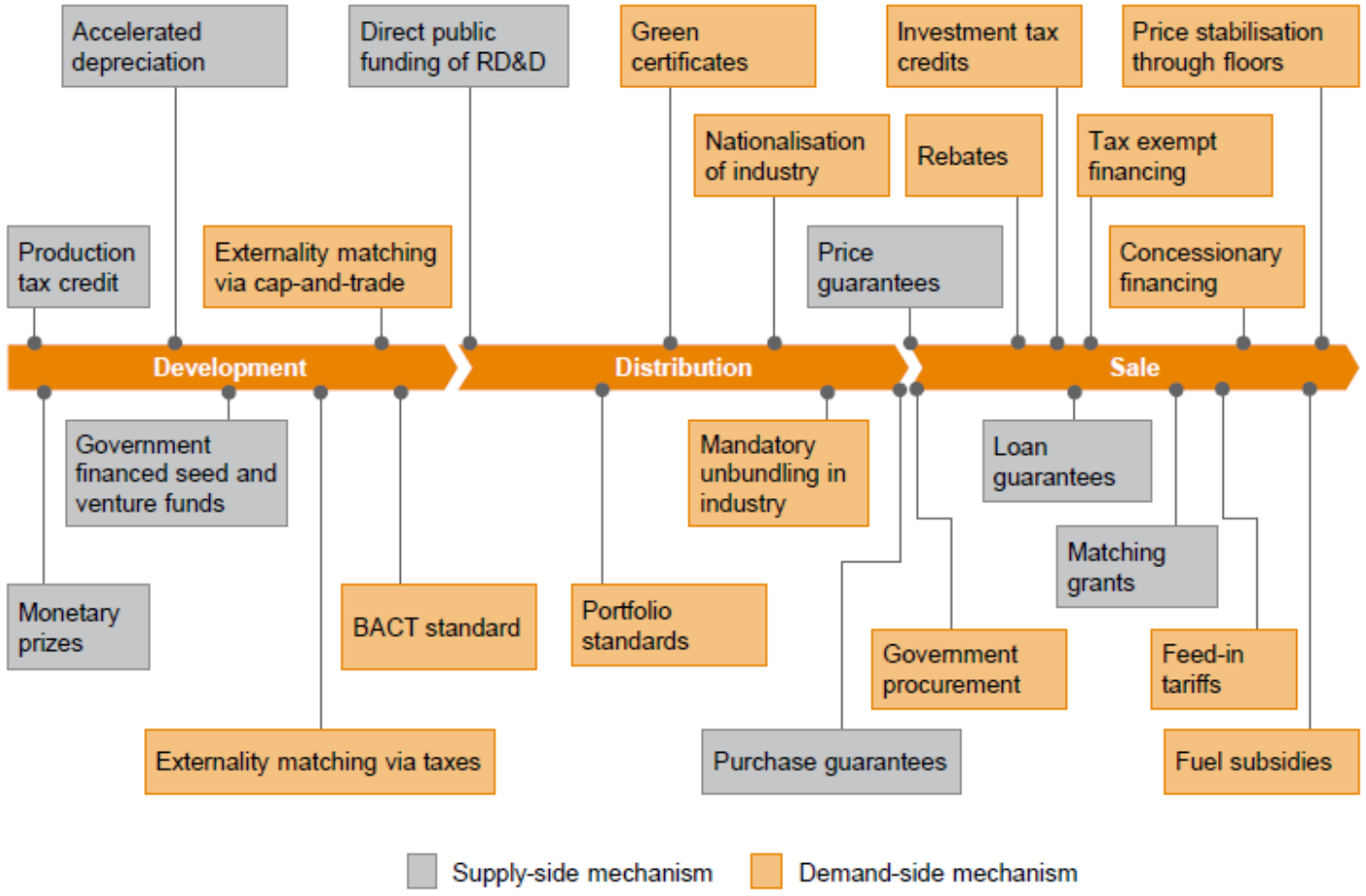
The role of energy policy

State tools/measures in energy sector:

- Direct ownership of strategic subjects (ČEPS, ČEPRO, MERO, SSHR) x NET4GAS, refineries (in private ownership in CZ), mining companies.
- Legislative and executive measures (direct):
  - Licenses, authorizations, penalization, emission limits, obligatory biofuel content, norms and limits – restriction of coal imports, concession for mining.
- Legislative and executive measures (indirect) – fiscal/budgetary and tax:
  - Feed in tariffs, feed in premium/green bonus, state subsidy schemes (EFEKT), EU structural funds (OPPIK), ecological taxes, fee for extracted mineral, podpora výzkumu a vývoje (TAČR, GAČR).
- Regulation (in CZ in responsibility of ERO):
  - Regulated part of electricity, allowable expenses and revenues, regulated/directed price of heat etc.
- Foreign energy policy.

Illustrative policy and regulatory mechanisms affecting energy pricing, investment, and return on investments

Source: WEC/Oliver Wyman, 2014



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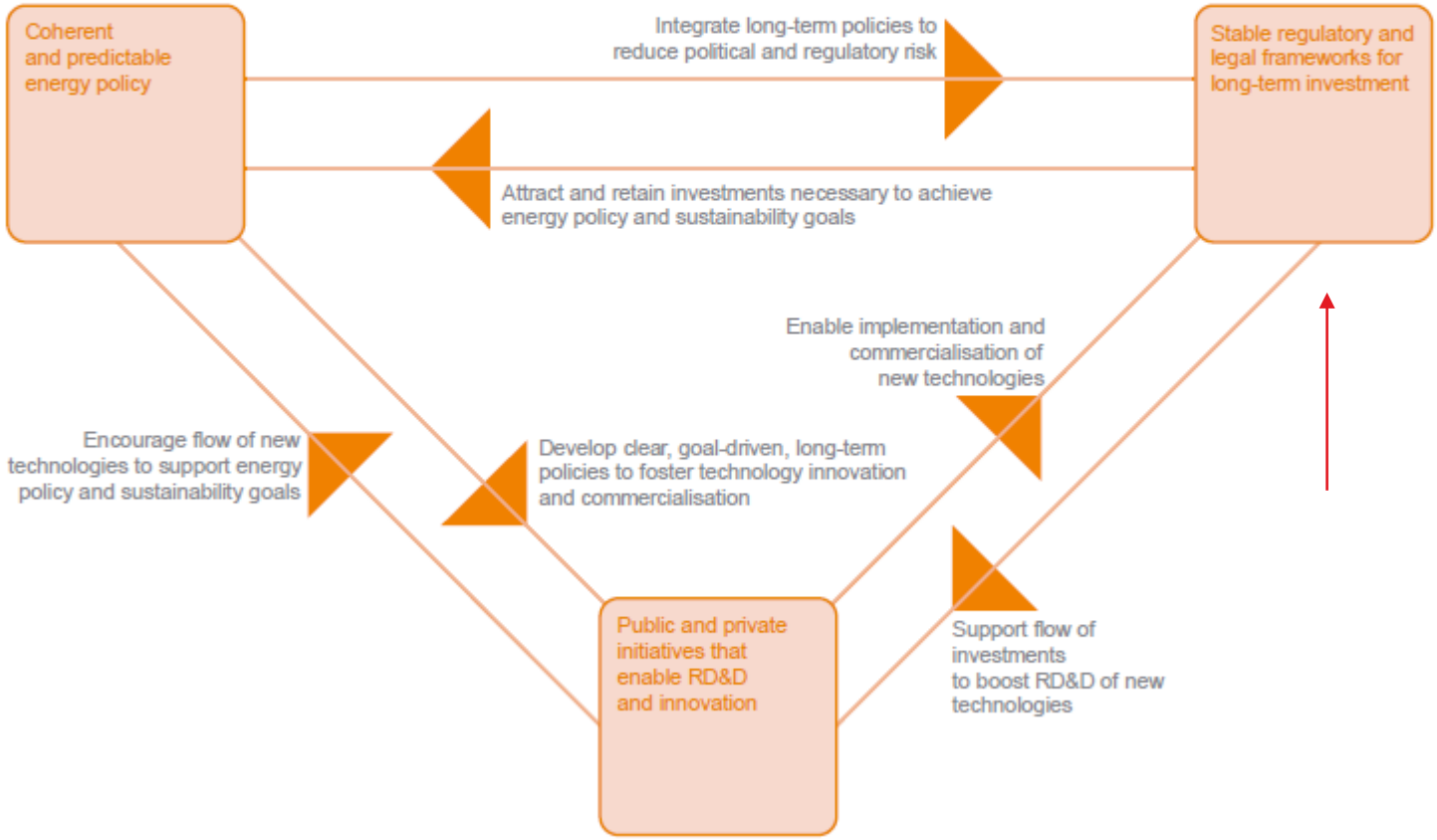
Three key interconnected policy areas are necessary to create an attractive foundation for energy investments

Source: WEC, 2012: World Energy Trilemma: Time to get real – the case for sustainable energy policy



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The lack of a global climate framework, the development of energy prices and capital markets are among the greatest uncertainties for energy leaders[18]

Source: WEC, 2014: World Energy Issues Monitor

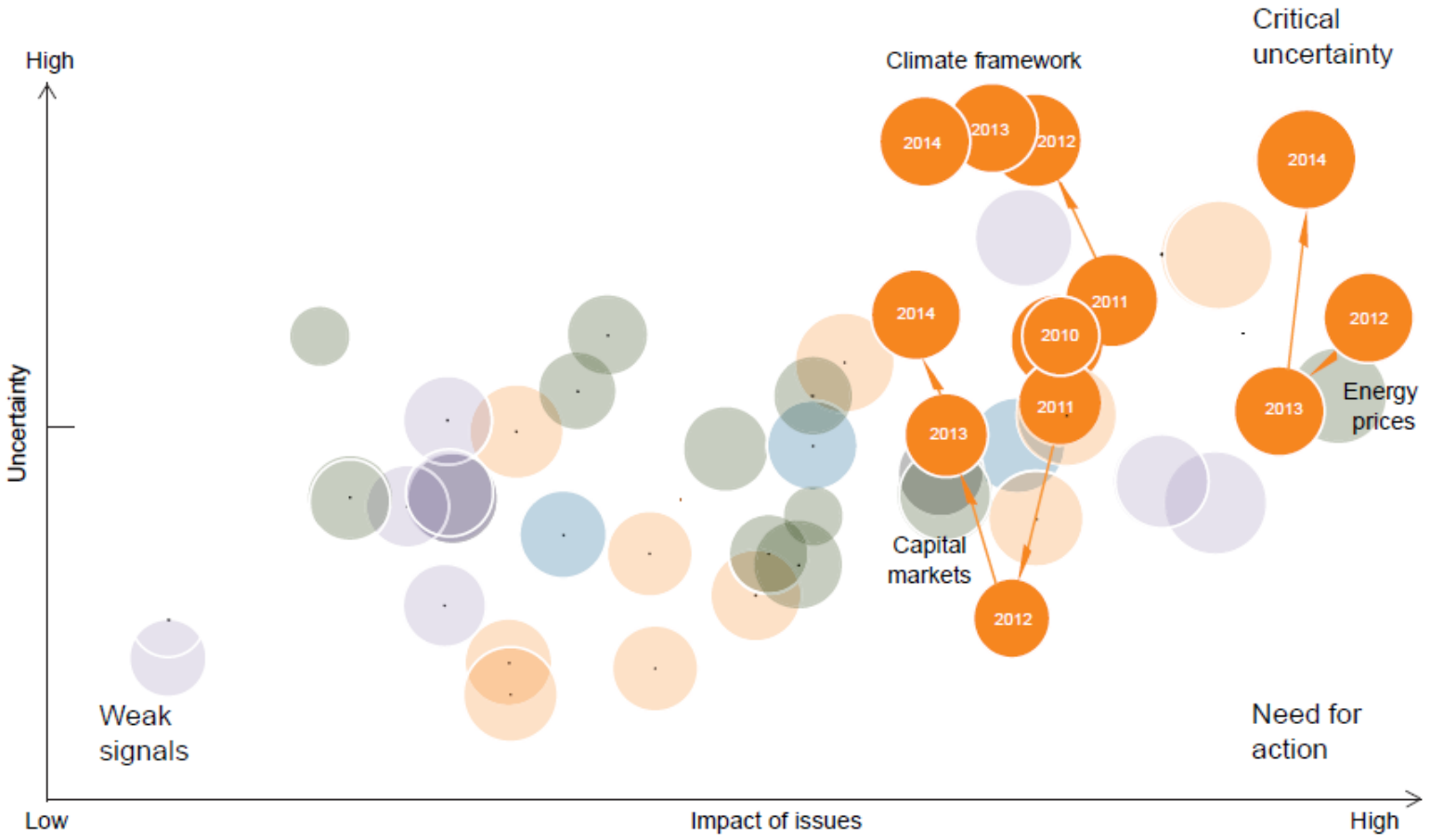

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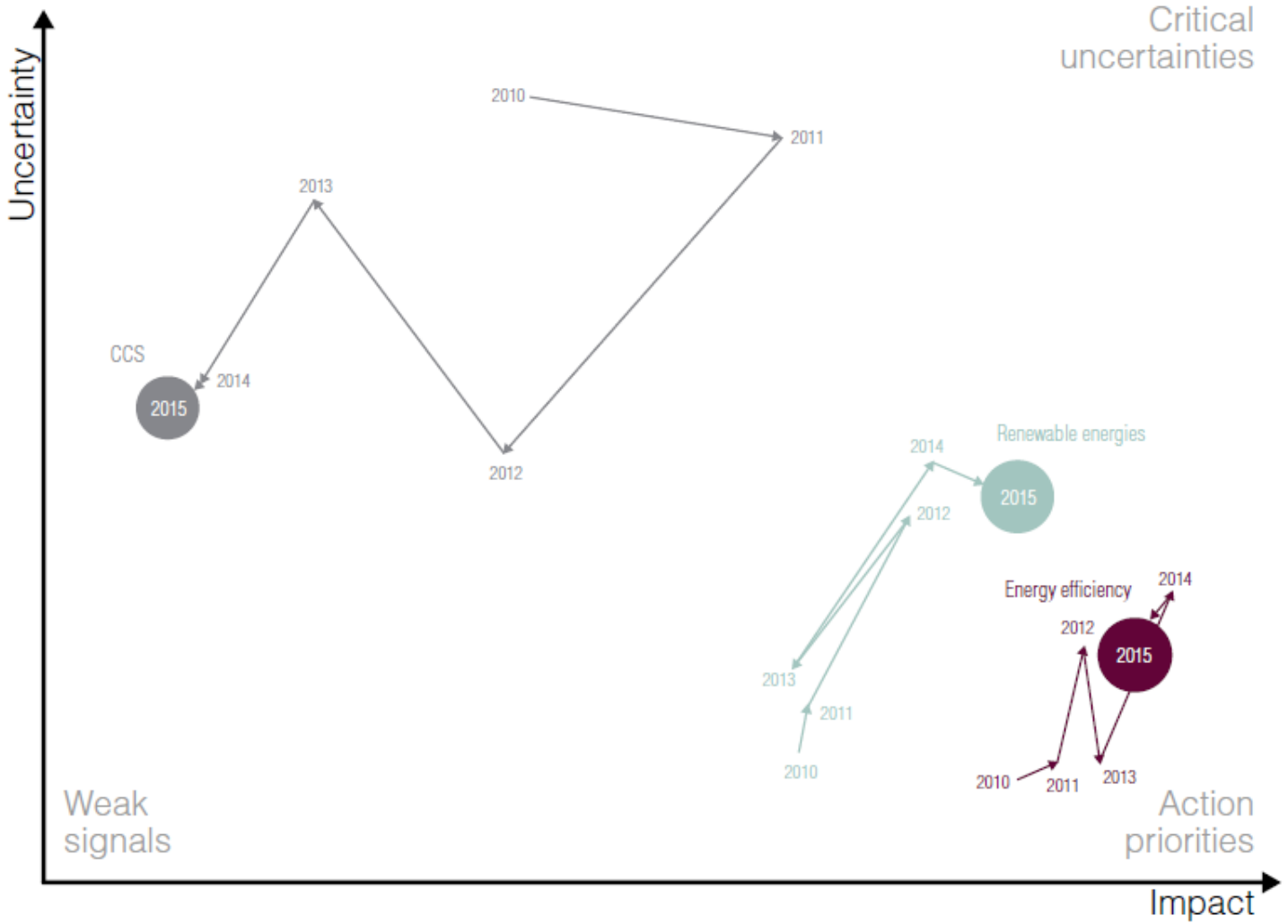
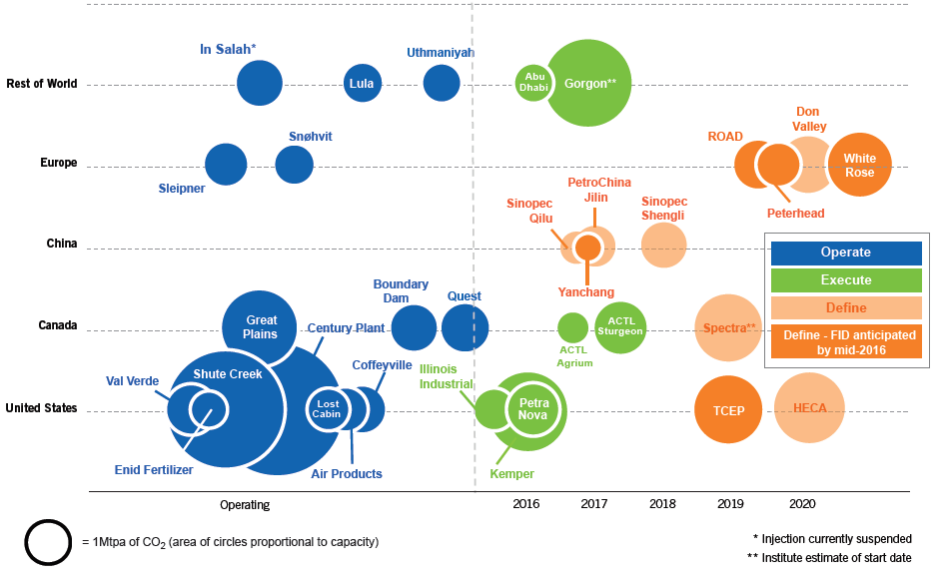
Figure

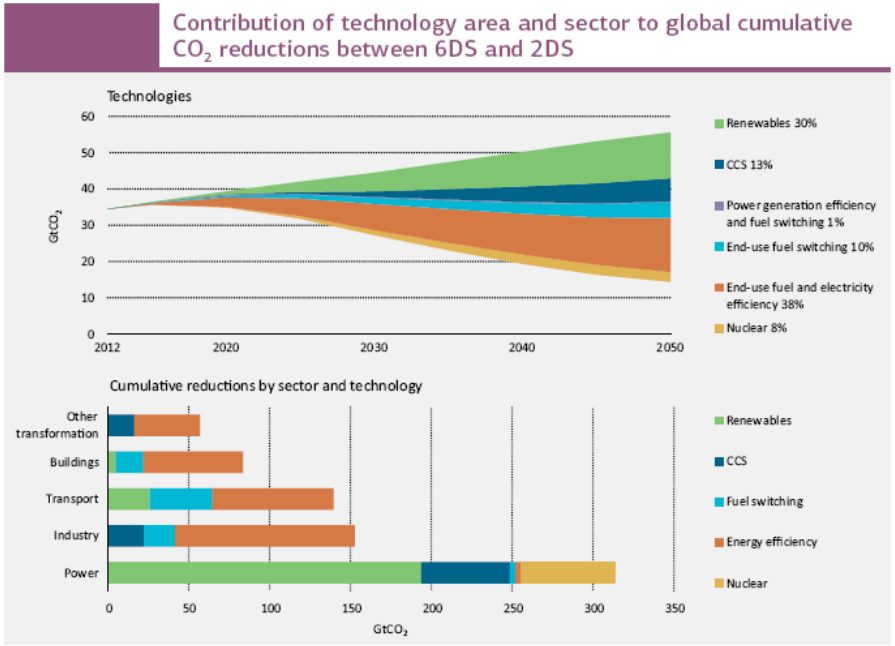
WEC's 2015 World Energy Issues Monitor: highlighting the most rapidly moving issue (CCS) versus robust action issues (energy efficiency, renewables)



Example CCS

Figure 4 Actual and expected operation dates for large-scale CCS projects in the Operate, Execute and Define stages by region and project lifecycle stage





- Storage of CO_2 is forbidden by Czech law till 2020, but there is a real possibility that from the year 2040/2050 all new sources would have to be equipped by CSS, in this case pilot projects are strongly needed.
- Britain withdrawing from CCS R&D => because of climate policy (abolishing of coal).

