What is shaping the energy policy

Winter/Summer Energy School

7nd of February 2019

Czech Technical University in Prague

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Energy Policy (EU level)

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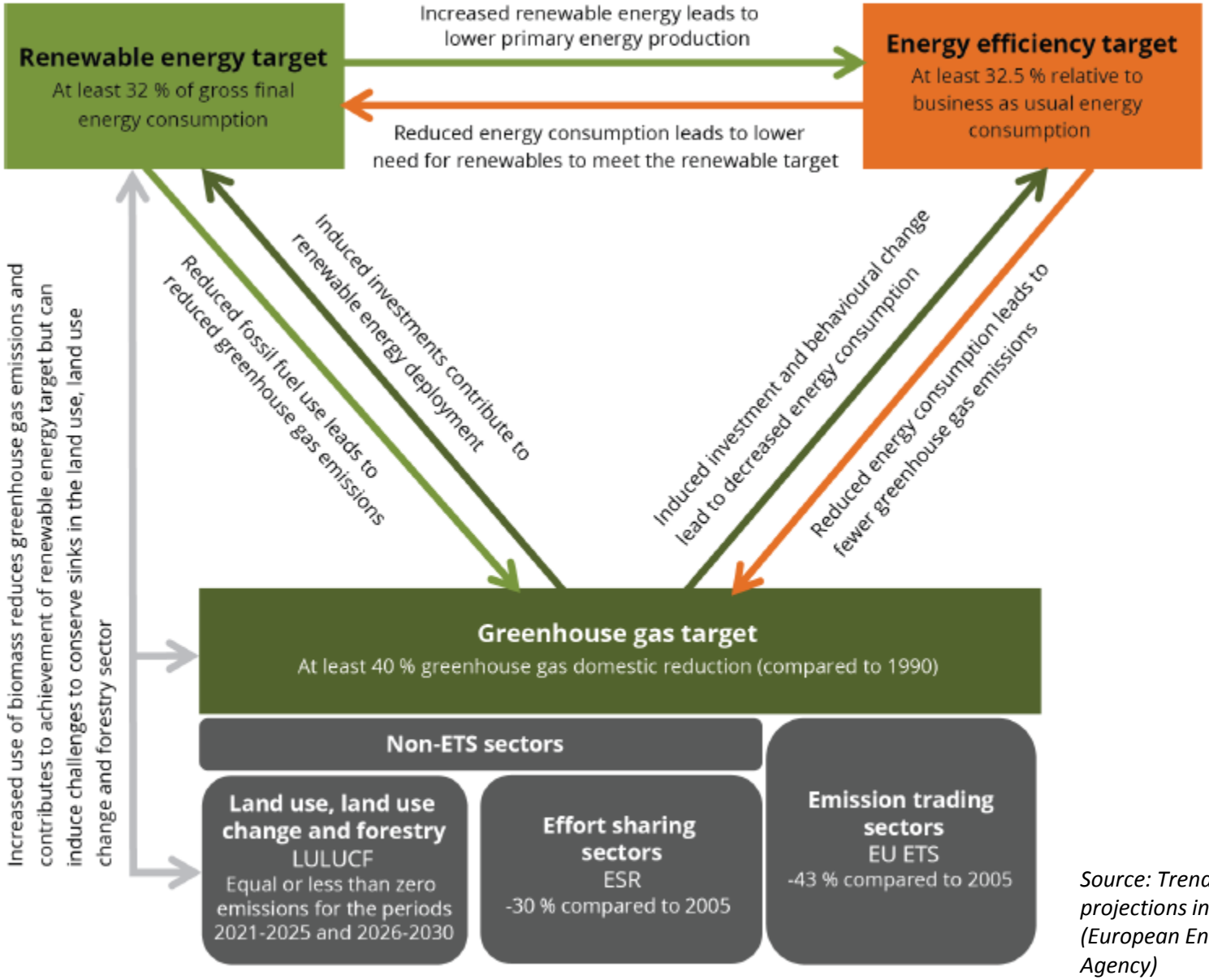
Energy Policy (EU level)

- **Energy and Climate goals for 2020**: 20/20/20
- **Energy and Climate goals for 2030**: 40/27/27 (European Council 2014)
- **Energy union (2015):** i) GHG, ii) EE; iii) IEM; iv) SoS; v) R&D.
- **COP21:** nationally determined contributions; well below 2 degrees
- **Clean Energy for all Europeans** (November 2016) – governance (NECP); RES; EE; market design etc. => new targets for 2030 (40/32/32,5).

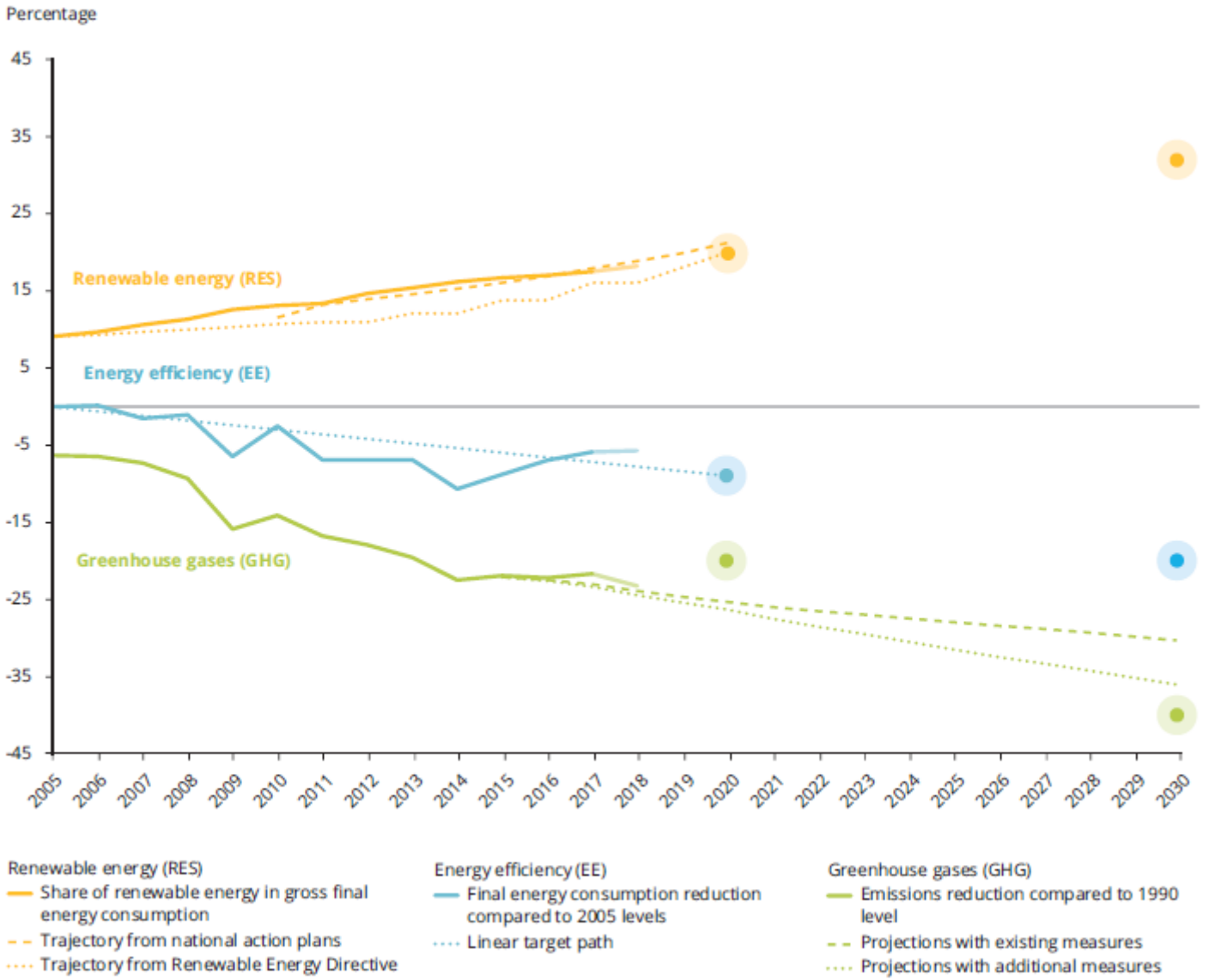
Energy Policy (EU level)

- **National Climate and Energy Plans** => change of paradigm compare to 2020 targets (European x national).
- **Long term low emission strategy**: EU (Clear Planet for All) => national LTS.
- **„Net zero carbon by 2050“ pledge** (European Council).
- **European Green Deal** => increase of ambition of 40% => 50-55%.
- **Preparation of „zero carbon“ legislation**.



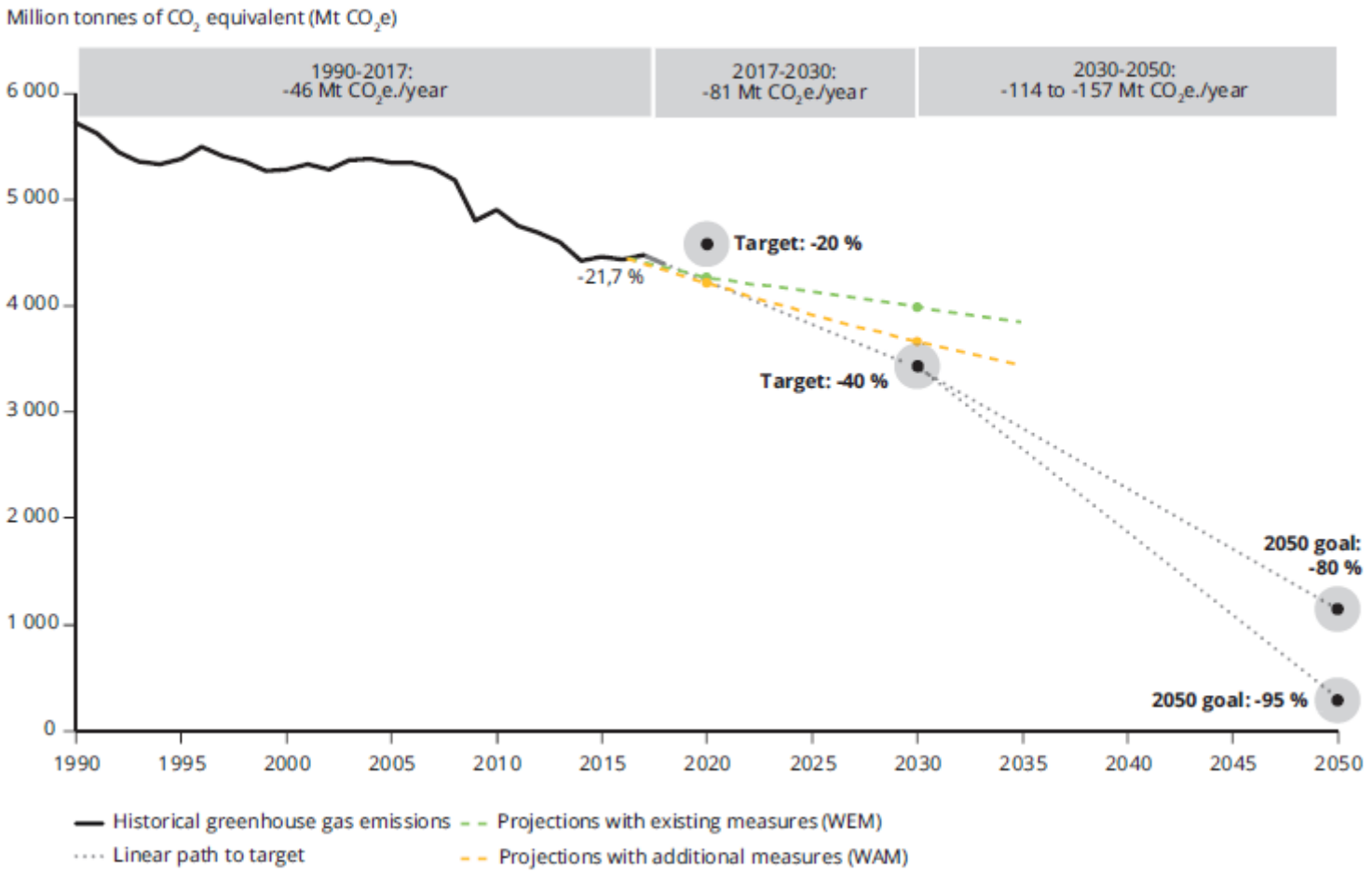
Source: Trends and projections in Europe 2019 (European Environmental Agency)

EU progress towards 2020 and 2030 targets on climate and energy



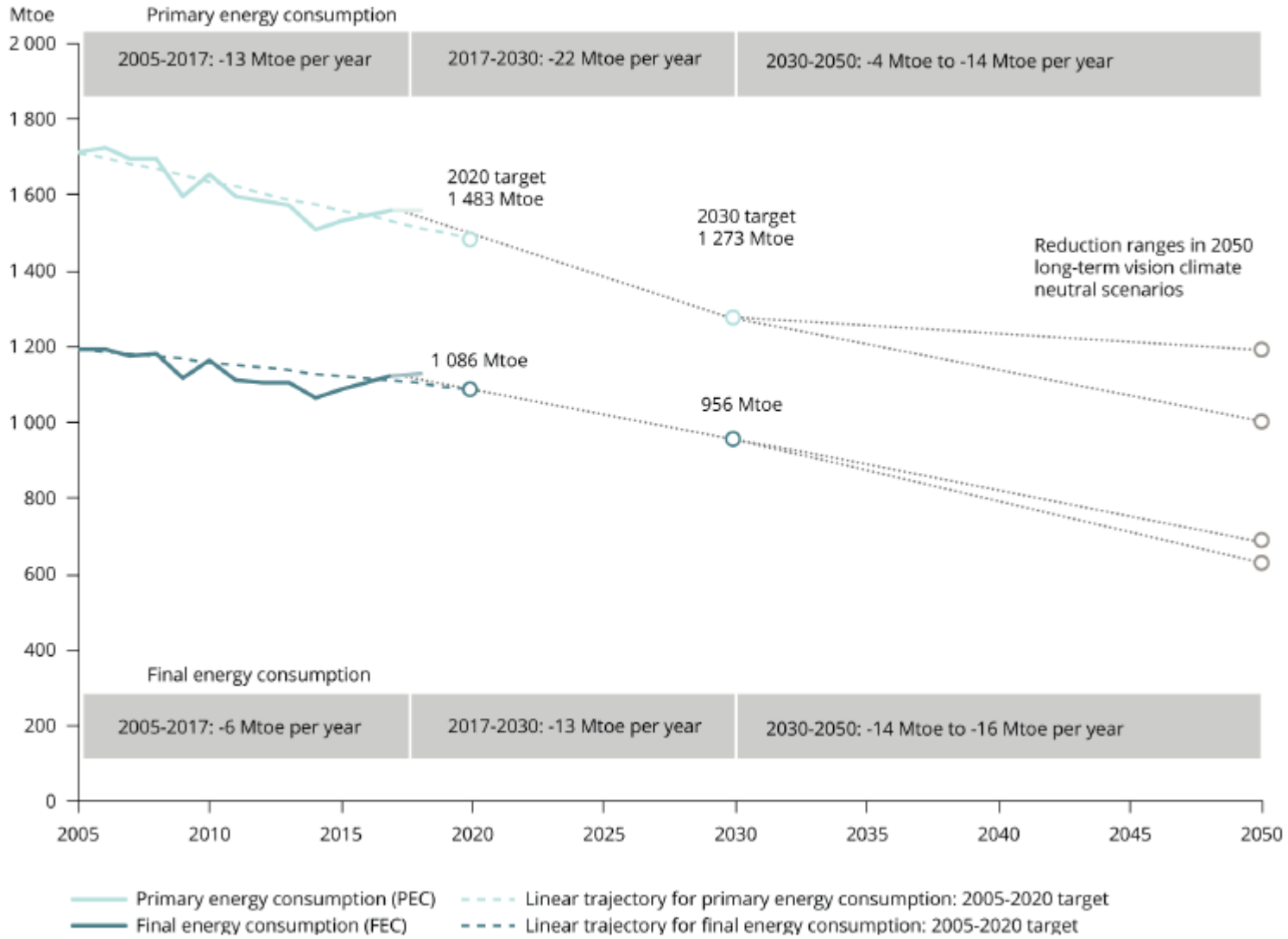
Source: Trends and projections in Europe 2019 (European Environmental Agency)

Greenhouse gas emission trends, projections and targets in the EU



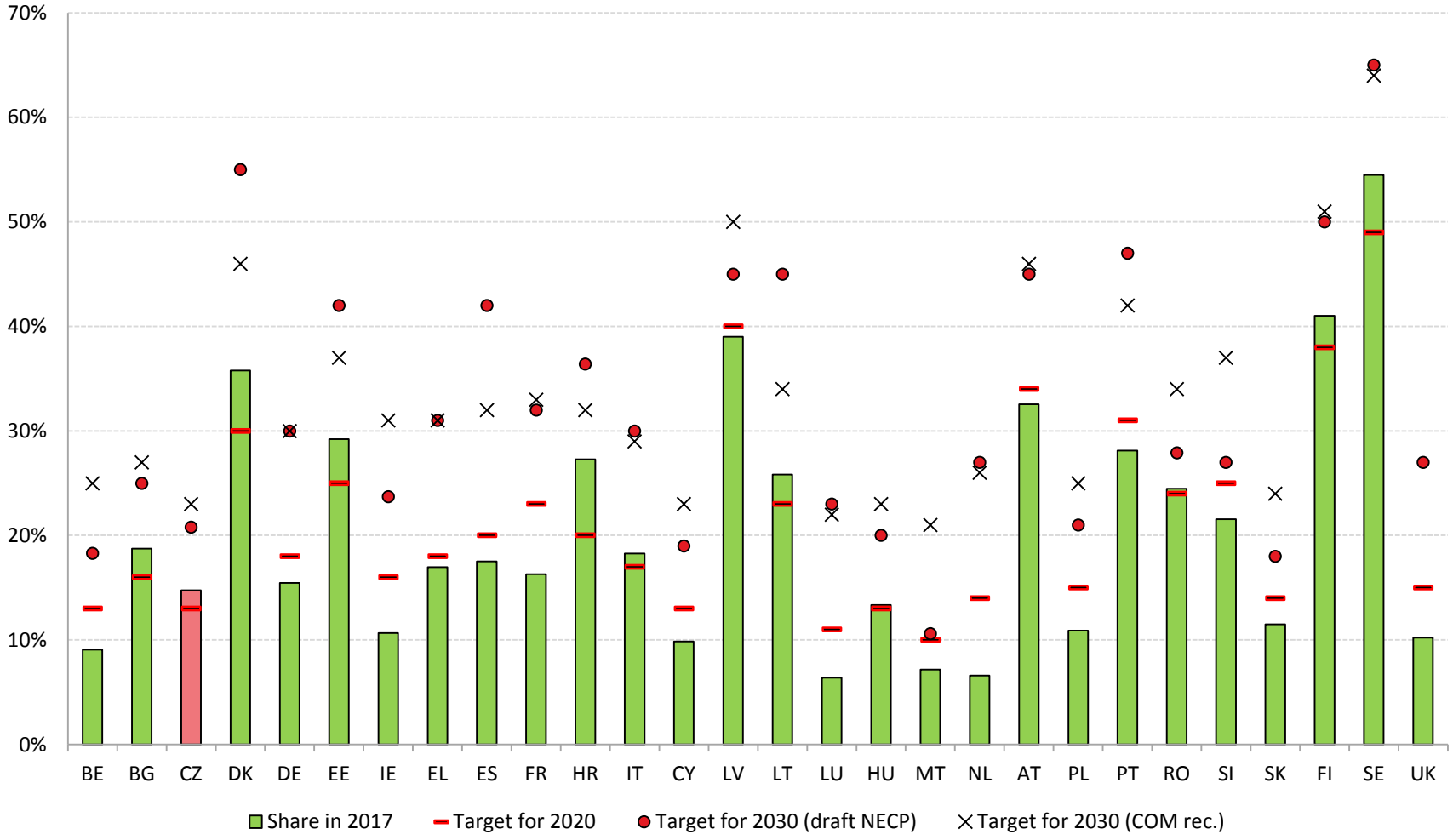
Source: Trends and projections in Europe 2019 (European Environmental Agency)

