

Electricity generation in the Czech Republic and in the Central European region

Or: without nuclear energy, the Czech Republic will not be decarbonized



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Content

Introduction

Balance of Central Europe

Balance of CR

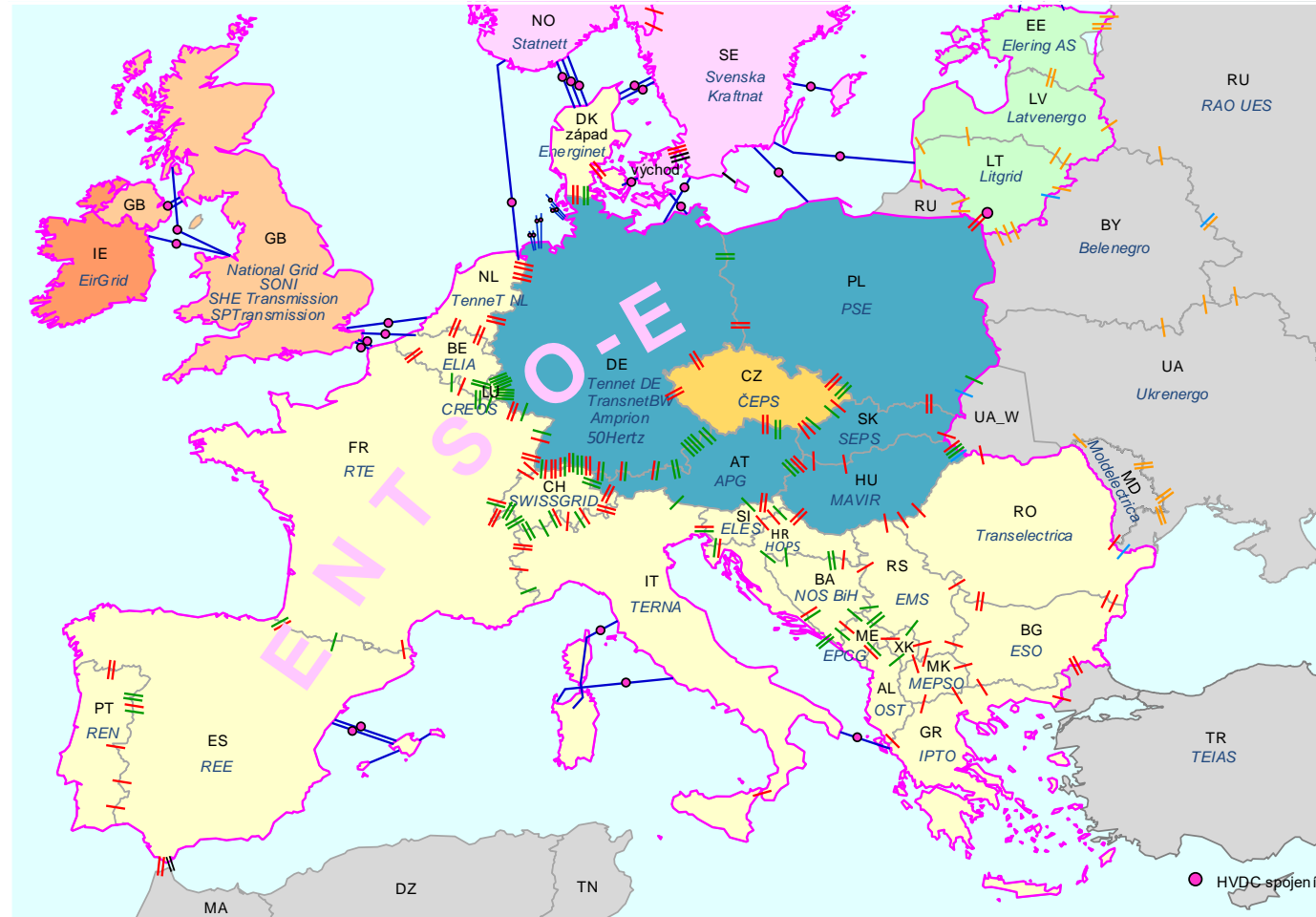
Conclusions

Introduction

CR in the Central Europe region (CER)

- CR electricity demand: **6,8 %**
- Installed electric power of CR: **7,6 %**
- For the Czech power industry, the context of the Central Europe region and also of Europe is decisive

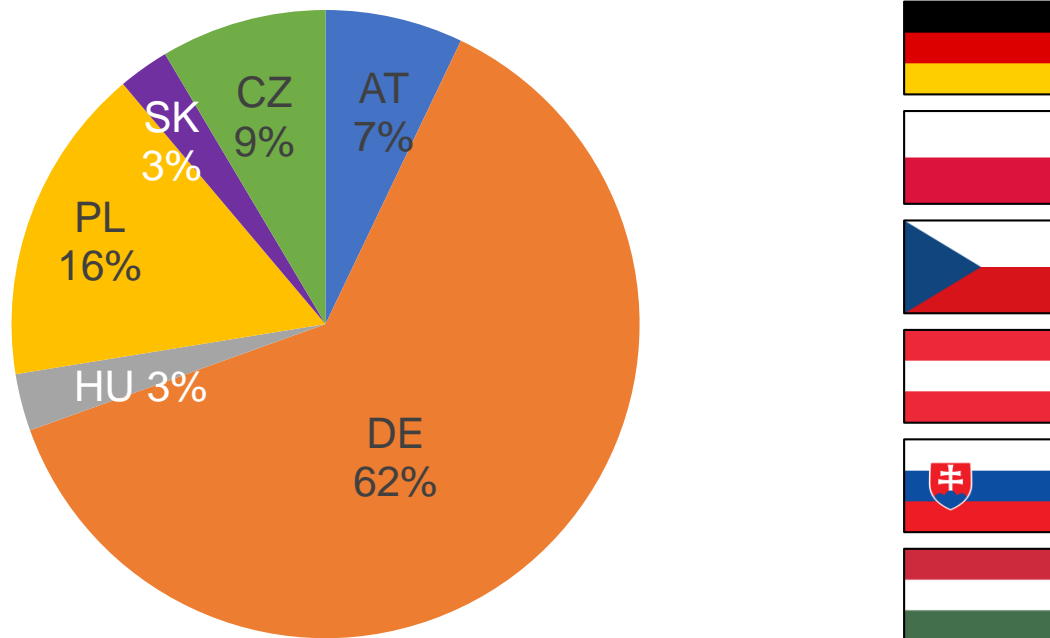
Synchronní zóny
ENTSO-E soustava 43 TSO z 36 zemí (1/2019)
region Kontinentální Evropa region Nordic region Baltic region UK region Ireland
Mezistátní propojení PS
750 kV 400 kV 330 kV 220 kV 110 kV podmořský kabel
ČEPS operátor (TSO)



