CARBON-FREE EUROPE
A TECHNOLOGY-INCLUSIVE CLIMATE INITIATIVE

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COUNTRY SUMMARY: CZECH REPUBLIC
ANALYSIS OF NET-ZERO PATHWAYS FOR THE EU AND UK

OVERVIEW OF MODELLING ANALYSIS

Carbon-Free Europe (CFE) modeled five potential pathways for the EU and UK to achieve net-zero emissions by 2050. The ***Core*** pathway is the least constrained, allowing countries to use all available clean energy technologies and assuming high levels of energy efficiency and electrification. This is the most feasible, cost-effective pathway to net-zero. The other four pathways are designed to explore how different policy and implementation constraints impact the route to carbon-neutrality. To learn more about the other pathways and our full analysis, visit www.carbonfreeeurope.org.

TODAY'S ENERGY SYSTEM

In 2019, 71% of the Czech Republic's energy supply came from fossil fuels (33% from coal, 16% from gas, and 22% from oil). Nuclear energy supplied 17% and renewable energy sources, including biofuels, provided 11%. 42% of Czech Republic's emissions in 2019 came from the energy sector (primarily electricity generation), 27% from industry, 15% from transport, and 11% from residential and commercial buildings. 2019 is a good baseline year to understand Europe's long-term energy demand and supply since impacts from the pandemic have heavily skewed data from 2020-2021. 2019 is also the most recent year for which Eurostat data is available.

KEY TAKEAWAYS: THE CORE PATHWAY IN 2050

1. **The Czech Republic's most feasible and cost-effective pathway to net-zero is the Core pathway, which includes the use of every available clean energy technology including nuclear energy and carbon capture.** In this pathway, by 2050, the Czech Republic's estimated electricity mix is 4% wind, 17% solar, 78% nuclear, and less than 1% gas. The Core pathway requires 246 billion Euros of investment through 2050 in key technologies including electricity generation and storage, clean fuels, direct air capture, and heat pumps.

2. **In a carbon-free economy, the Czech Republic becomes a key nuclear energy producer, building the third most nuclear power of any EU + UK country and exporting electricity to its neighbors.** The Czech Republic expands its existing nuclear generation capacity by 23 gigawatts (GW) by 2050 in the *Core* pathway.

3. **The Czech Republic also adds substantial solar capacity through 2050.** In the *Core* pathway, Czechia adds 27 GW of new solar photovoltaic capacity through 2050, the 6th most of any EU + UK country.

4. **Czechia leverages nuclear heat to become an important producer of high-temperature hydrogen.** The Czech Republic produces 12 kilotons of high-temperature hydrogen in the *Core* pathway, becoming the 12th largest producer among EU + UK countries. High-temperature hydrogen production in Czechia is very sensitive to constraints, with total production reaching a maximum of more than 750 kilotons when demand-side electrification is constrained (***Slow Demand Transformation*** pathway).

5. **The Czech Republic builds significant new electric transmission and hydrogen pipeline capacity to export energy to neighboring countries.** In the *Core* pathway, Czechia adds 17 GW of transmission and 5 GW of hydrogen pipeline. Though both are substantially lower under constrained pathways.

6. **Total electricity demand increases by 165%**, driven by electrification of end uses and growth in hydrogen production.

7. **Czech Republic ranks in the top 10 largest reductions in end-use gas demand.**[1] Gas transitions from providing 16% of the country's energy in 2019 to less than 1% in 2050.

8. **Czechia is in the top 10 biofuel producing states in Europe, leveraging its supply of both woody biomass and its potential for energy crop production.** The Czech Republic produces 3800 kilotons of oil equivalent (ktoe) of biofuel in the *Core* pathway.

9. **The Czech Republic will need to ramp up the pace of renewables deployment by as much as 13 times to decarbonize in line with goals to reach net-zero.** From 2011 to 2020, the Czech Republic built on average 100 megawatts of renewable energy per year. To meet demand, the Czech Republic will need to build between 700 megawatts to 1.3 gigawatts annually (representing a 7 to 13x increase).

KEY ENERGY METRICS

The table below shows key energy system metrics from the ***Core*** pathway, which is the most cost-effective, feasible trajectory to net-zero. The table also shows a range for each metric. That range is generated by comparing the ***Core*** pathway to four other modelled pathways designed to evaluate specific constraints.

The ***Slow Demand Transformation*** pathway imposes delays in electrification of surface transportation, heating, and industry. The ***100% Renewables*** pathway relies strictly on renewables, phases out nuclear power, and prevents carbon capture and sequestration. The ***Limited Renewable Siting*** pathway restricts the deployment of wind and solar to reflect land-use and siting constraints. The ***Domestic Preference*** pathway prioritises domestic energy supplies and reduces transborder transmission lines and pipelines.

We provide a range for each metric in the table to indicate which model results are highly sensitive to constraints, and which are consistent across all scenarios such that they represent low-regret strategies. We also show the Czech Republic's rank in each metric relative to all EU + UK countries, to identify segments of the decarbonised energy economy where the Czech Republic has an opportunity to lead.

Category	Metric	Core Case	Min	Max	EU & UK Rank
Demand Transformation	electrification share (% of final demand)	47%	41%	47%	18
	reduction in end-use gas demand (ktoe)	-3,234	-2,235	-3,234	9
	reduction in end-use oil demand (ktoe)	-5,948	-5,396	-5,948	15
	zero-emission vehicles (million vehicles)	6.6	6.4	6.6	12
Electricity	new battery storage (GW)	1	0	1	19
	new nuclear (GW)	23	15	23	3
	new solar (GW)	27	19	37	6
	new onshore Wind (GW)	5	2	5	18
Fuels	biofuels (ktoe)	3821	2067	3822	9
	e-fuels (ktoe)	21	7	2310	28
Hydrogen	electrolysis - high temperature (kilotonnes h2)	12	12	757	12
	electrolysis - low temperature (kilotonnes h2)	26	18	28	20
Other Resources	Biomass (million dry tons)	17	12	17	11
	geologic sequestration (million tons co2)	4	4	8	12
Transmission and Pipelines	new electricity transmission (GW)	17	2	17	12
	new h2 pipelines (GW)	5	3	22	12

Table 1: https://www.carbonfreeeurope.org/modeling

ENDNOTES

1. This takeaway is a 2050 projection based on 2019 historical data. It does not reflect recent prioritisation of gas phase-out for geopolitical reasons, which we do not expect to be a strong predictor of residual gas demand in 2050. All countries in our analysis significantly reduce gas consumption by 2050.