Primary and final energy consumption in the EU, 2005-2017, 2020 and 2030 targets and 2050 scenario ranges for reaching carbon neutrality under the long-term vision

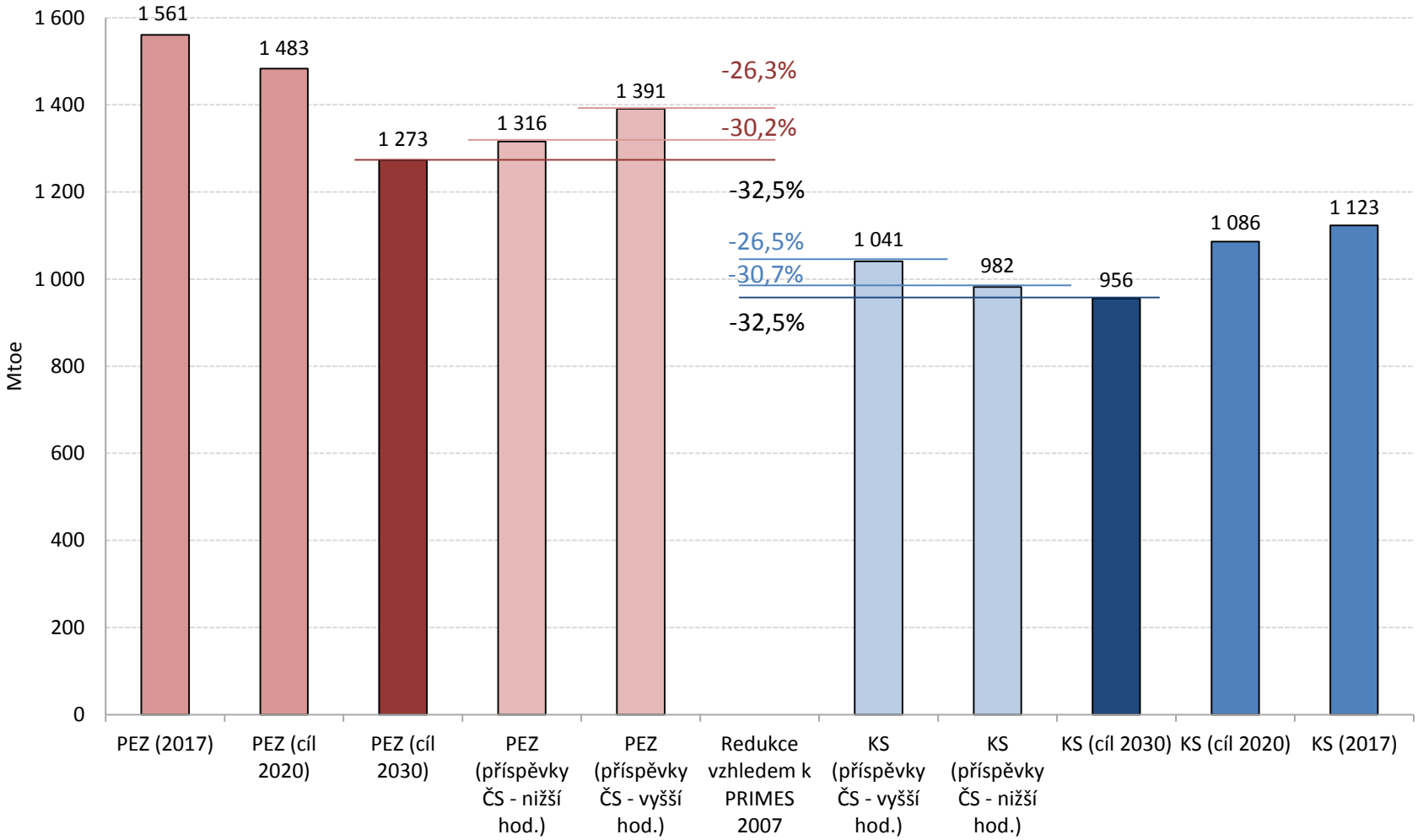


Source: Trends and projections in Europe 2019 (European Environmental Agency)

Comparisons of current shares and targets (renewable energy sources)



Comparisons of current shares and targets (energy efficiency)



Energy Policy (national level)

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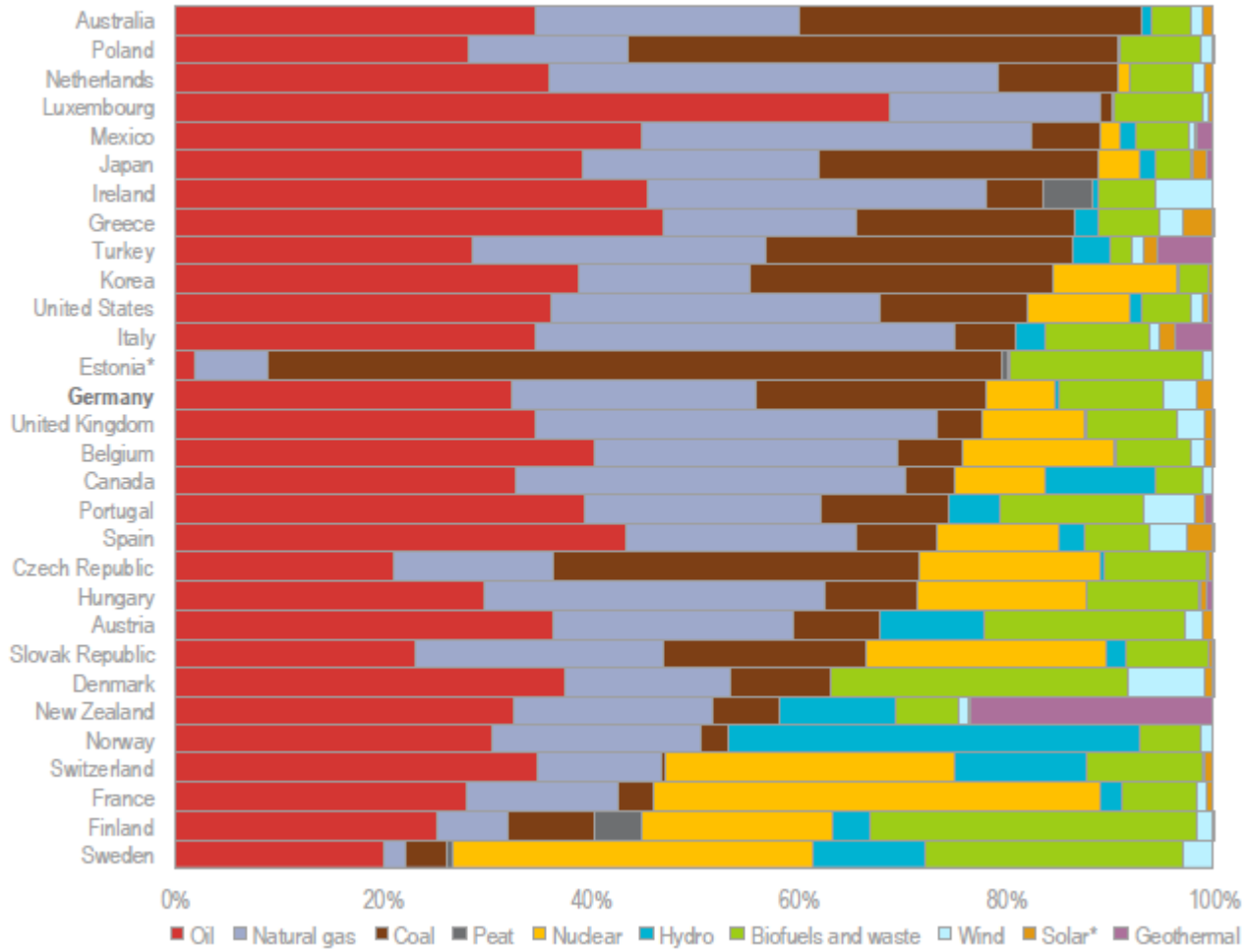
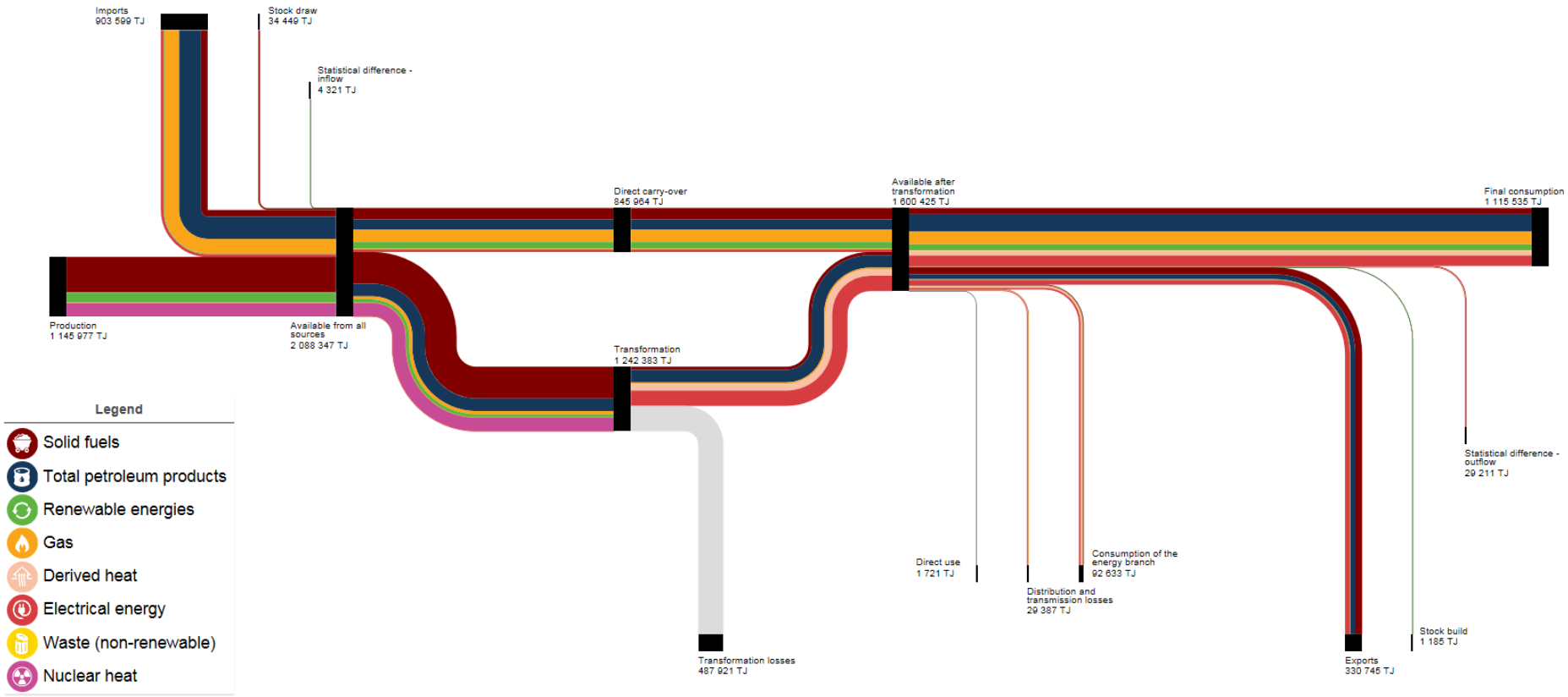
Breakdown of TPES in IEA member countries, 2018

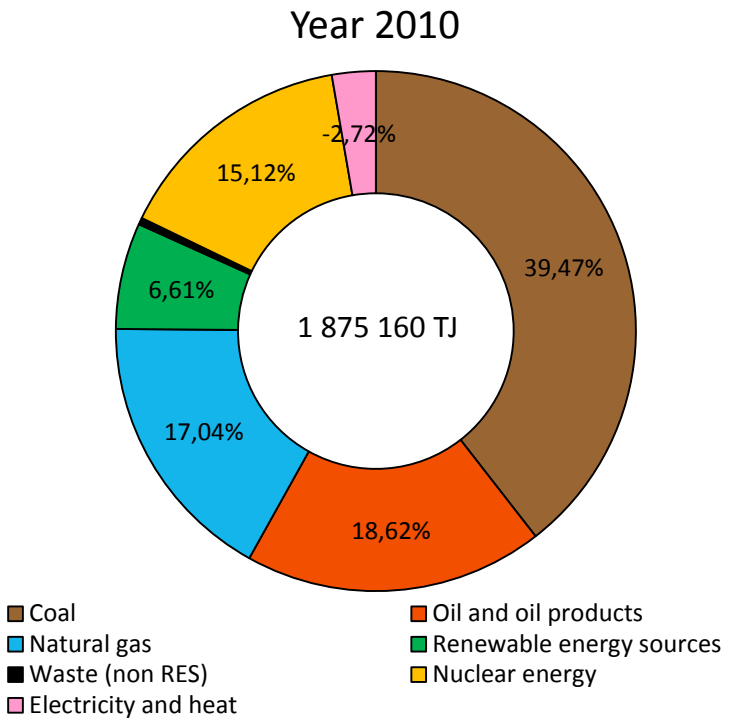


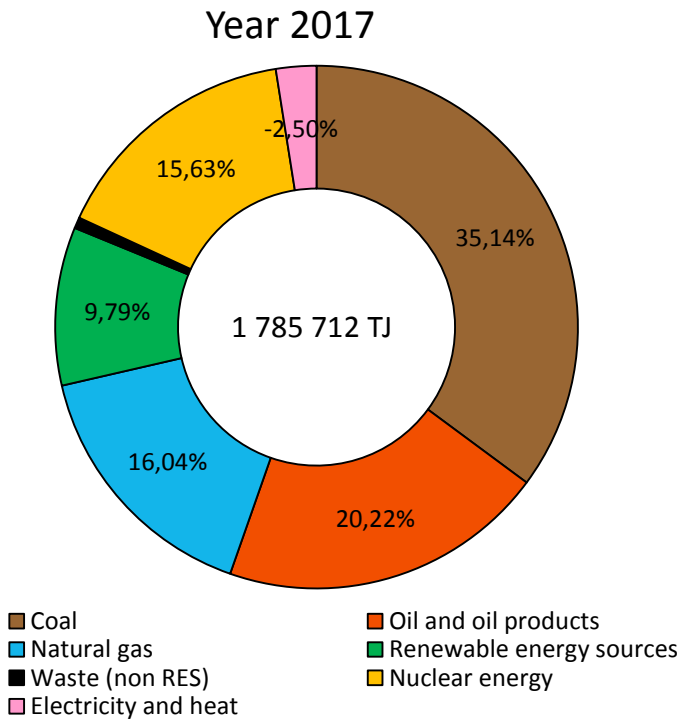
Sankey chart (flow chart) of CZ



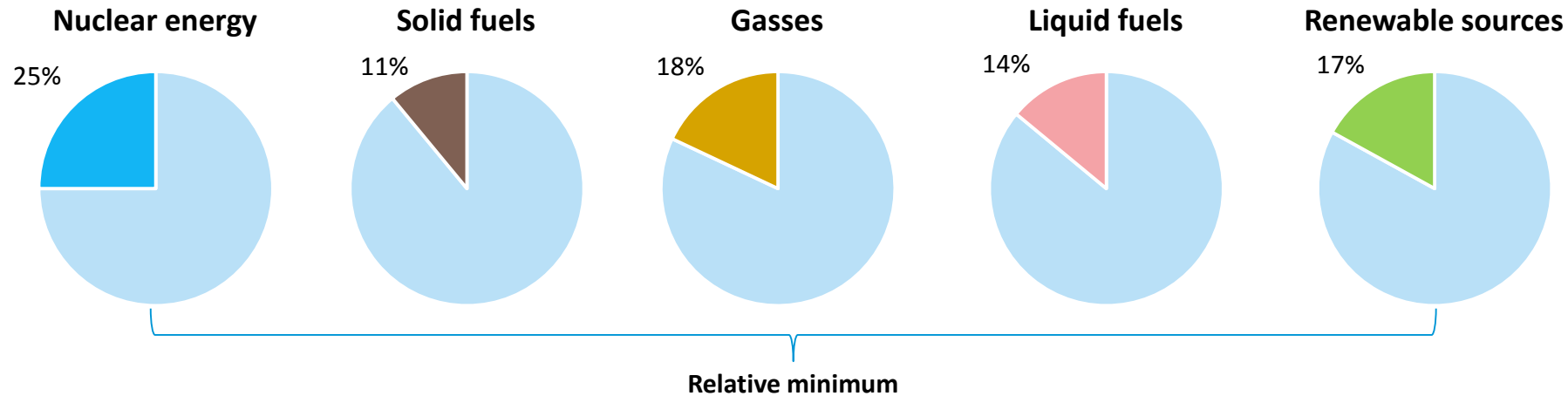
Source: EUROSTAT/Energy balance flow for Czech Republic 2016

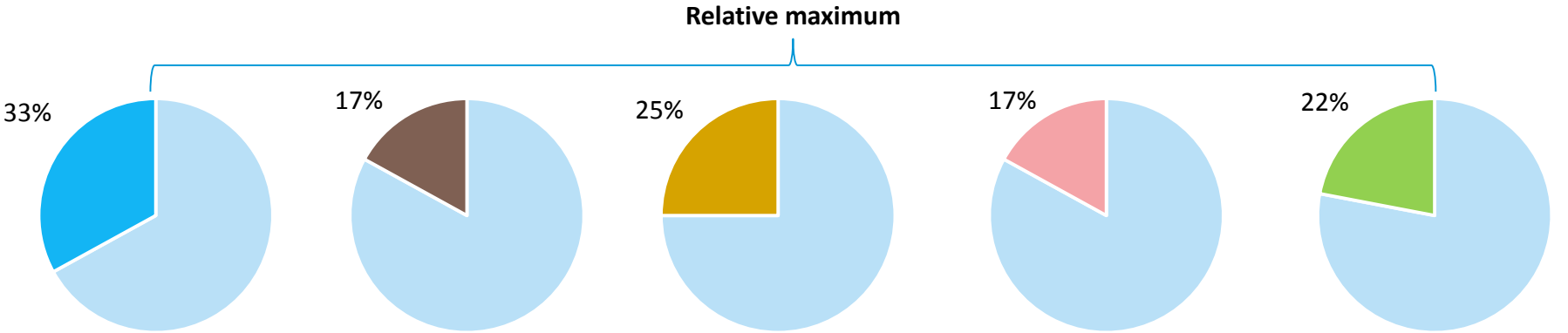
Energy mix (primary energy sources)





