



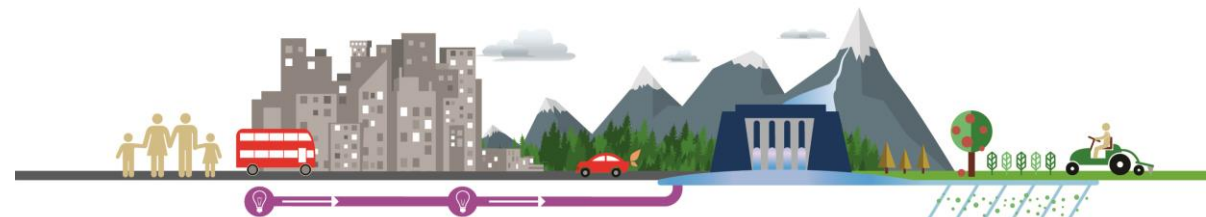
A Low Carbon Growth Path for Slovakia

Findings from a project of the Ministry of Environment and the World Bank

“Construction of economic modeling tools and building capacity in modeling for sustained growth in Slovakia”



13 September 2018



Coming out of the dark

- Too many questions but few answers about low-carbon transition
 - What are the cost-effective (cheapest) policies to decrease emissions?
 - What would be the impact on growth and employment in different sectors?
 - What would be the total costs of such a transition?
- Finally in 2016, a political decision was made to team up with the World Bank to prepare a Low Carbon Study
 - Institute for Environmental Policy (IEP) in charge of the project

Joint project with the World Bank

- World Bank is providing:
 - A low carbon study
 - Macro and energy models with technical documentation
 - Trainings (total of 33 days)
- IEP brought together Slovak experts, provided data and local expertise (3 ministries, SHMU, STU)
- Capacity building: IEP will own and maintain models and will be able to provide ad hoc analysis in the future

The low carbon study as a basis for policy making

- A low carbon strategy will:
 - provide long term vision of a Slovak low carbon future,
 - align Slovak policies with the Paris Agreement,
 - set new Slovak goals and policies to achieve them and ensure financing.
- Work on strategy has already begun:
 - public consultation in May 2018
 - first draft should be ready at the end of 2018.
- Regular emissions projections, future policies' impact evaluation