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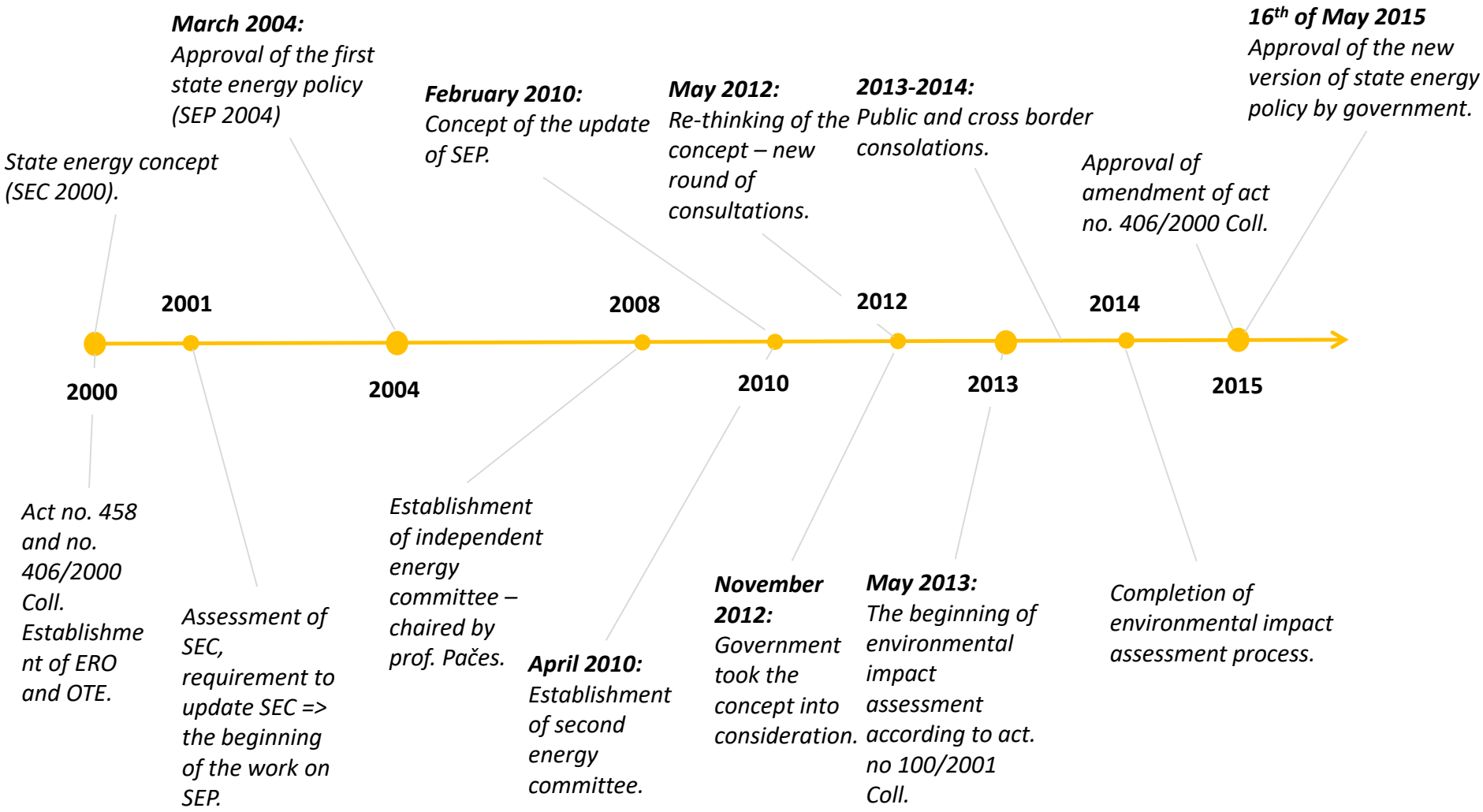
State Energy Policy (timeline)



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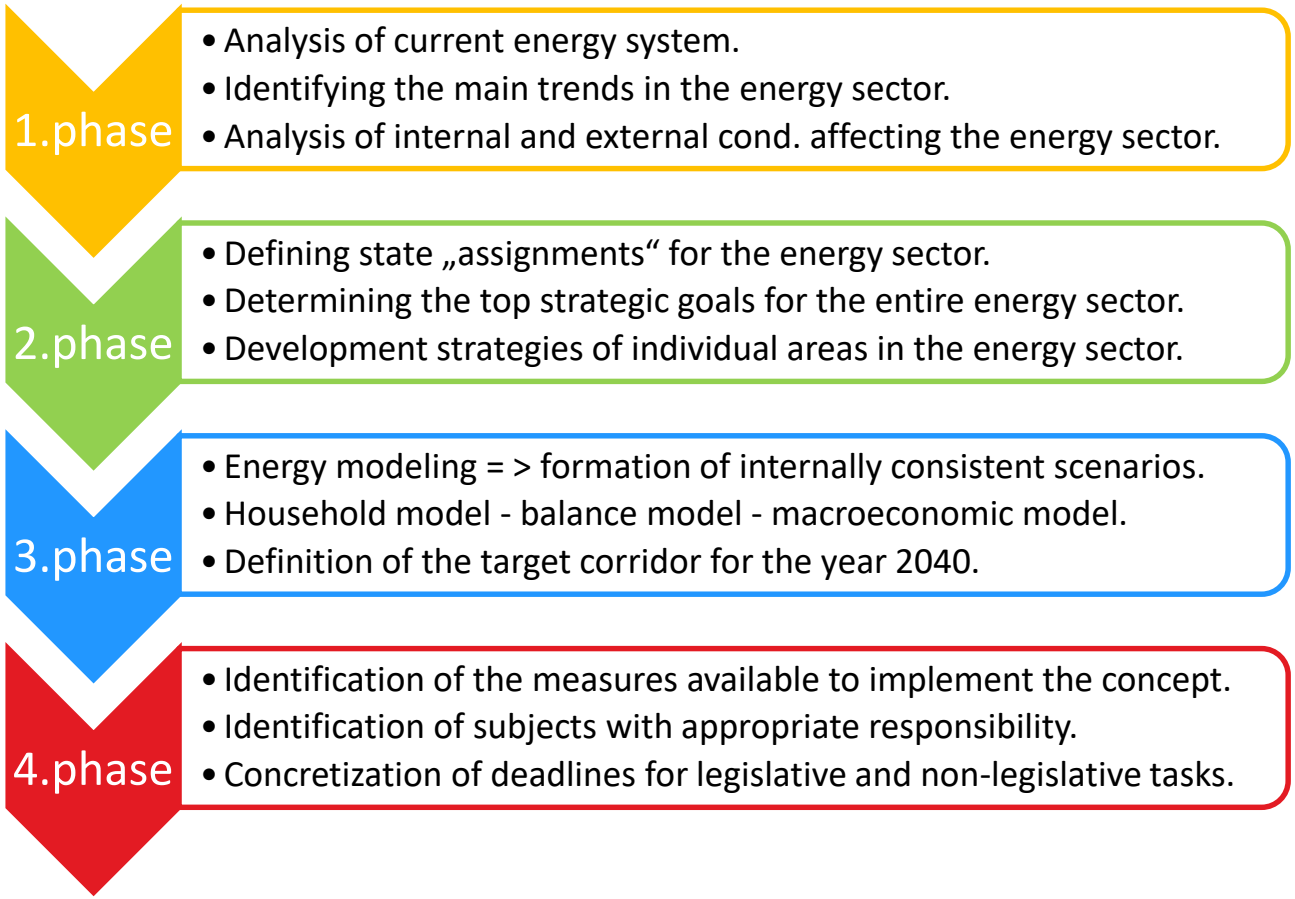
Methodology of State Energy Policy



3 priority/top goals + 5 strategic priorities + vision of development in 9 key areas + interval definition of long term targets + identification of necessary measures

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Hierarchy of documents

Implementing documents of State Energy Policy:

- National action plan for smart grids.
- National action plan for renewable energy sources.
- National action plan for biomass.
- National action plan for clean mobility.
- National action plan for energy efficiency.

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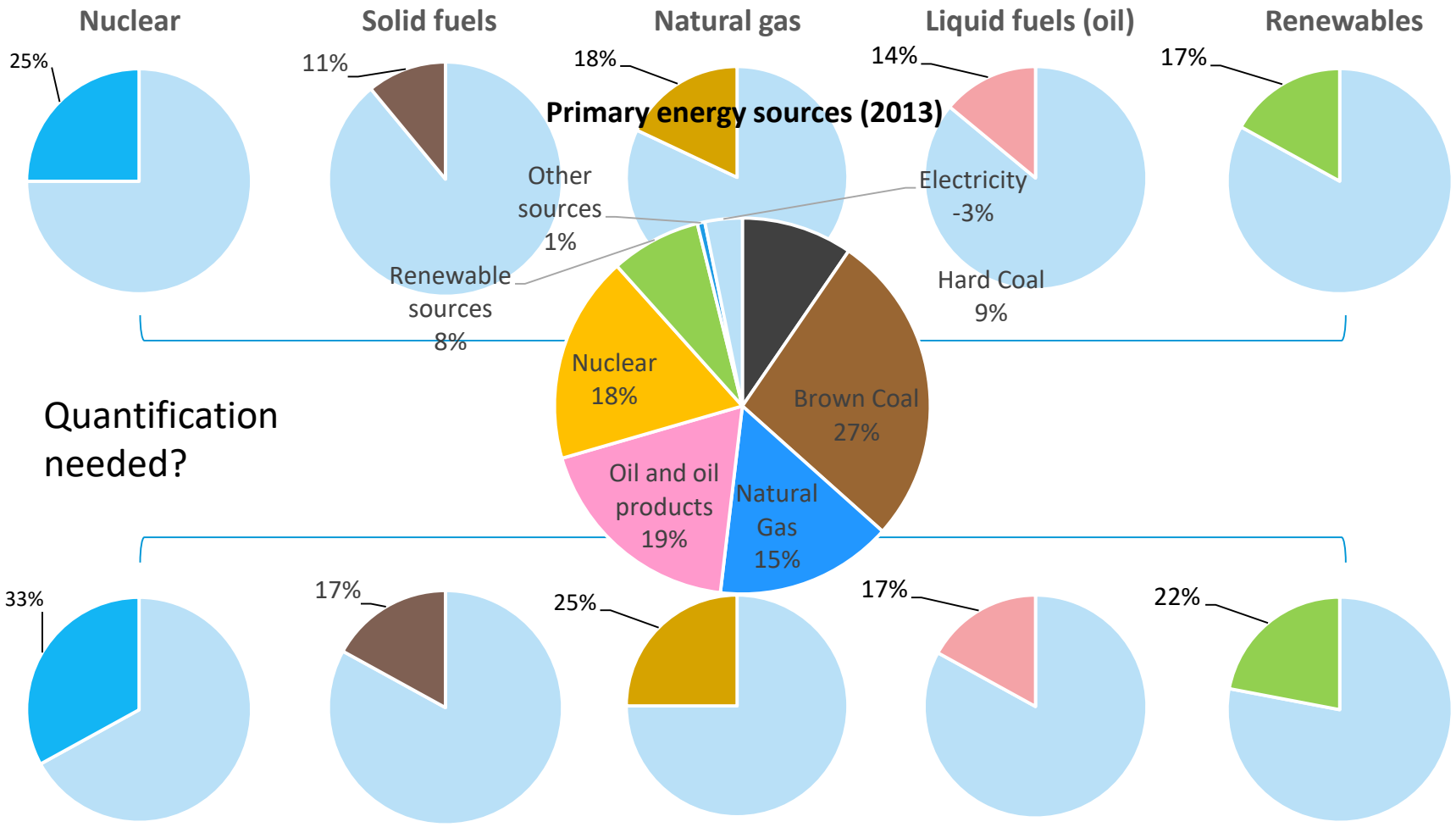
Targeted energy mix (2040)



Quantification needed?

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„Hard issues“

- Some problems/issues are **not clear cut** – there are gains for someone and losses for someone else (**zero sum game**).
- These issues are specially hard, because **communication is the key factor** and there is lot of emotions with insufficient informational/expert background.
- The **political and expert view is intertwined**, political cycle plays a role.
- It is enormously **hard to reach general agreement** => opposing site is generally much „louder & visible“ compare to agreeing site.

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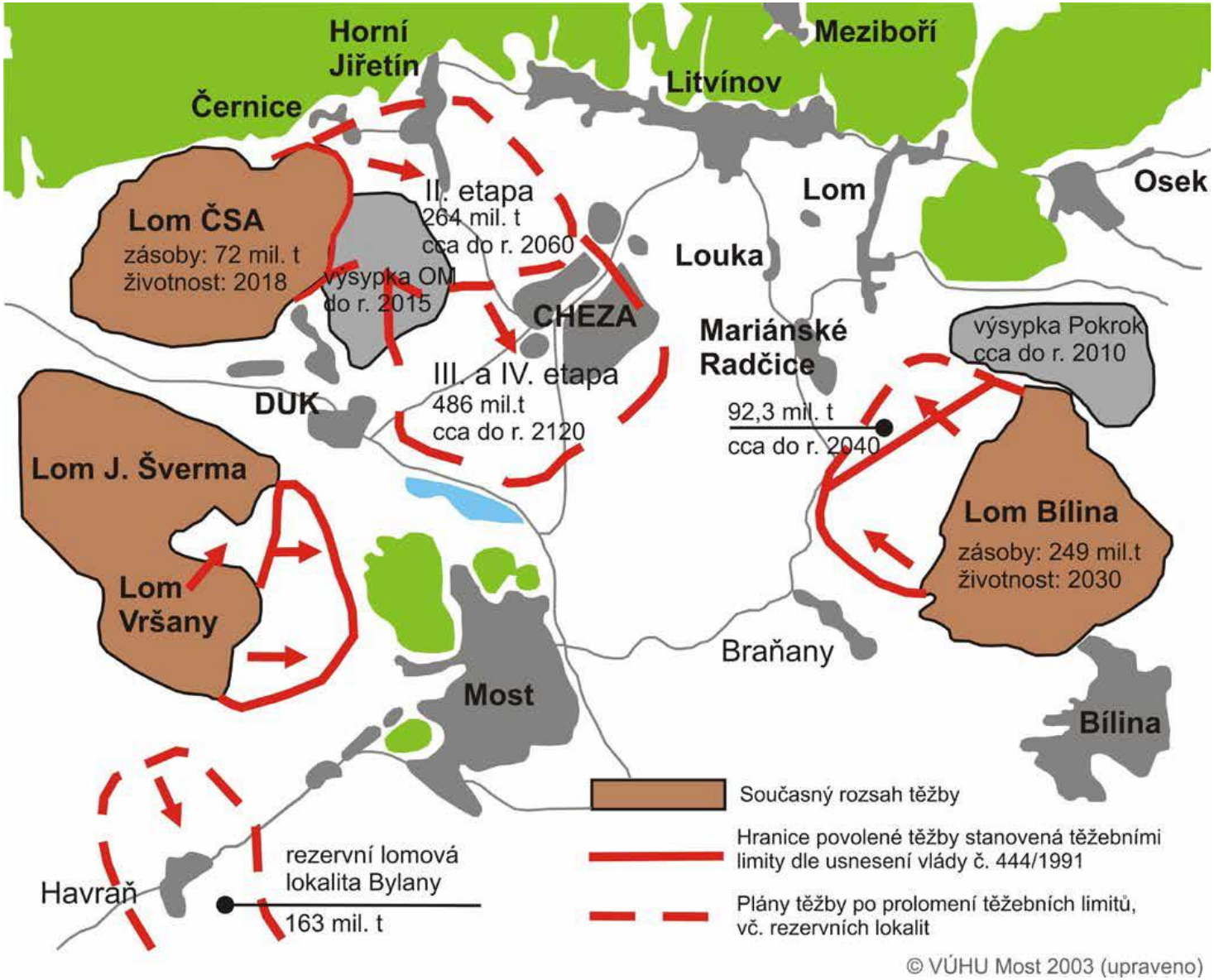

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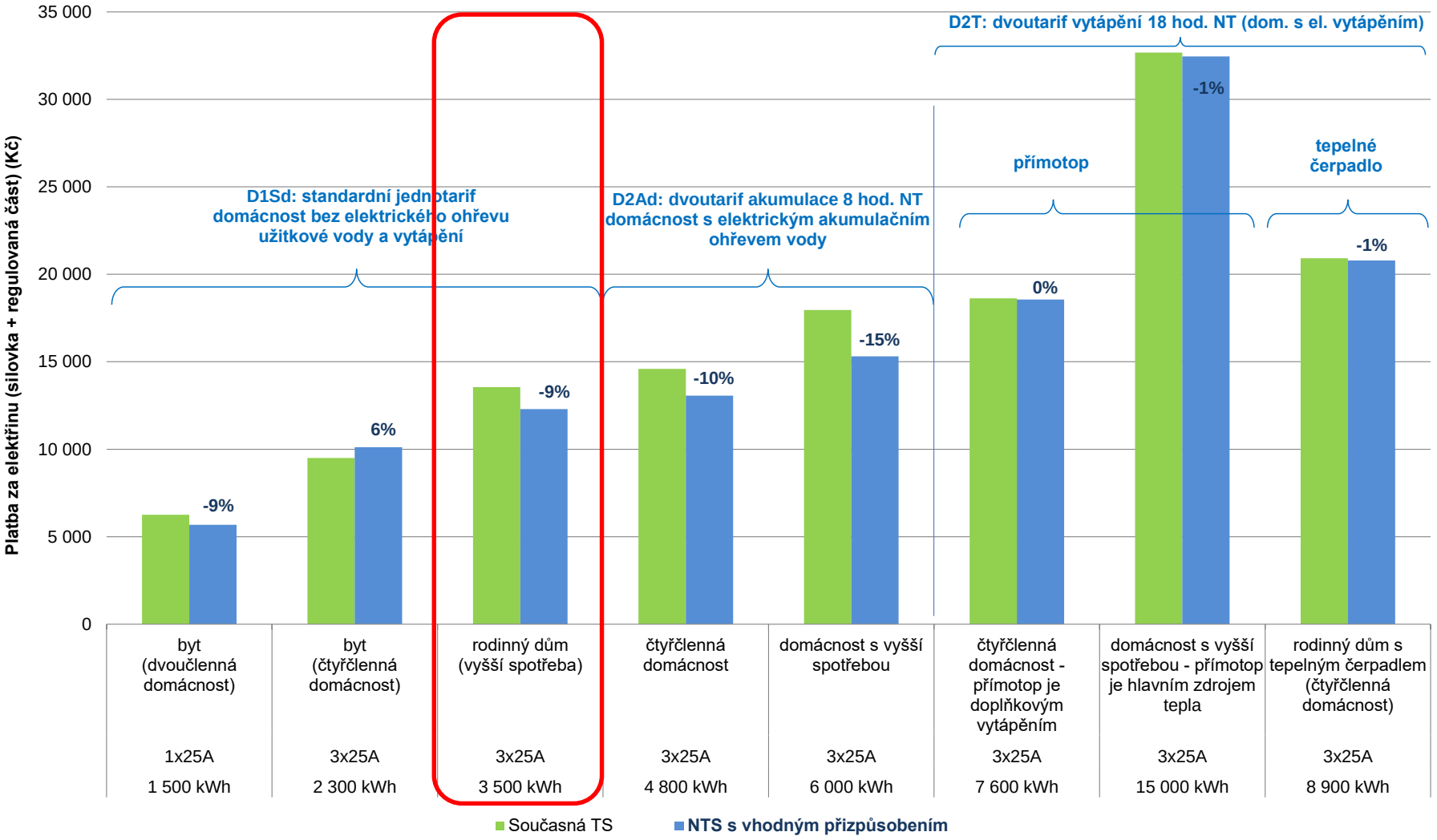

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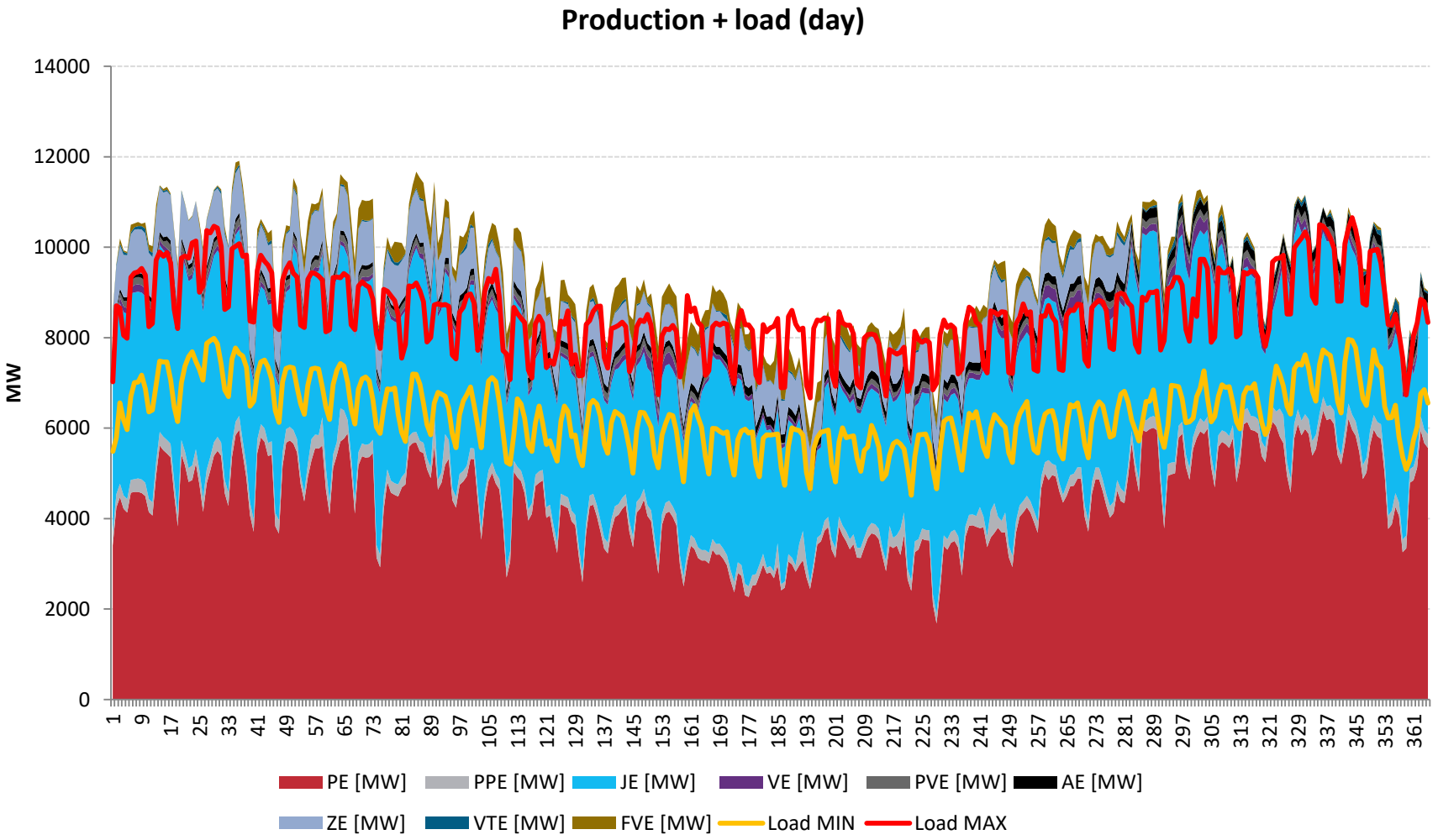
Road ahead


Production + load (day)
MW
14000
12000
10000
8000
6000
4000
2000
0
1
9
17
25
33
41
49
57
65
73
81
89
97
105
113
121
129
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345
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361
PE [MW]
PPE [MW]
JE [MW]
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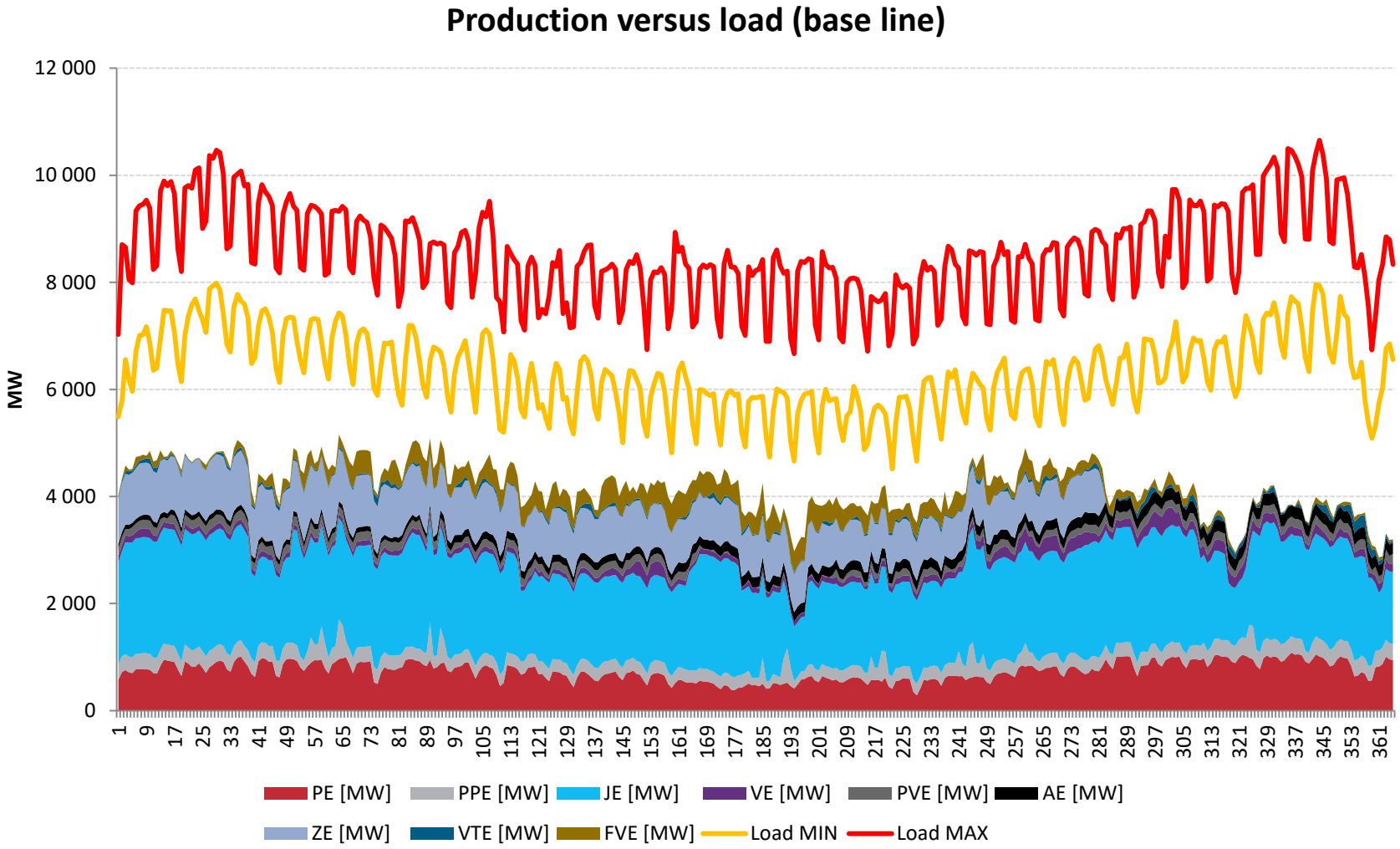
PVE [MW]
AE [MW]
ZE [MW]
VTE [MW]
FVE [MW]
Load MIN
Load MAX