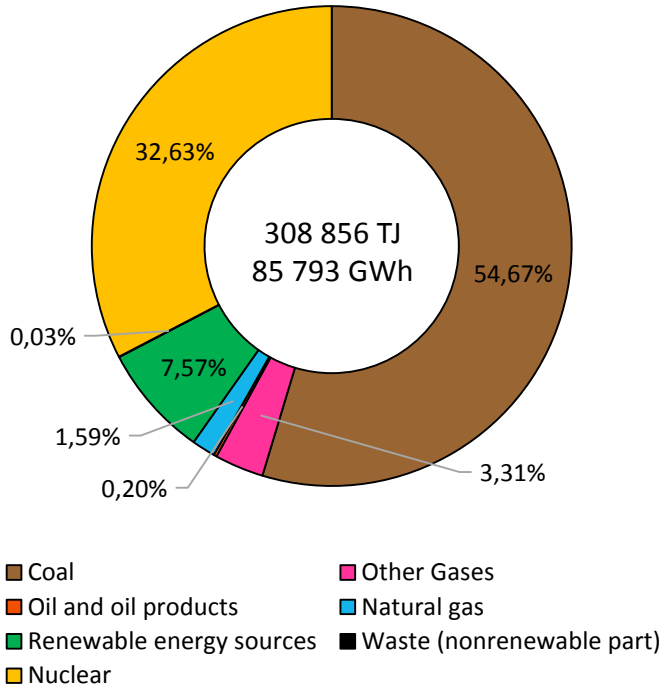
Primary energy sources „corridors“ (2040)



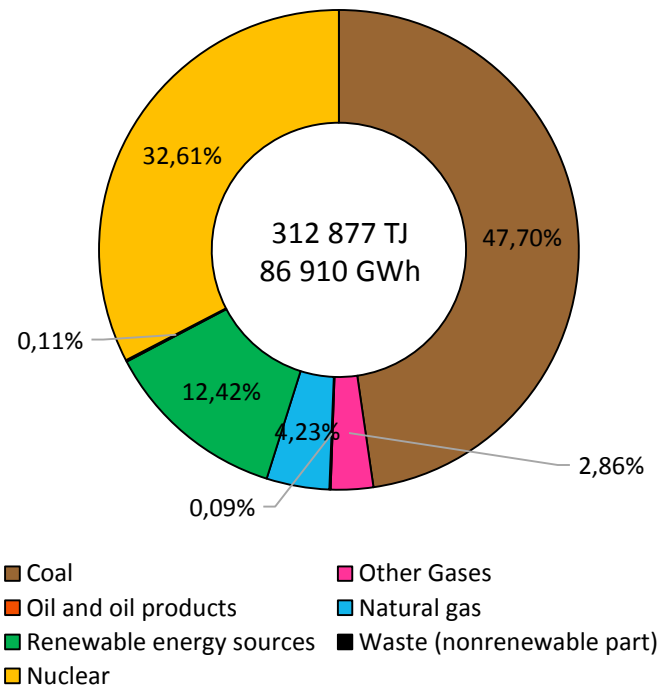


Gross electricity production by main fuels

Year 2010

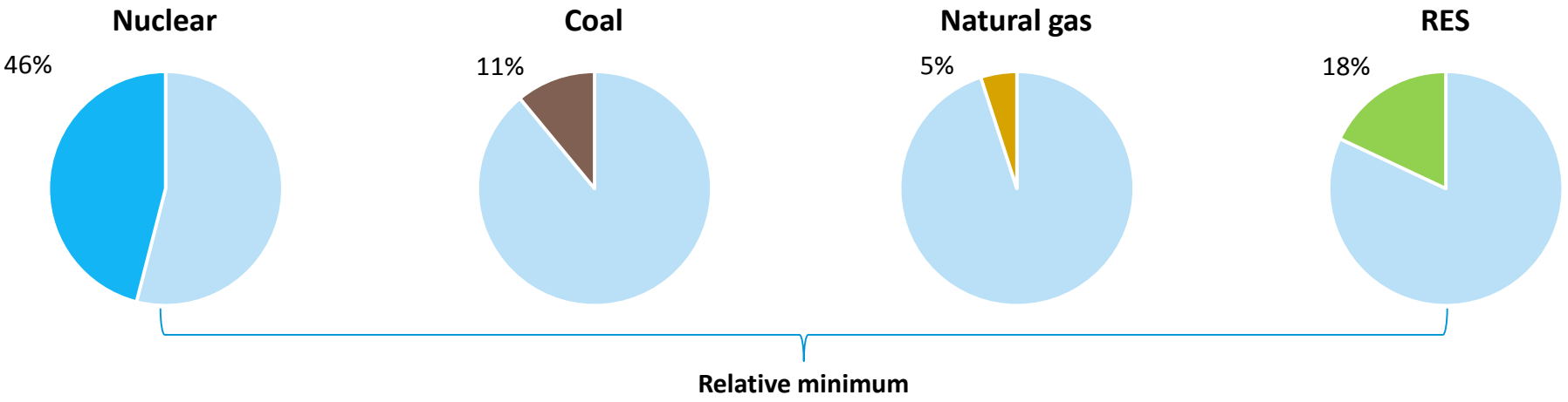


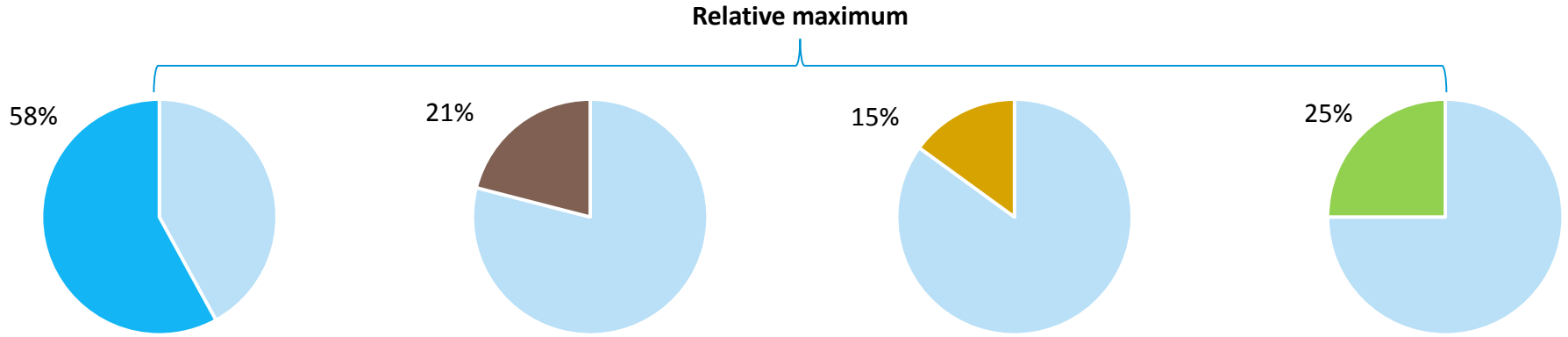
Year 2017



Source: Energy balance in EUROSTAT methodology for 2010-2017

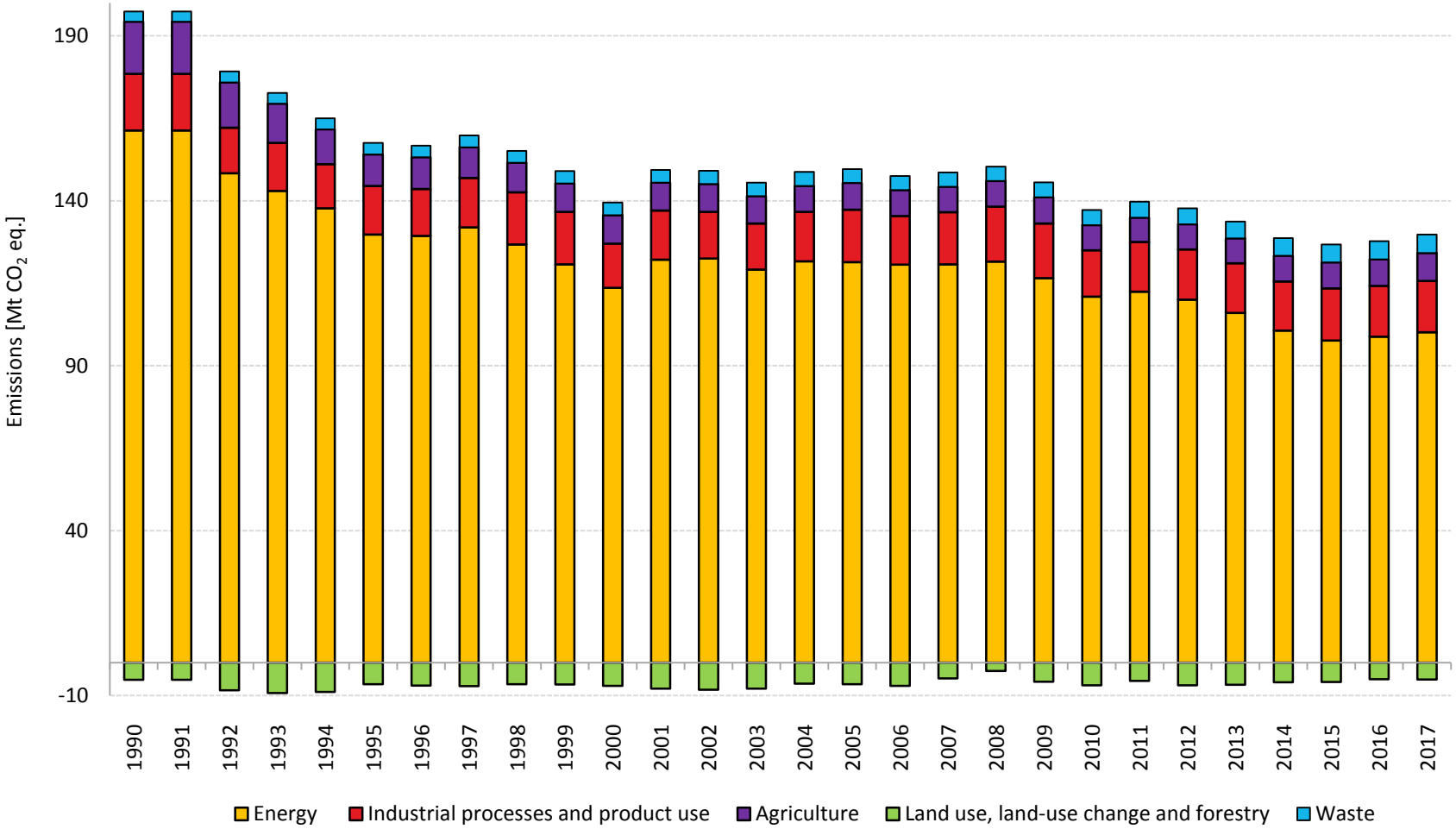
Power generation mix „corridors“ (2040)



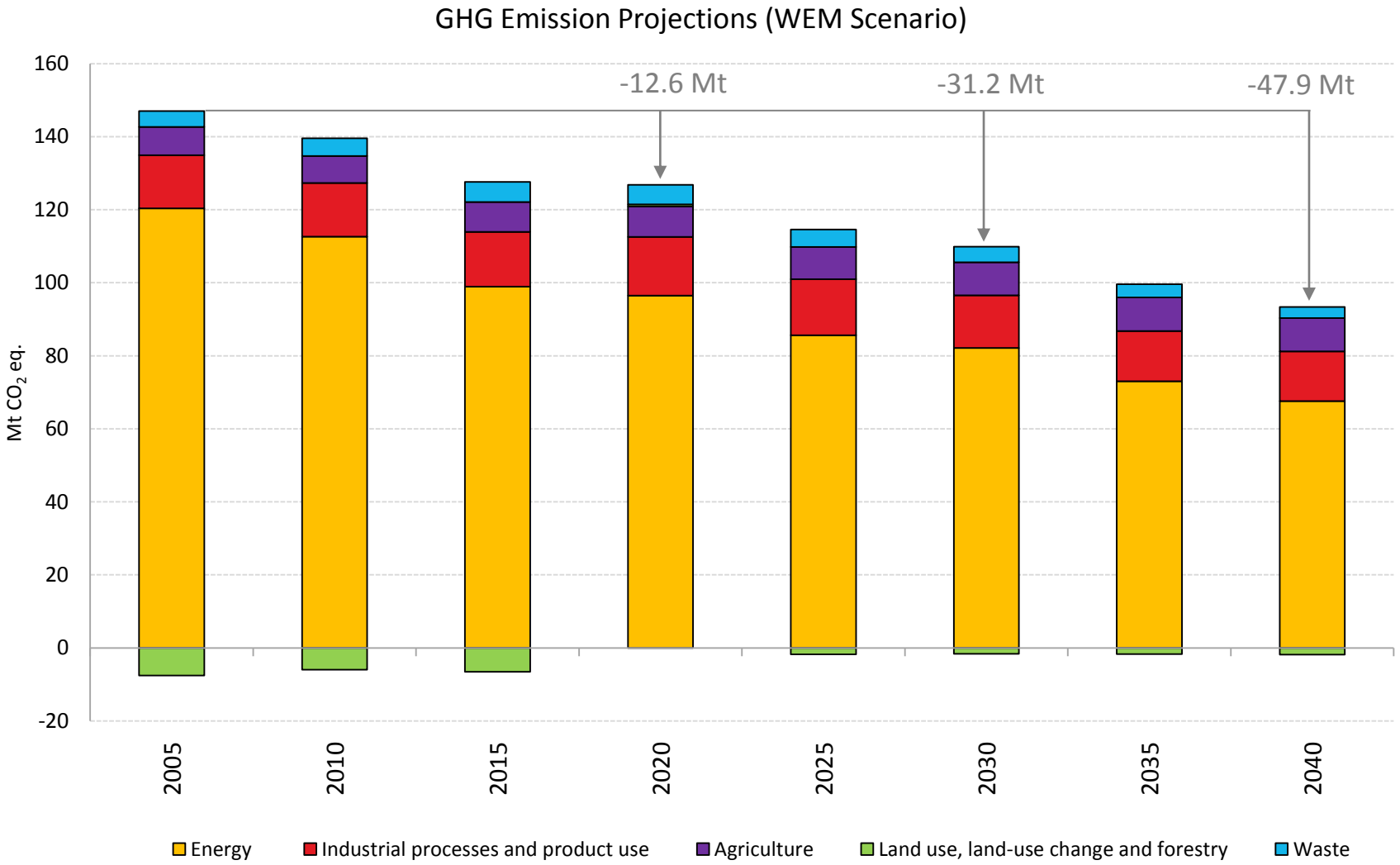


Source: State Energy Policy (2015)

GHG emission in period 1990-2017

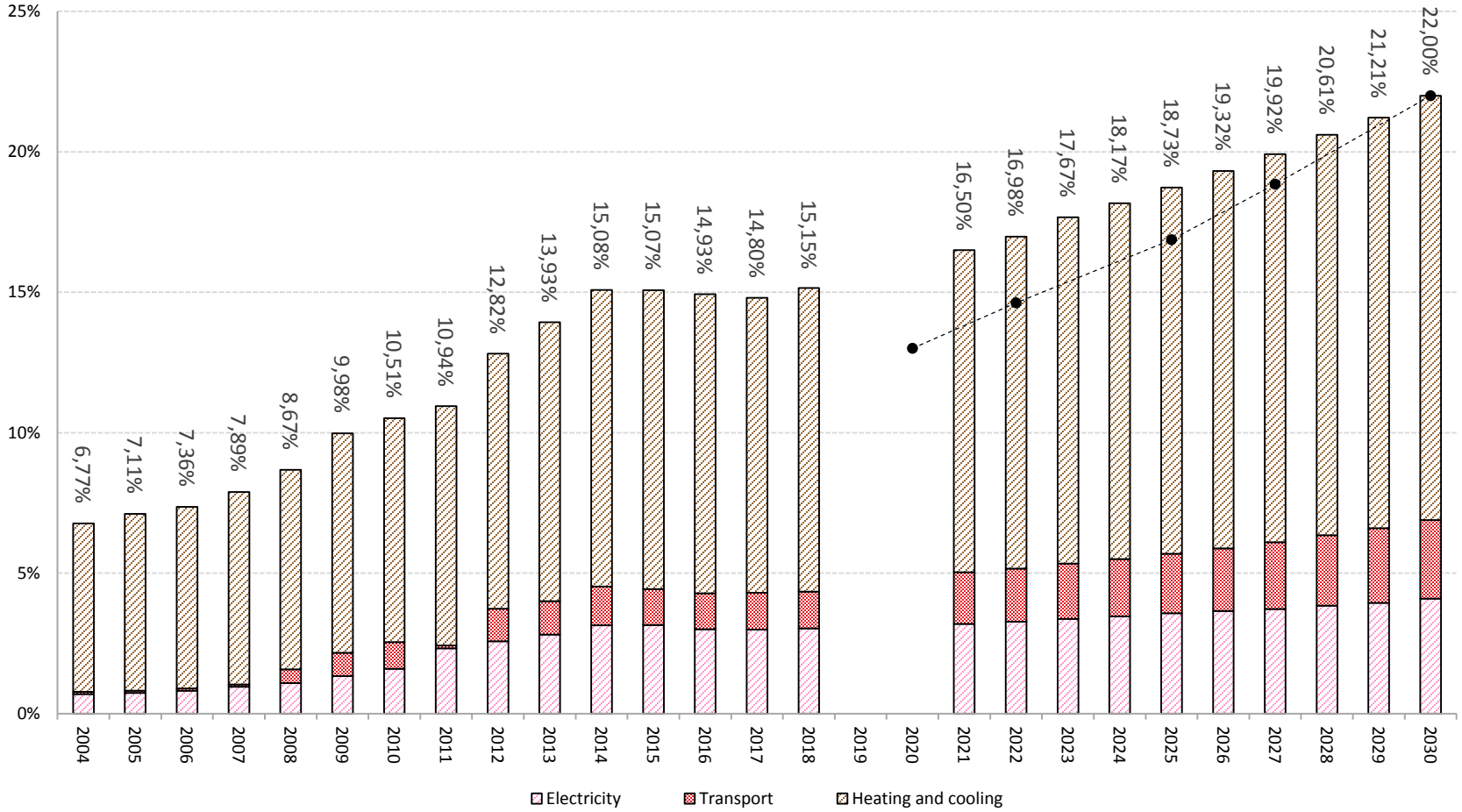


Source: National Inventory 2017 (submission 2019)