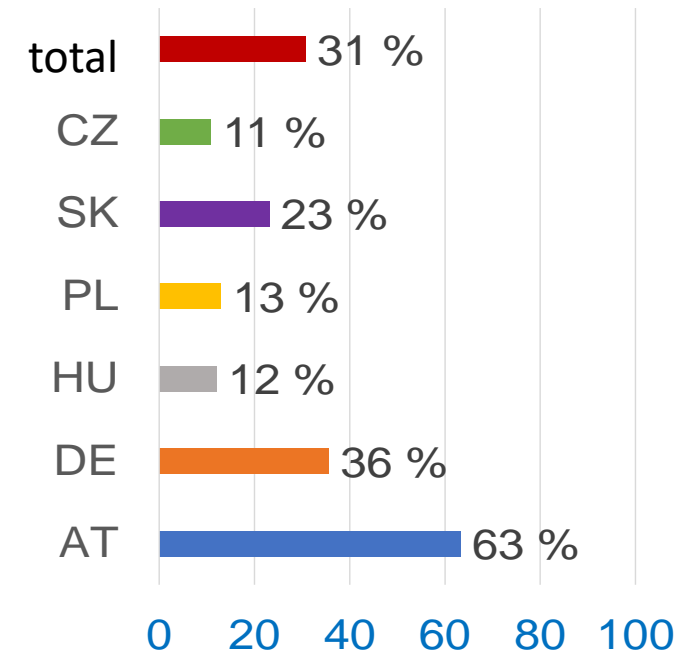
Central Europe Region (CER) in 2018

- Total production: **957 TWh (net)**
- total consumption : 909 TWh (net+losses)
- net P_{inst} : **317 GW**
- net P_{inst} renewables: 150 GW

Share of countries on electricity production



Share of renewables on production



Content

Introduction

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Balance of CR

Conclusions

Electricity demand in the Central Europe region

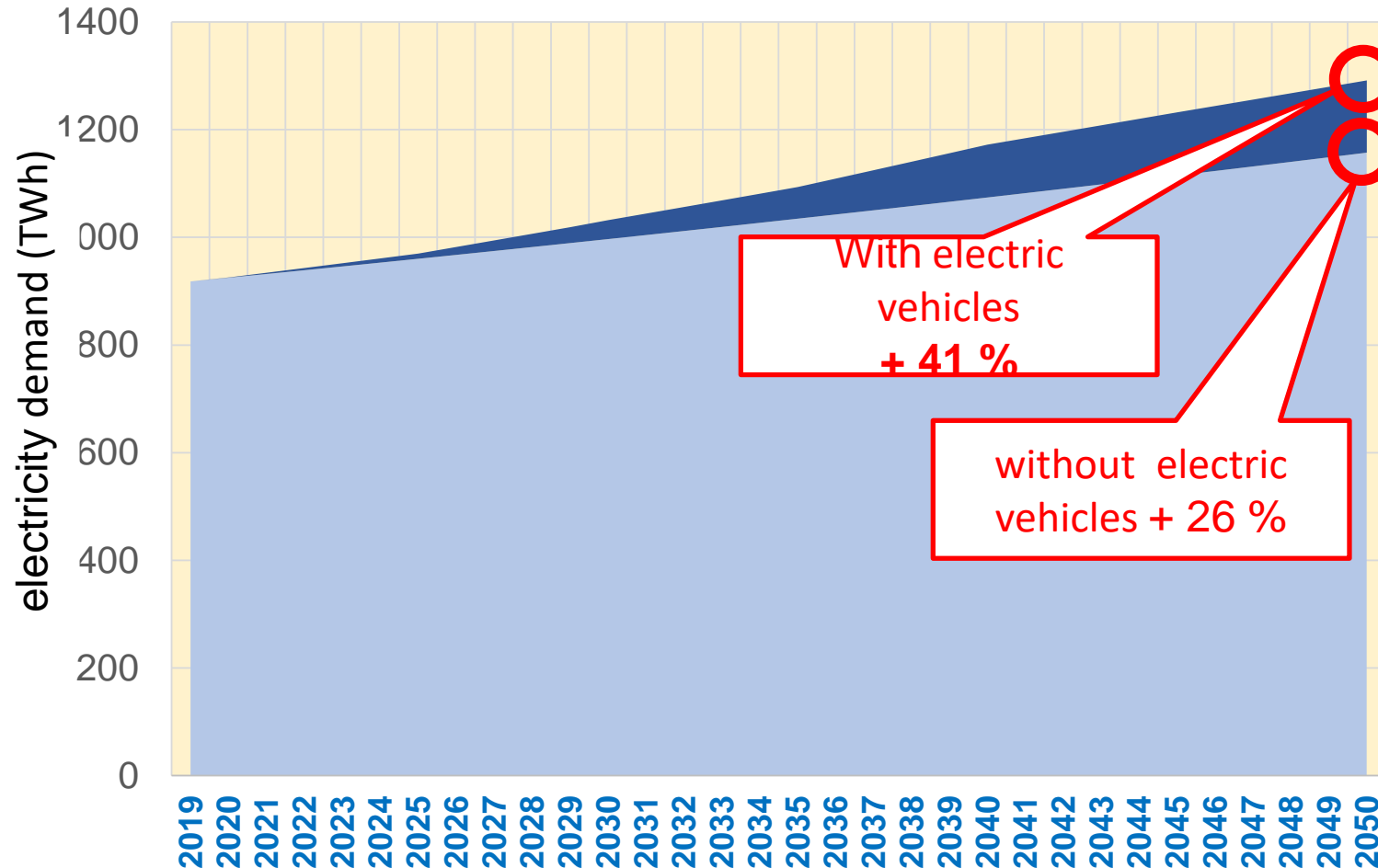
- Facts
- **year-on-year growth** in final electricity consumption from 2010 to 2017:
- **region** **0.84%**
Germany 0,48 %
 1. economic growth leads (in spite of decreasing severity) to an increase in electricity consumption
 - 2. decarbonisation leads to an increase in the share of electricity in final consumption**
 - 3. new consumption sectors are emerging:** electromobility, heat pumps, robotics and automation

Electricity demand in Central Europe

■ outlook:

- **the growth trend** of current demand **will prevail** at level 0.75% year on year
- **electromobility** in the region in 2050 will be on level 135 TWh
- **the risks to the outlook are considerably pro-growth:**
 - only the final energy consumption of fossil fuels in the region is 2,600 TWh
 - replacing a third of this energy with electricity (and half of that third with the support of heat pumps) **a new consumption will be of approximately 550 TWh/yr** (more than half of today's consumption) that almost no one counts on

Development of electricity demand in Central Europe - invariant



predictory

- GDP growth
- electricity growth for heating
- robotization and automation
- air conditioning
- electromobility
- savings
- zero population growth

Electricity demand

- electric vehicles
- consumption without electric vehicles

Offer of electricity supply in the Central European region

facts:

1. up to 2025 will be shut down: **45 to 50 GW of torque power** (depending on decarbonisation rate)
2. up to 2050 will be shut down: **103 to 142 GW of torque power** (according to emission reduction target)
3. EU wants faster and faster decarbonisation (Roadmap 2050 is no longer a chimera)
4. **the only truly low-emission sources of electricity for large-scale production are:** solar, wind and nuclear (biomass and biogas have limited availability and emissivity of about 250 kg/MWh)

Offer of electricity supply in the Central European region

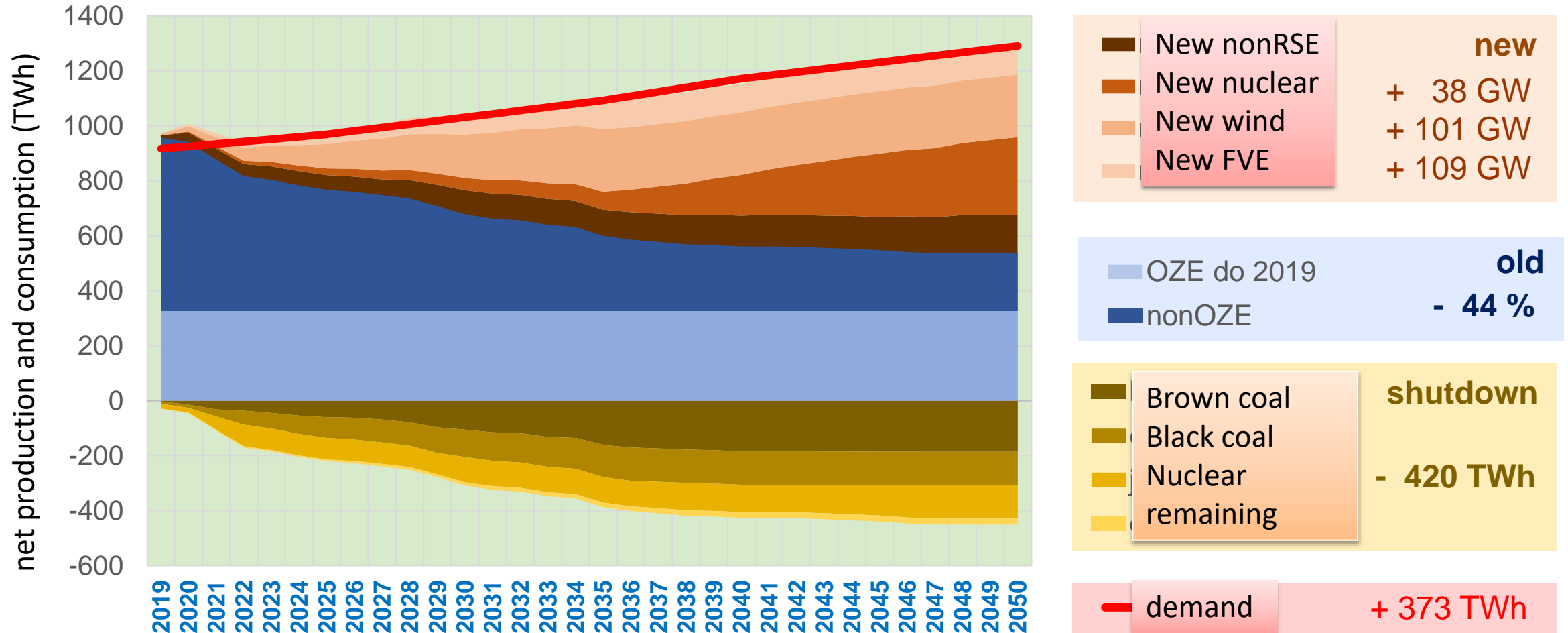
- Outlook:
 - by 2025 will be needed to find 190 to 200 TWh of new electricity production
 - the decarbonisation requirement will be strengthened for at least the next 5 years
 - for the choice of mix the state of **global warming discourse about 2025 will be decisive** (approximately 35 to 40% of the output by 2050 will be shut down)
 - the risks to the outlook are above all :
 - economic recession
 - socially unacceptable growth of the electricity prices

Two of the possible worlds - variants of the development of electricity sources in the Central Europe region

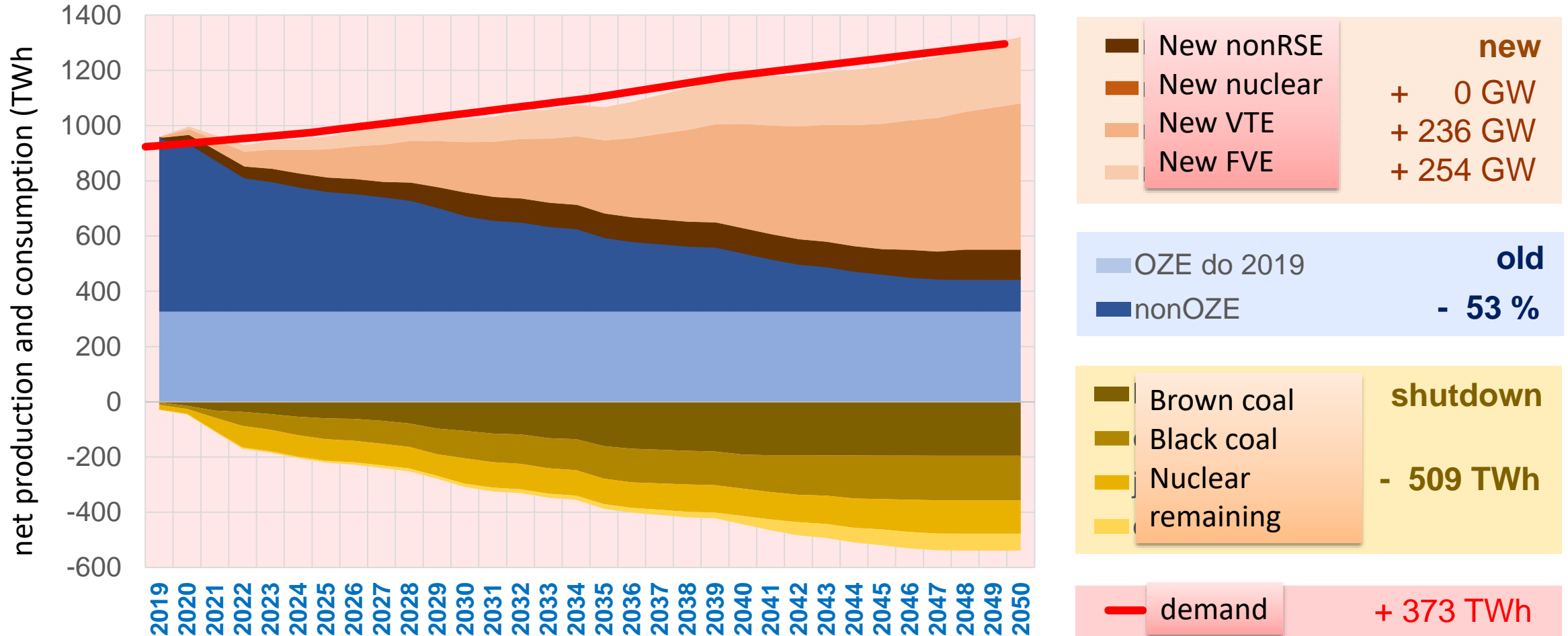
- criterion of differentiation of variants: rate and speed of changes in the energy sector by 2050:

EVOlution	REVOlution
<p data-bbox="282 625 1261 715">SIGNIFICANT DECARBONIZATION TO 15% WITH NUCLEAR</p> <p data-bbox="443 768 1100 853">shutting down the vast majority of coal resources</p> <p data-bbox="504 903 1037 946">total shutdown 103 GW</p> <p data-bbox="410 996 1133 1075">Germany almost coal and nuclear free and with little gas</p> <p data-bbox="425 1118 1116 1160">the rest of the region gas developing</p> <p data-bbox="428 1203 1113 1282">equalization by means of solar, wind and nuclear (SMR after 2040)</p>	<p data-bbox="1437 625 2237 715">DECARBONIZATION RoadMap2050 TO 5 % WITHOUT NUCLEAR</p> <p data-bbox="1600 768 2071 861">shutting down all coal and most gas sources</p> <p data-bbox="1569 903 2102 946">total shutdown 142 GW</p> <p data-bbox="1467 953 2206 989">Germany without coal, gas and nuclear</p> <p data-bbox="1345 1032 2326 1110">the rest of the region without coal, with little gas and almost no nuclear</p> <p data-bbox="1457 1153 2214 1196">equalization by means of solar and wind</p>

Elektroenergy balance of region – variant **EVOLution** (15 % of emissions in 2005)



Elektroenergy balance of region – variant REVOLUTION (5 % of emissions in 2005)



Two of the possible worlds - consequences

situation for 2050 and the region as a network well connected and operationally cooperating unit:

	EVOLution	REVolution
Solar + wind	326 GW (+ 181 %)	606 GW (+ 423 %)
New nuclear	38 GW	No capacity
Central heating system	Solves also a large part of CHS	CHS solved
accumulation	only daily (lower tens of GW)	daily and seasonal (lower hundreds of GW)
backups (engines, gas - SCGT)	cca 65 GW	cca 125 GW