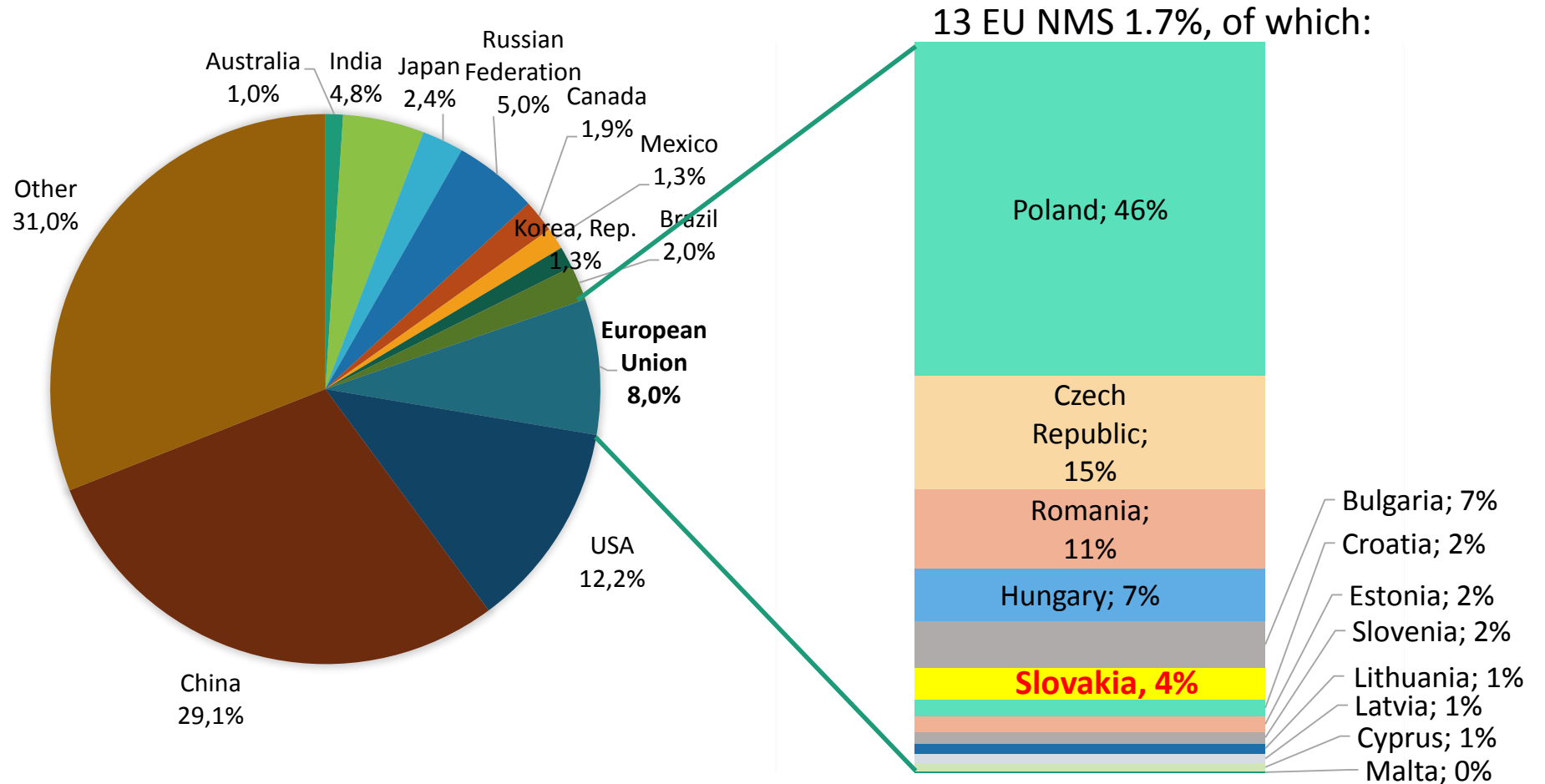


Slovakia's greenhouse gas emissions

Some key facts

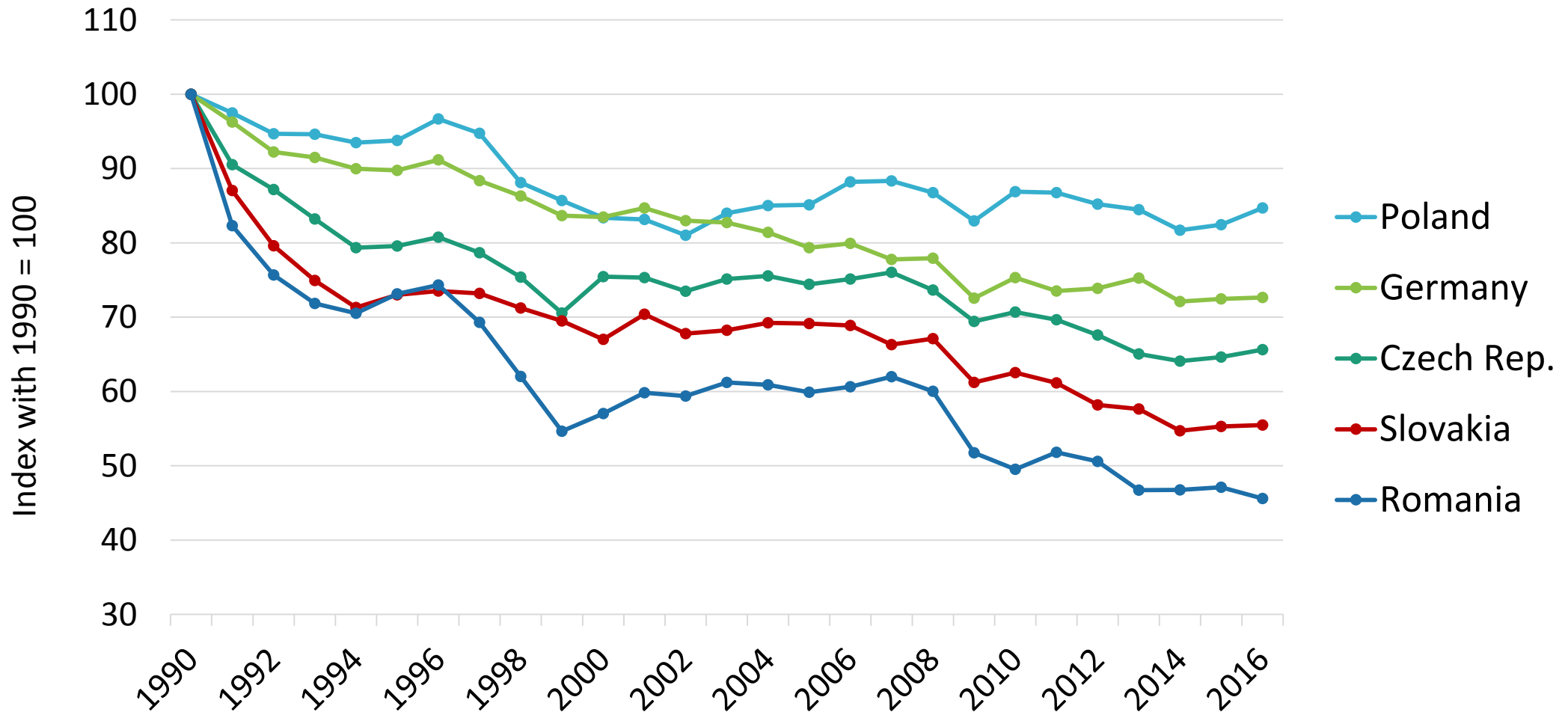
Slovakia's emissions constitute a small share of global and EU emissions