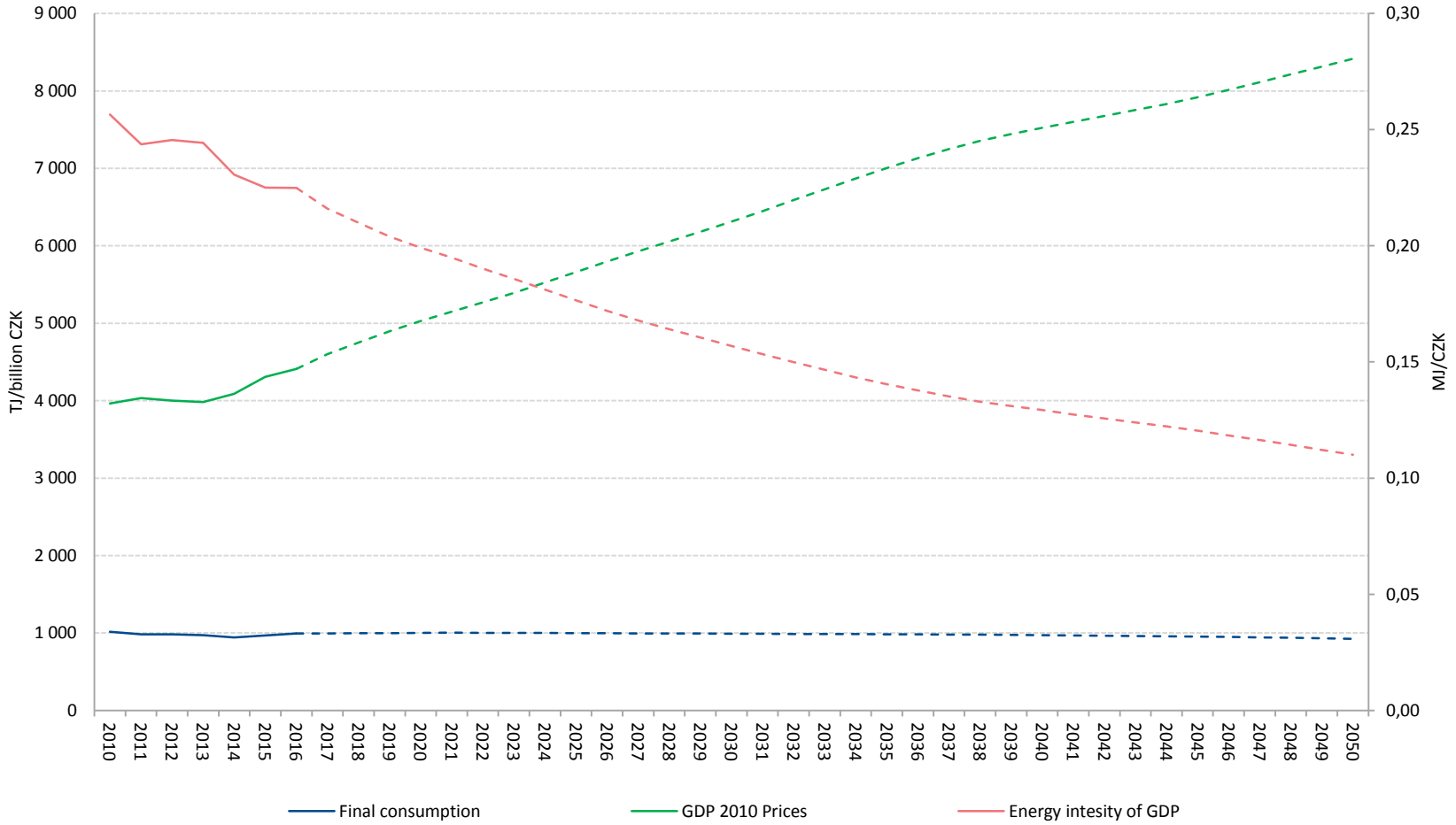


Source: National Energy and Climate Plan of CZ

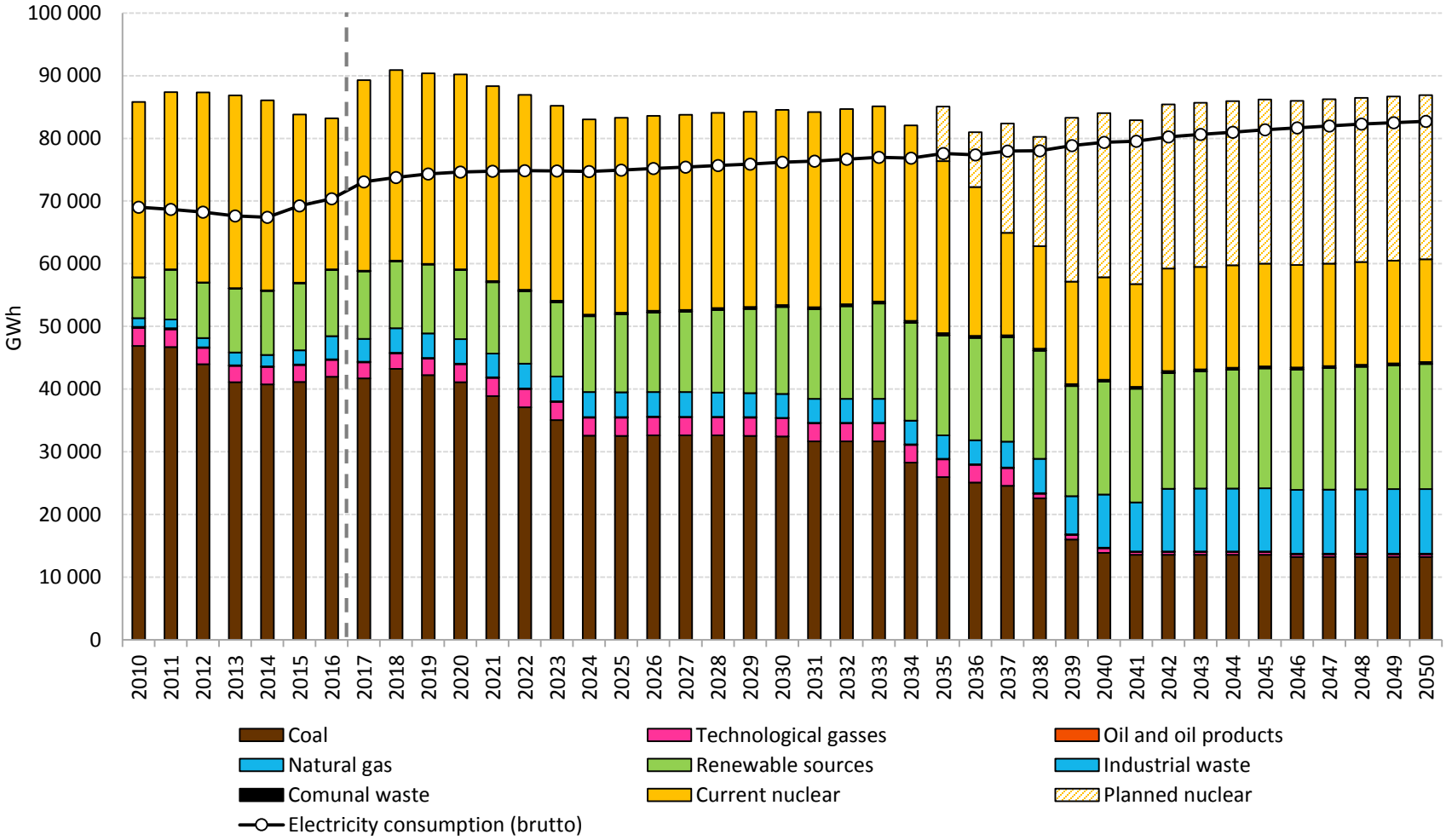
Total RES share on gross energy consumption (contributions by main sectors)



Expected development of energy intensity of final energy consumption

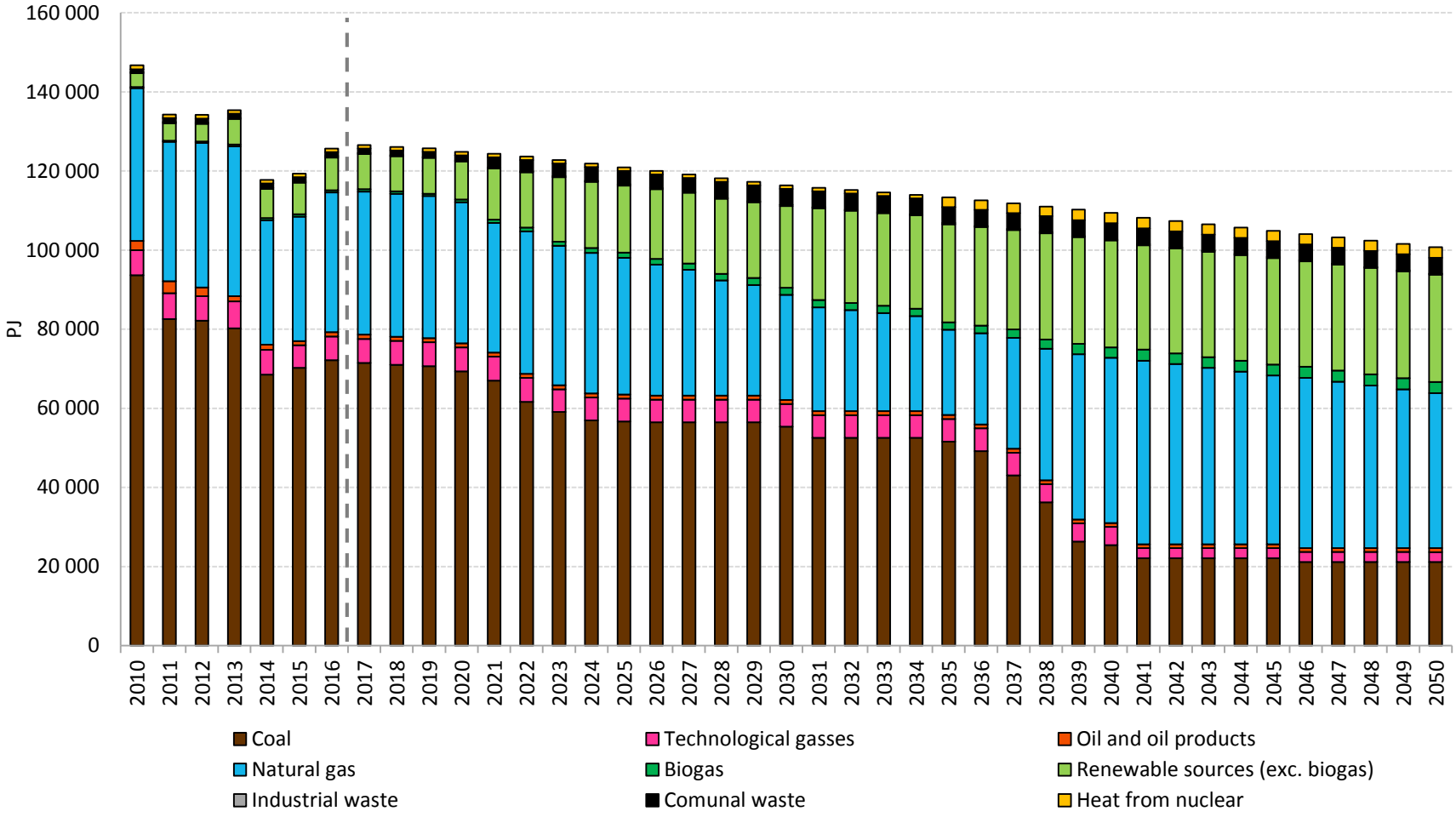


Expected/forecasted gross electricity production/consumption



Source: National Energy and Climate Plan of CZ

Expected/forecasted gross heat production



Generation adequacy

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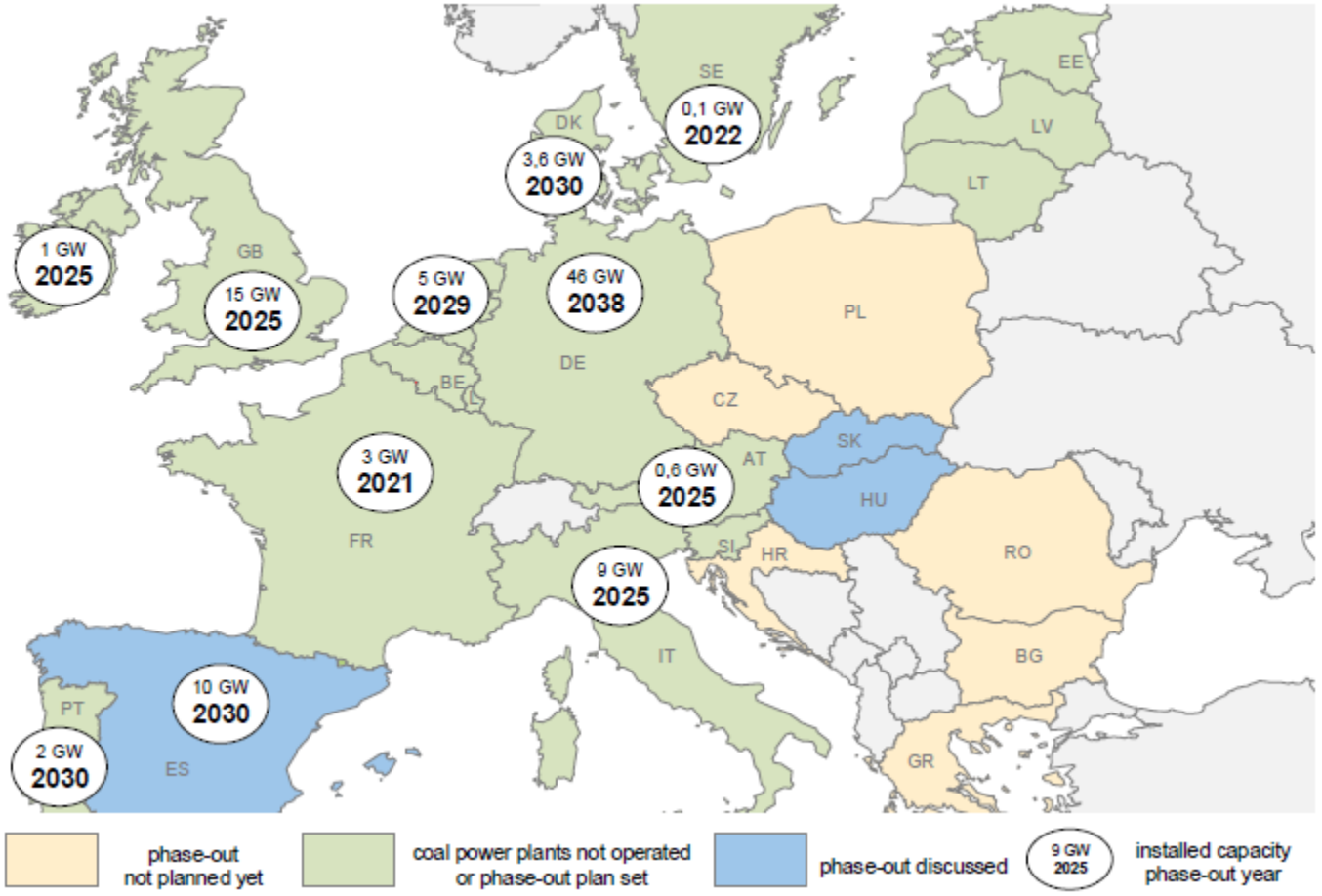
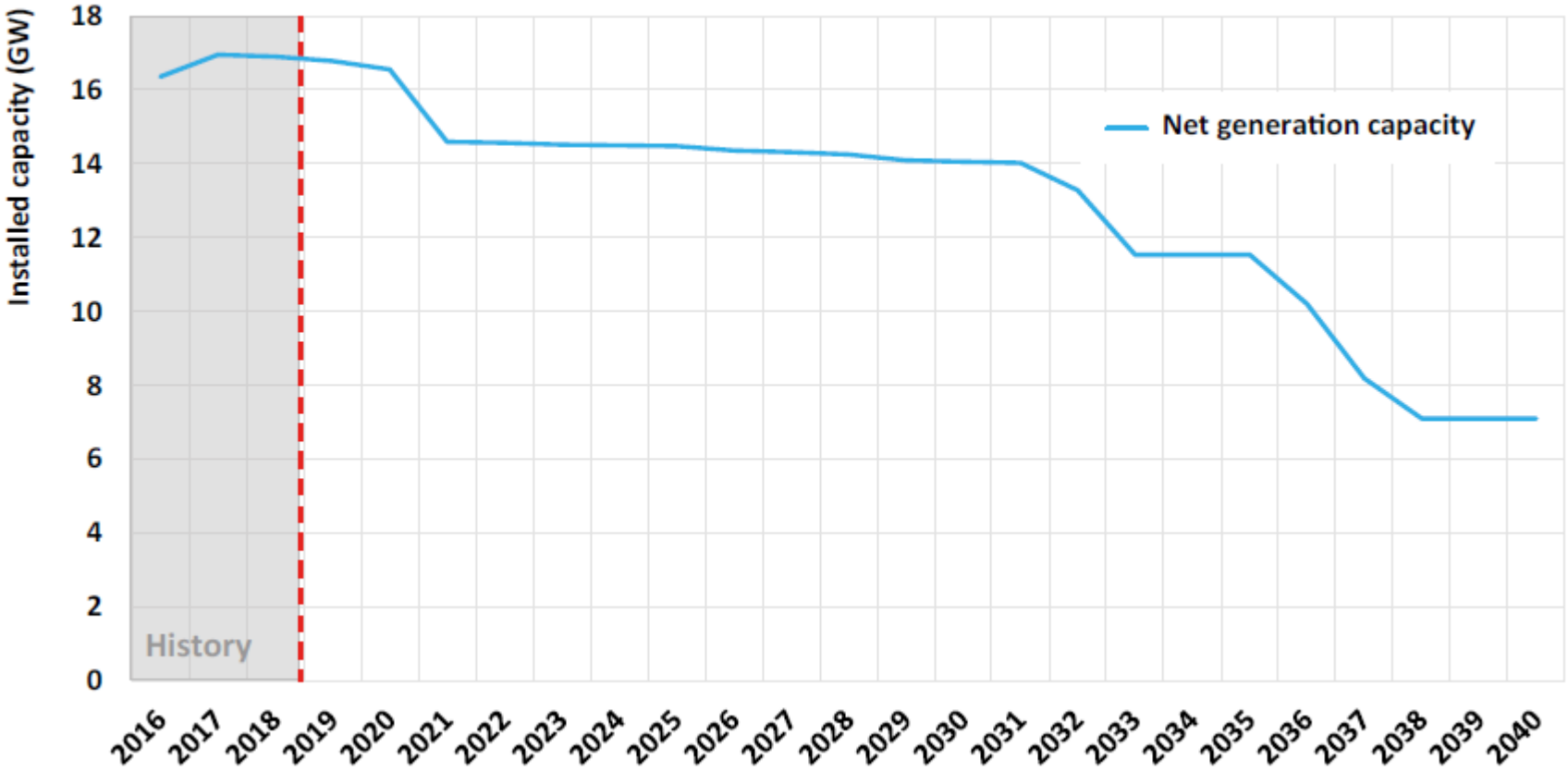
Outlook for operation of coal power plants in EU countries



Source: The anticipated long-term balance between power/gas supply and demand in the Czech Republic

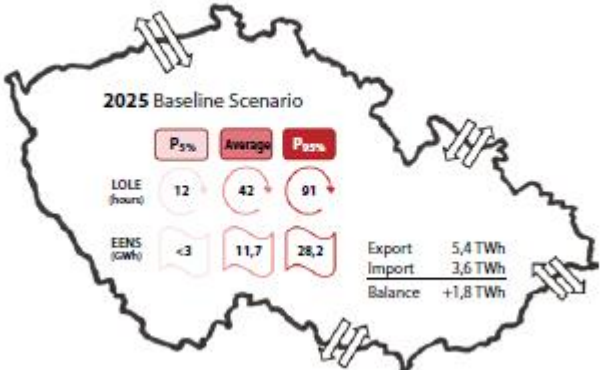
Development of net installed capacity of existing sources over 10 MWe in the CR PS, excluding RES.