Content

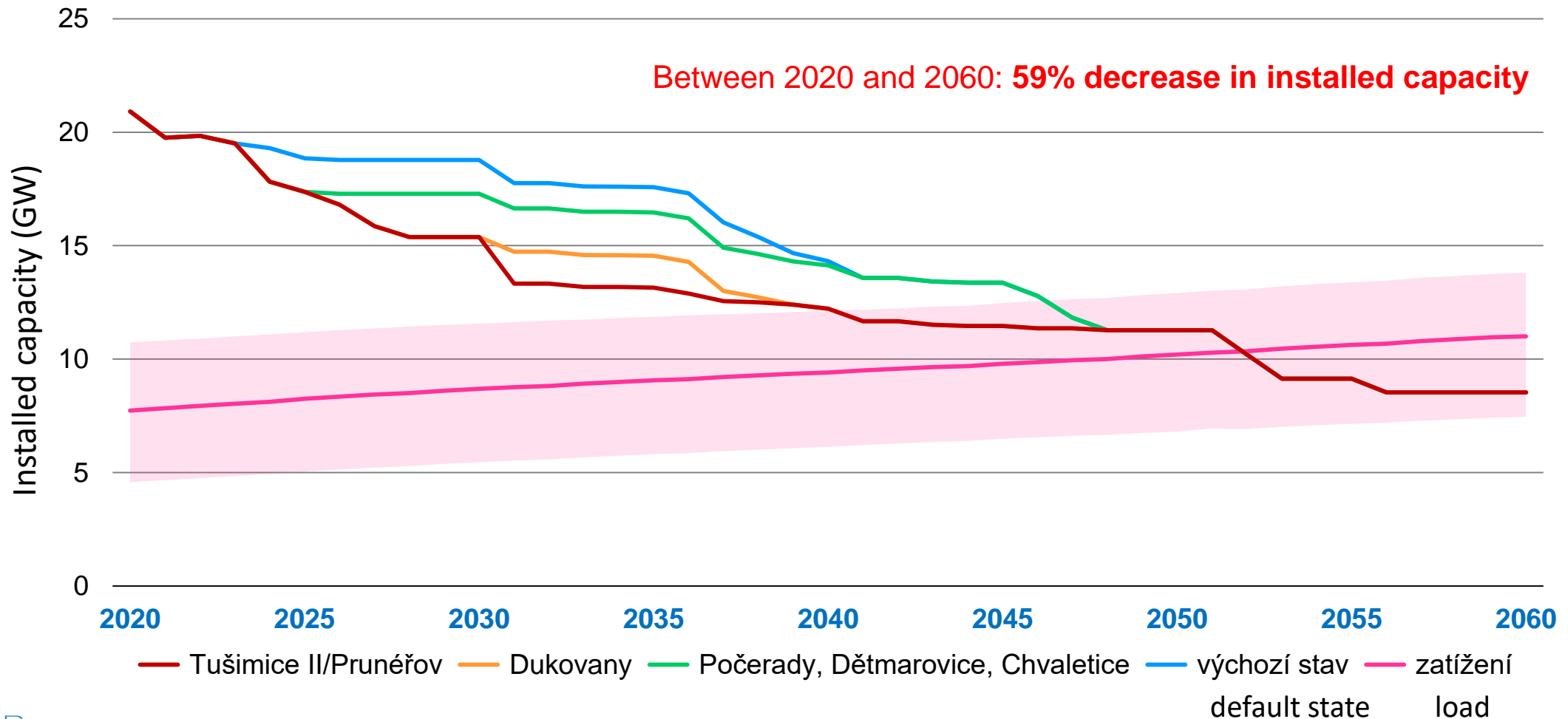
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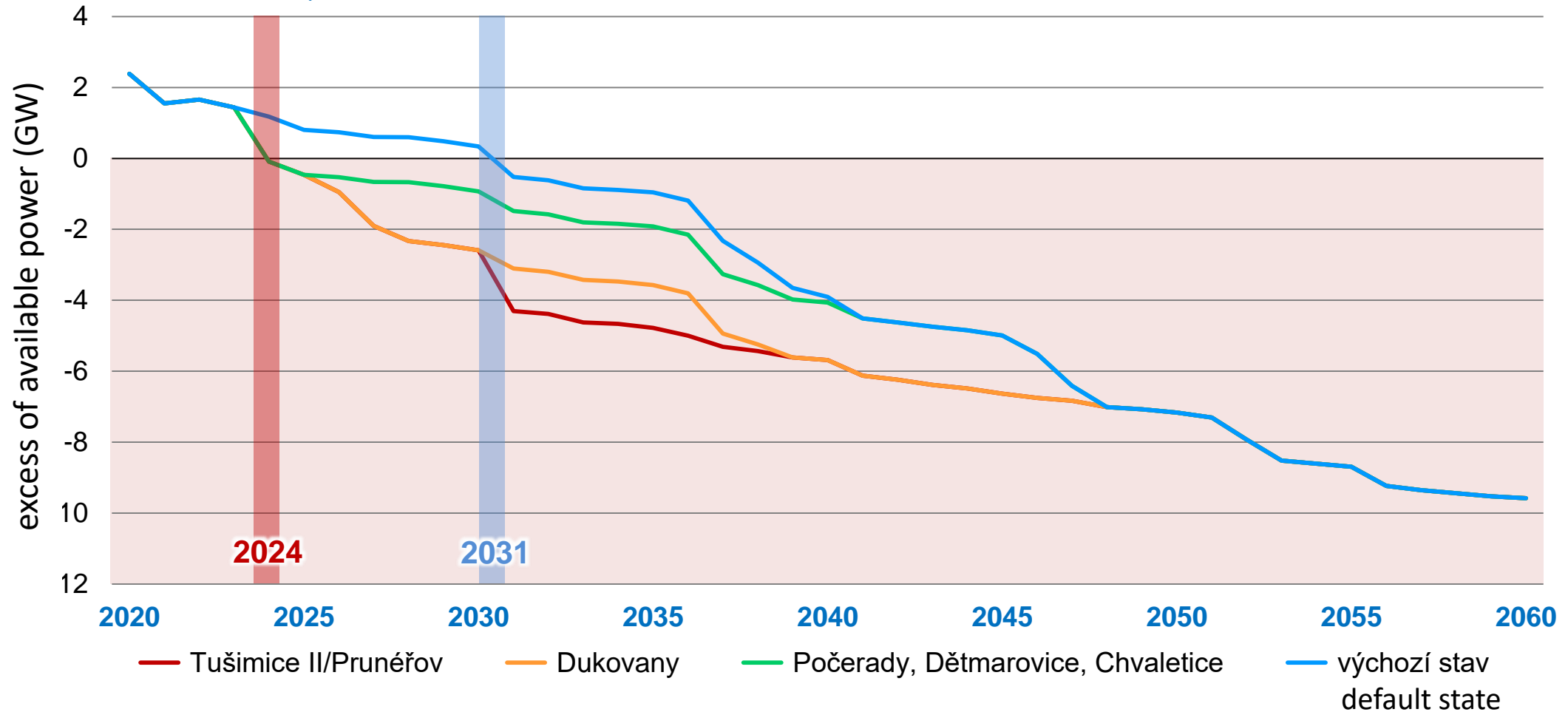
Conclusions

Installed capacity of the Czech Republic - zero variants



Balance of CR

Power balance of the Czech Republic - zero variant (for required reliability LOLE - Loss of Load Event = 6 h)