Road ahead



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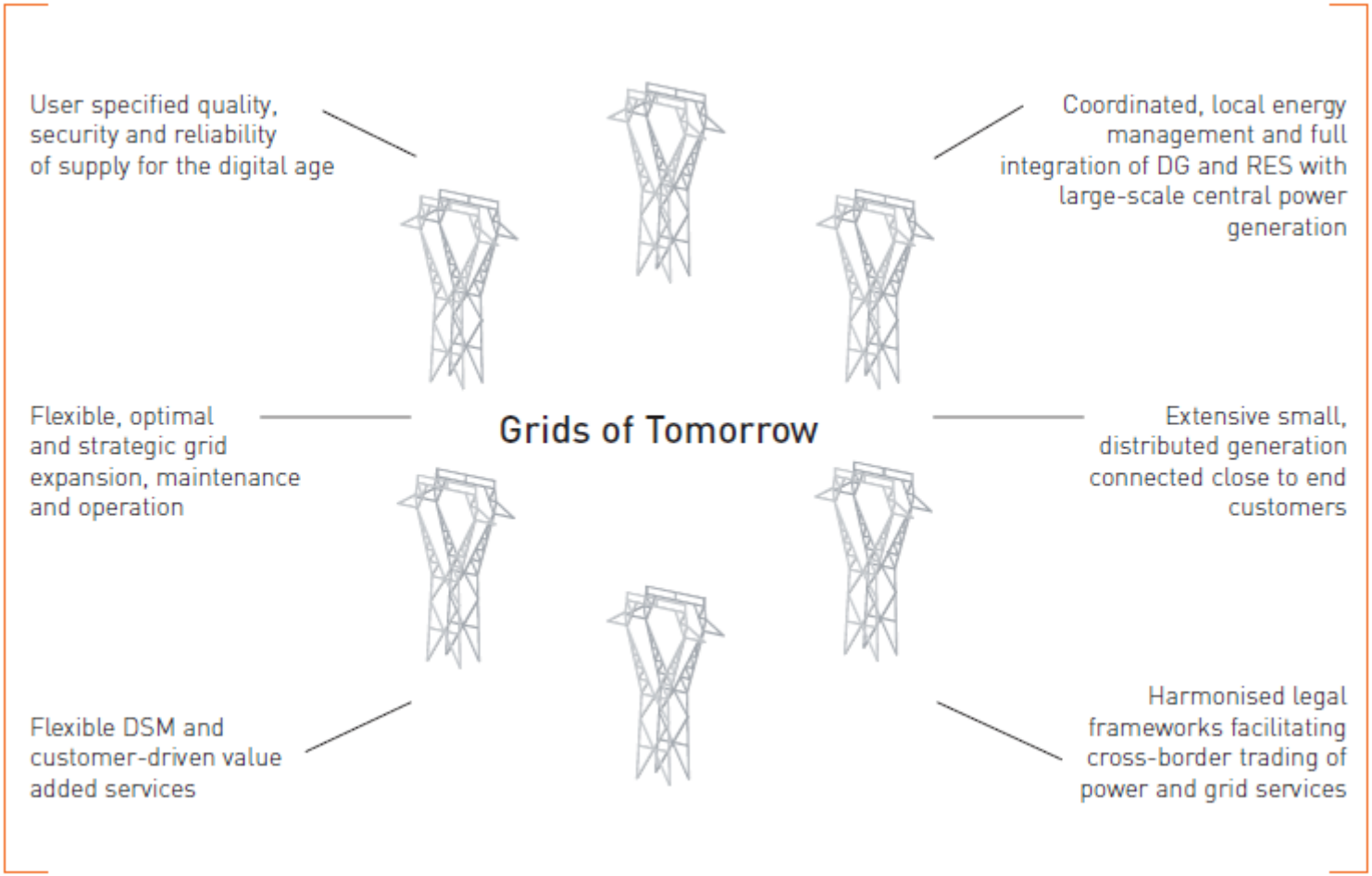
Road ahead


Value added services
Forecast information
Off-shore wind
Small hydro power
Solar power plant
Hydro power station
Biomass
Low emission power plant
control
communication
HVDC link
Transformer
Microgrid
Wave energy
Photovoltaic
Residential CHP
Solar
Underground info and power transmission
H_2 production and filling station
H2
Demand side management
HP
Micro storage of electricity
Thermal storage
SMES
Fuel cells
Compressed hydrogen storage

Road ahead



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Energy modeling

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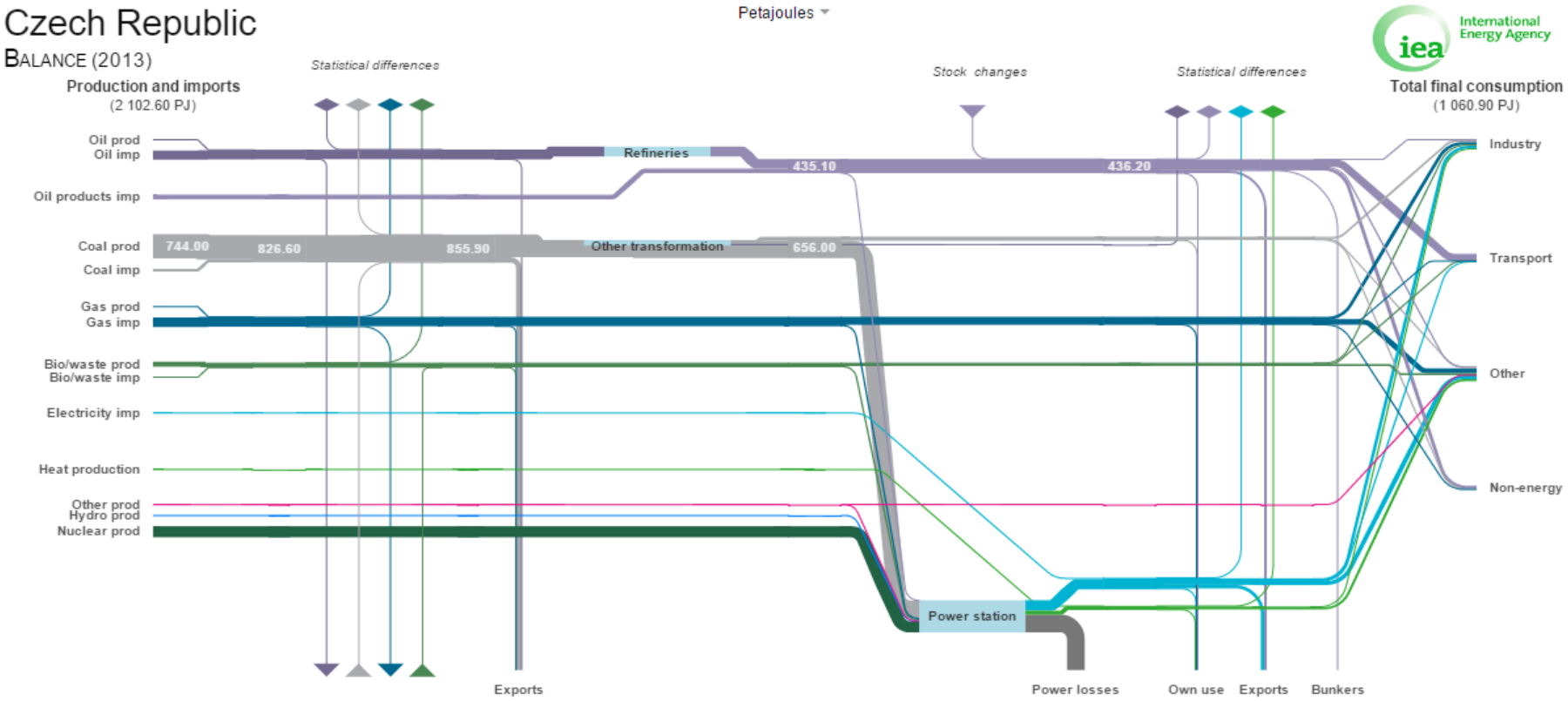

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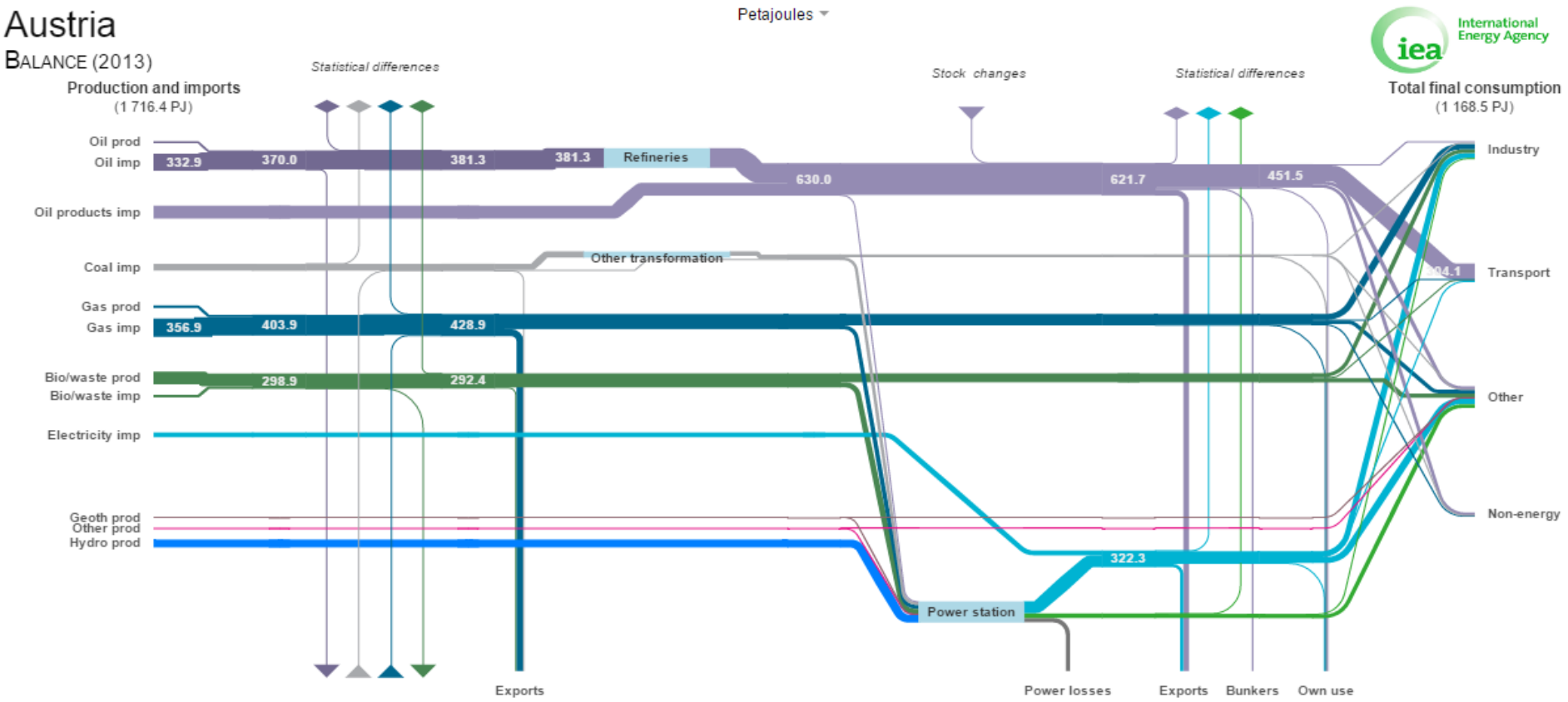

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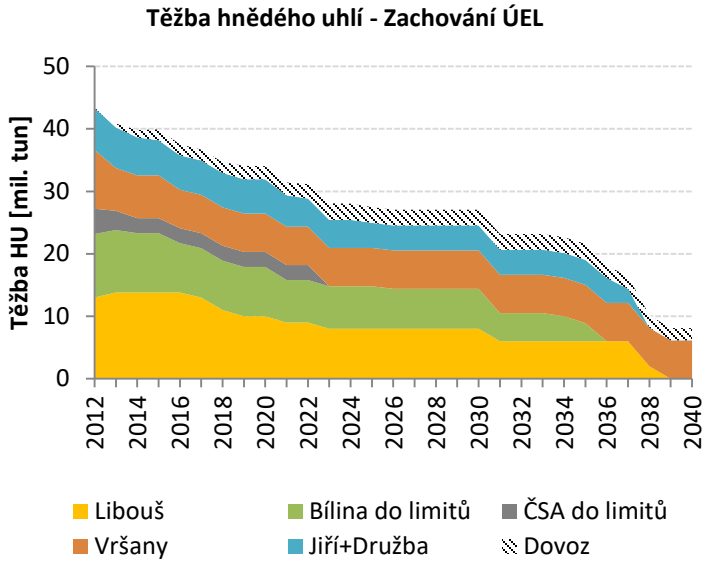

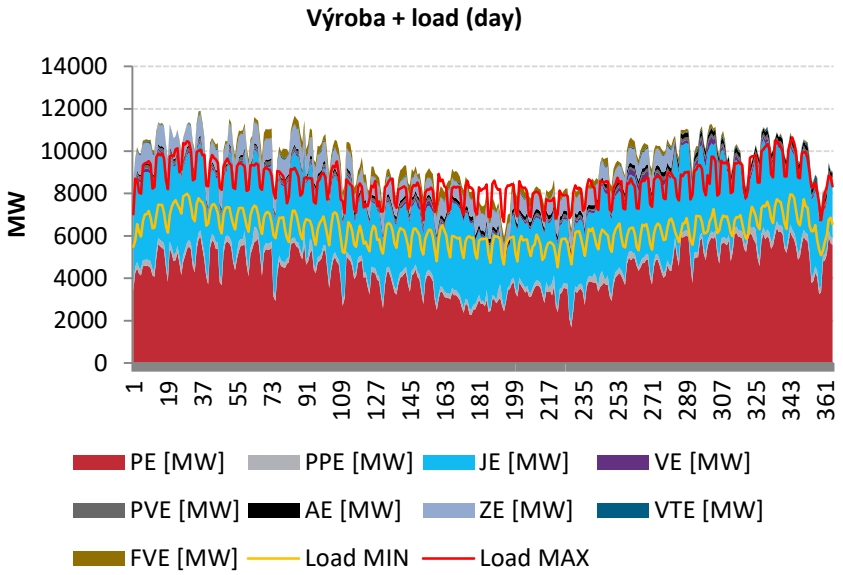

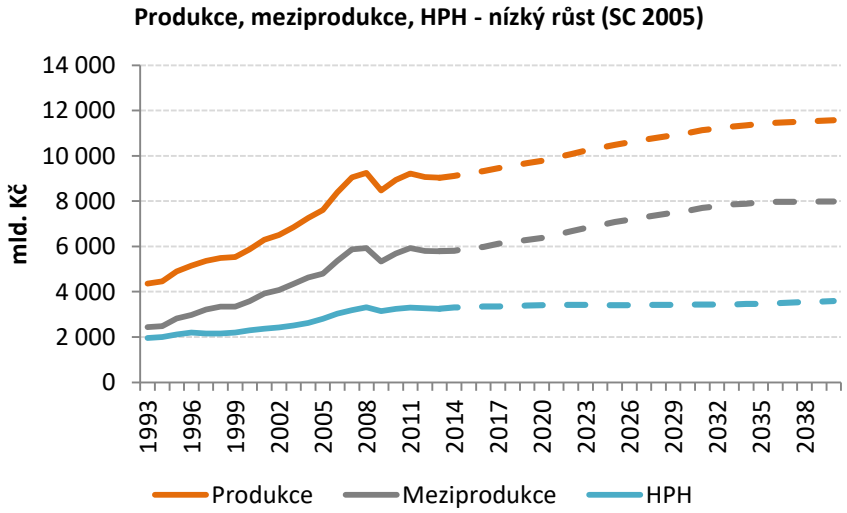

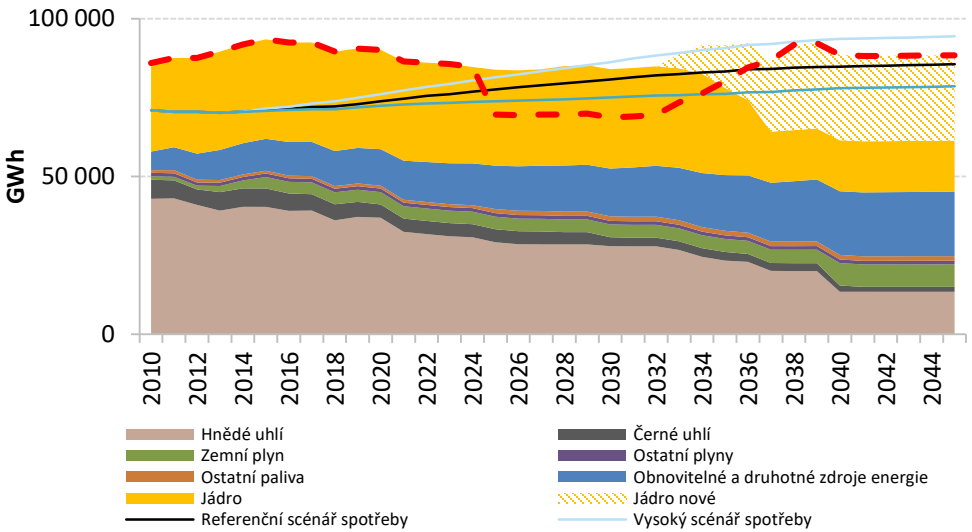

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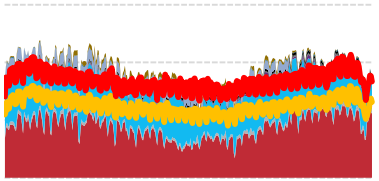
Energy policy



Energy statistics

Reference years

„Big“ sources treated individually

Generation adequacy, unit commitment, economic dispatch.

30 types of fuels/inputs

- Hard coal
- Brown coal
- Biomass
- •
- •
- •

Sources (supply)

Energy input for heat and electricity

Electricity produced

Heat produced

Final consumption in each major sector

Consumption (demand)

Forecast of elec. consumption

Heat consumption

Prediction of final consumption

Market concentration /social aspects

Households

Sources of raw material (mining forecast etc..)

Predikce ekonomiky – makroekonomické modelování. Energetické úspory.

Demand response/ demand elasticity

25 indicators *indicating the fulfillment of priorities*

Clear metrics; EU targets – GHG emissions, energy efficiency, RES; legislative and fiscal measures.

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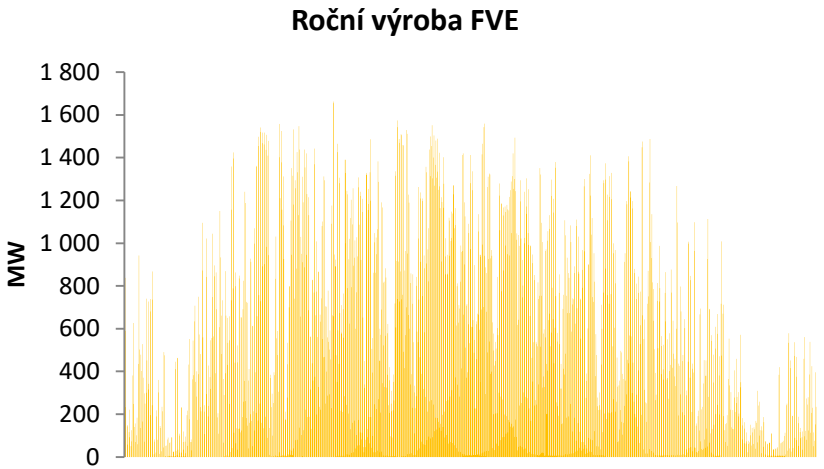

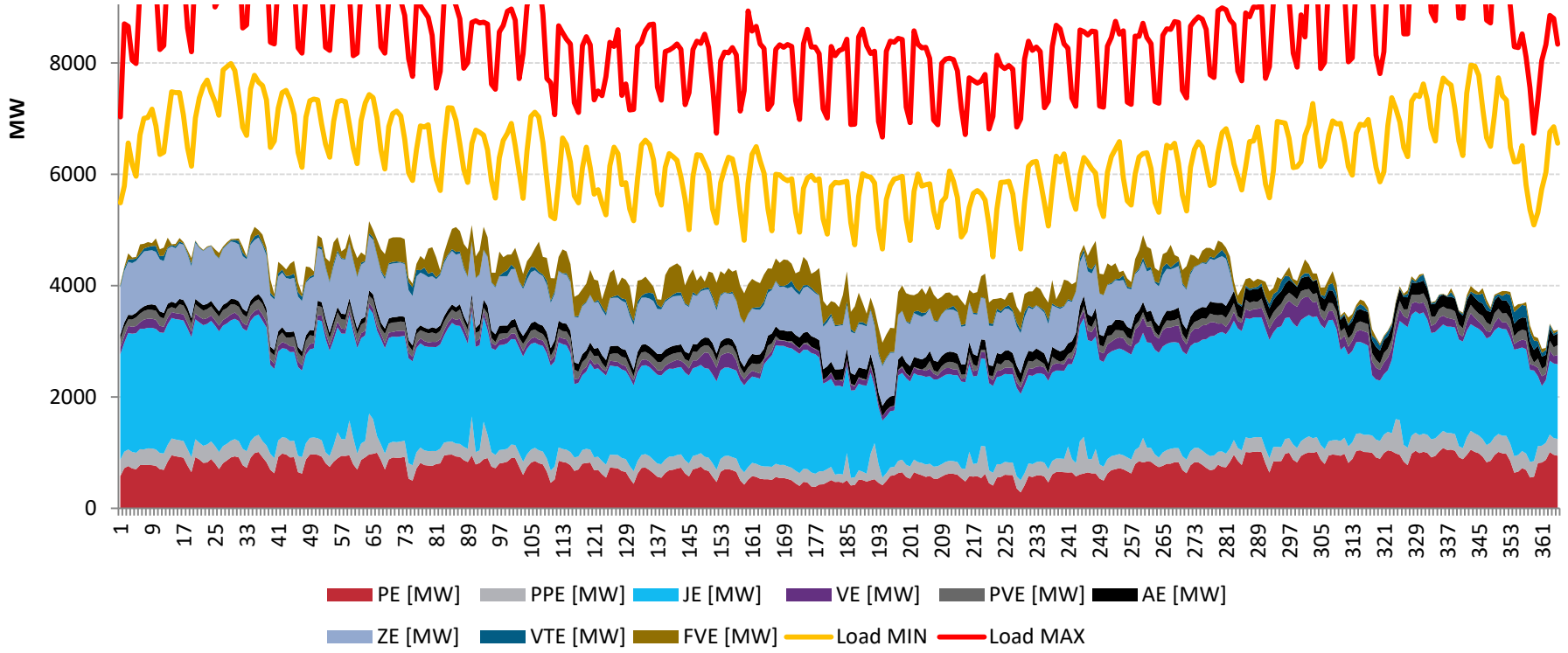

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Climate-energy Policy, Energy Union