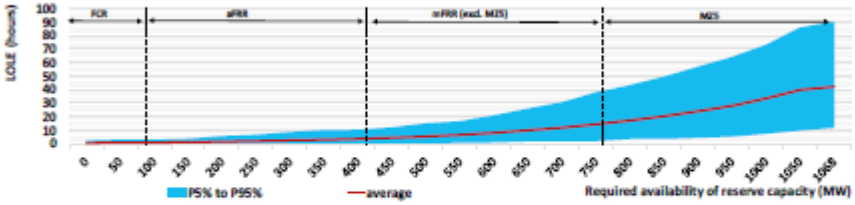
Source: Resource Adequacy Assessment of the Czech Power System until 2040 (MAF CZ)

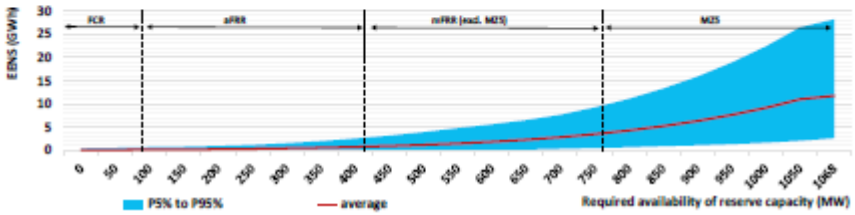
Baseline scenario (2025)

Probability indicators LOLE and EENS for the Baseline Scenario in 2025, including export and import



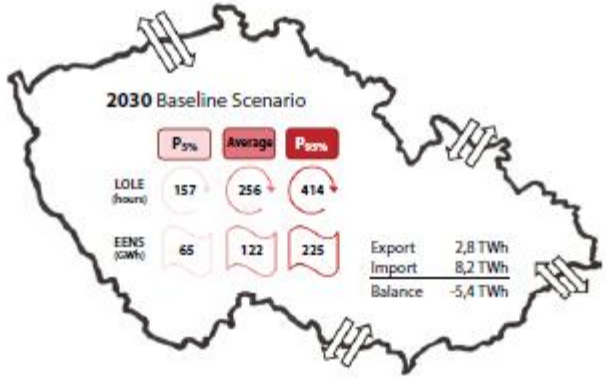
Development of the LOLE and EENS probability indicators (the blue area represents the spread of values between the 5% percentile and the 95% percentile, the red curve represents the average) for various requirements on reserve capacity availability for the Baseline Scenario in 2025.



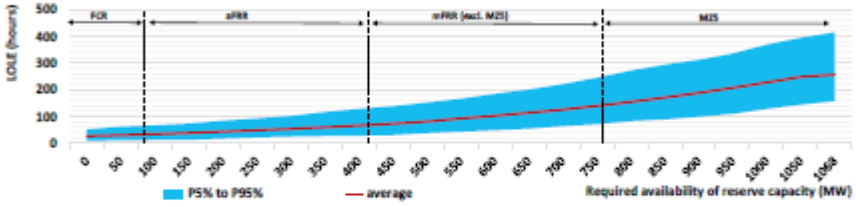


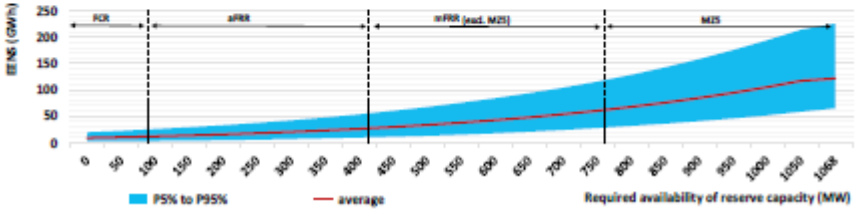
Baseline scenario (2030)

Probability indicators LOLE and EENS for the Baseline Scenario in 2030, including export and import



Development of the LOLE and EENS probability indicators (the blue area represents the spread of values between the 5% percentile and the 95% percentile, the red curve represents the average) for various requirements on reserve capacity availability for the Baseline Scenario in 2030.

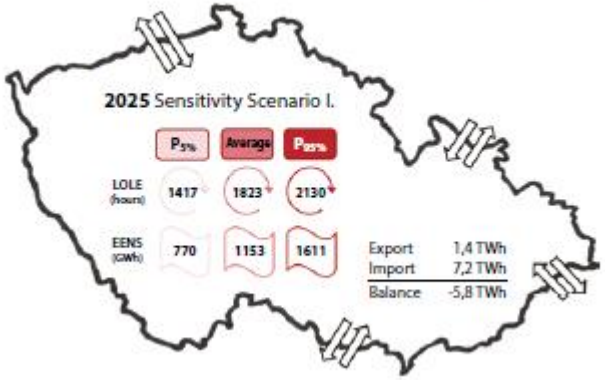




Source: Resource Adequacy Assessment of the Czech Power System until 2040 (MAF CZ)

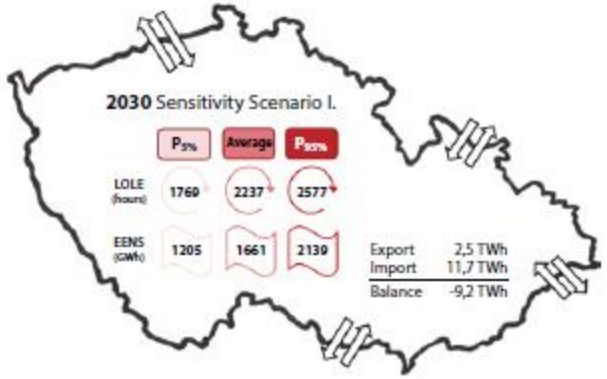
Sensitivity scenario (2025)

Probability indicators LOLE and EENS for the Sensitivity Scenario I in 2025, including export and import



Sensitivity scenario (2030)

Probability indicators LOLE and EENS for the Sensitivity Scenario I in 2030, including export and import



Major Scenario factors till 2030

Scenario	Modelled years		NPP limited operation		Additional phase-out
	2025	2030	2025	2030	
Baseline Scenario	✓	✓	No	No	×
Sensitivity Scenario I. – low-carbon	✓	✓	No	No	✓
Sensitivity Scenario II. – NPP limited operation	×	✓	×	Yes	×

Source: Resource Adequacy Assessment of the Czech Power System until 2040 (MAF CZ)

Generation adequacy

ENTSO-E member states balance overview in 2040 in Scenario A

ENTSO-E member states balance overview in 2040 in Scenario B

Source: Resource Adequacy Assessment of the Czech Power System until 2040 (MAF CZ)

Possible future pathways

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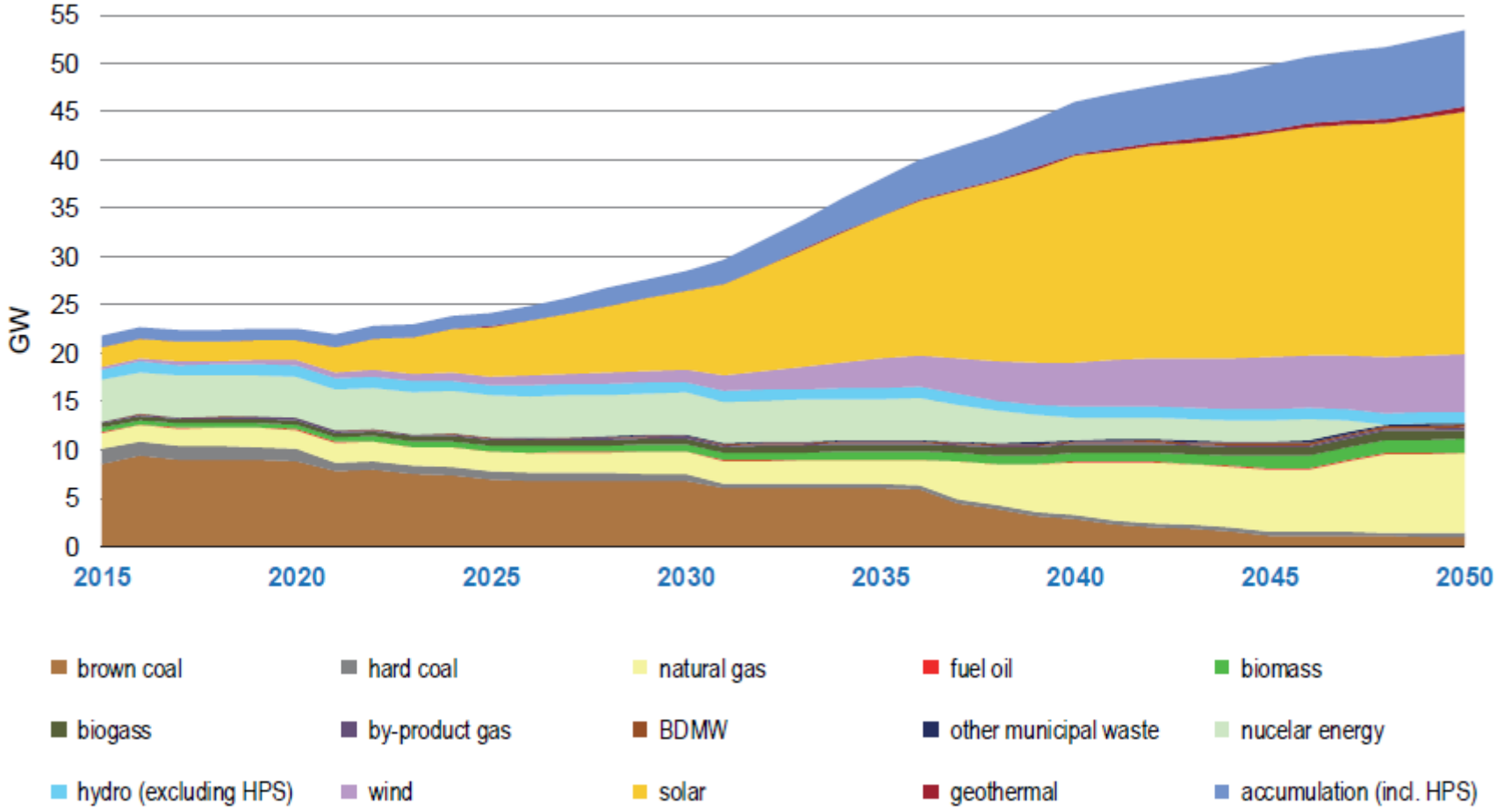
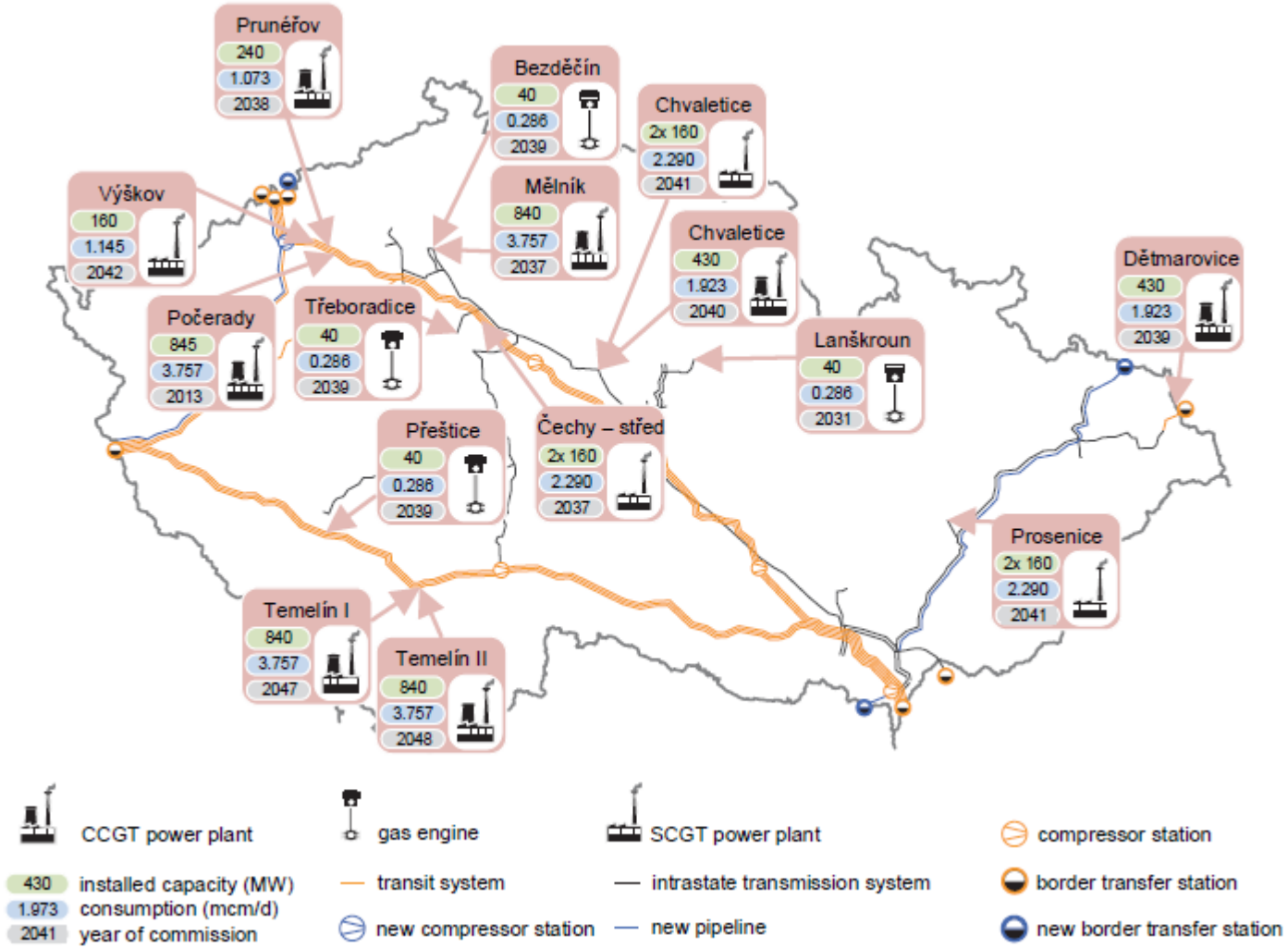
Renewable case study – installed capacity according to PES



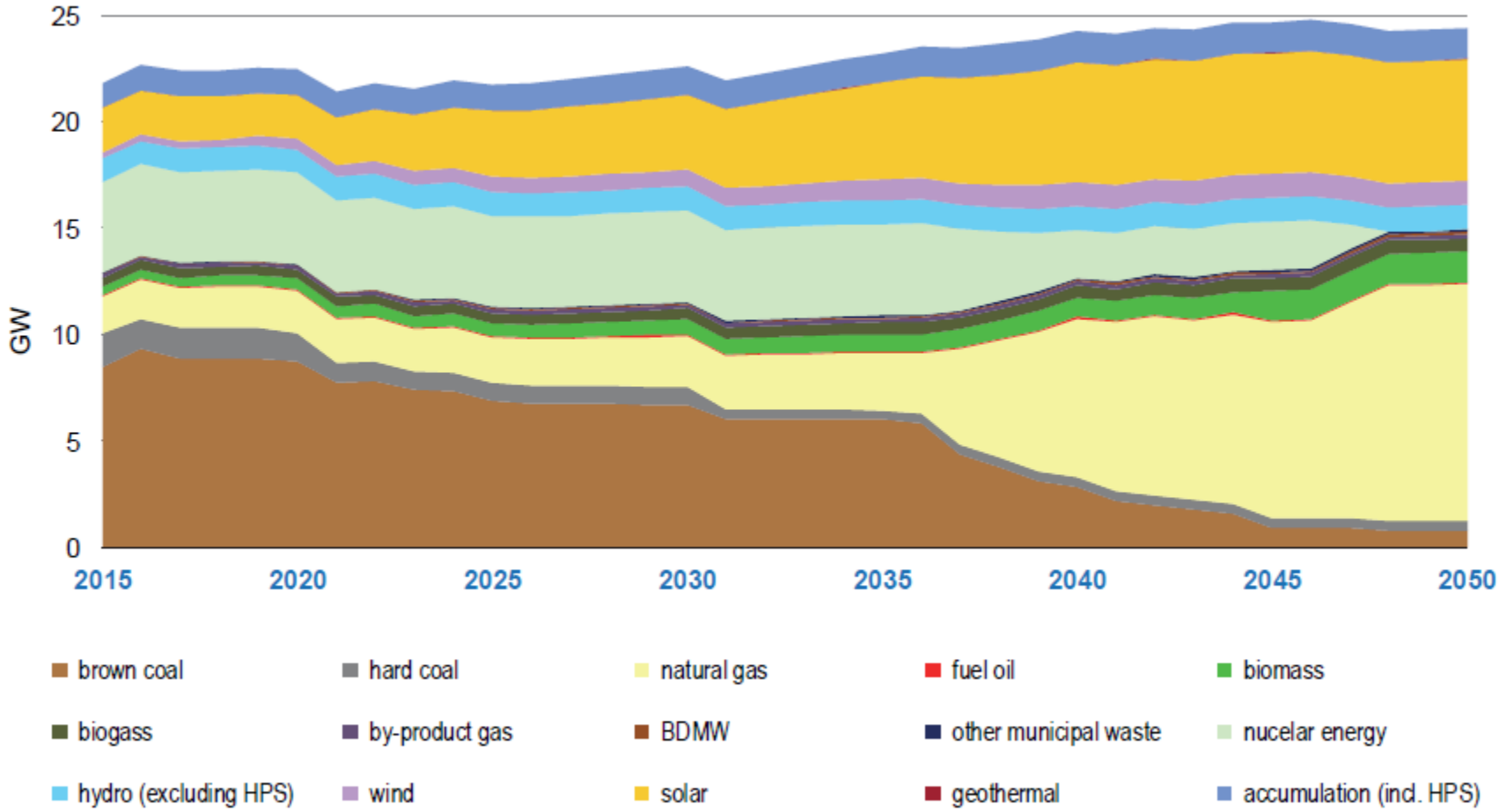
Source: The anticipated long-term balance between power/gas supply and demand in the Czech Republic