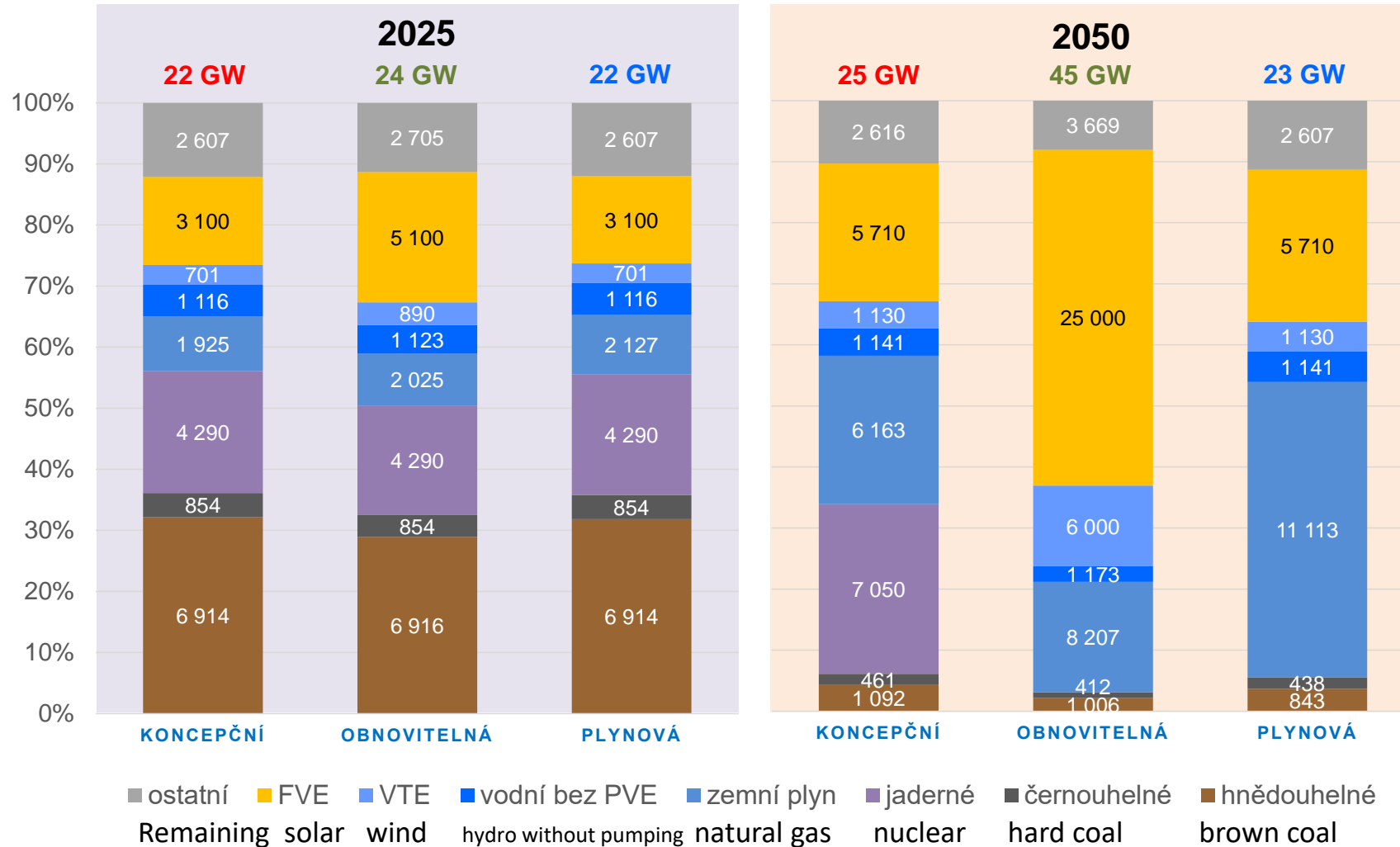


Variants of development – case studies

- problem was solved as *Case Study* for energy sector – **variants 2018**:

main criterion for differentiation of variants: the share of nuclear energy in the energy mix				
	Zero	Conceptual	Renewable	Gas
variant	without power plant development	development according to national energy conception	maximum emphasis on RES	maximum emphasis on gas sources
	reference consumption	reference consumption	higher savings and also new consumption branches	higher savings and also new consumption branches
		7,1 GW nuclear 2050	since 2048 without nuclear	since 2048 without nuclear
	system operation is not possible	balanced mix of sources , high RES	RES instead of nuclear and supplemented with gas	gas instead of nuclear

Installed gross capacity (without accumulation)

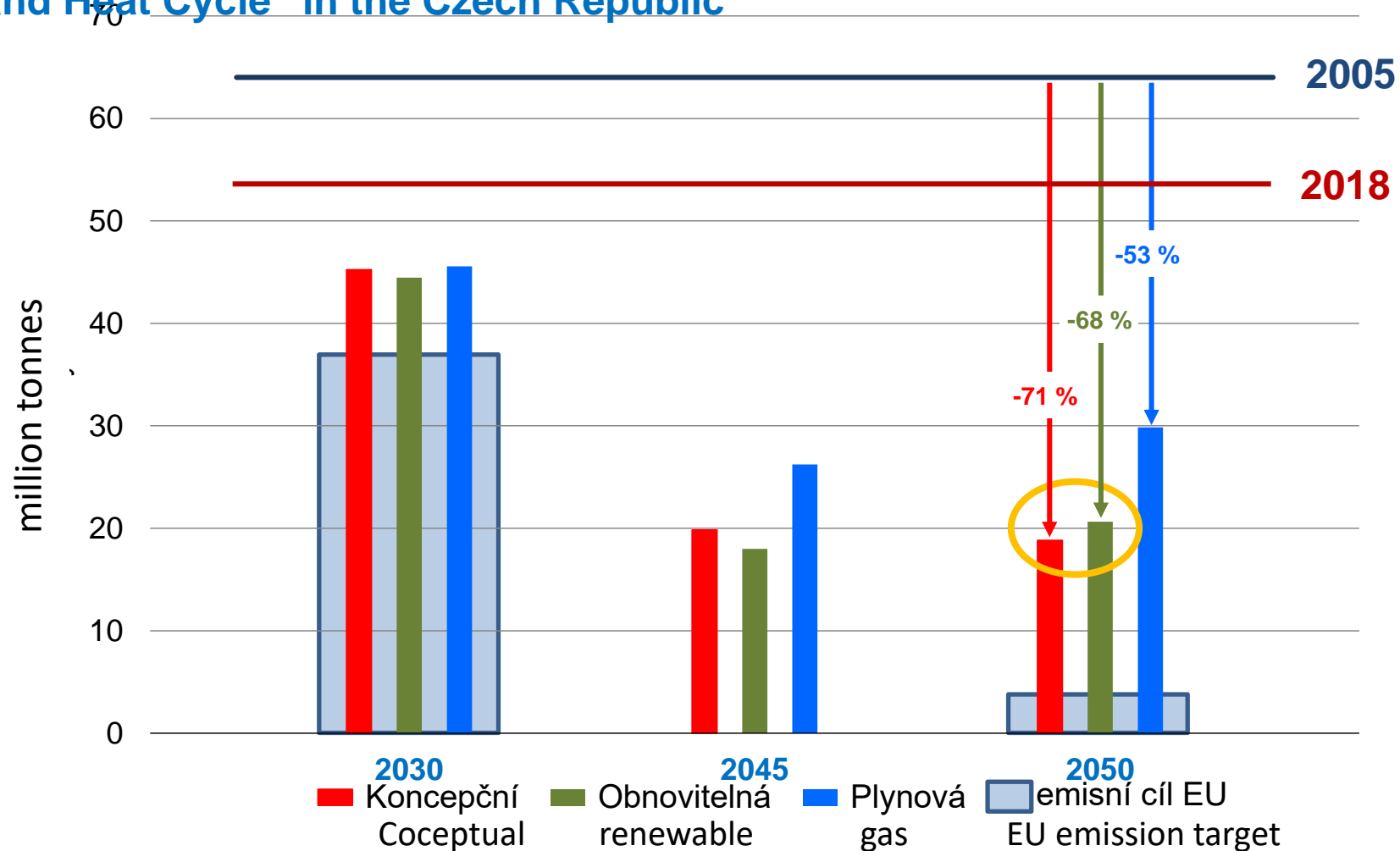


Support measures - tools of flexibility

need for new flexibility means in the electricity system of CR in 2050:

	Conceptual	Renewable	Gas
Daily accumulation (without pumping)	0,7 GW	6,8 GW	0,3 GW
Seasonal accumulation (P2G)	-	2,6 GW	-
New gas engines and SCGT	0,12 GW	1,3 GW	0,16 GW
new demand side management	0,6 TWh	1,4 TWh	0,6 TWh
electric boilers	100 MW	500 MW	100 MW
discarded solar production	do 0,2 TWh	do 1,2 TWh	do 0,2 TWh

CO2 emissions in electricity and electricity and heat production in the „Combined Electricity and Heat Cycle“ in the Czech Republic



What will be the specific production costs around 2050?