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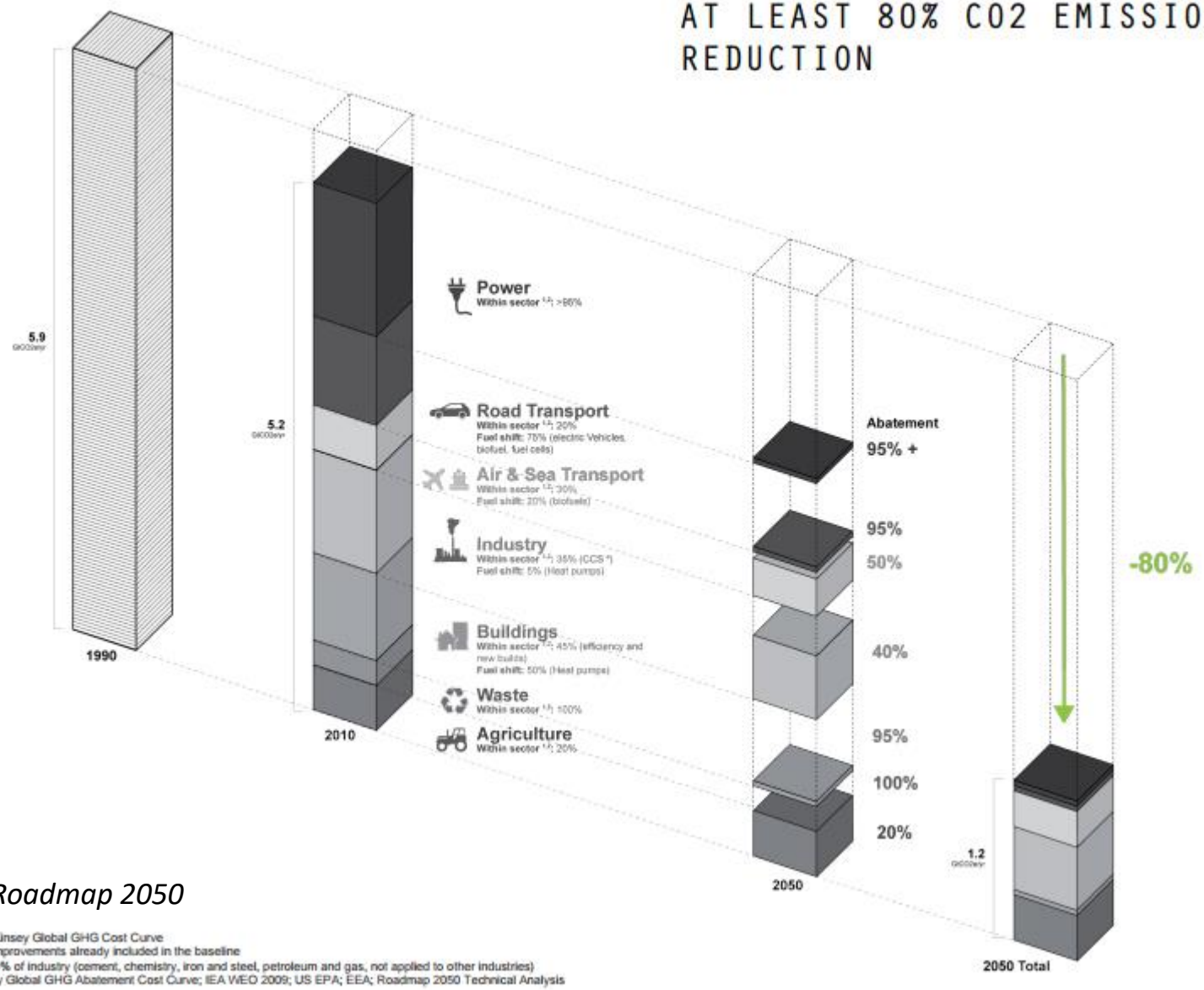


Source: Roadmap 2050

1 Based on the McKinsey Global GHG Cost Curve
2 Large efficiency improvements already included in the baseline
3 CCS applied to 50% of industry (cement, chemistry, iron and steel, petroleum and gas, not applied to other industries)
SOURCE: McKinsey Global GHG Abatement Cost Curve; IEA WEO 2009; US EPA; EEA; Roadmap 2050 Technical Analysis

Member states approved three climate-energy targets for 2030

On 23rd and 24th of November 2014 (on the level of European Council)

min. 40 %
decrease of emission
of GHG gases
compare to 1990.

- **Binding on the European level**
- Partial goal for EU ETS: 43 % red. (2005 => 2020)
- Potentially stricter depending on COP21 follow up

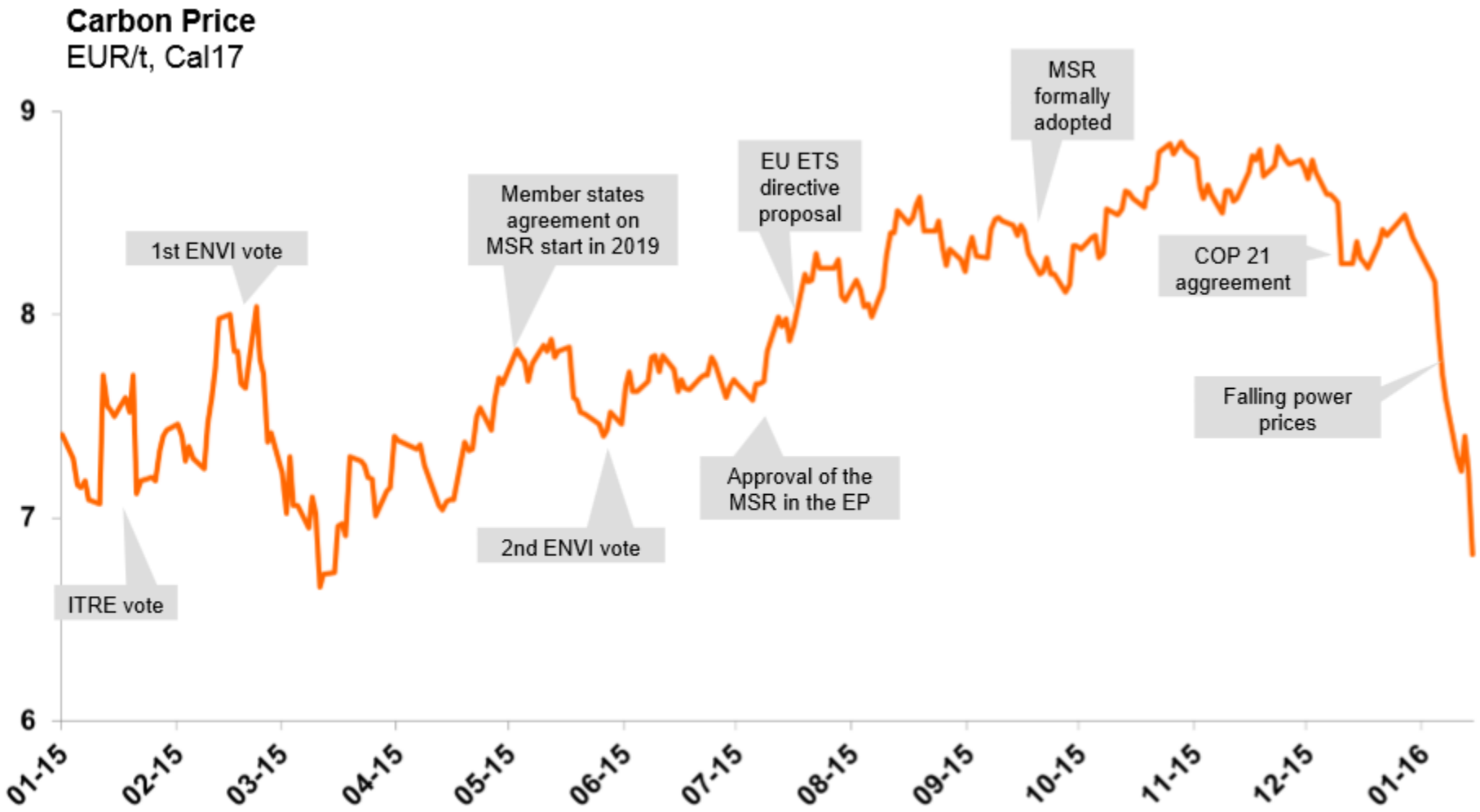
min. 27 %
share of RES
on final gross energy
consumption.

- **Binding on the European level**
- It means app. 47 % of RES share on electricity
- Support should be primarily market based

min. 27 %
of energy savings
comparing to
prediction from 2007

- **Indicative on the European level**
- Motivated mainly by decreasing of import dep.
- Might be increased to 30 %

- Target for interconnectivity – 10% until 2020, 15% until 2030 (already fulfilled in CZ)
- Targets are related to other measures, such as Market design, MRS for EU ETS etc.



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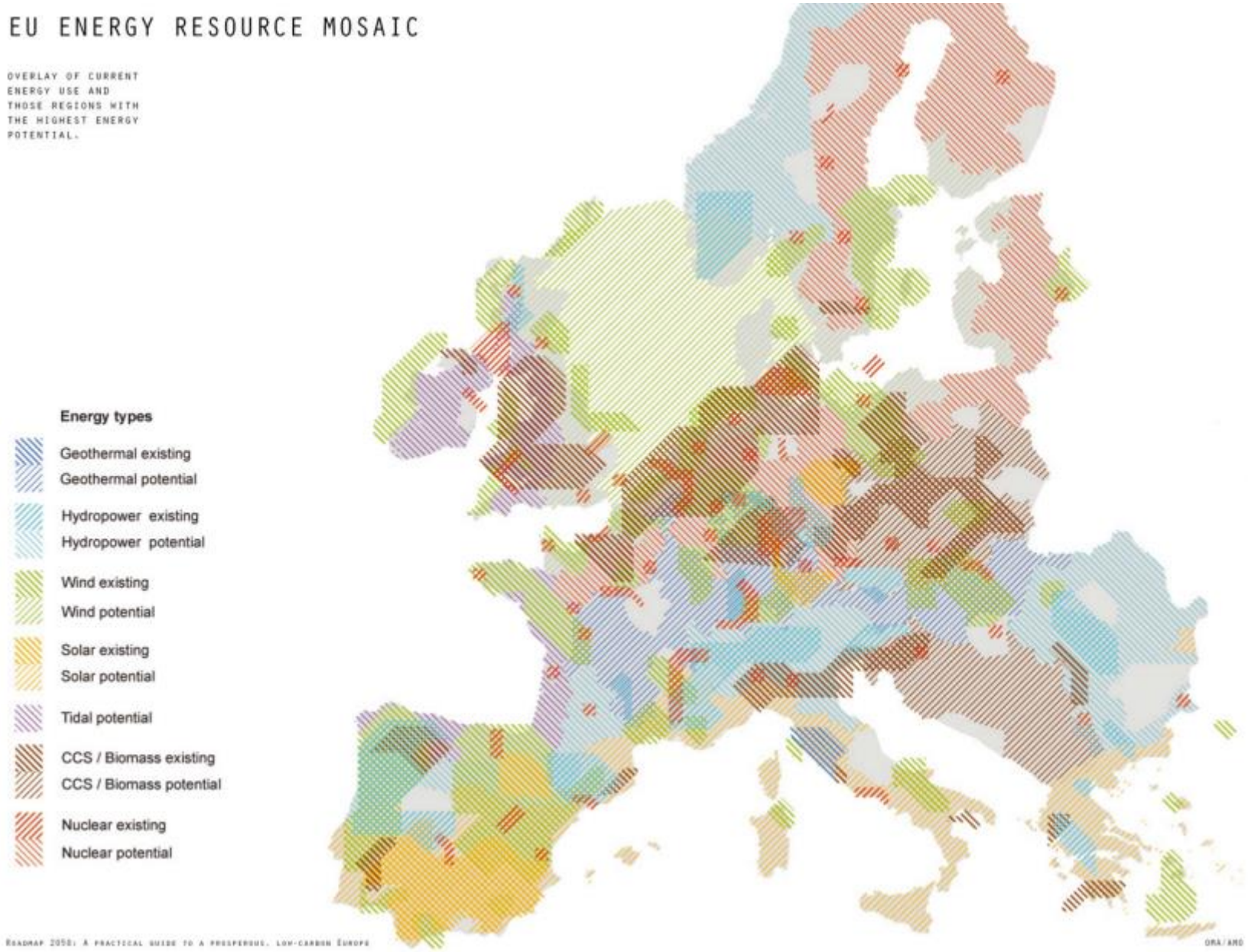
Targets – repercussions for competitiveness

- Driven by climate and energy targets, the share of renewable energy in the EU has increased **from 8.5% in 2005 to 15.3% in 2014** (26% in electricity).
- Between 2010 and 2014, the **cost of photovoltaic** (PV) systems has fallen, globally, by **50 %** but EU PV cell production has decreased from **3GW in 2010 to below 1.3 GW in 2013**.
- Similarly, while Europe leads in biotechnology and biomass conversion technologies the **overall share of bioenergy patents fell from 2000 to 2010**, and industrial investments in Europe have been put on hold.

Source: *COM(2015)6317 Towards an Integrated Strategic Energy Technology (SET) Plan*

EU ENERGY RESOURCE MOSAIC

OVERLAY OF CURRENT ENERGY USE AND THOSE REGIONS WITH THE HIGHEST ENERGY POTENTIAL.

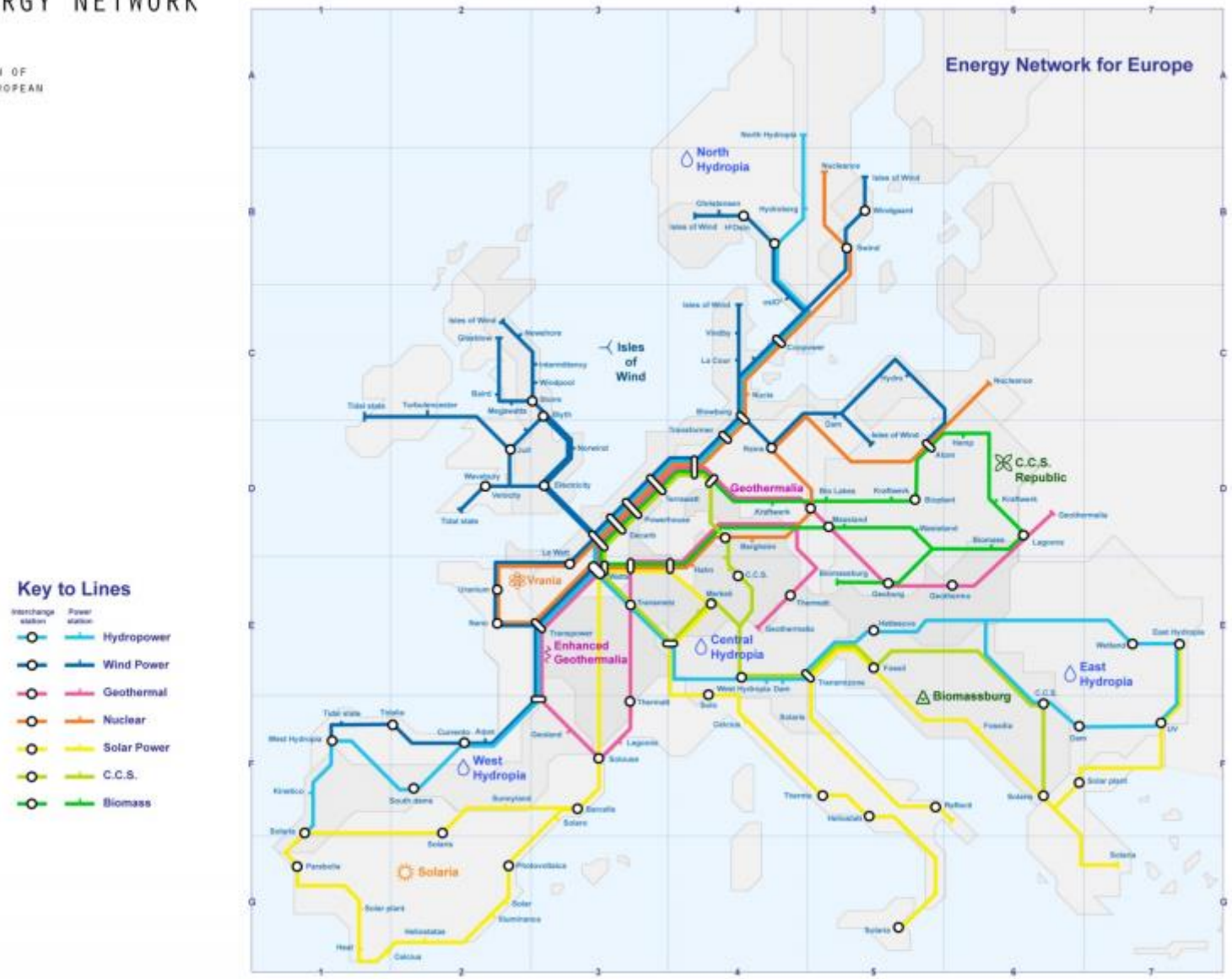


ROADMAP 2050: A PRACTICAL GUIDE TO A PROSPEROUS, LOW-CARBON EUROPE

ORA/AMO

EU ENERGY NETWORK

Diagrammatic representation of integrated European power grid.



Energy Union

Supply security

Diversifying Europe's sources of energy and making better, more efficient use of energy produced within the EU.

A fully-integrated internal energy market

Using interconnectors which enable energy to flow freely across the EU - without any technical or regulatory barriers. Only then can energy providers freely compete and provide the best energy prices.

Energy efficiency

Consuming less energy in order to reduce pollution and preserve domestic energy sources. This will reduce the EU's need for energy imports.

Climate action - emission reduction

Renewing the EU Emissions Trading System, pushing for a global deal for climate change in Paris in December 2015, and encouraging private investment in new infrastructure and technologies.

Research and innovation (climate)

Supporting breakthroughs in low-carbon technologies by coordinating research and helping to finance projects in partnership with the private sector.

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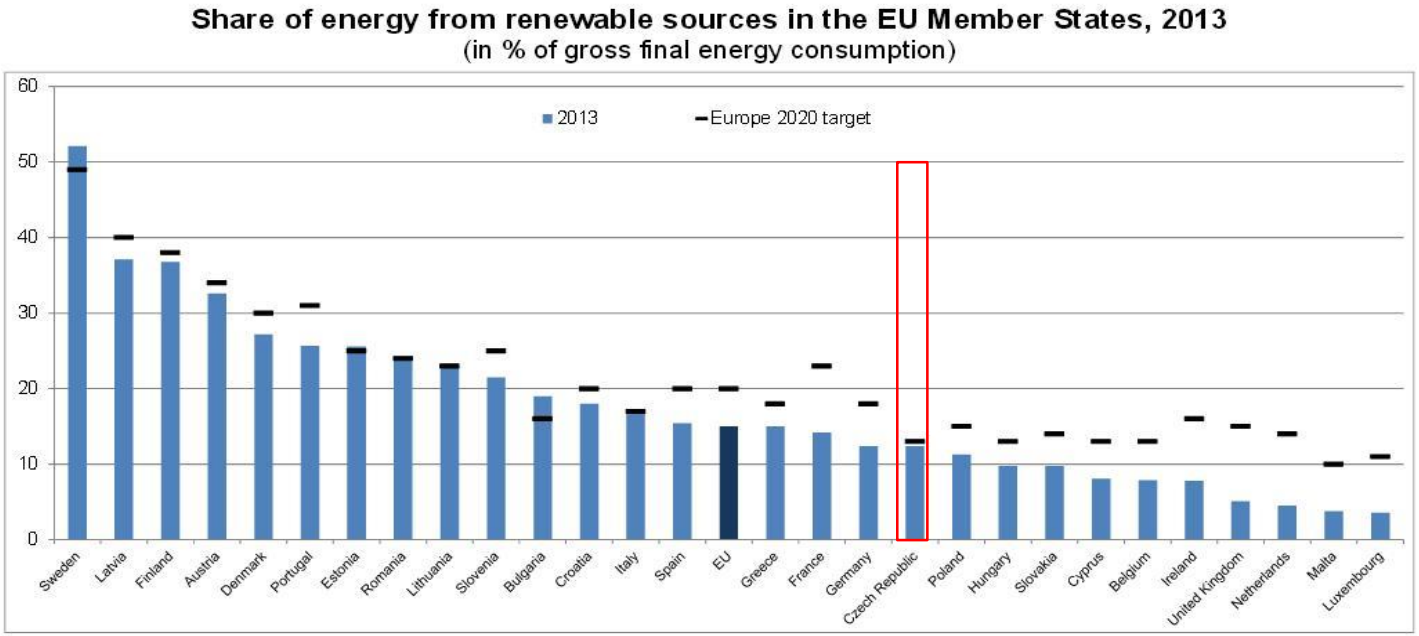


GHG:

2020: 20%

2030: 40%

2050: 85-90%

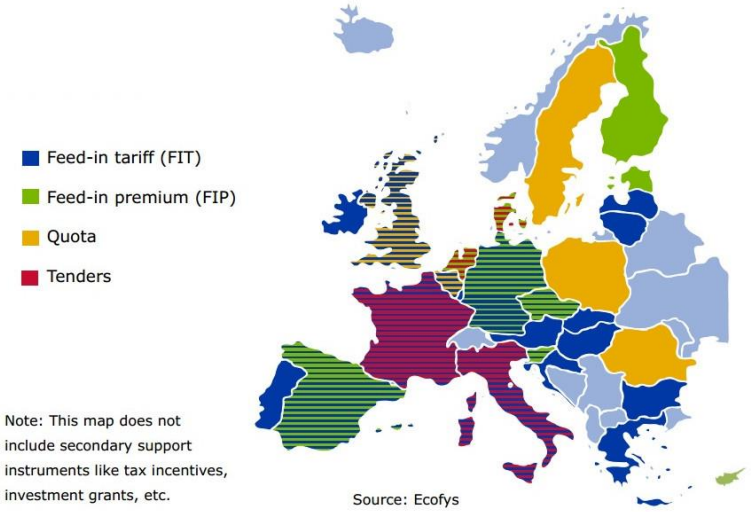
RES:

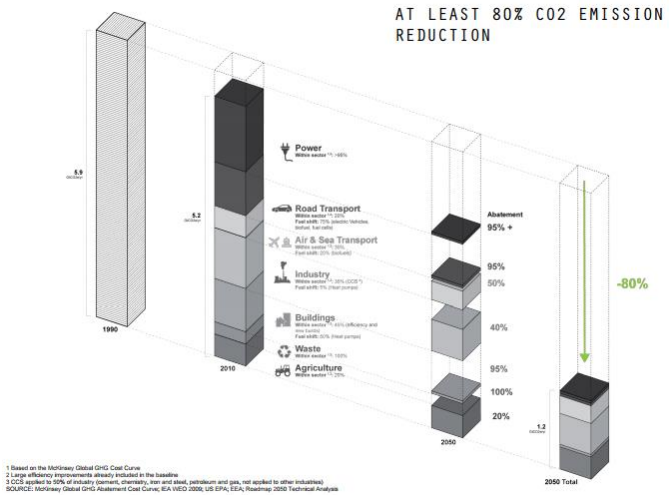
2020: 20% (13% CZ)

2030: 27%

2050: ? (100%?)