Connection of new sources to transmission system – Renewable case study



Source: The anticipated long-term balance between power/gas supply and demand in the Czech Republic

Gas case study – installed capacity according to PES



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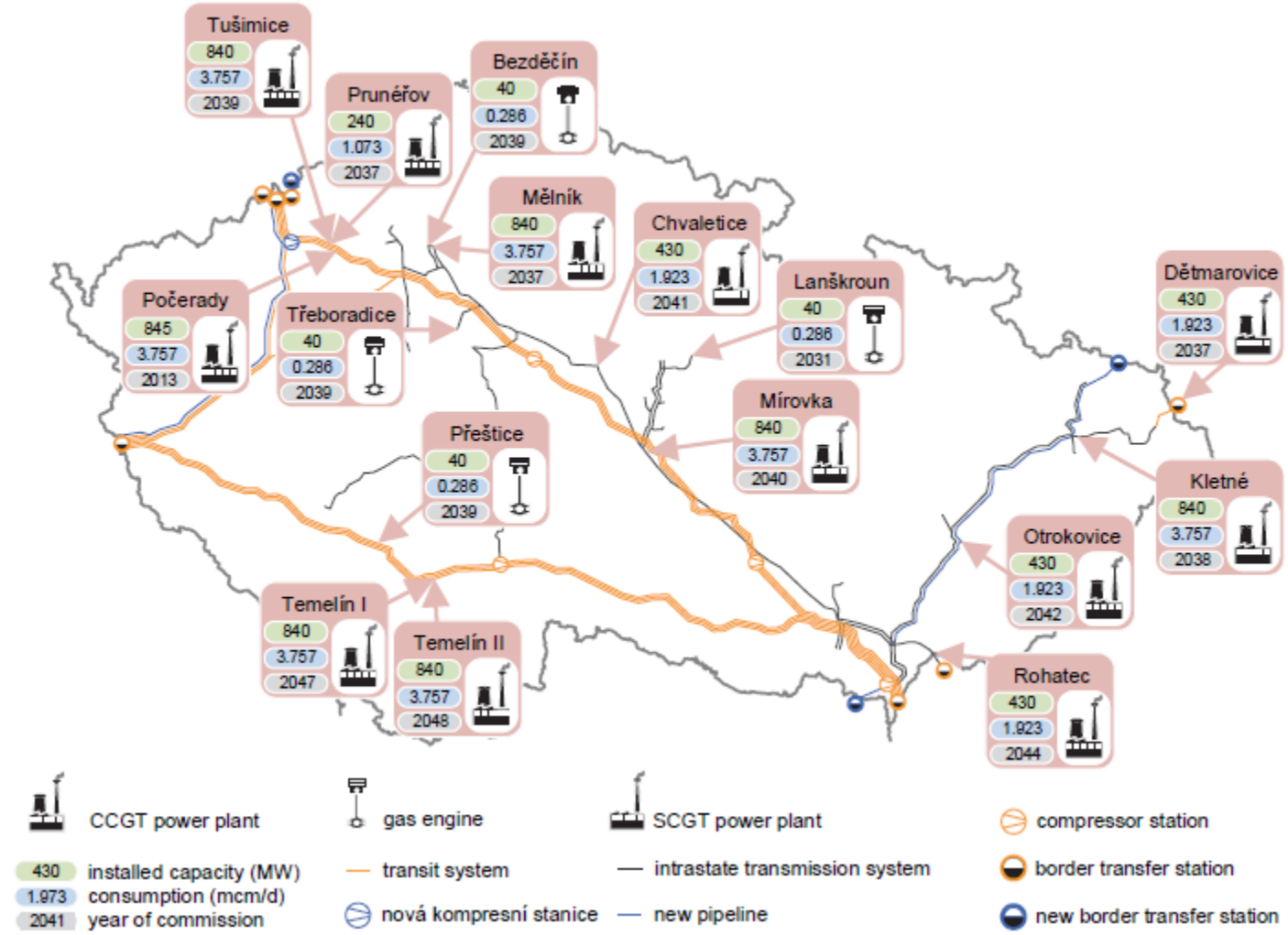
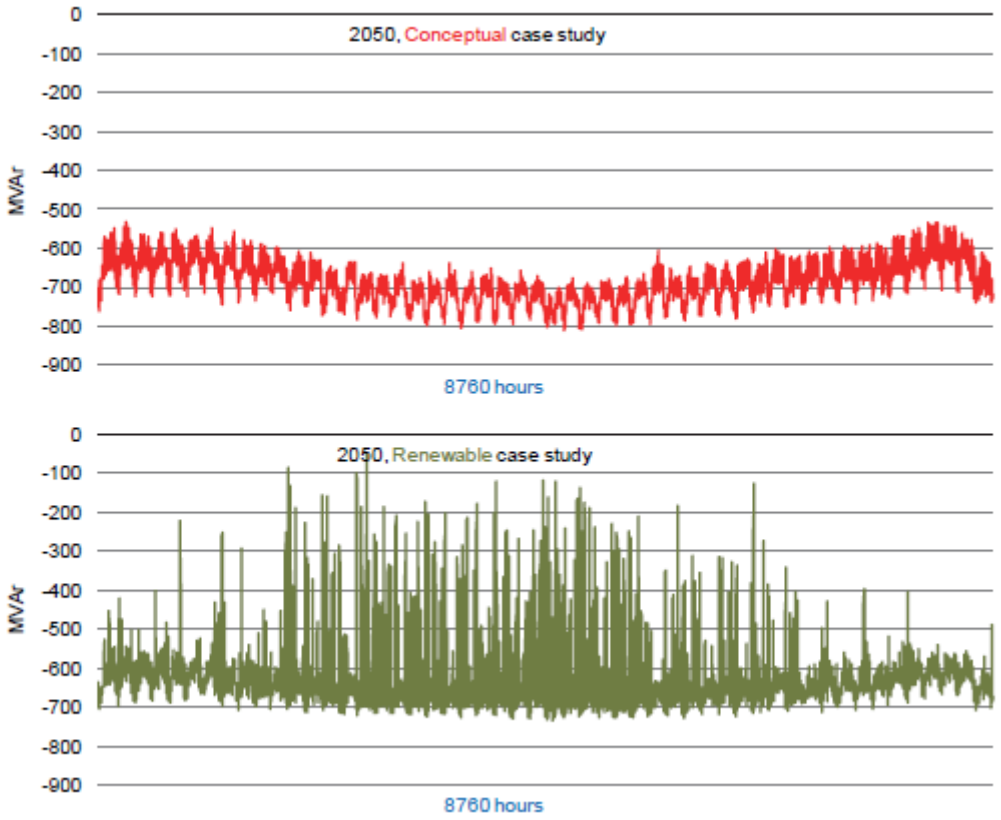
Connection of new sources to transmission system – Gas case study



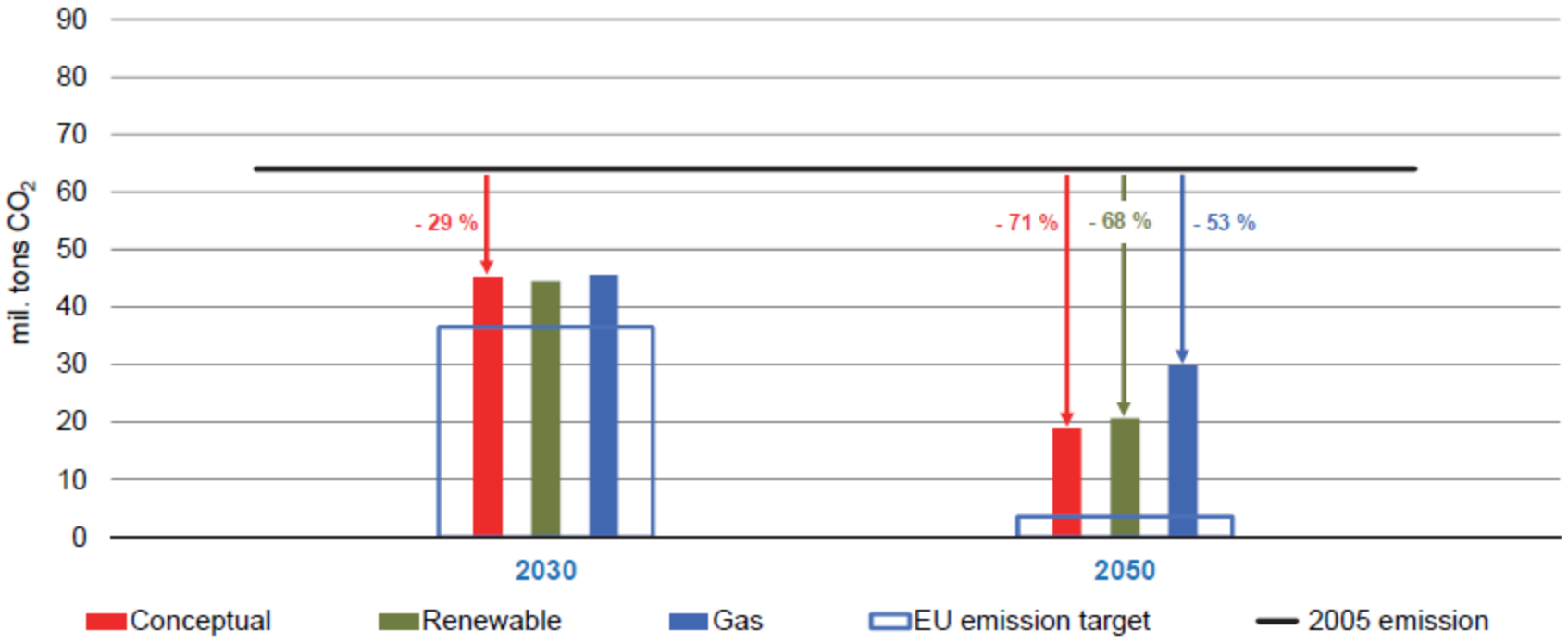
Source: The anticipated long-term balance between power/gas supply and demand in the Czech Republic

Hourly course of reactive power (Q) generated by 110 kV TS lines – 2050



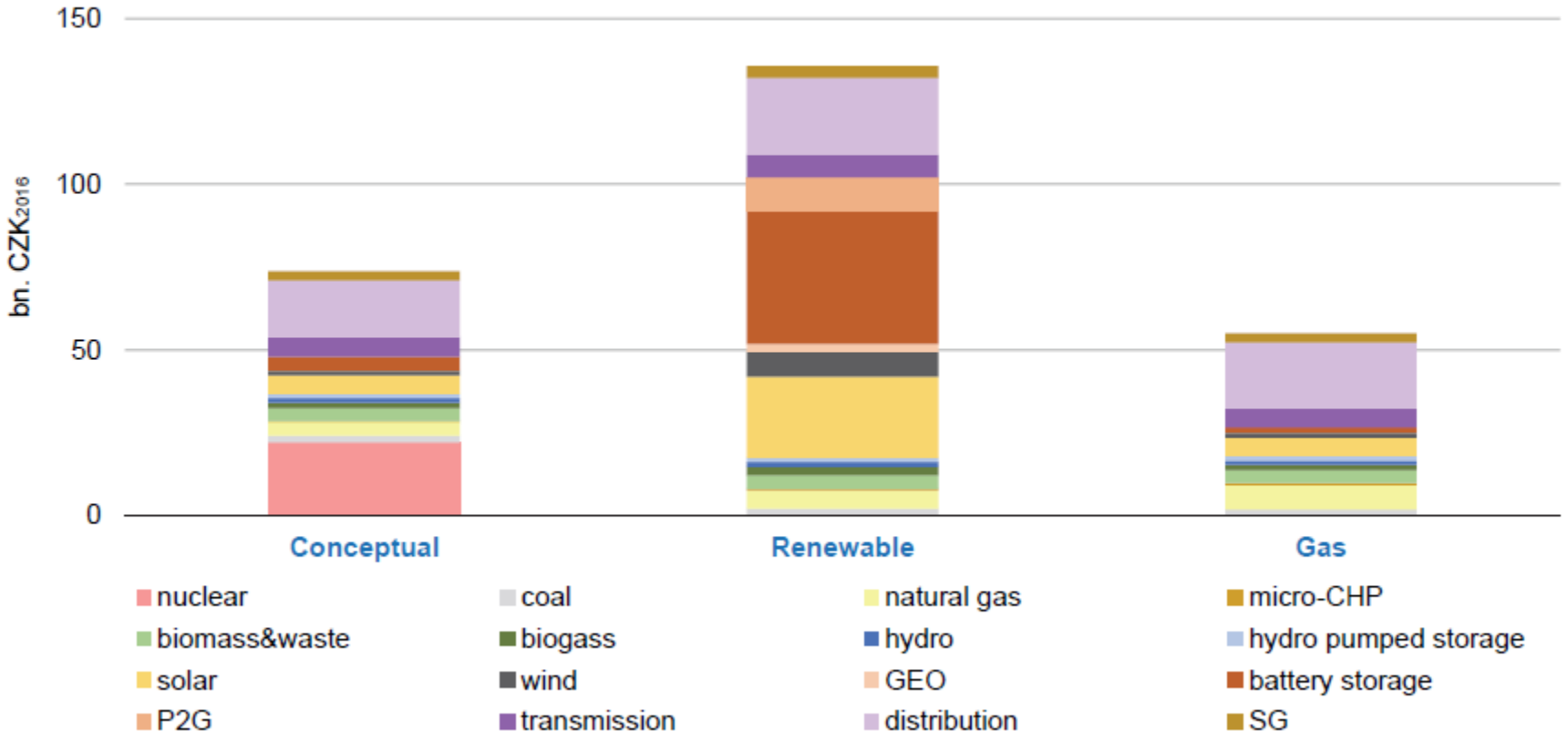
Source: The anticipated long-term balance between power/gas supply and demand in the Czech Republic

Evaluation of CO_2 emission reduction target fulfilment



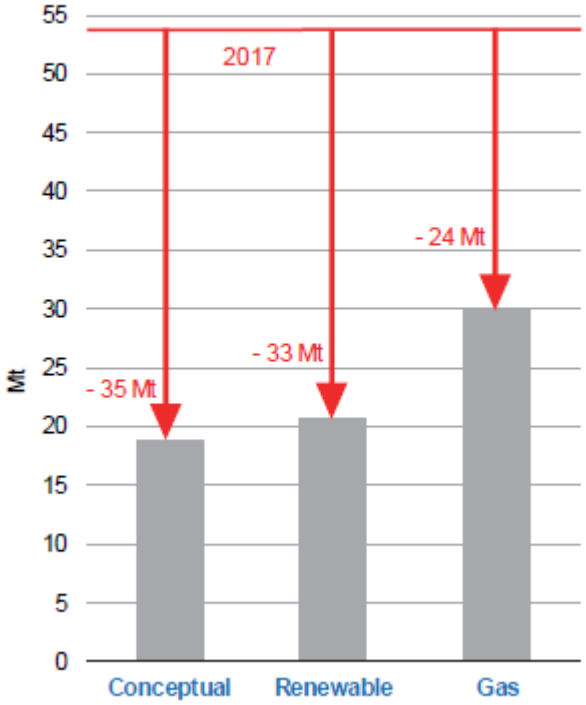
Source: The anticipated long-term balance between power/gas supply and demand in the Czech Republic

Estimated annual investment in 2050

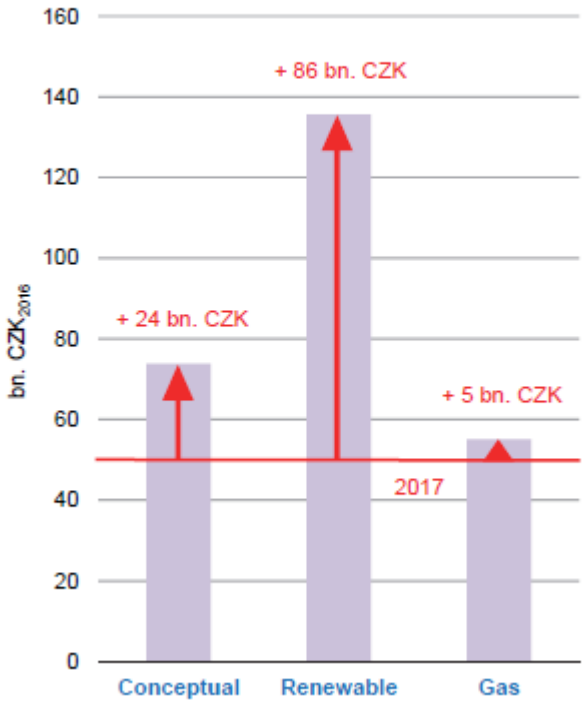


Source: The anticipated long-term balance between power/gas supply and demand in the Czech Republic

CO_2 emissions of the Czech Republic – 2050



Annual investment in the Czech Republic power system – 2050



Source: The anticipated long-term balance between power/gas supply and demand in the Czech Republic