- two versions of assumptions how the environment will move (DR = 5%, **constant prices 2016**):

1. Just a trend change

- lifetime of nuclear 60 let
- nuclear price 6500 EUR/kW
- price PV 800 EUR/kW
- price WP 1280 EUR/kW
- battery price 700 EUR/kWh
- price P2G 3500 EUR/kW
- EU ETS price 50 EUR/t

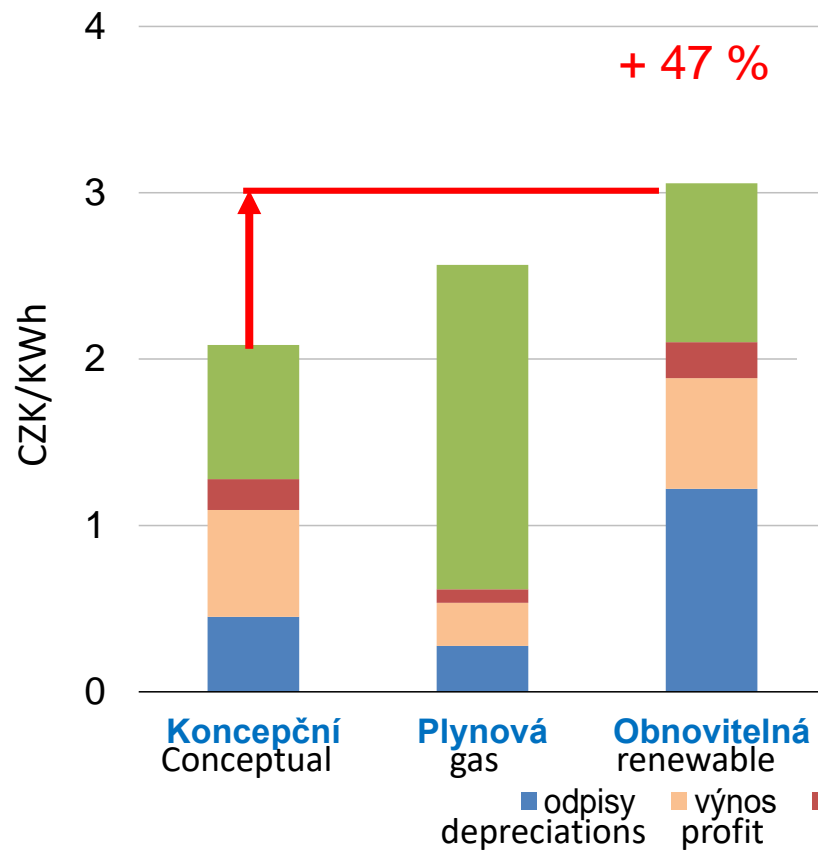
2. Everything favorize renewables

- lifetime of nuclear 50 let (- 17 %)
- nuclear price 7000 EUR/kW (+ 8 %)
- price PV 400 EUR/kW (-50 %)
- price WP 640 EUR/kW (-50 %)
- battery price 525 EUR/kWh (-25 %)
- price P2G 2625 EUR/kW (-25 %)
- EU ETS price 75 EUR/t (+50 %)

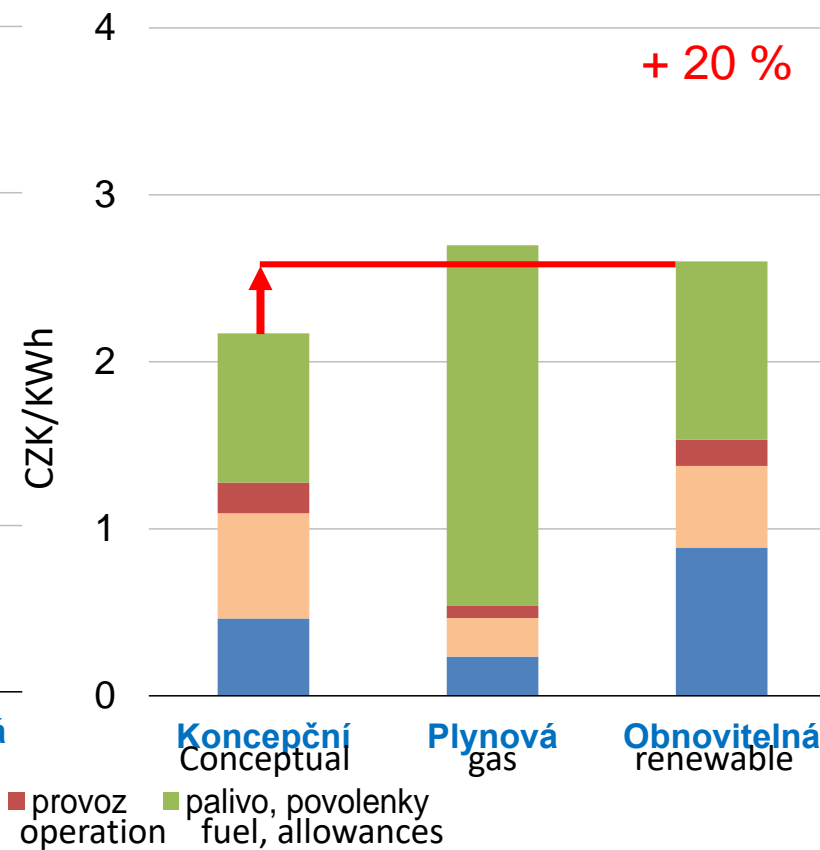
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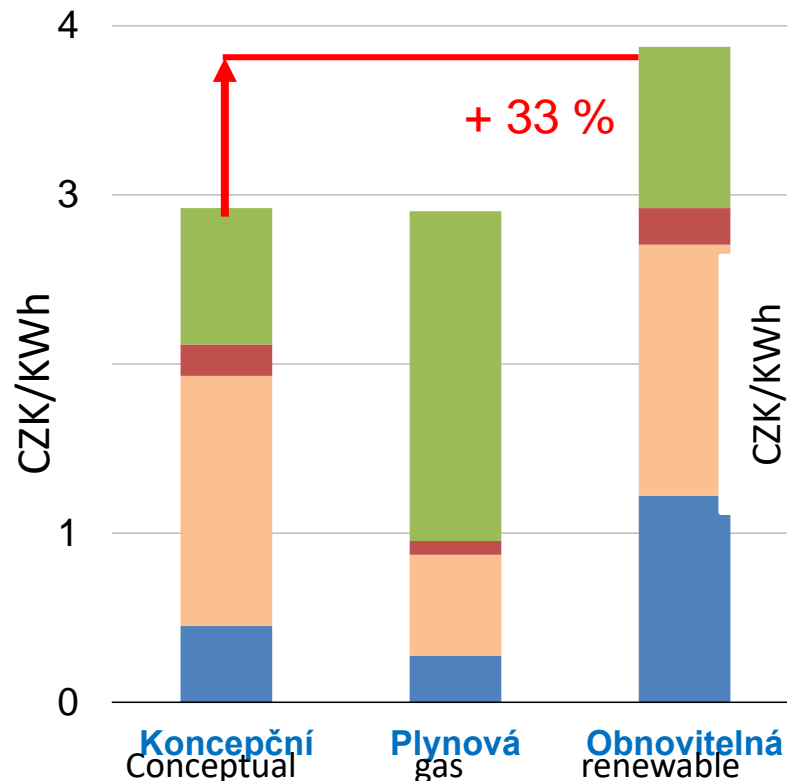
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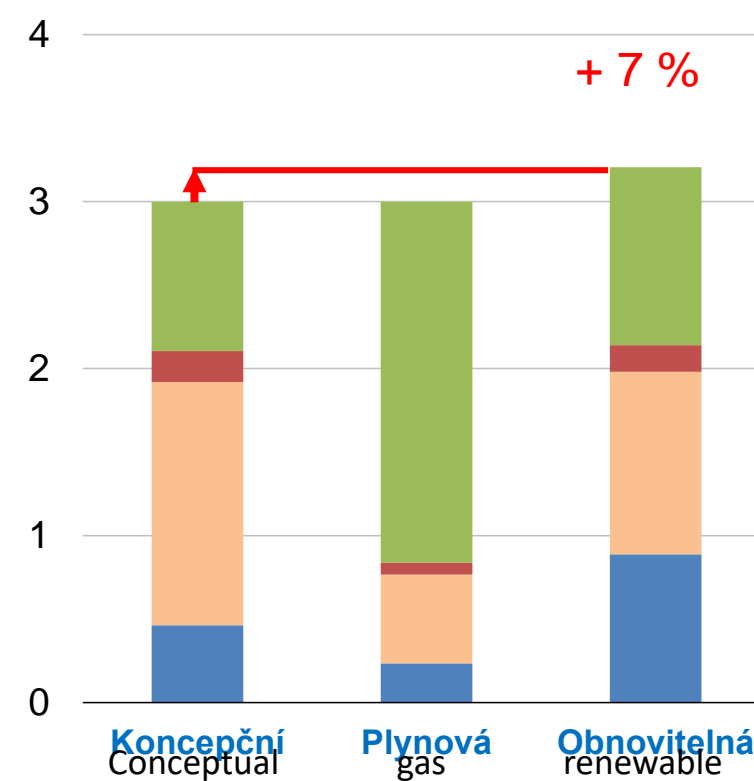
What will be the specific production costs around 2050?