=> Standardization in EU – notification process, common scheme – RES auction





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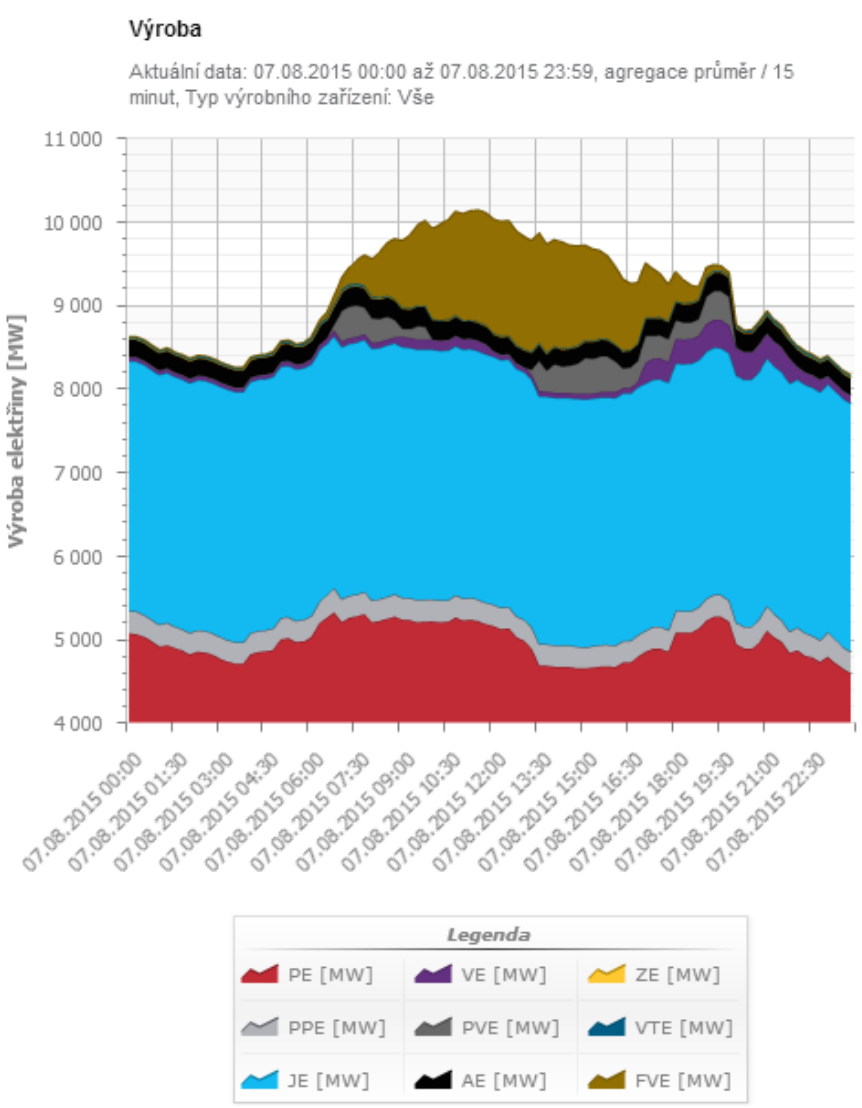

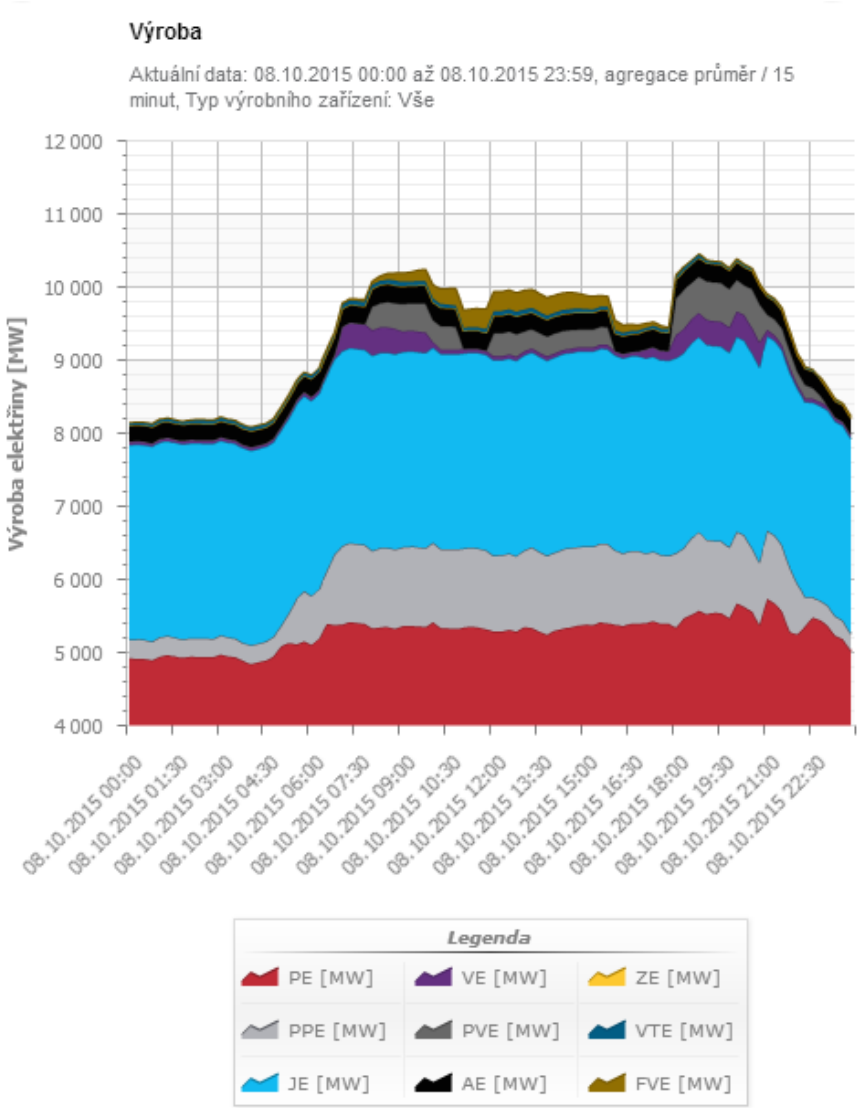

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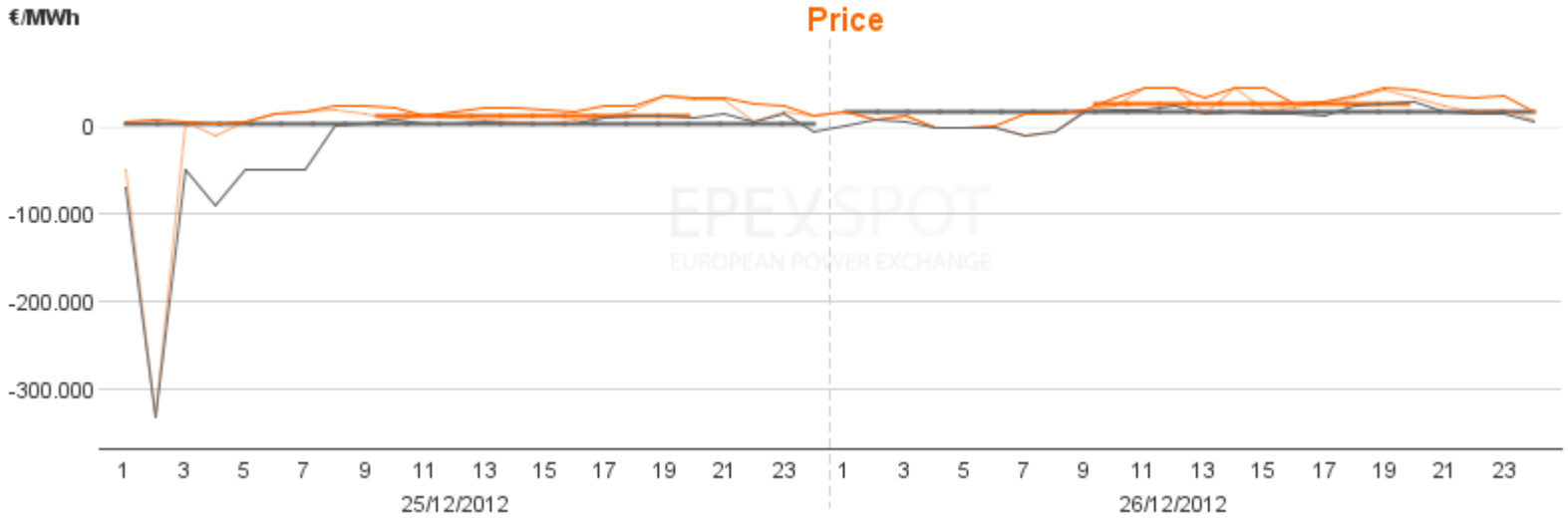

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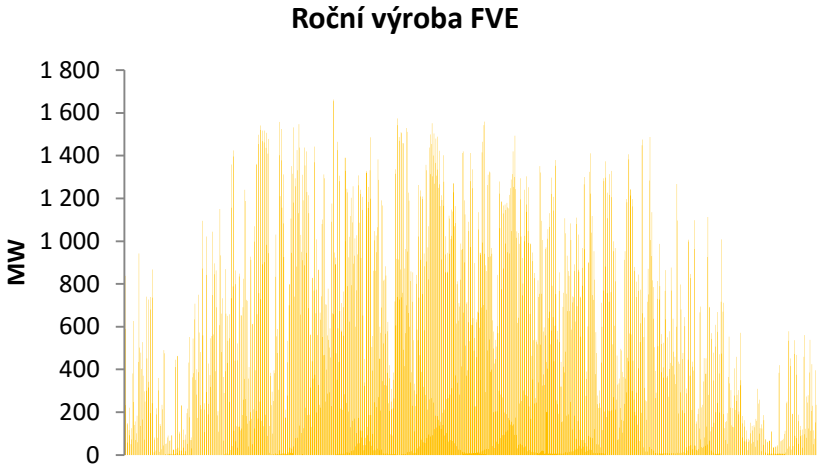

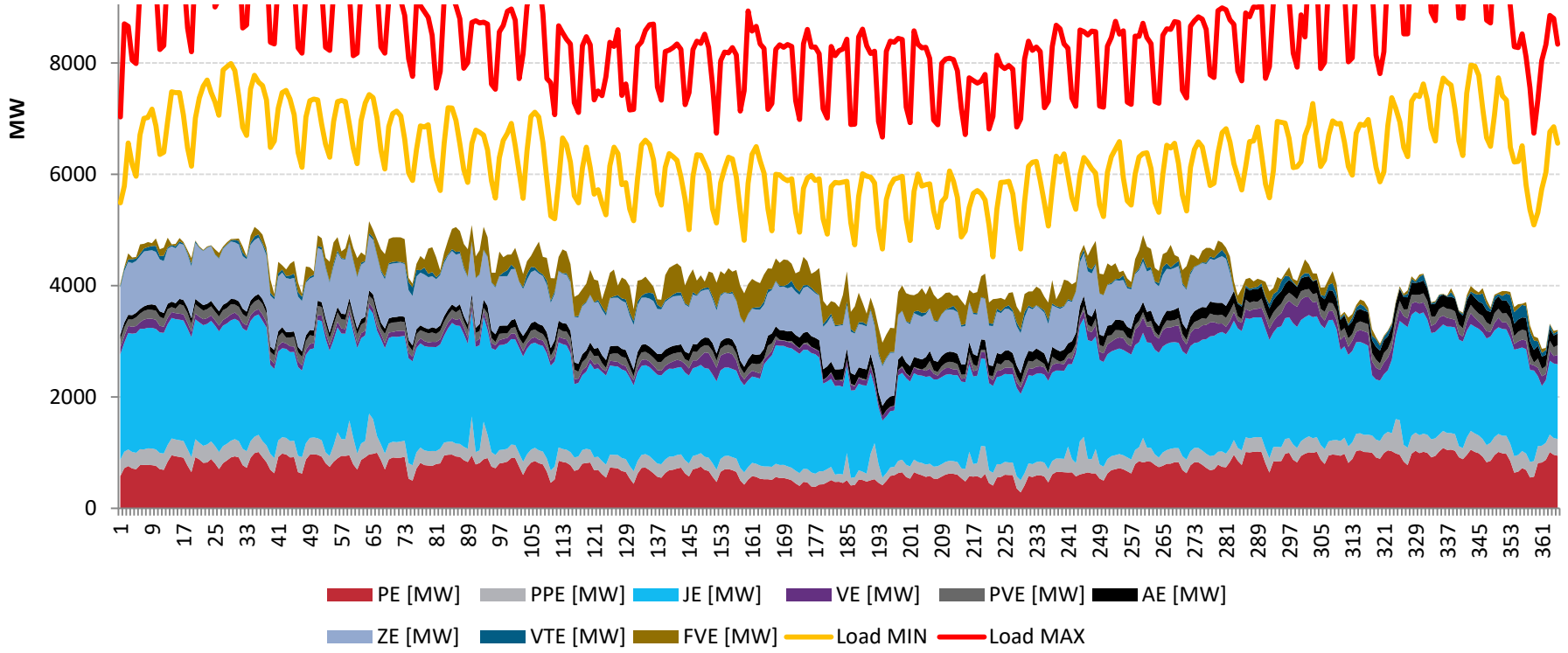

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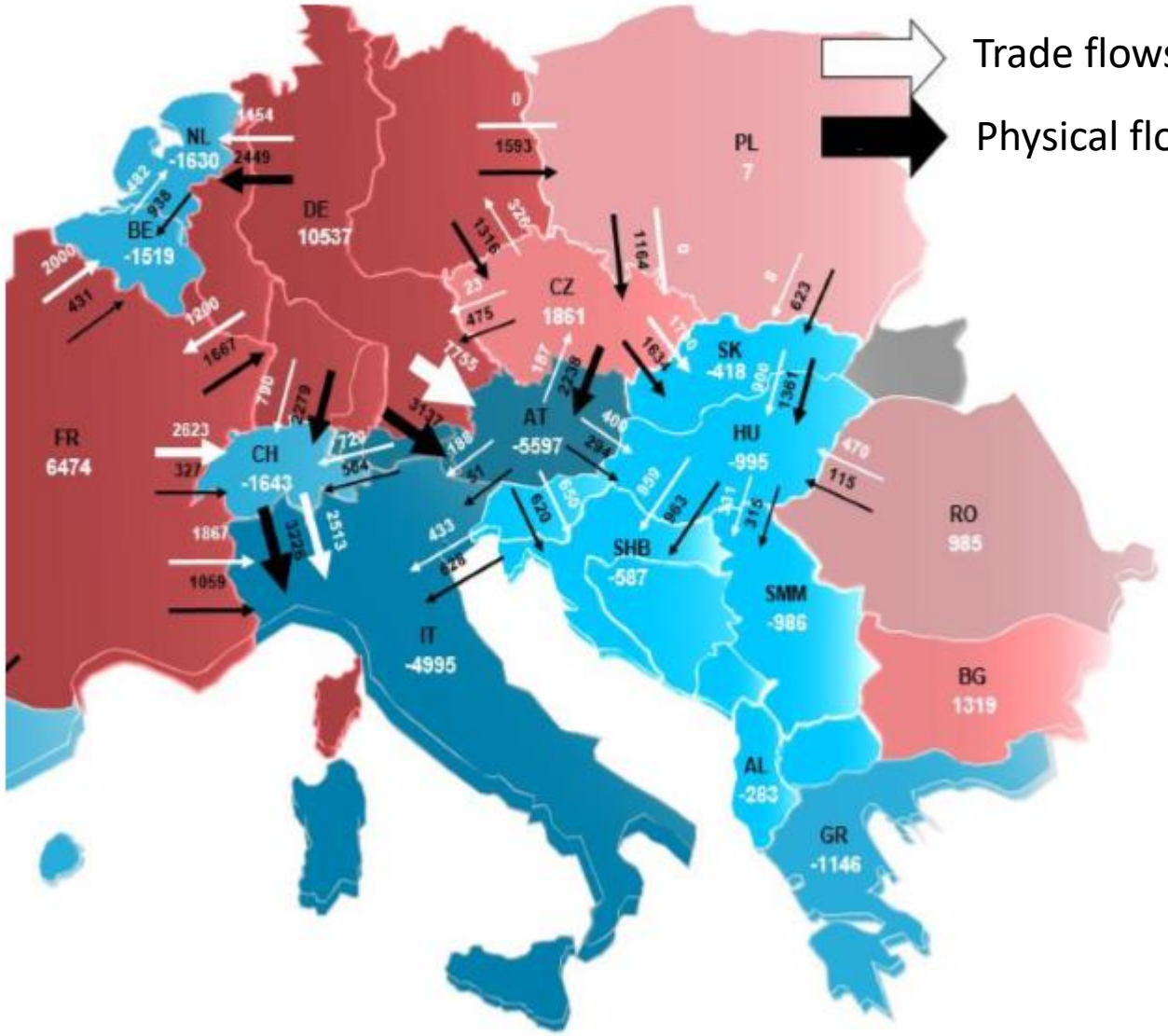

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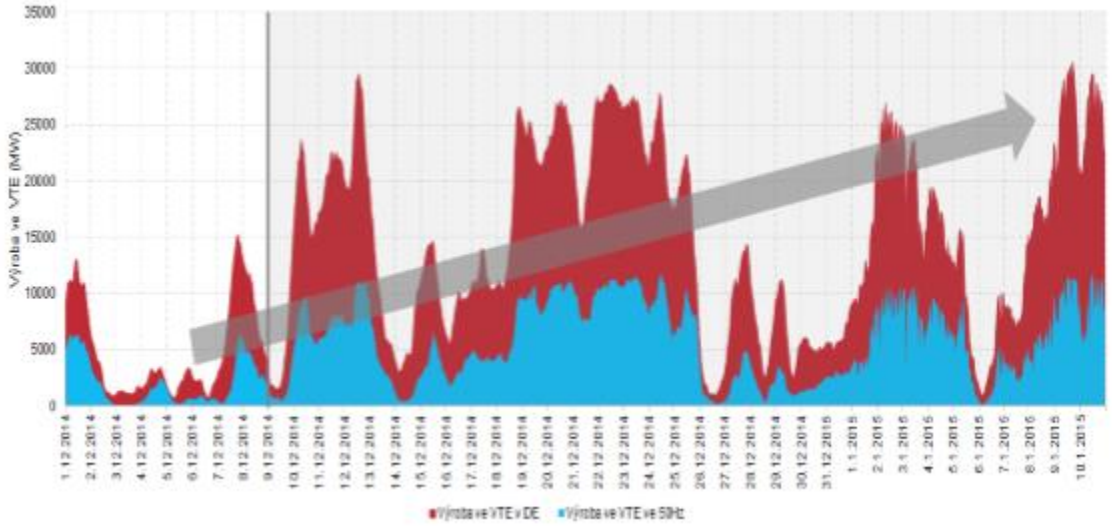
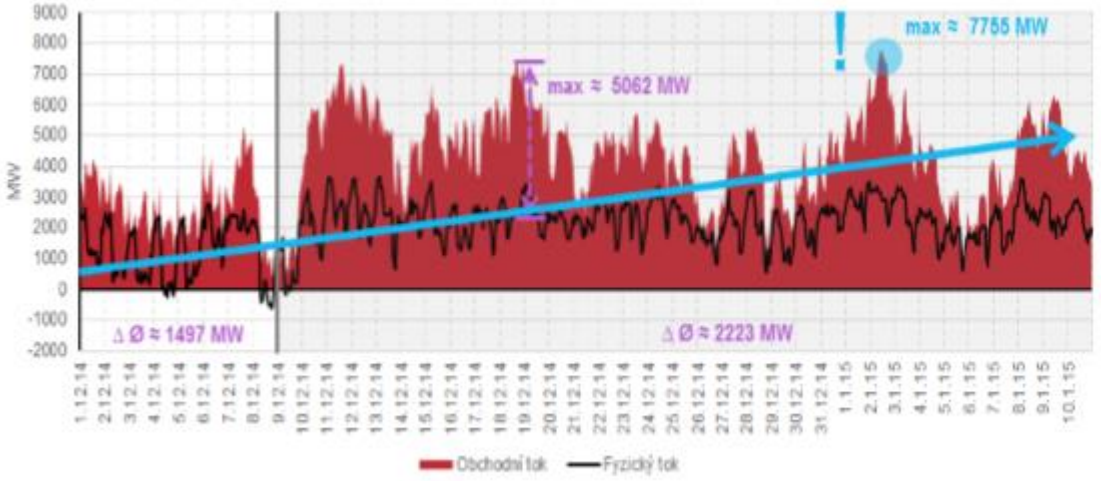

Výroba ve VTE (MW)
35000
30000
25000
20000
15000
10000
5000
0
Výroba ve VTE v DE
Výroba ve VTE ve 50Hz


MW
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
-1000
-2000
max ≈ 5062 MW
max ≈ 7755 MW
Δ Ø ≈ 1497 MW
Δ Ø ≈ 2223 MW
Obchodní tok
Fyzický tok

Long term vision of EU energy sector

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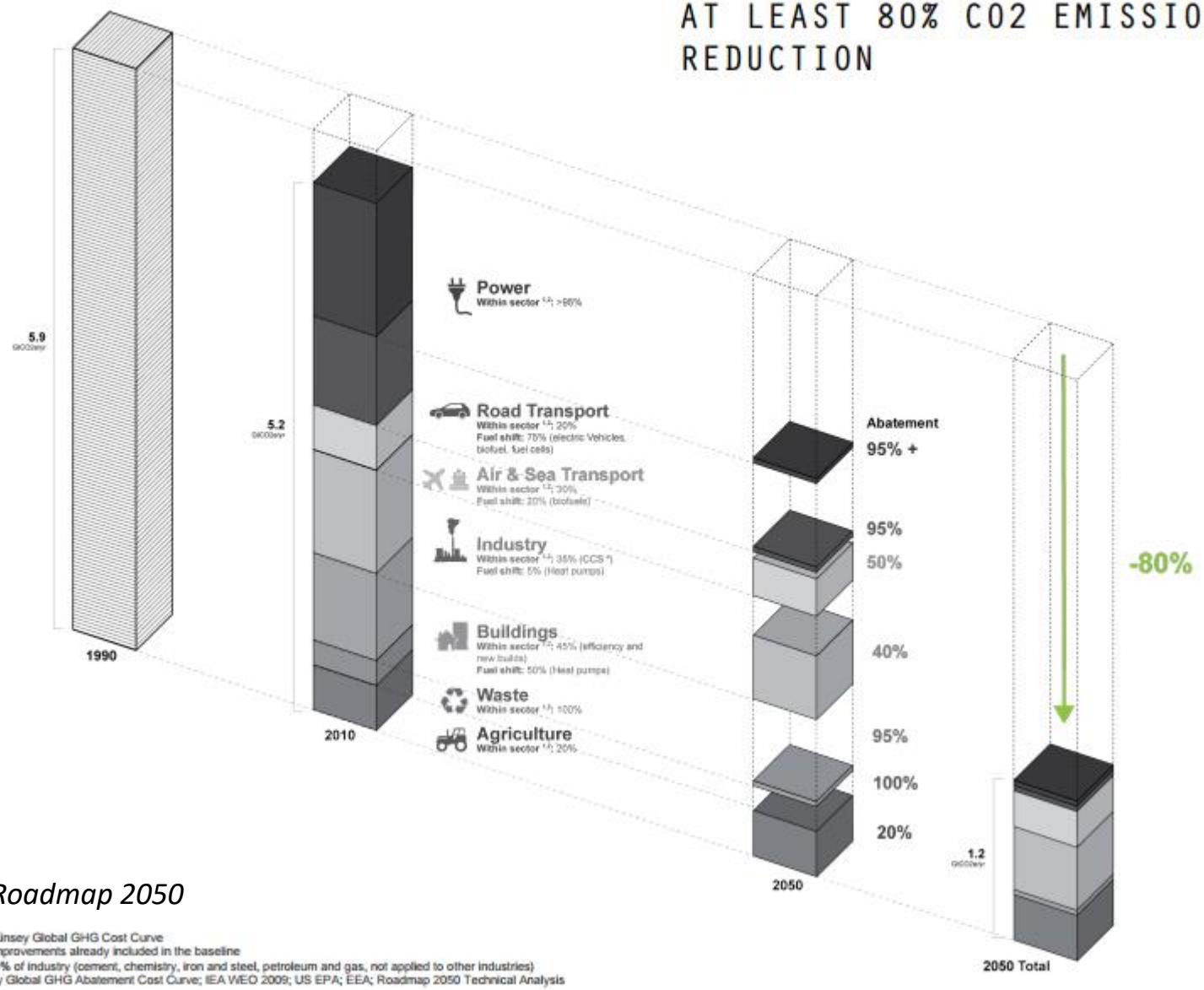
Ministry of Industry and Trade

Long term vision of EU energy sector

In order to sustain the temperature below 2 °C => decrease of CO_2 emissions till the year 2050 to **80–95 %** of the year 1990.