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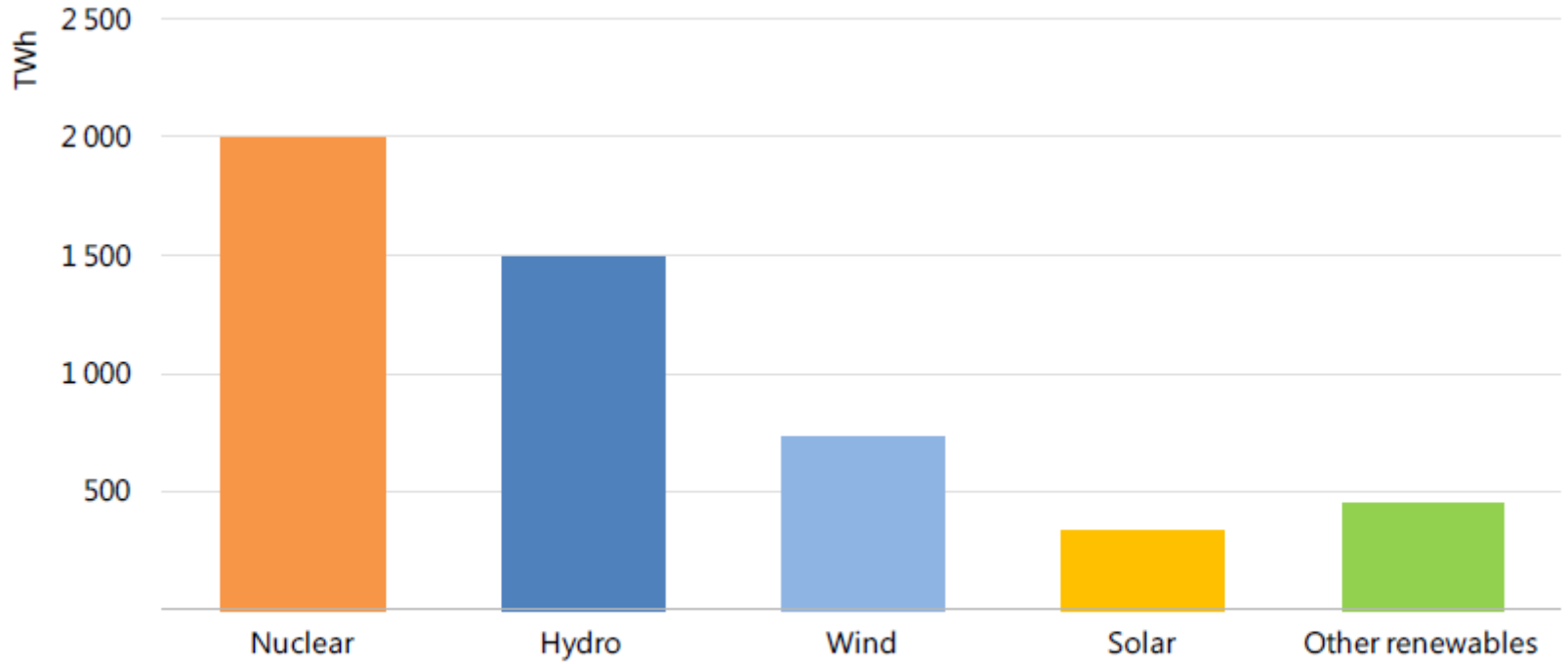
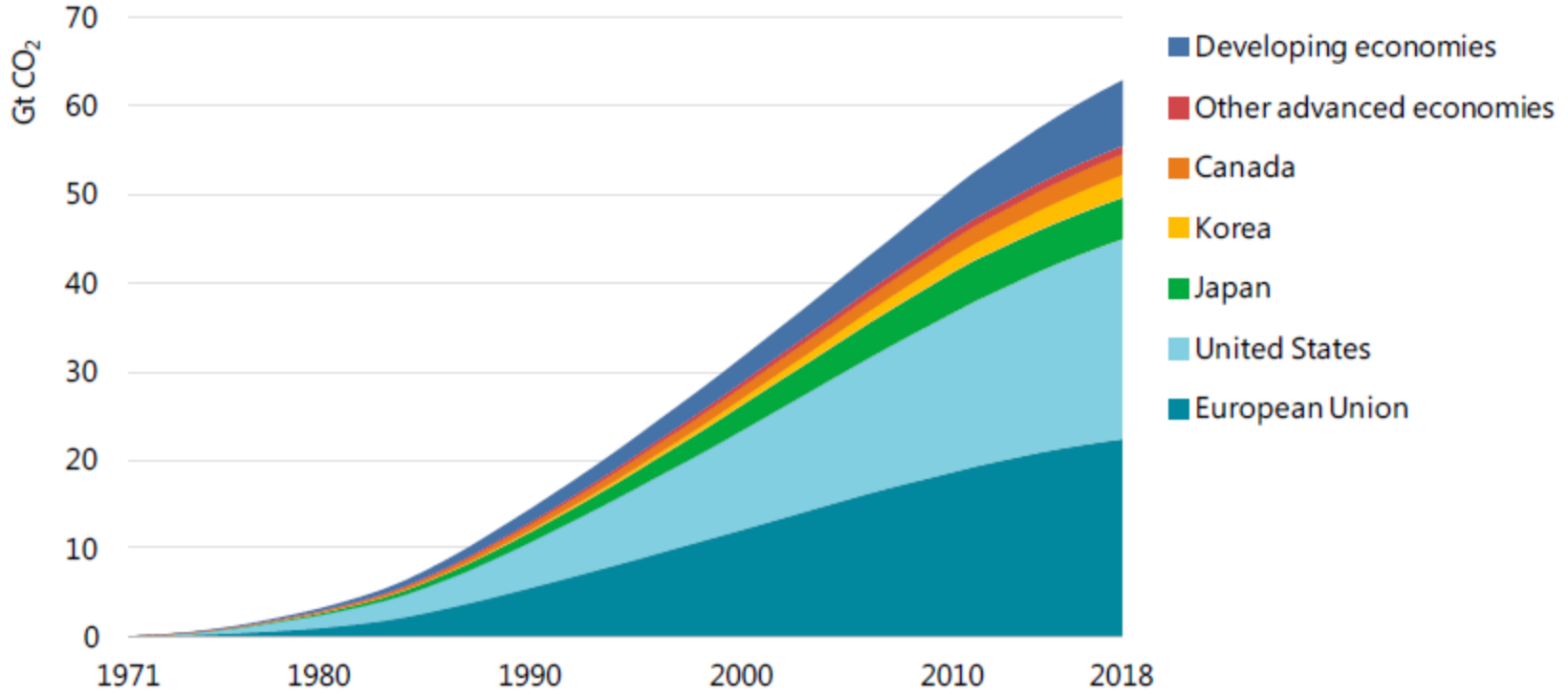
Low-carbon electricity generation in advanced economies by source, 2018



Nuclear power is the leading low-carbon source of electricity in advanced economies today.

Source: Nuclear Power in a Clean Energy System (IEA)

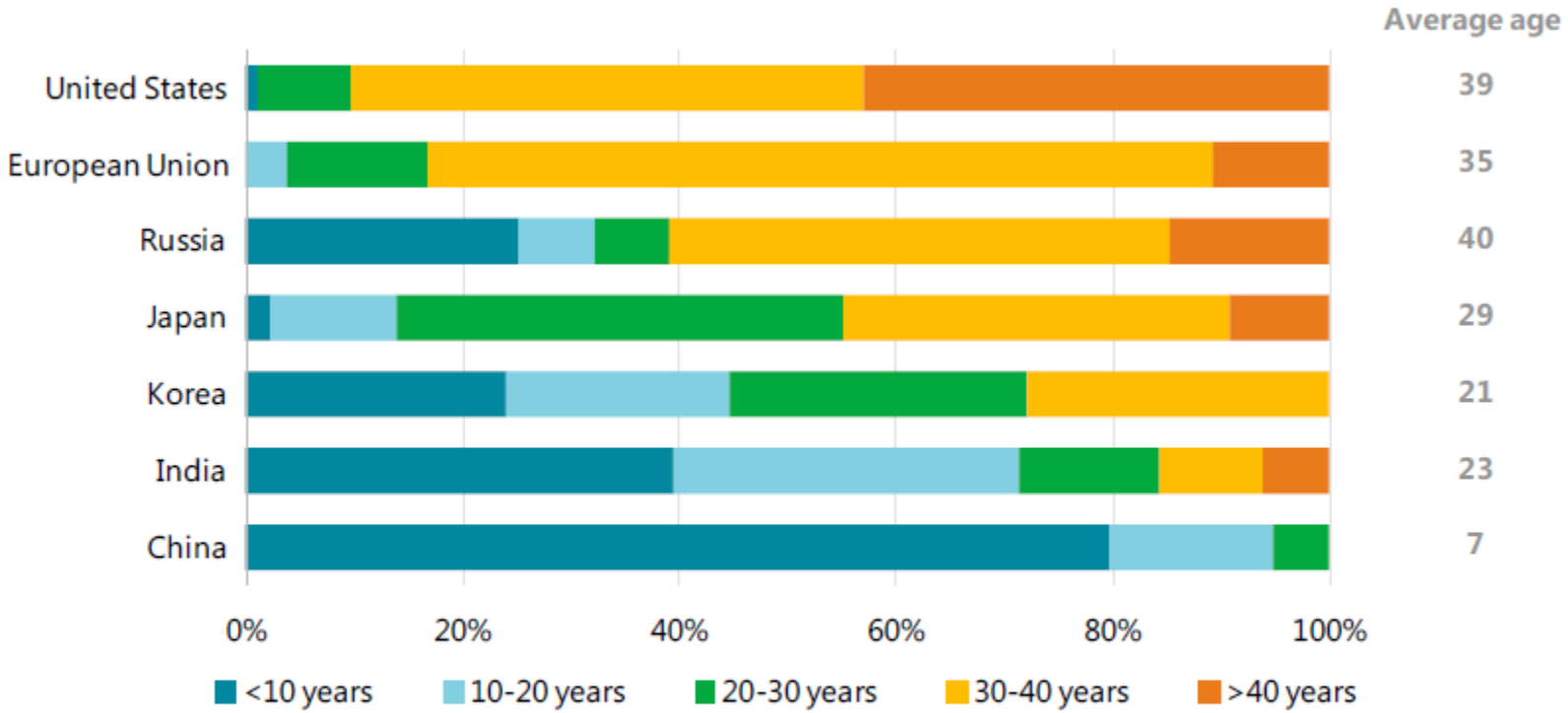
Cumulative CO_2 emissions avoided by global nuclear power to date



Without nuclear power, global CO_2 emissions from electricity generation would have been almost 20% higher over the last half-century.

Source: Nuclear Power in a Clean Energy System (IEA)

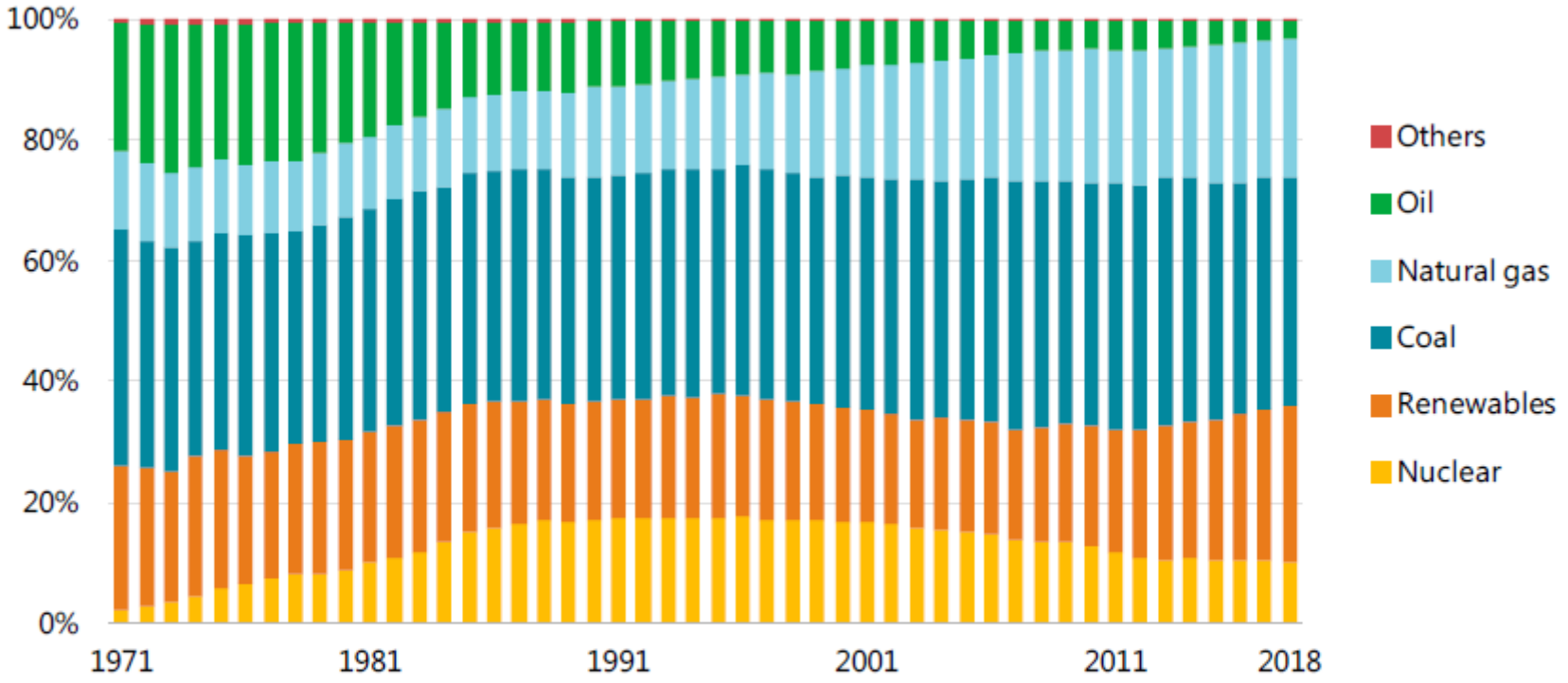
Age profile of nuclear power capacity in selected countries/regions



Source: IAEA (2019), Power Reactor Information System (PRIS) (database).

Most nuclear power plants in the European Union and the United States are more than 30 years old, while plants in developing countries – notably China – are much younger.

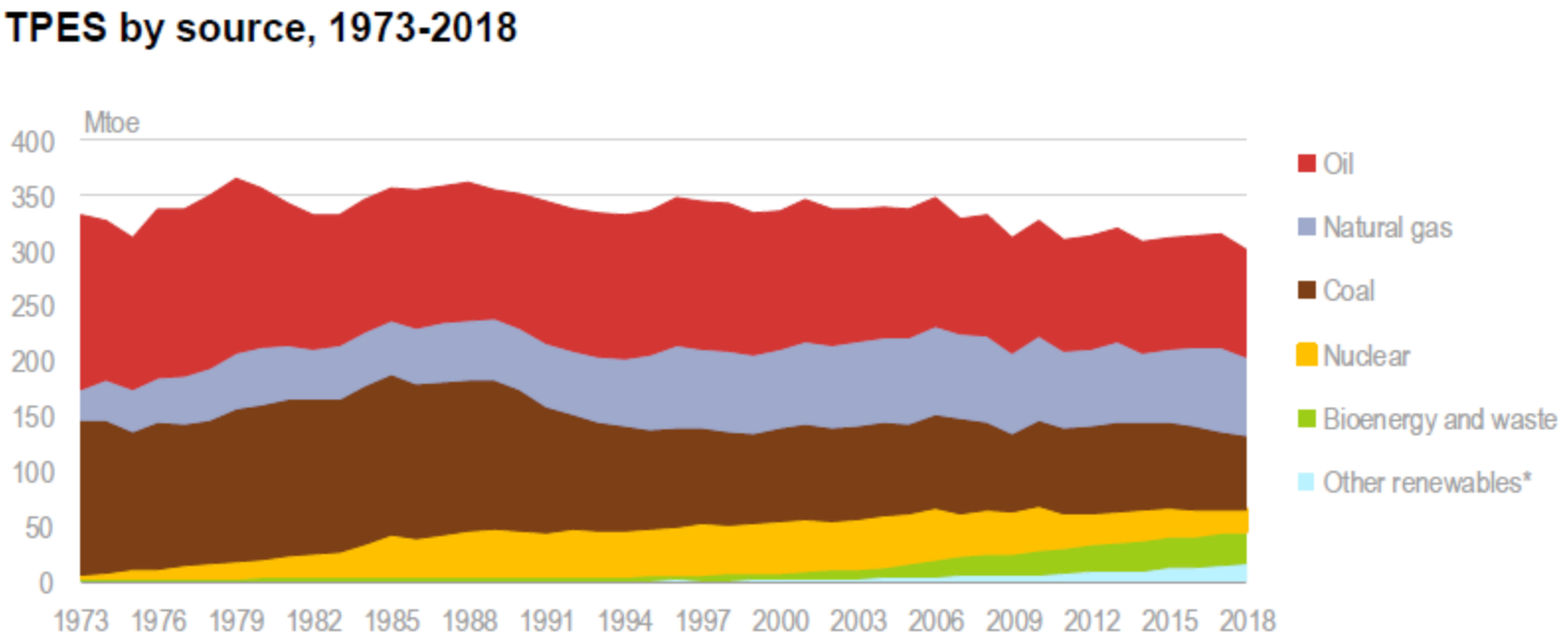
Share of energy sources in global electricity generation



The decline in nuclear power's share in electricity generation has entirely offset the growth in the share of renewables since the late 1990s.

Source: Nuclear Power in a Clean Energy System (IEA)

TPES (Germany)



Source: In-depth Review of Germany (IEA)

Impact of various risks on net present value of a 1 GW nuclear power project with guaranteed revenues to 2040

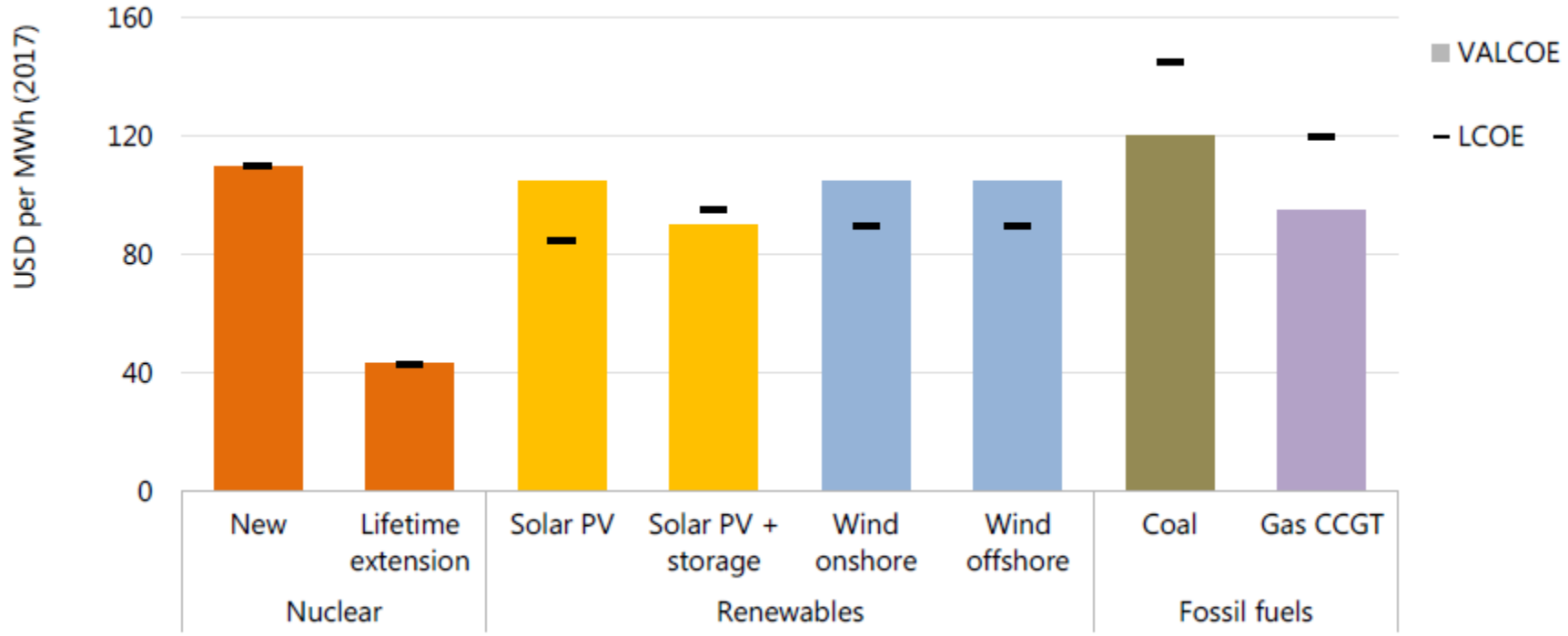
Note: All the sensitivities are compared with a "best-case" nuclear project, which assumes an investment cost of USD 4.5 billion per GW, a six year project construction time frame, a 60 year lifetime and a 7% cost of capital.

Economic viability of a large-scale nuclear power plant is highly sensitive to project delays, future electricity prices, cost overruns and plant lifetime.