- two versions of assumptions how the environment will move : (DR = 10 %, constant prices 2016)

1. Just a trend change



2. Everything favorize renewables



■ odpisy (depreciations)
 ■ výnos (profit)
 ■ provoz (operation)
 ■ palivo, povolenky (fuel, allowances)

Content

Introduction

Revolution versus evolution

Demand and offer of
electricity

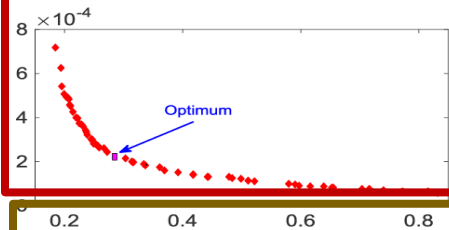
Conclusions

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Energy change is primarily a social and political process

- decarbonisation is the mainstream in the EU
- whether it will be the revolution or evolution will not be decided by the energy experts

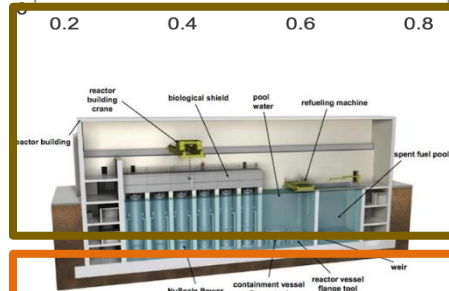


„Pareto Principle“ for reducing emissions of electricity

- Reducing CO2 emissions to 20 to 15% is reasonably feasible
- the last 10% practically cannot be decarbonised

Nuclear energy is a necessity of socially viable decarbonisation

- above all, ensuring a reliable baseload
- Renaissance from about 2030



Time of significant investment and an increase in electricity prices is coming

- only 40-60% to resources - the rest to supporting measures
- new CAPEXs - backups and accumulations (so far the resources made themselves)



CR Electricity System

- it is evident from the simulations of operation of ES, that a full substitution of nuclear power in the Czech Republic is even possible under the certain conditions, and maybe technically feasible...

... But:

1. A complete replacement of nuclear power would cause very significant problems in the Czech Republic (a very significant increase in costs, an increase in problems in ensuring reliable operation, and a significant increase in import energy dependence).
2. Even putting into operation an extreme amount of renewable electricity sources at the level of technical potential cannot ensure decarbonisation of the Czech energy sector. New nuclear units are needed to decarbonise the Czech energy sector.
3. Not including the necessary support measures in comparing the cost of the different options for the development of the electricity sector is the greatest threat to finding a political consensus for choosing the optimal direction for energy development.

CR Electricity System

4. Even the **unprecedented and totally unreasonable amount of RES in the Czech Republic** ($P_{inst} = 34$ GW, gross output = 58 TWh) cannot cover the power cut of all nuclear and coal sources... it is always necessary to add gas.
5. Gas consumption for electricity and CHP production in 2050 (today approximately 11 TWh):
 - variant **Renewable:** 67 TWh
 - variant **Gas:** 136 TWh
6. If we include at least the cost of providing flexibility to enable RES to be included in the power electricity costs, the **Renewable** option cannot be cheaper than the **Conceptual** option.
- 7 The paradox of the enforcement of RES is, by the way that there very likely will produce (as now in Germany) higher emissions compared to the development according to the State Energy Policy.

S energií počítáme!

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The presentation used the results of the project Expected Long-Term Balance between Supply and Demand of Electricity and Gas (project of company OTE, a.s. of 2018).