- **COM(2011)112:** A Roadmap for moving to a competitive low carbon economy in 2050 (March 2011).
- **23rd a 24th of October 2014** the approval of new climate-energy package (40/27/27-30, EU ETS, interconnectivity).
- UNFCCC - **COP 21** – September 2015; OECD Ministerial (3. a 4. of June); IEA Ministerial (17. a 18. of November).
- The absolute fulfillment of **Strategic Energy Technology Plan** is needed => investment into research, development and demonstration of around **50 billion EUR** (in the following 10 years).



Source: Roadmap 2050

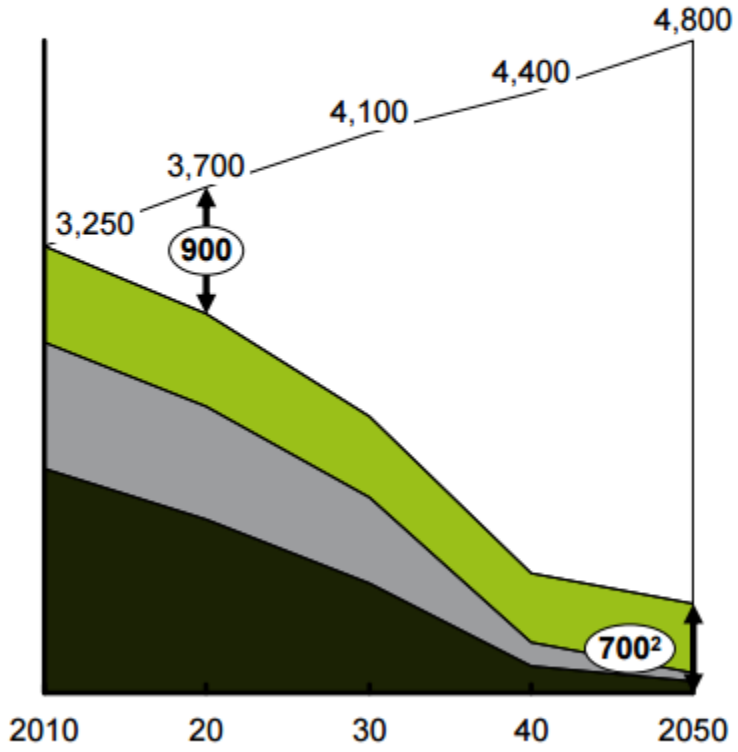
1 Based on the McKinsey Global GHG Cost Curve
2 Large efficiency improvements already included in the baseline
3 CCS applied to 50% of industry (cement, chemistry, iron and steel, petroleum and gas, not applied to other industries)
SOURCE: McKinsey Global GHG Abatement Cost Curve; IEA WEO 2009; US EPA; EEA; Roadmap 2050 Technical Analysis

Current plants are assumed to retire at the end of a fixed lifetime

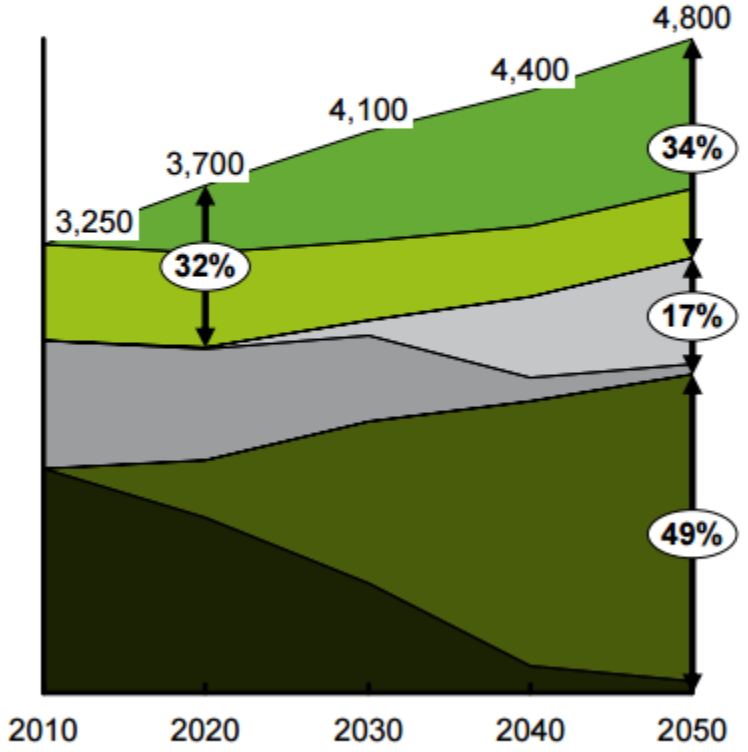
EU-27, Norway and Switzerland, TWh per year

RES new build | Nuclear new build | Fossil new build
RES existing[1] | Nuclear existing[1] | Fossil existing[1]

Production from existing and planned power supply and forecasted power demand



Baseline power supply development and forecasted power demand



1 Existing capacity includes plants under construction
2 RES capacity remaining in 2050 is entirely made of hydropower plants

Zdroj: Roadmap 2050

The transformation of energy sector

Targets are financially and technologically achievable => implementation?

- Average installation of 5 000 km^2 **PV panels** (0,1% EU).
- Installation of 100 000 new **wind turbines**: 2 000 – 4 000 per year (installation rate of last 10 years) – 50% might be off-shore.
- Additional capacity of **transmission grids** – 300 % increase in 40 years, France – Spain increase 1 GW => 40 GW, pan-European transmission grid.
- Required **back-up capacity**: 190 – 270 GW, average load factor: 5 – 8 %.
- **Carbon capture and storage/use** technology in all scenarios – primarily in industrial processes, other reduction-oxidation reagent.
- App. 200 GW of new NPPs => 100 new NPPs (80 % RES repl. of ½ NPPs).
- Deployment of 200 mil. **electric vehicles** and cars with **fuels cells** (hydrogen), 100 mil. **heat pumps** for buildings and central heating.

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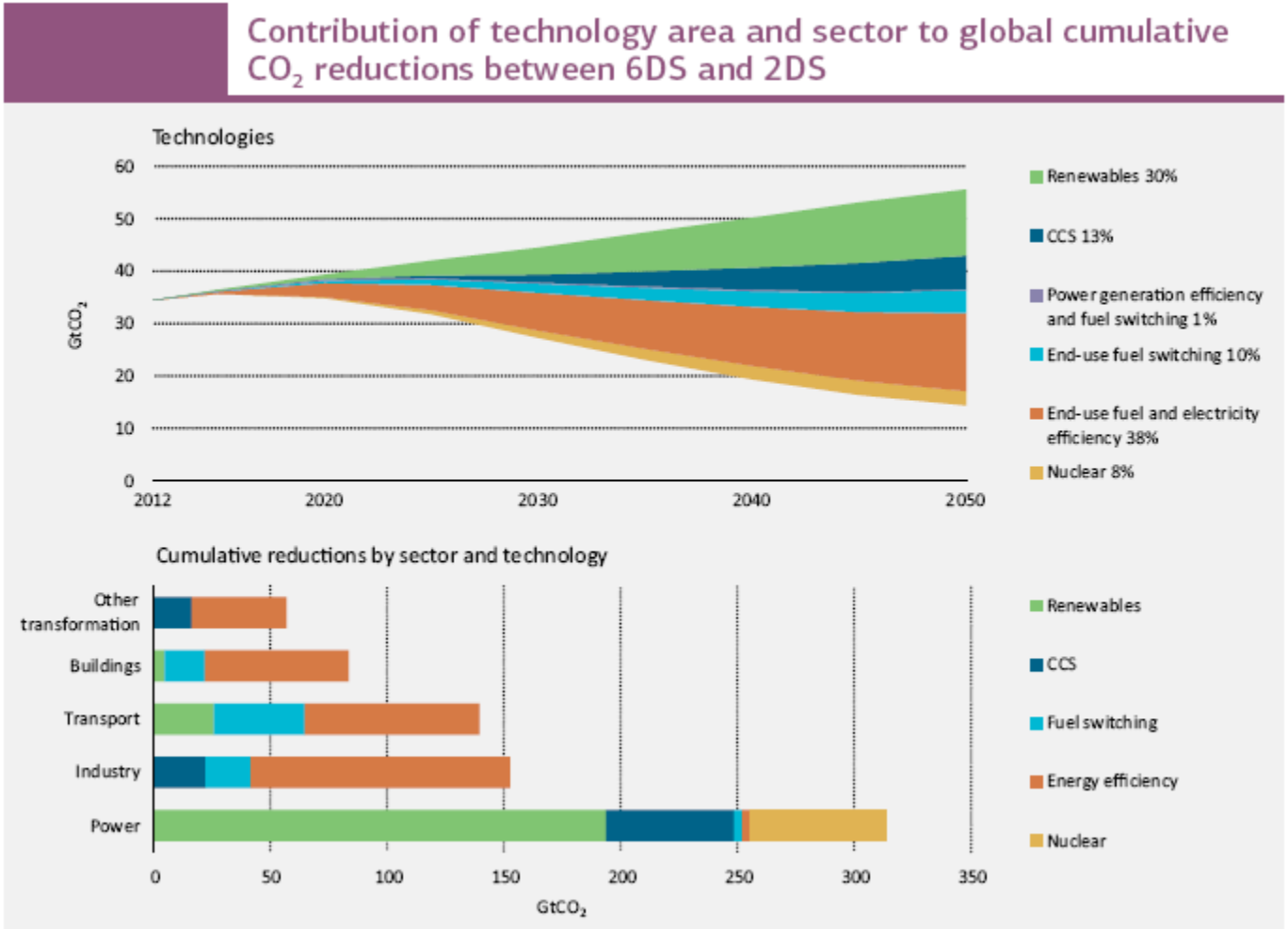
Transformace energetiky



Zdroj: ETP 2015 (IEA)

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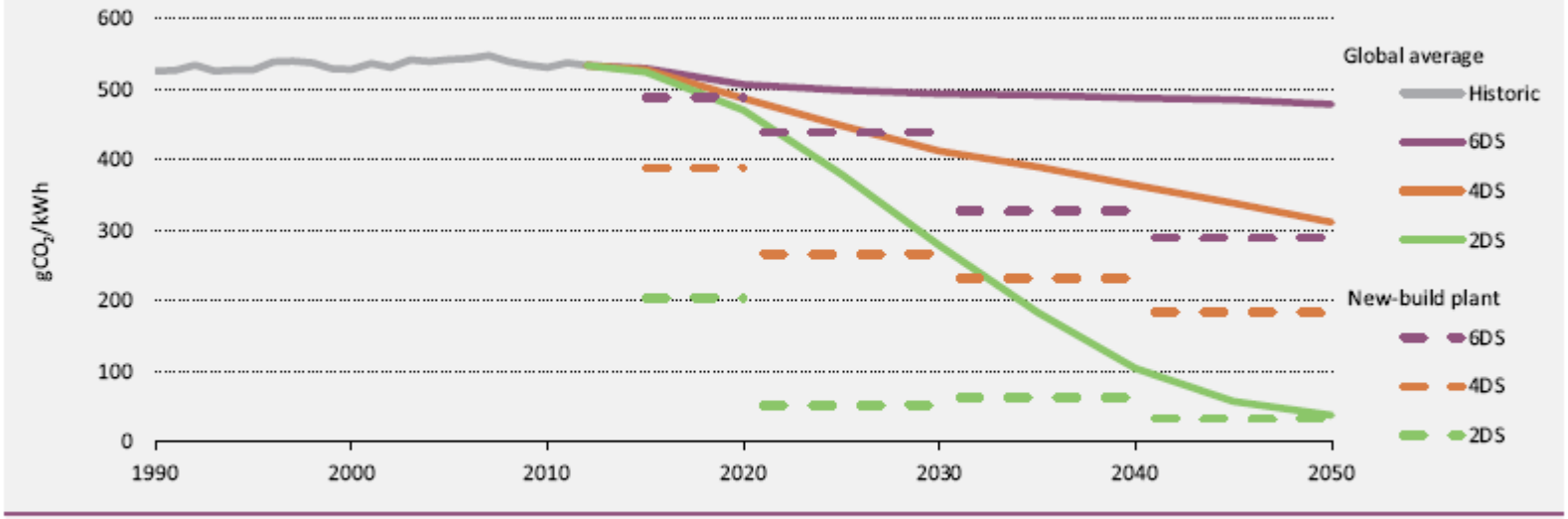
Transformace energetiky

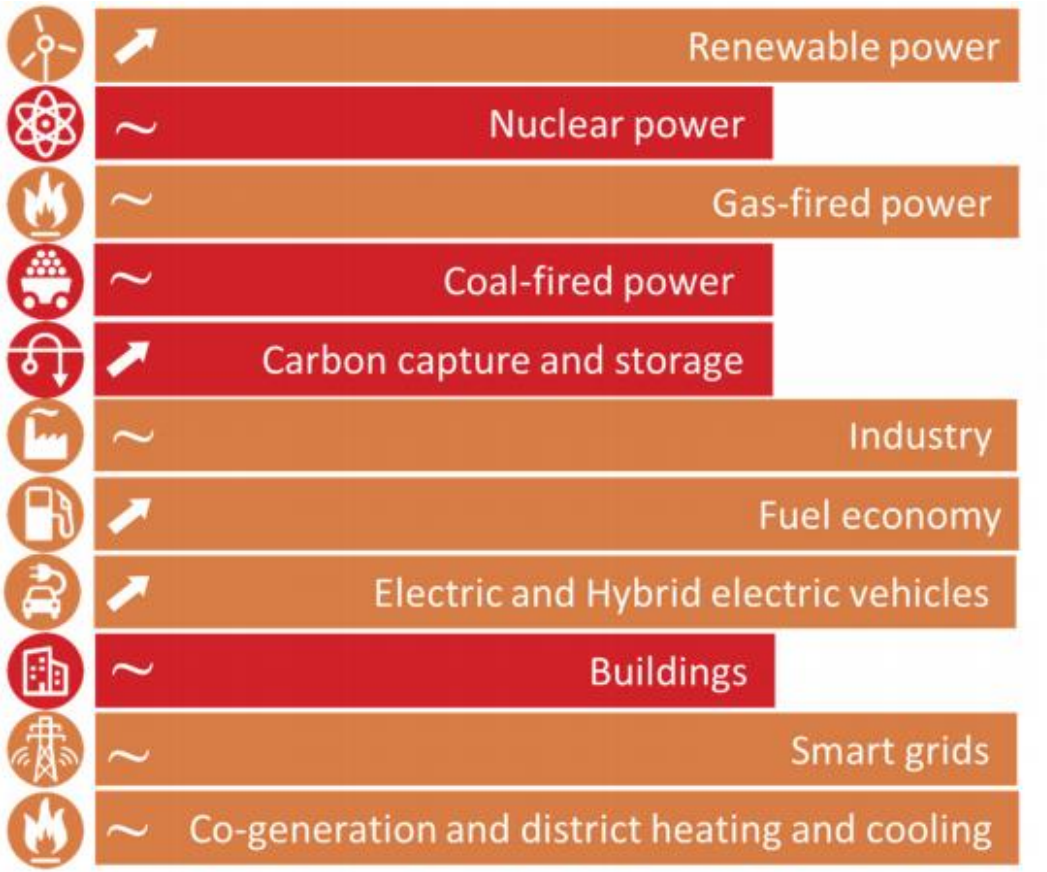
Global fleet average and new-build plants emissions intensity of power generation in IEA scenarios



Key point *To achieve the sharp decline in fleet-wide emissions intensity in the 2DS, the average emissions intensity of new generation must be lower than that of natural gas by 2020 and only 10% of today's levels after 2020.*

Zdroj: ETP 2015 (IEA)

Energy Technology Perspectives 2015 (IEA)

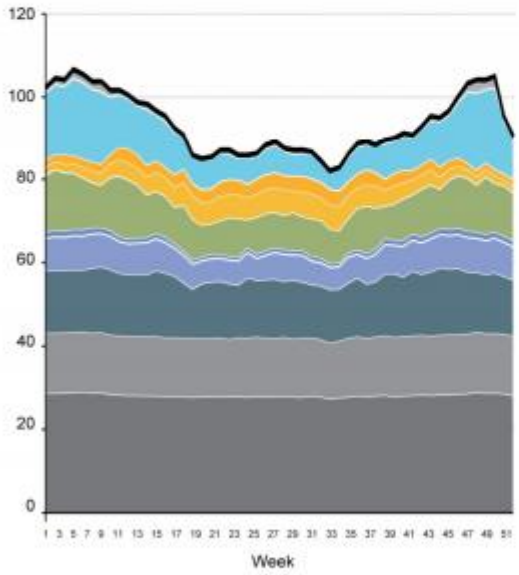


Evidence shows that despite continued progress in many areas, for the first time none of the technologies is in line with 2DS goals

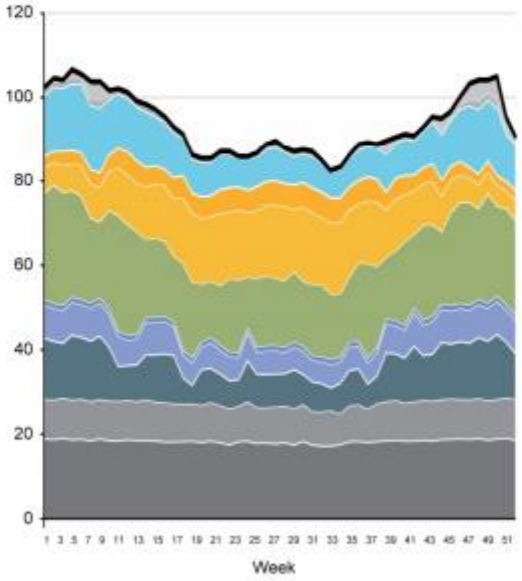
Zdroj: ETP 2015 (IEA 2015)

THREE SPECIFIC PATHWAYS MODELED INCLUDING BOTH GENERATION AND GRID COSTS

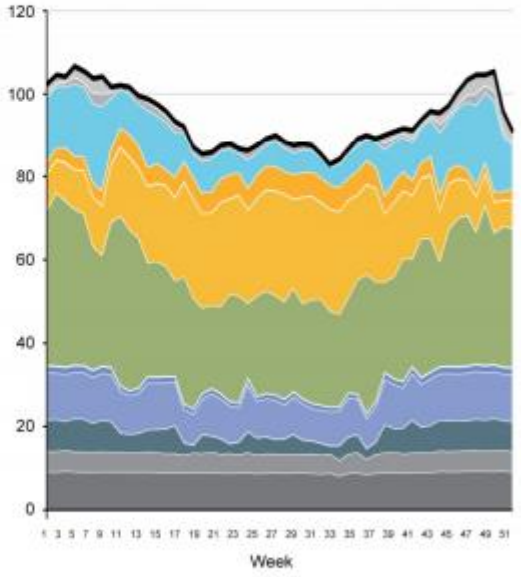
40% RES
30% CCS
30% nuclear



60% RES
20% CCS
20% nuclear



80% RES
10% CCS
10% nuclear



Energy production mix over the year, TWh per week

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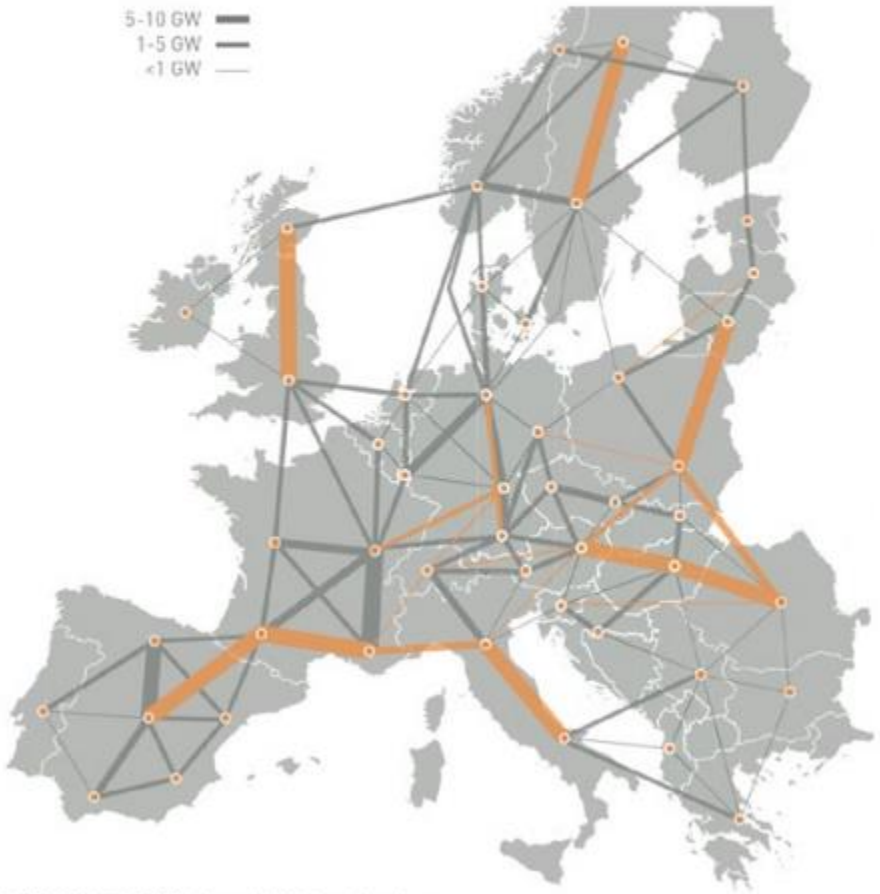
An 'overlay grid' of extra-high voltage DC lines would facilitate the transport of large amounts of bulk power over long distances

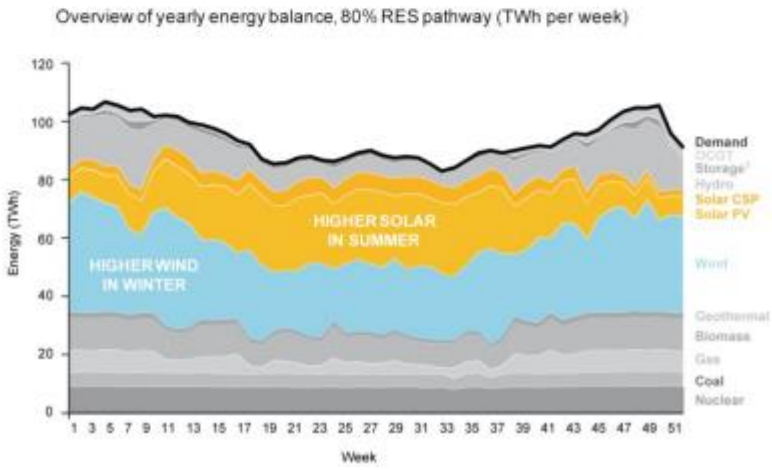
Transmission required
GW, 2040, Overlay grid



- Reduced need for new lines of about 10,000km (or 2.5%)
- Capex reduction of approx. 4%
- Overall transport capability increases by 6,227 GW - km