Source: Nuclear Power in a Clean Energy System (IEA)

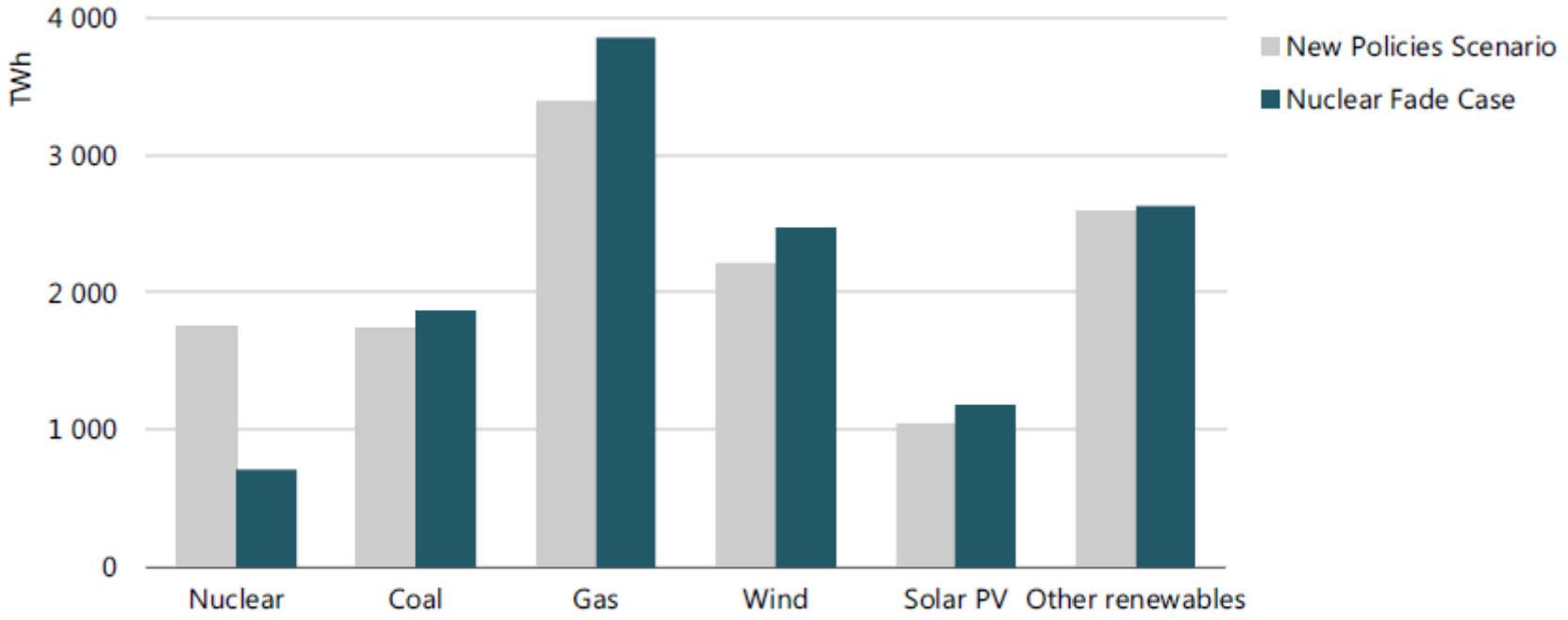
Projected LCOE and value-adjusted LCOE by technology, 2040

European Union



Source: Nuclear Power in a Clean Energy System (IEA)

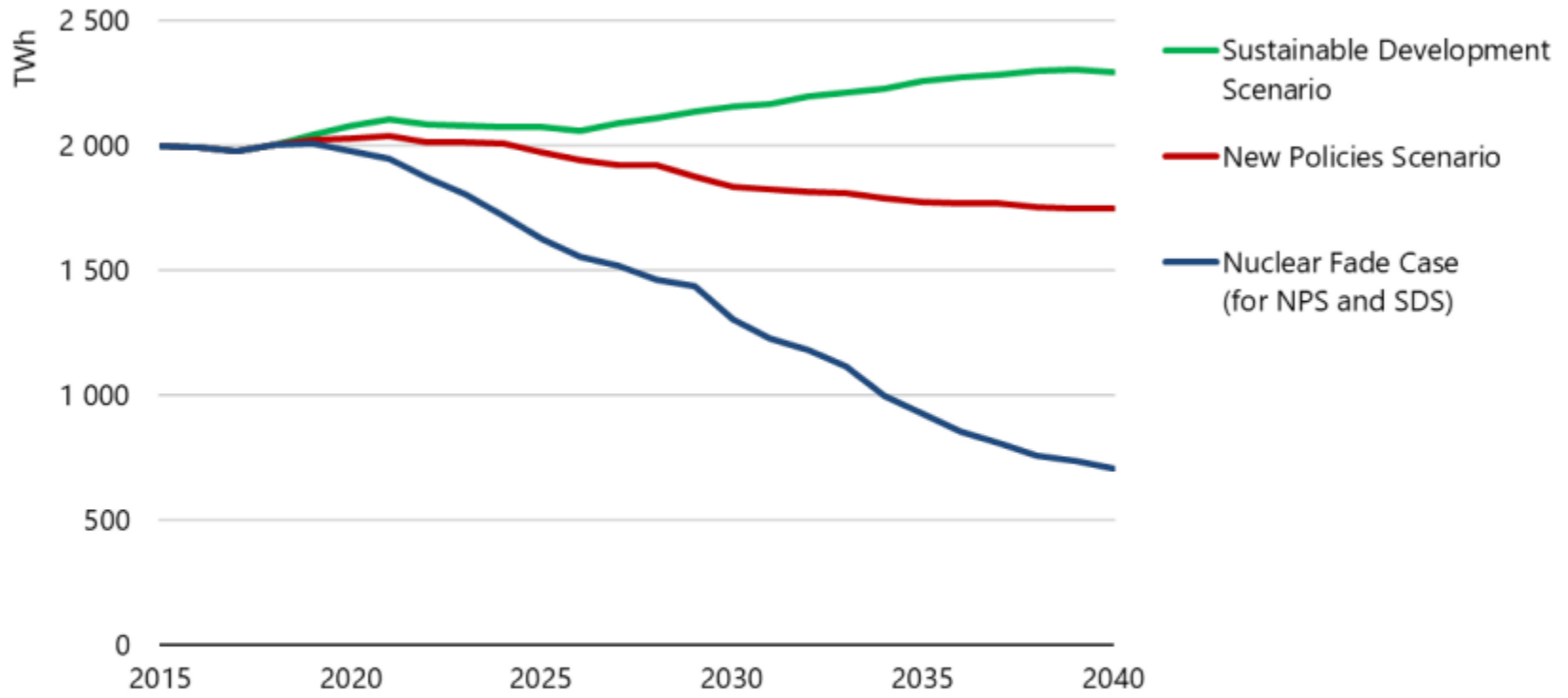
Electricity generation by source in advanced economies in the New Policies Scenario and Nuclear Fade Case, 2040



Natural gas contributes the biggest increase in electricity generation to compensate for less nuclear in the Nuclear Fade Case, with renewables – notably wind and solar PV – adding most of the rest.

Source: Nuclear Power in a Clean Energy System (IEA)

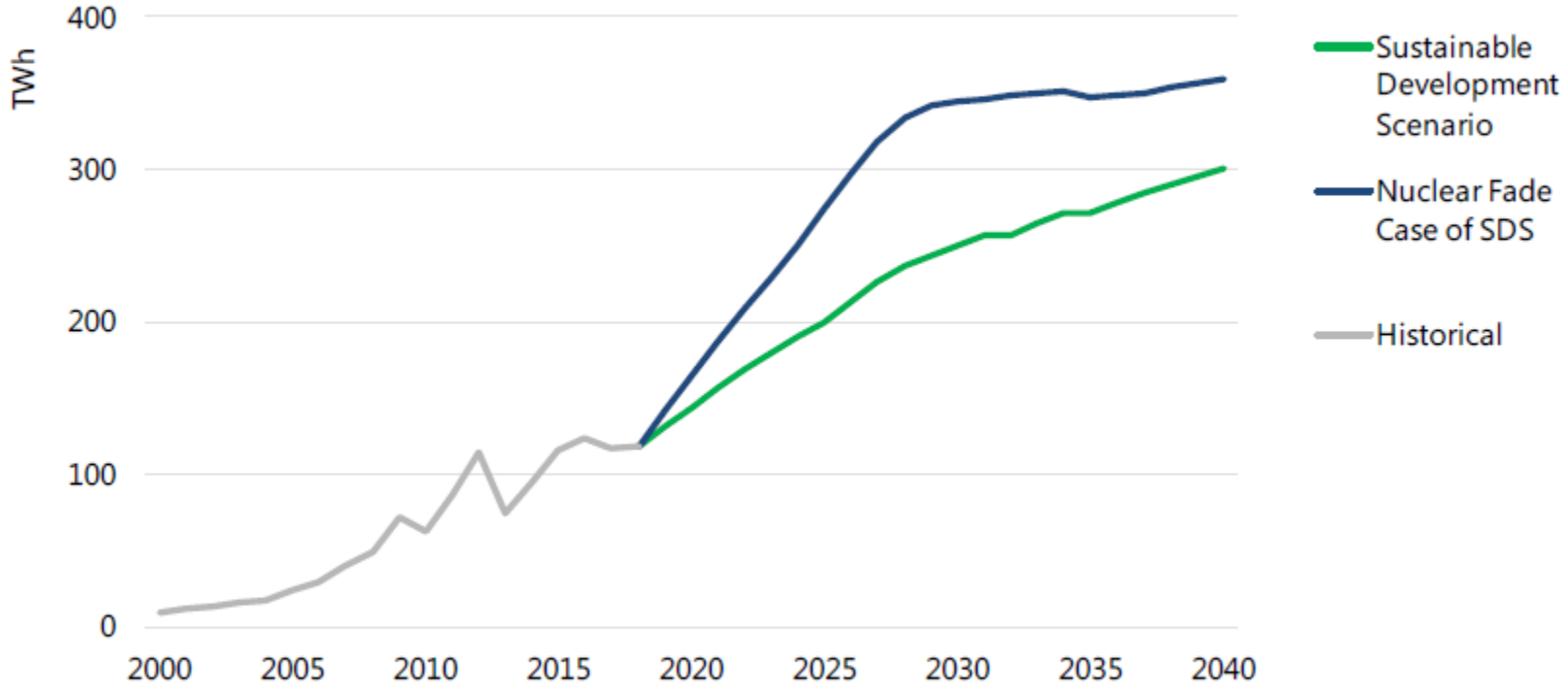
Nuclear power production in advanced economies by scenario



A large shortfall in low-carbon electricity would emerge without nuclear lifetime extensions or new projects, calling on other low-carbon sources to fill the gap to keep to a sustainable energy path.

Source: Nuclear Power in a Clean Energy System (IEA)

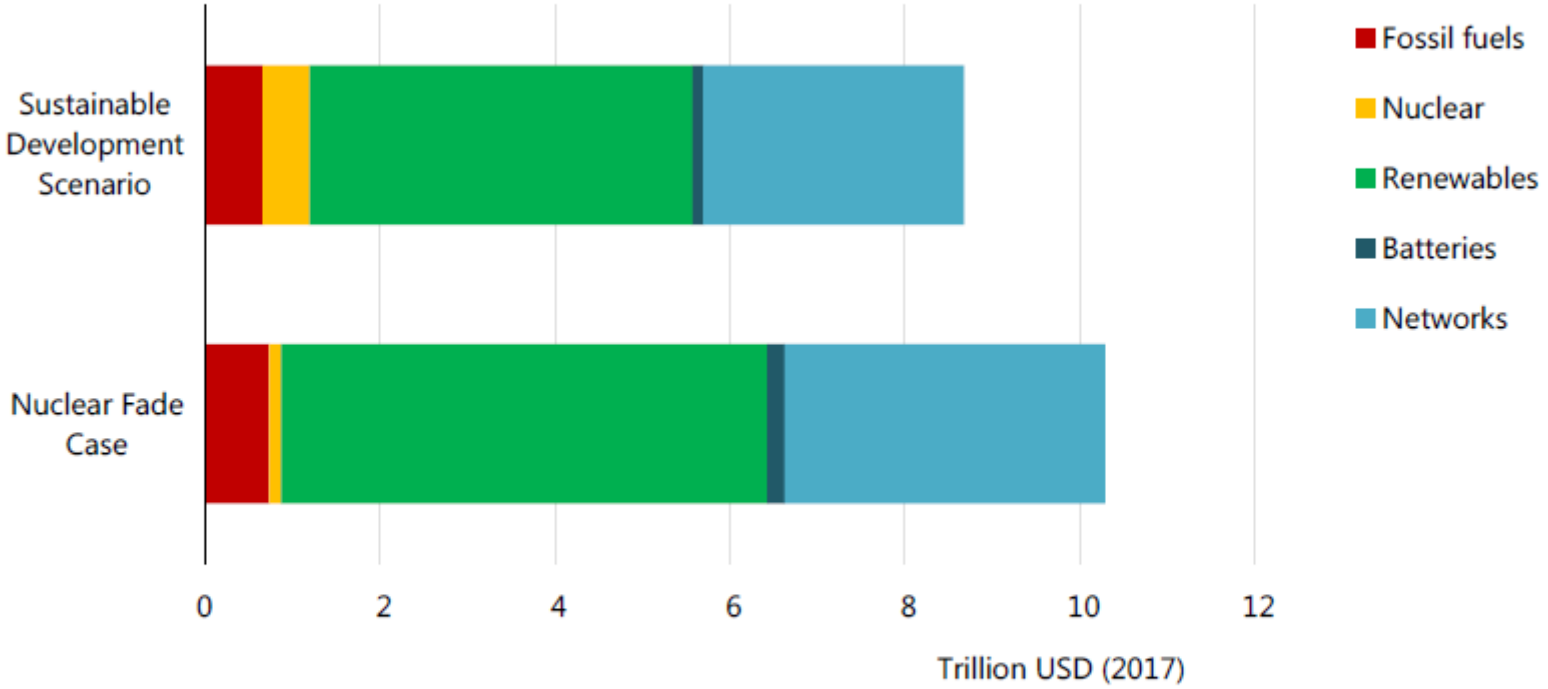
Combined wind and solar power production growth in advanced economies in the Sustainable Development Scenario and the Nuclear Fade Case



To achieve sustainable energy development, output from wind and solar power would need to expand twice as fast as in the past, and three times as fast in the absence of new nuclear investment.

Source: Nuclear Power in a Clean Energy System (IEA)

Cumulative electricity sector investment in advanced economies in the Sustainable Development Scenario and Nuclear Fade Case, 2019-40



An additional USD 2 trillion of investment in renewables and in networks would be required to achieve sustainability, far exceeding the USD 400 billion reduction in nuclear investment.

Source: Nuclear Power in a Clean Energy System (IEA)

World perspective

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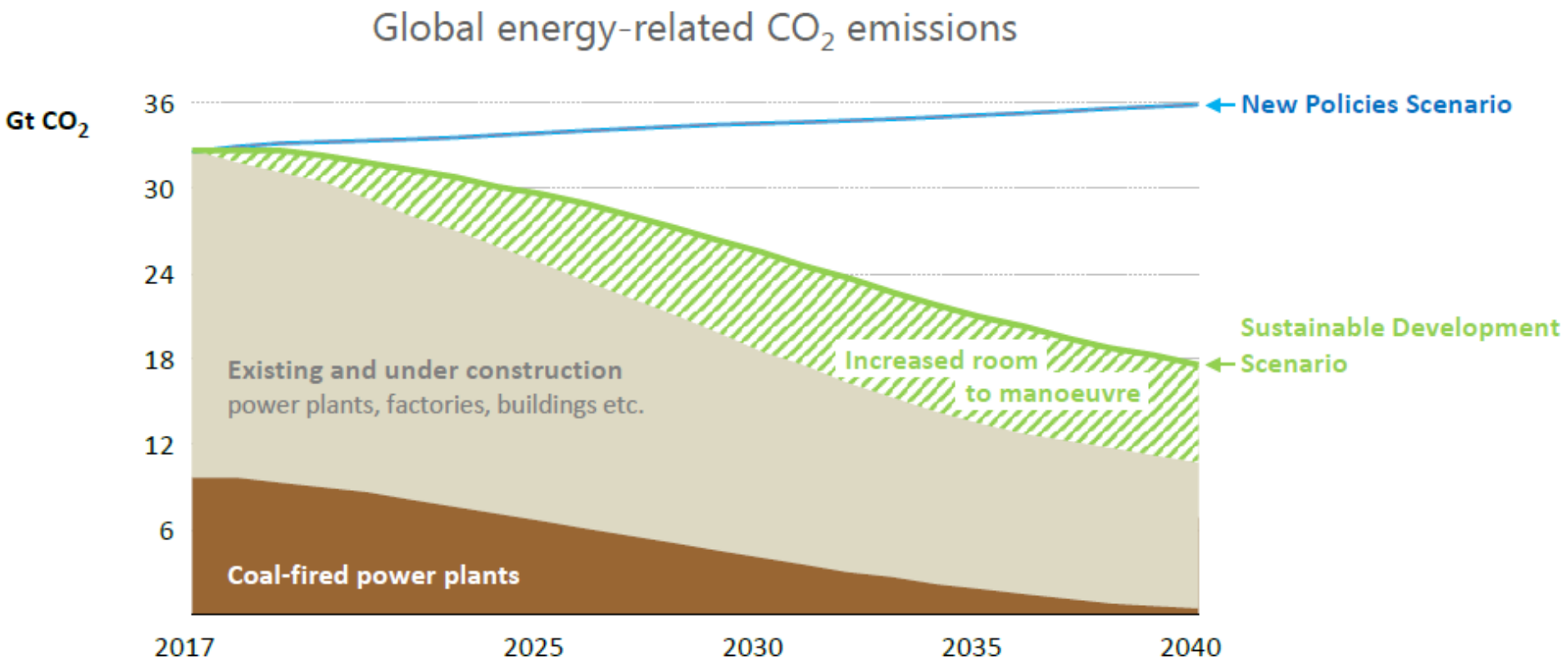
$$\frac{population}{1} \times \frac{GDP}{population} \times \frac{Energy}{GDP} \times \frac{GHG}{Energy}$$

	Population (million)	
	2018	2040
North America	490	559
United States	328	368
Central and South America	520	598
Brazil	211	231
Europe	692	695
European Union	513	508
Africa	1 287	2 095
South Africa	57	71
Middle East	241	324
Eurasia	234	249
Russia	145	138
Asia Pacific	4 138	4 652
China	1 400	1 422
India	1 353	1 593
Japan	126	113
Southeast Asia	654	768
World	7 602	9 172

	2018-40
North America	2.0%
United States	2.0%
Central and South America	2.9%
Brazil	2.8%
Europe	1.6%
European Union	1.5%
Africa	4.3%
South Africa	2.5%
Middle East	3.2%
Eurasia	2.3%
Russia	1.8%
Asia Pacific	4.4%
China	4.3%
India	6.4%
Japan	0.7%
Southeast Asia	4.4%
World	3.4%



Source: World Energy Outlook (2018)

Děkuji za pozornost

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