SOURCE: ENTSO-E; KEMA; Imperial College London

RES DIVERSITY CONTRIBUTES TO CONSISTENT SUPPLY



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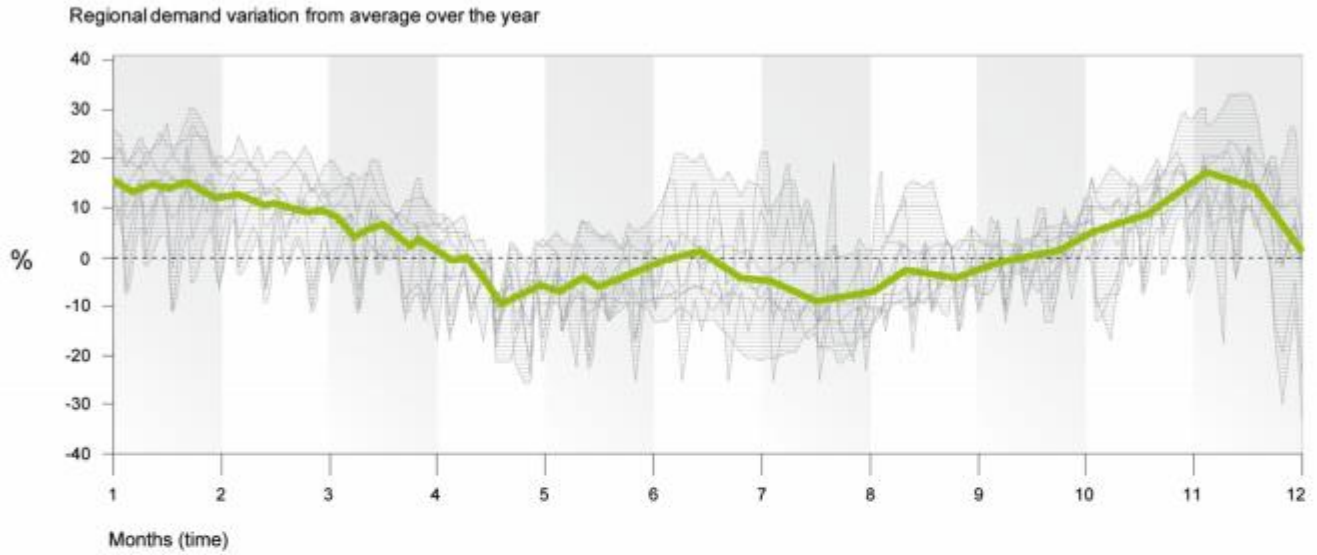
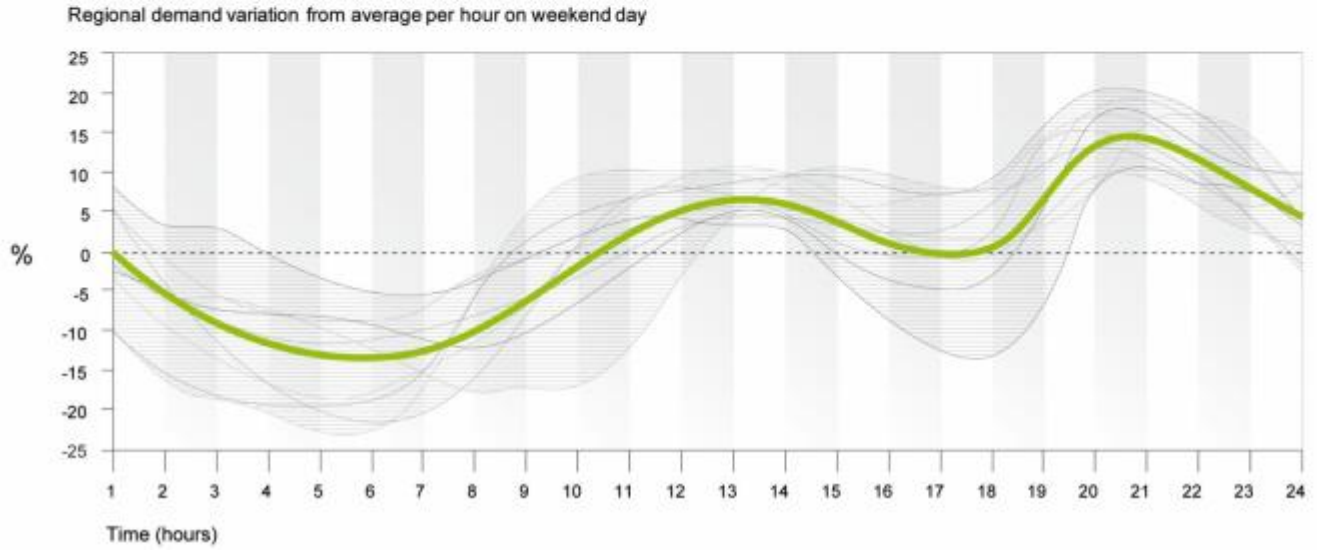
COMBINING REGIONAL DEMAND CURVES REDUCES VOLATILITY





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Energy only market, capacity market

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Energy only market

- In „normal“ markets there might be **excess of demand over supply** => in this case someone with relatively low willingness to pay will be left up empty handed.
- In power market **this situation cannot happen**, it would influence the quality of supply for everyone.
- The supply has to be „calibrated“ to **meet the highest possible demand**.
- Currently, **power plants profits through selling units (kWh/MWh)** of electricity, this should cover their variable cost (in short run) and fixed cost (in long run) => **it is assumed** that this should ensure long term investment ensuring/leading to sufficient power supply.

What is security of (electricity) supply?

Security of electricity supply means different things in different contexts. A reliable supply comprises several elements operating effectively at the same time:

Fuel adequacy: Power generation is the conversion of an alternative source of energy (gas, wind, uranium) to electrical power. A key driver of security of electricity supply is the availability of sufficient resources.

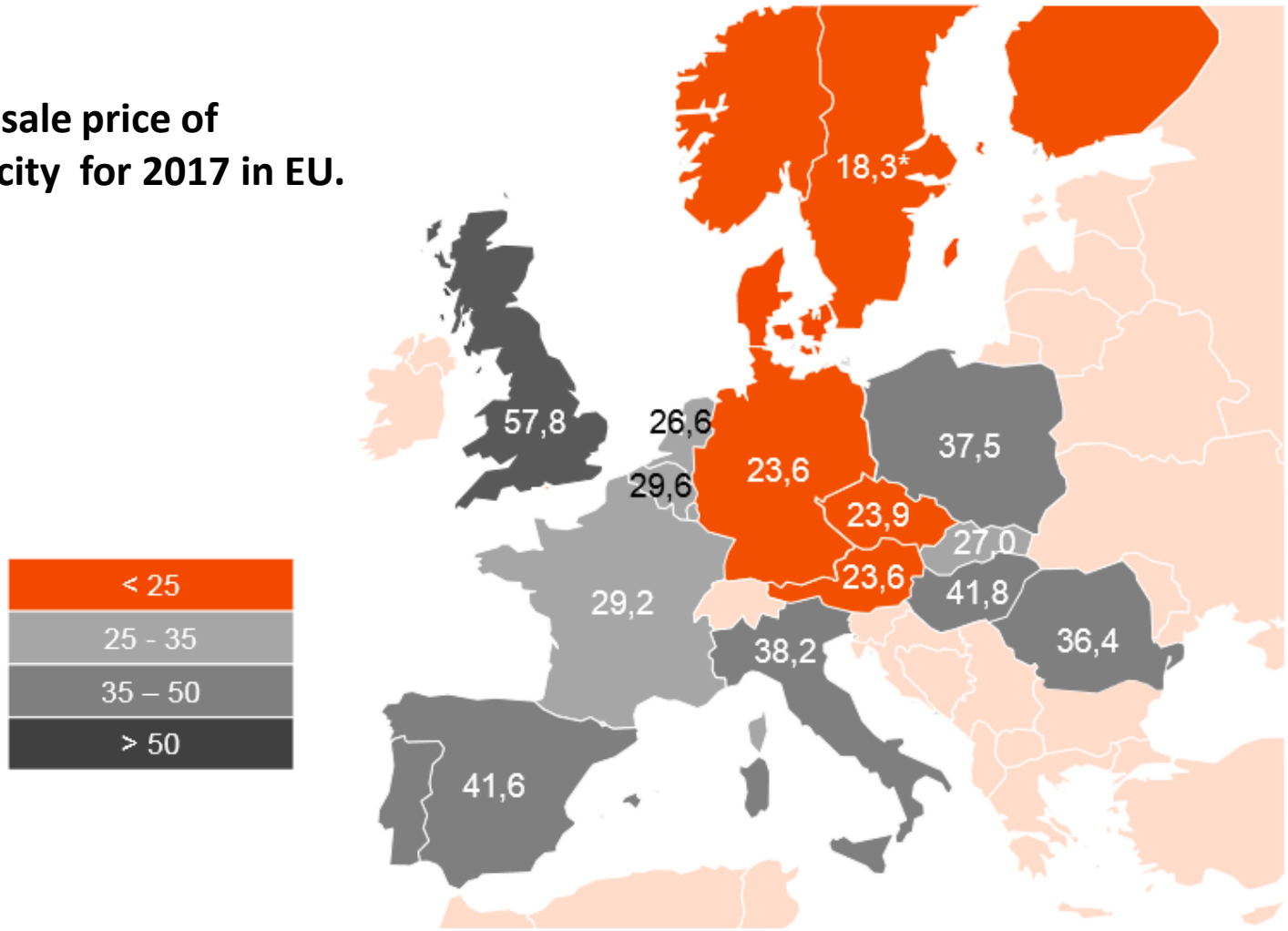
Generation capacity adequacy: The capacity of a generation portfolio must be large enough to meet maximum (or "peak") load, taking into account unavailability of plants from time to time. Capacity adequacy is a medium-to long-term issue, requiring investment planning, matching generation capacity with forecast growth in demand.

Balancing and flexibility adequacy: The balance between generation and demand must be managed on a continuous basis, as the ability to store electricity is limited. Some forms of renewable generation are intermittent in that they do not run all the time (wind, solar). Generation capacity therefore needs to be flexible enough to fill the gaps at night or when the wind doesn't blow. As the wind and solar sectors expand, the issue becomes more pressing.

Network adequacy: Electricity generated must be transported from power plant to consumer through transmission and distribution networks. Transmission System Operators (TSOs) and Distribution System Operators (DSOs) must coordinate network investment with the development of generation and demand.

Prices of electricity

Wholesale price of electricity for 2017 in EU.



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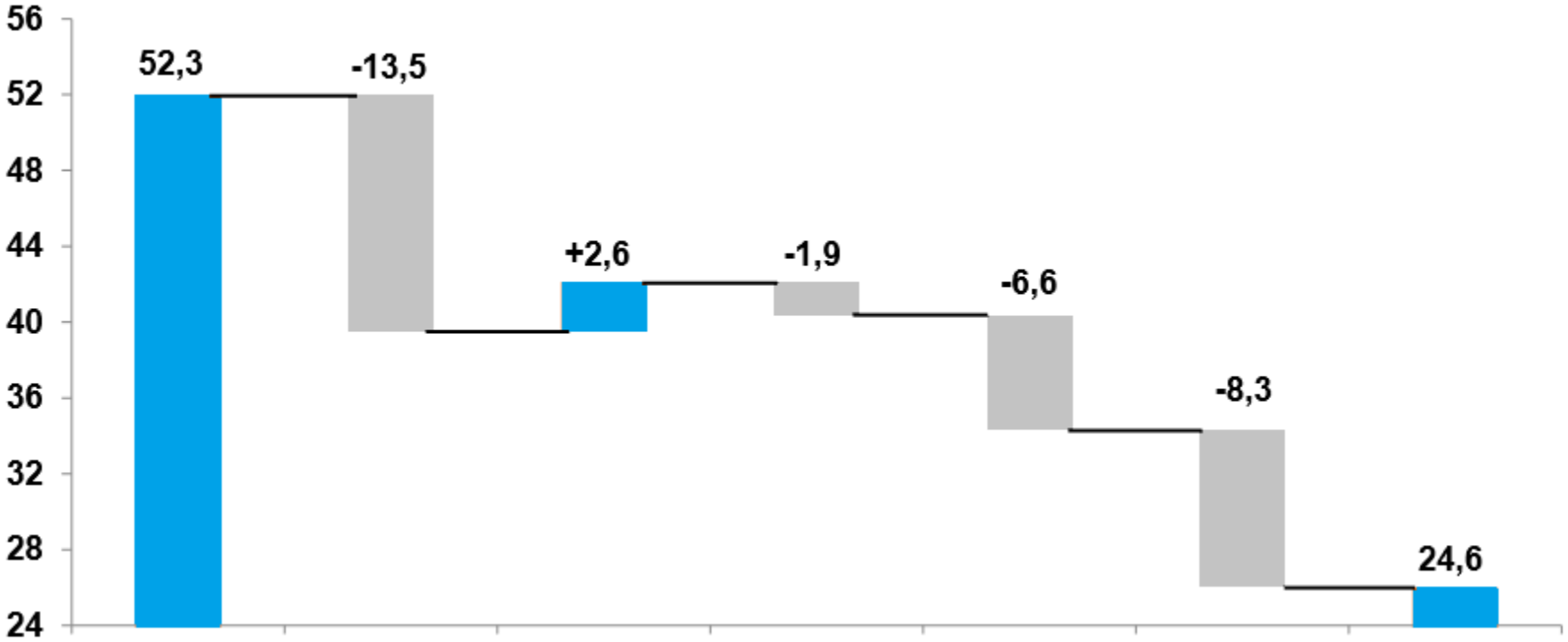
Breakdown of electricity price change (01/2011 – 01/2016)

Germany, EUR/MWh, year ahead forward



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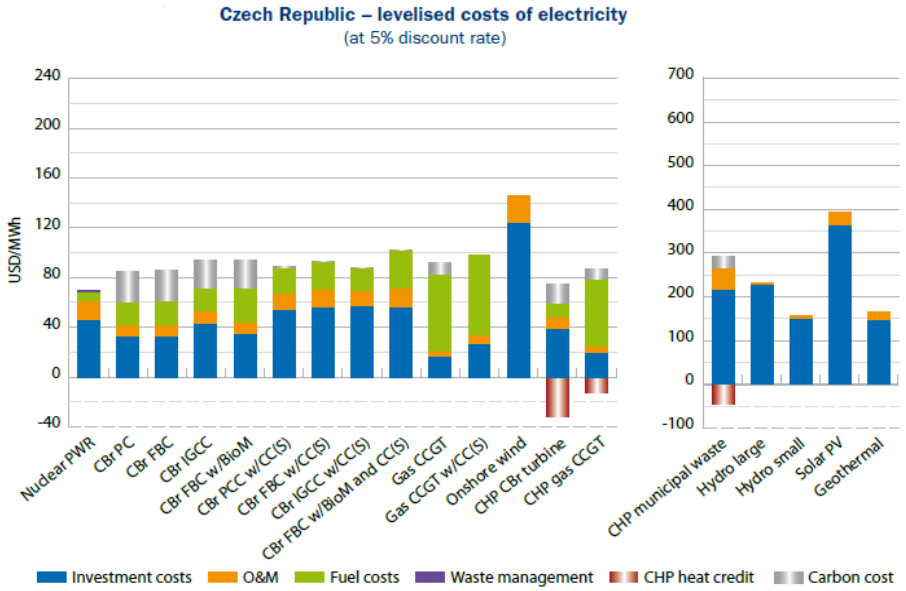

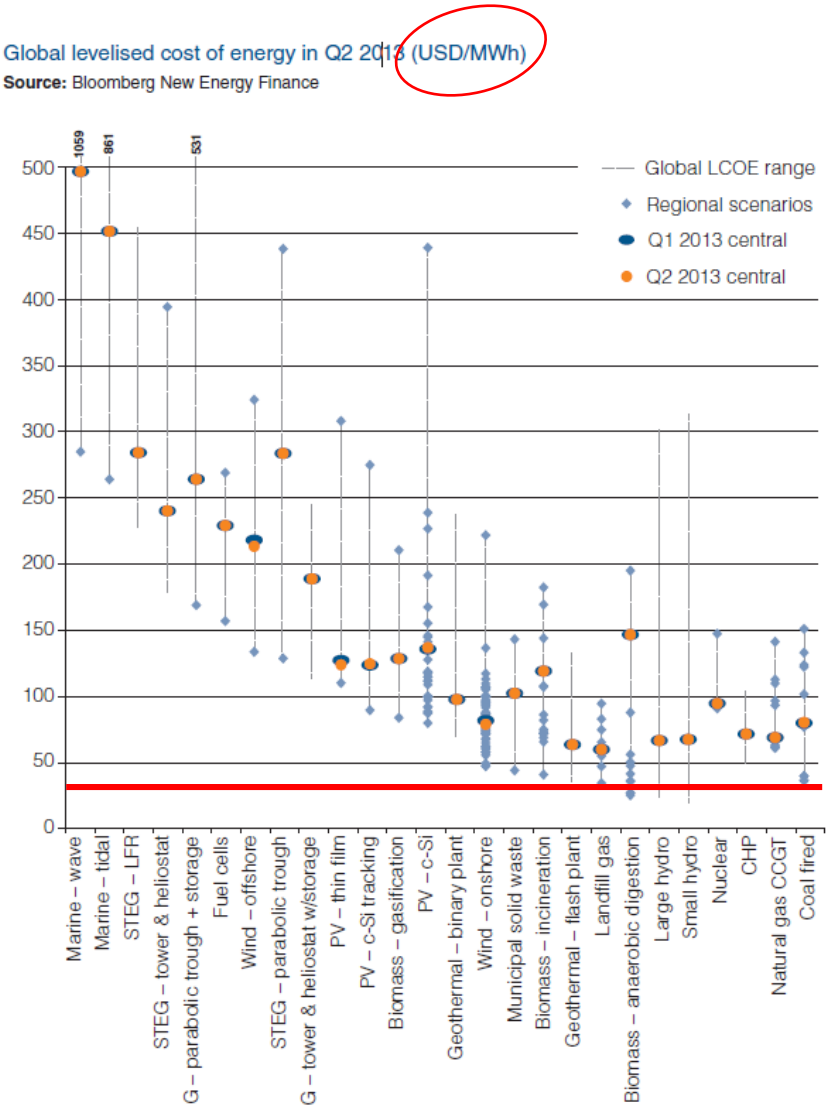

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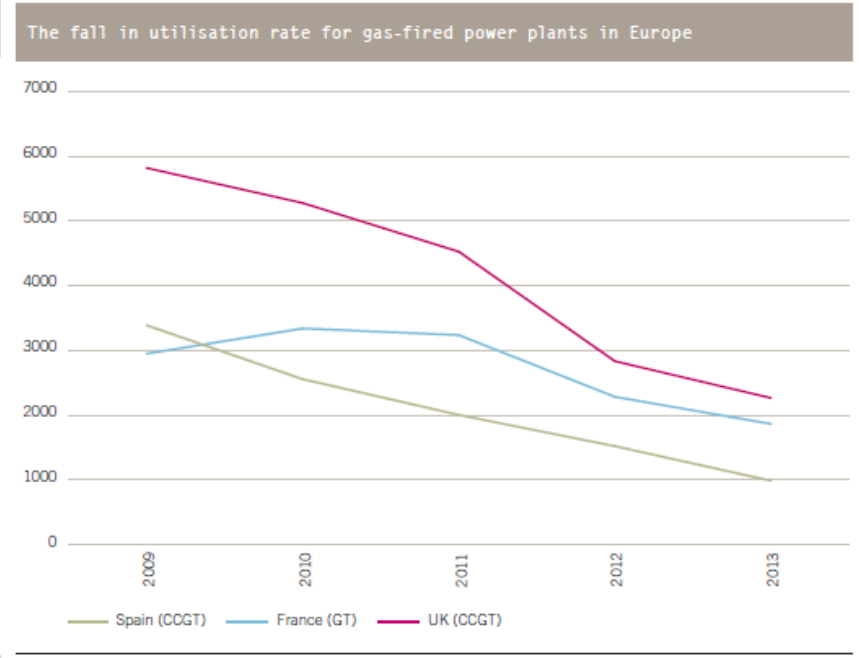
Investment model



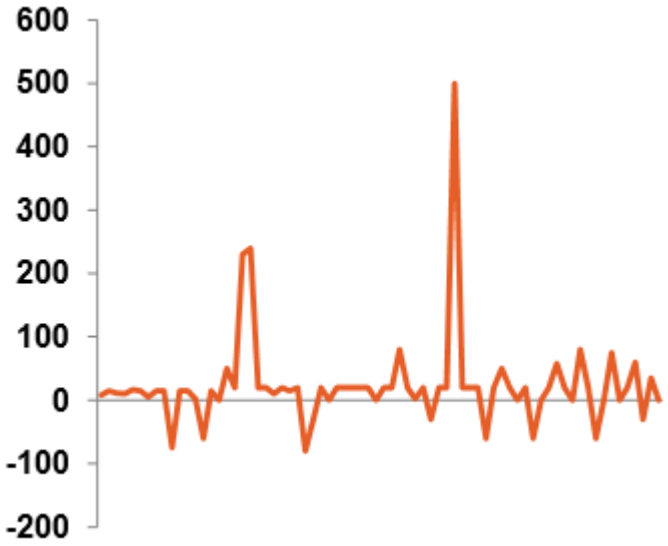
Analysis: FTI-CL Energy

Sources: RTE, REE, ENTSO-E, DUKES[3]

Sources: EPEX, APX, IHS CERA

Profit margin without capacity market

EUR/MWh, prices per hour 2025, illustrative



- Profitable operation of power sources is possible due to price spikes, utilities use price spikes to cover fixed costs.

- **Uncertain magnitude of price spikes.**
- **Risk of intervention limiting price spikes.**

Profit margin with capacity market

EUR/MWh, prices per hour 2025, illustrative

- Profitable operation of power sources is partially covered from capacity margin/payment).

- **Potentially more stable cash flow.**
- **Higher profits in mid and long term period.**

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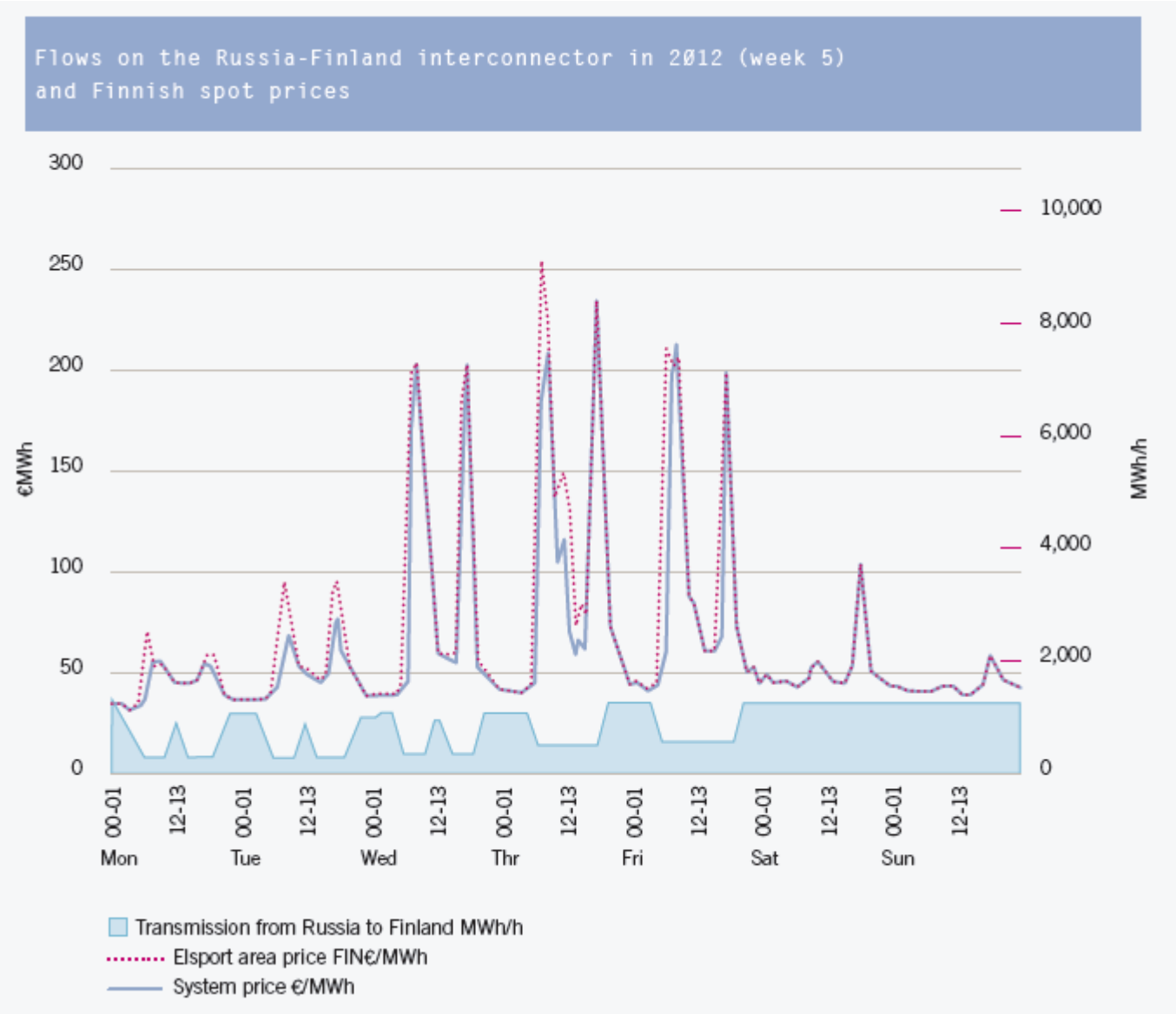
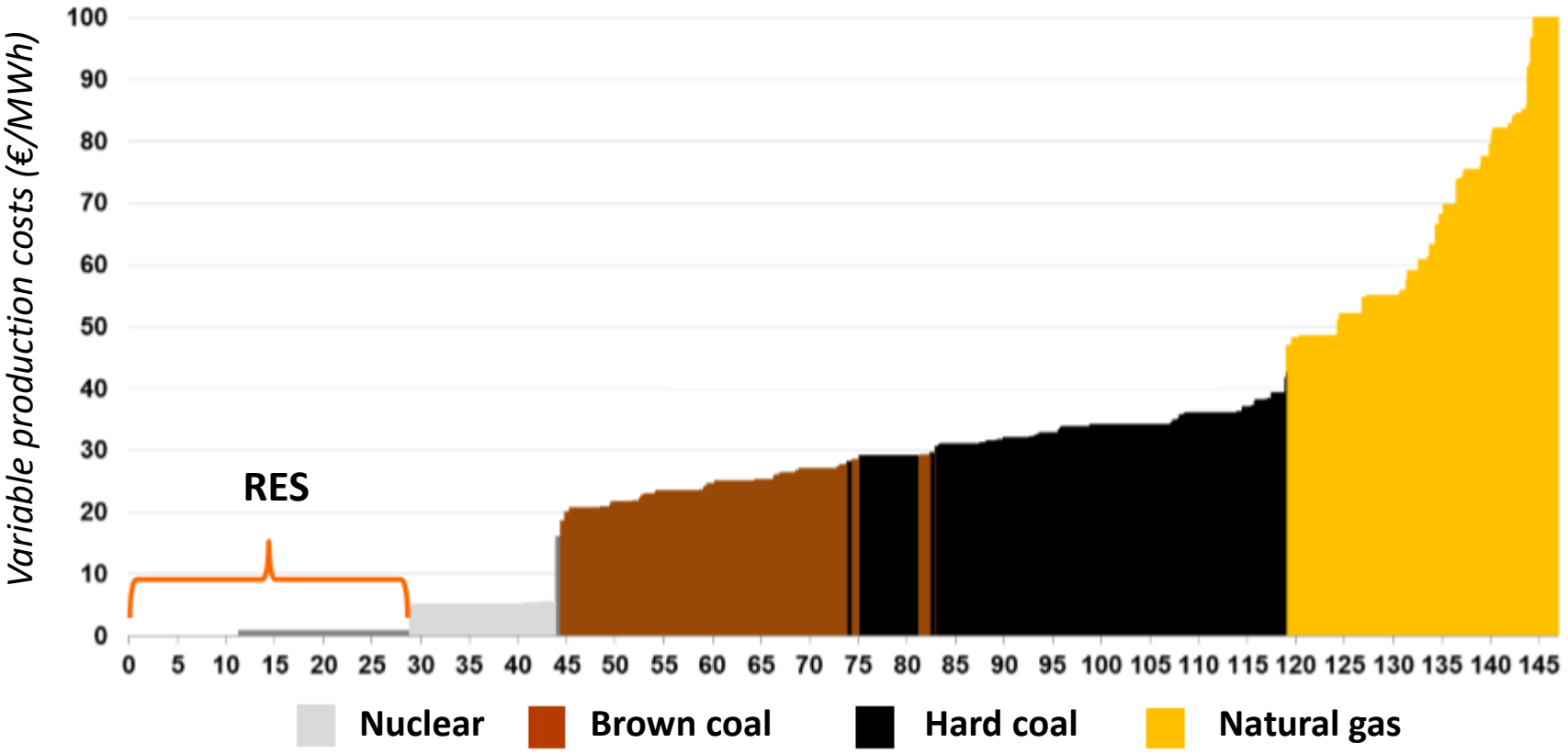
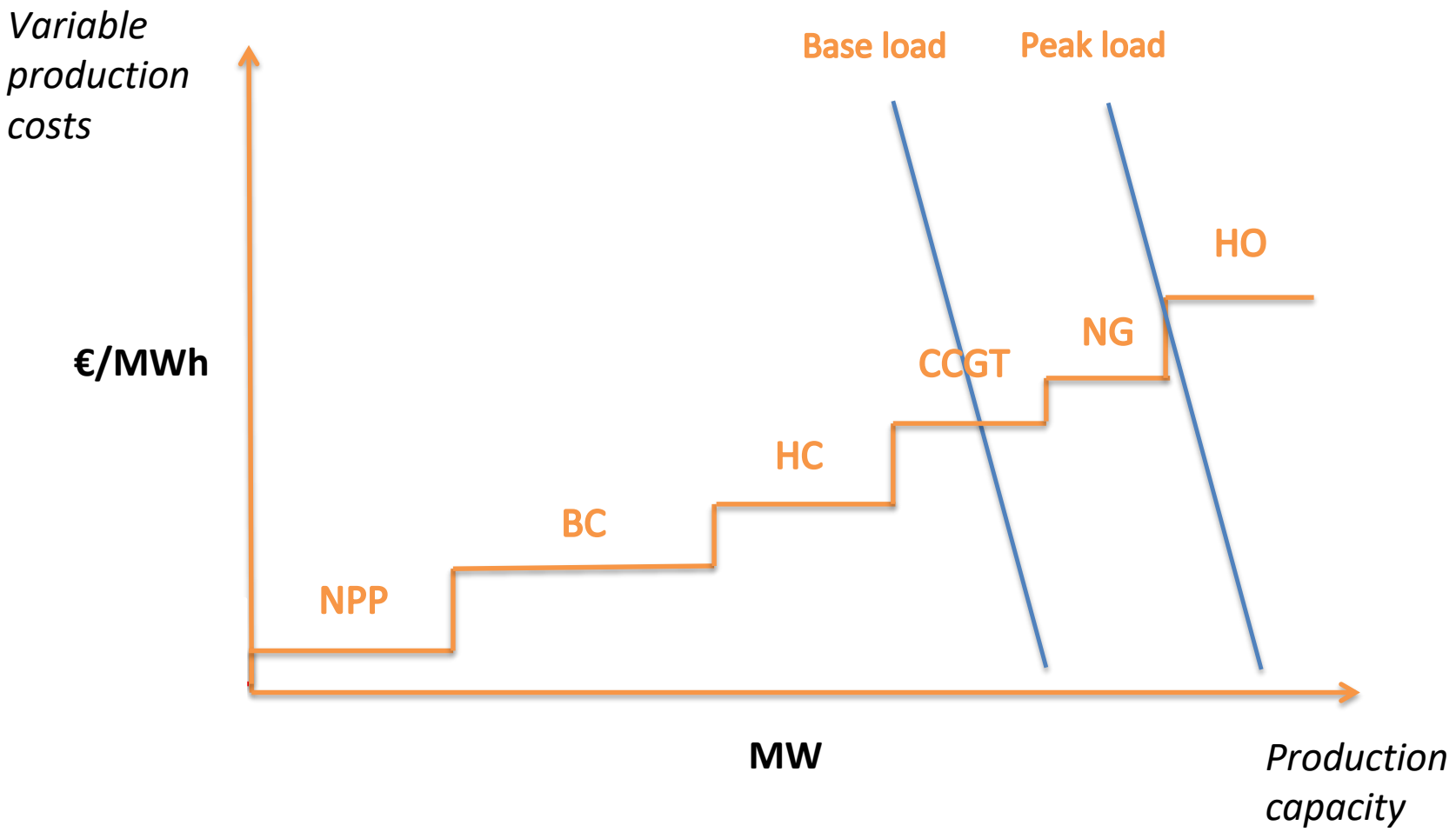
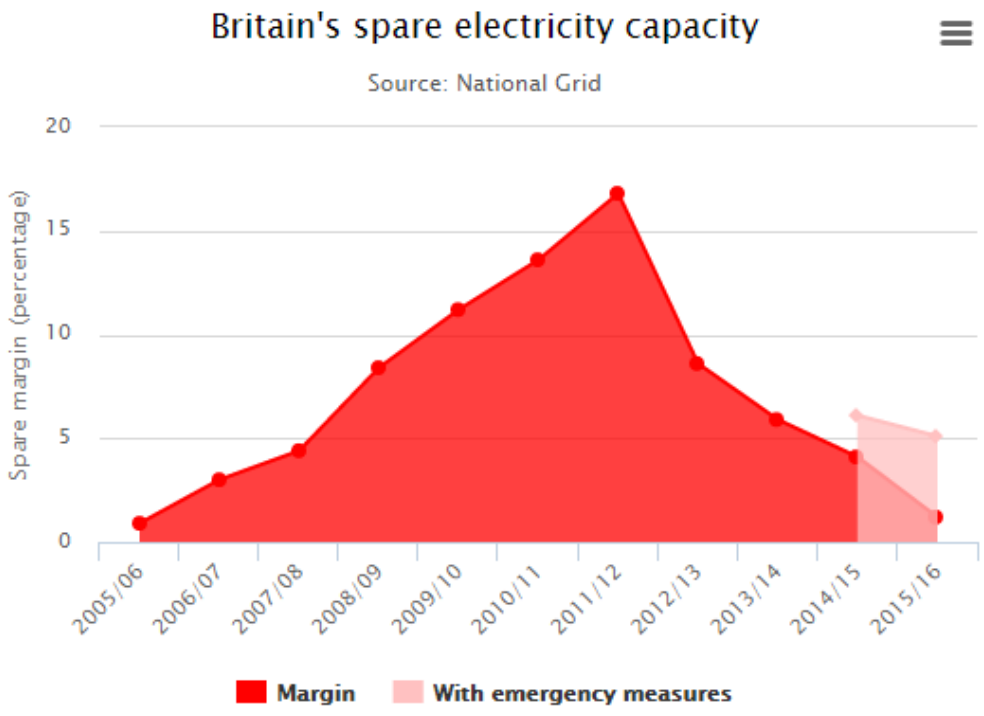

Flows on the Russia-Finland interconnector in 2012 (week 5)
and Finnish spot prices
300
250
200
150
100
50
0
€/MWh
10,000
8,000
6,000
4,000
2,000
0
MWh/h
00-01
12-13
Mon
Tue
Wed
Thr
Fri
Sat
Sun
Transmission from Russia to Finland MWh/h
Elsport area price FIN€/MWh
System price €/MWh

Merit order curve, middle Europe

EUR/MWh, 2015




Variable production costs
€/MWh
Base load
Peak load
HO
NG
CCGT
HC
BC
NPP
MW
Production capacity



Contract for difference (UK):

Nuclear power plants: **92,5 GBP/MWh.**

On shore wind: **95 GBP/MWh**.

Hydro (5 - 50 MW): **100 GBP/MWh.**

Photovoltaics: **120 GBP/MWh.**

Biomass sources: **125 GBP/MWh.**

Geothermal: **145 GBP/MWh.**

Off shore wind: **155 GBP/MWh.**

Tidal plants: **305 GBP/MWh.**

New energy market design

The Energy Union strategy is designed to help deliver our 2030 climate and energy targets and make sure that the European Union becomes the world leader in renewable energy. Achieving these goals will require a fundamental transformation of Europe's electricity system including the redesign of the European electricity market.

Today's Communication launches a Public Consultation on what the new electricity market design should look like in order to meet consumers' expectations, deliver real benefits from new technology, facilitate investments, notably in renewables and low carbon generation; and recognize the interdependence of European Member States when it comes to energy security.

This should reap maximum benefits from cross-border competition and allow decentralized electricity generation, including for self-consumption and support the emergence of innovative energy service companies.

IV. Market Design Initiative

Commission Communication: Public consultation on energy market design

Translations

Decentralized energy sector

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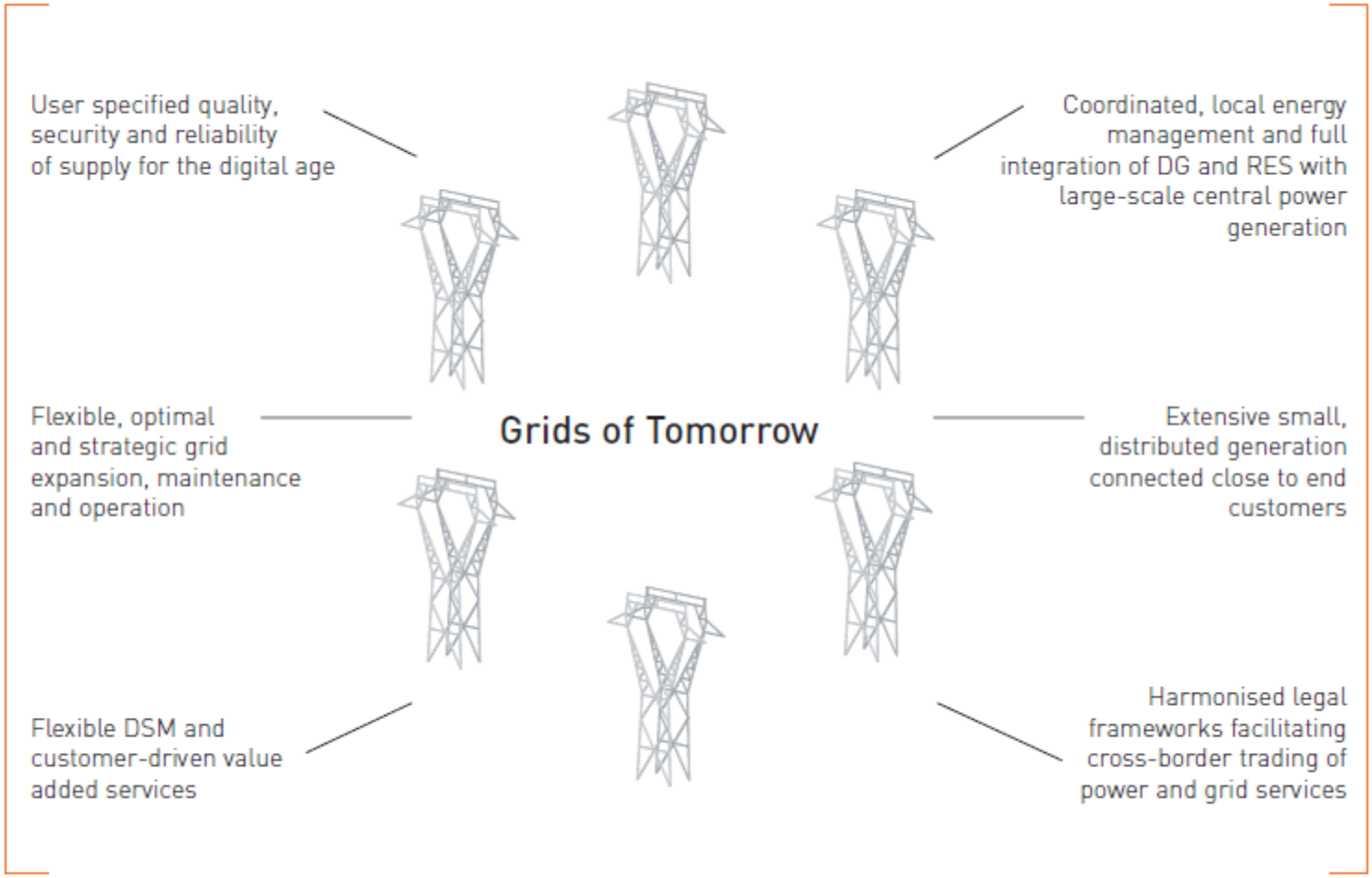
The Traditional Grid

- Limited cross-border interconnections
- Large generating stations
- Centralised control
- Technically optimised for regional power adequacy
- Technology approaching an age of one century
- Differing regulatory and commercial frameworks



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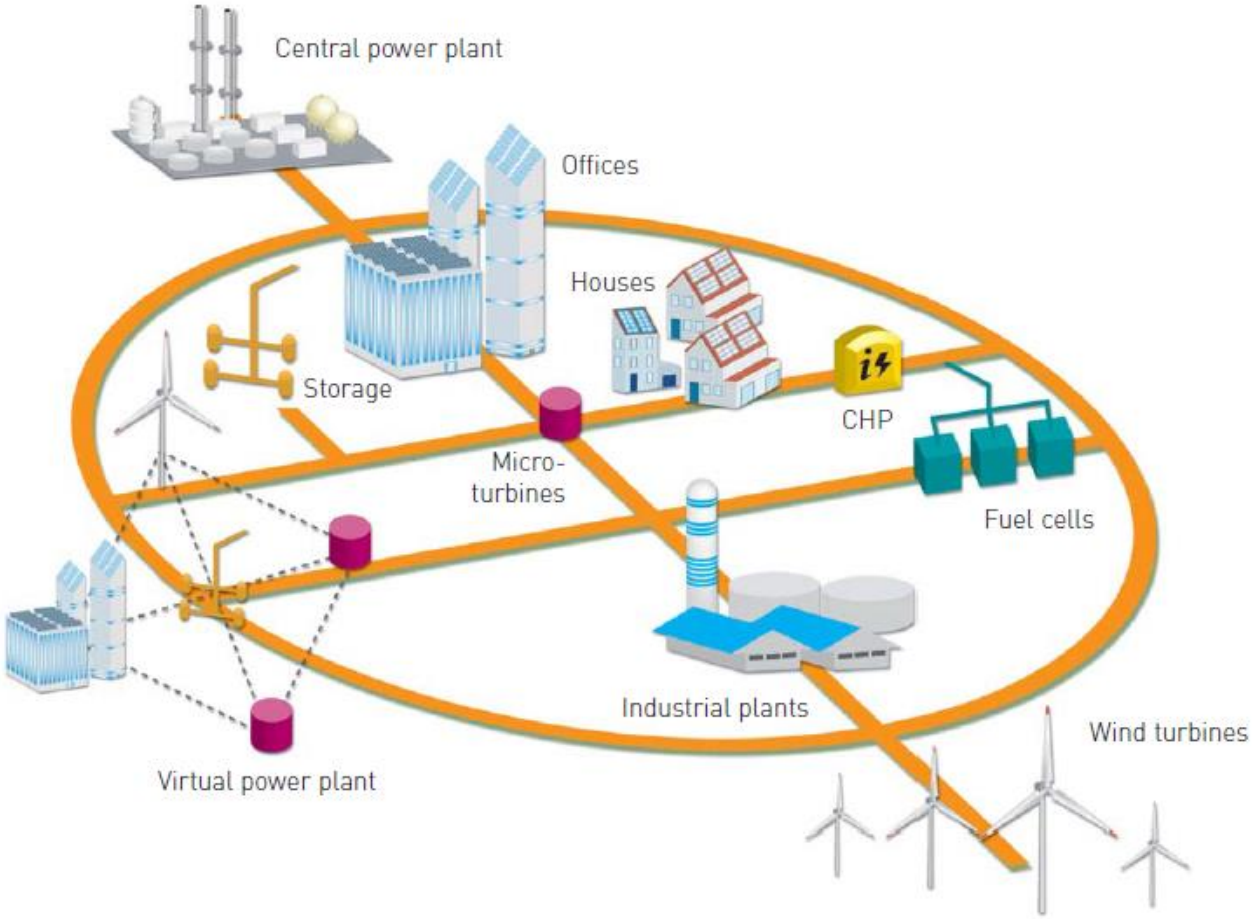

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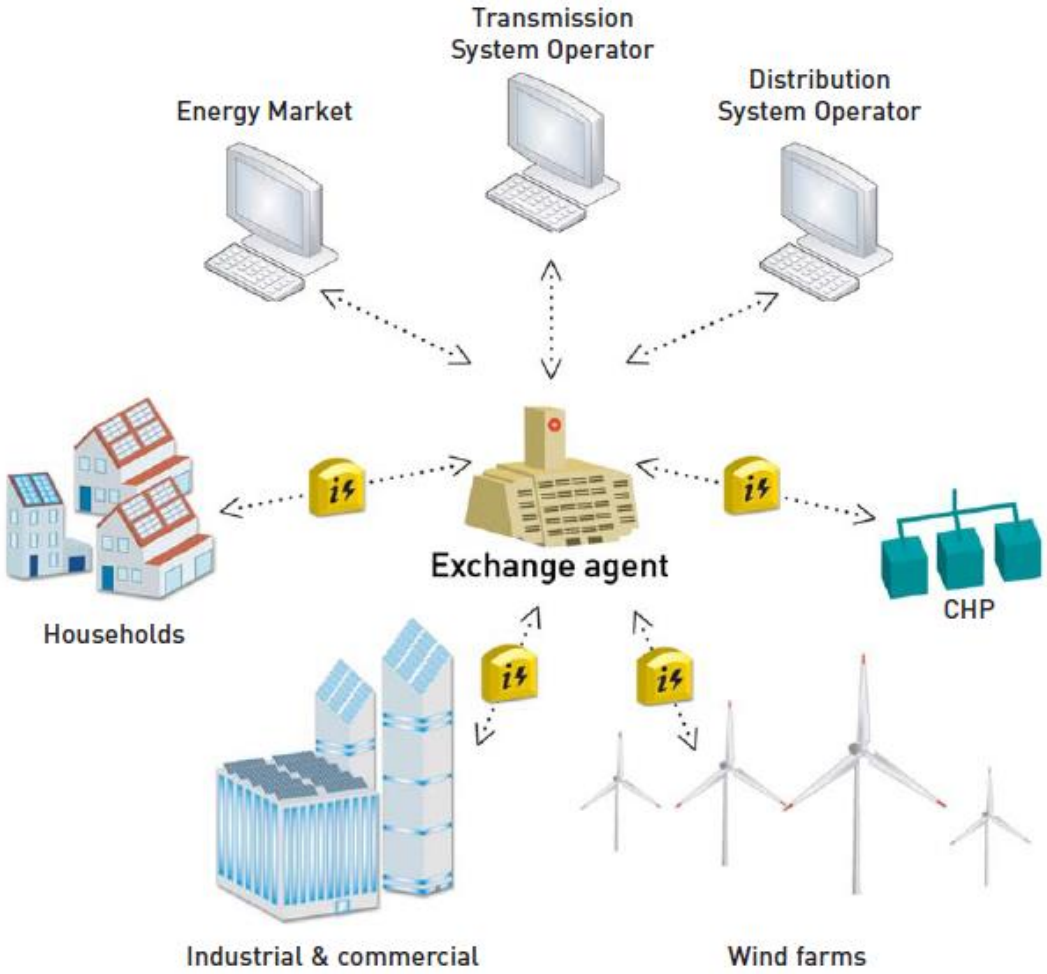
Transmission
System Operator
Energy Market
Distribution
System Operator
Exchange agent
Households
CHP
Industrial & commercial
Wind farms


Value added services
Forecast information
Off-shore wind
Small hydro power
Solar power plant
Hydro power station
Biomass
Low emission power plant
control communication
HVDC link
Transformer
Microgrid
Wave energy
Residential CHP
Solar
Photovoltaic
Underground info and power transmission
H_2 production and filling station
H_2
Demand side management
HP
Micro storage of electricity
Thermal storage
SMES
Fuel cells
Compressed hydrogen storage

Děkuji za pozornost

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