Global emissions by selected countries, % of total



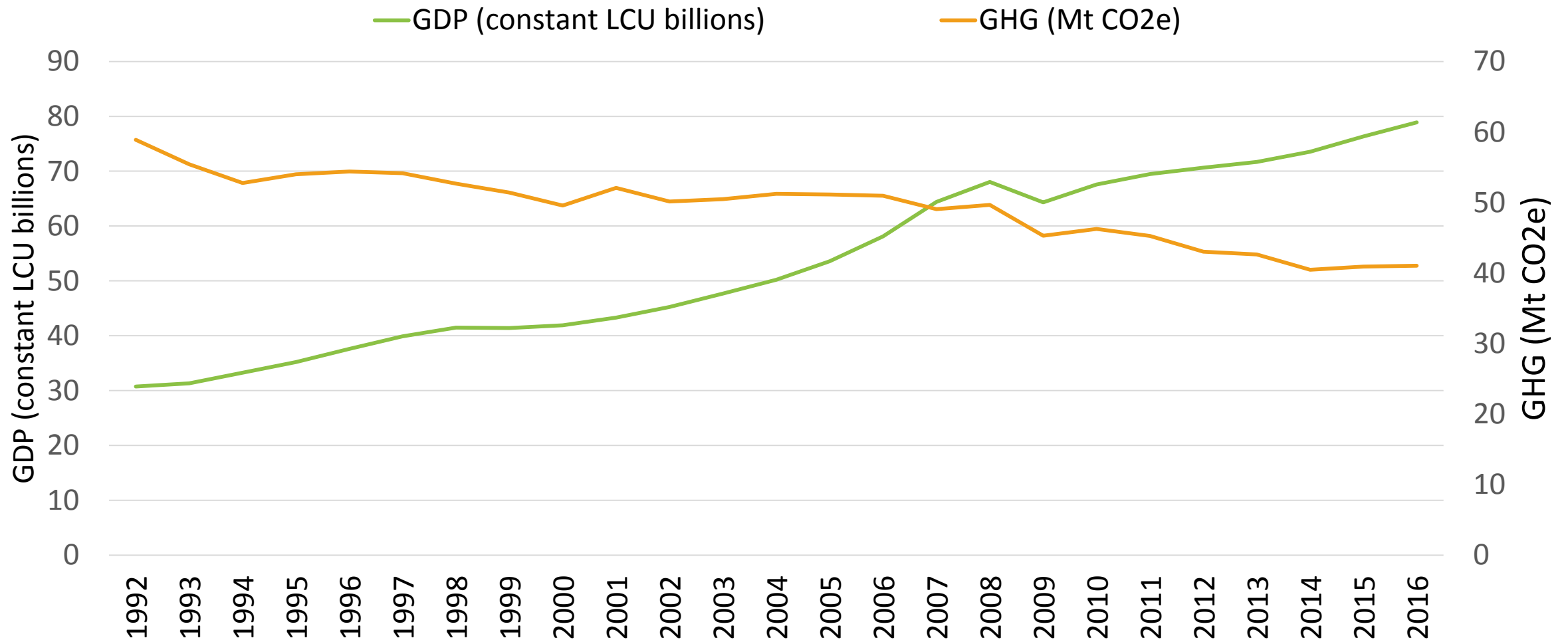
Slovakia's emissions have declined significantly

Changes in GHG emissions in selected EU countries



Slovakia has delinked growth from emissions

GDP and greenhouse emissions, 1992-2016

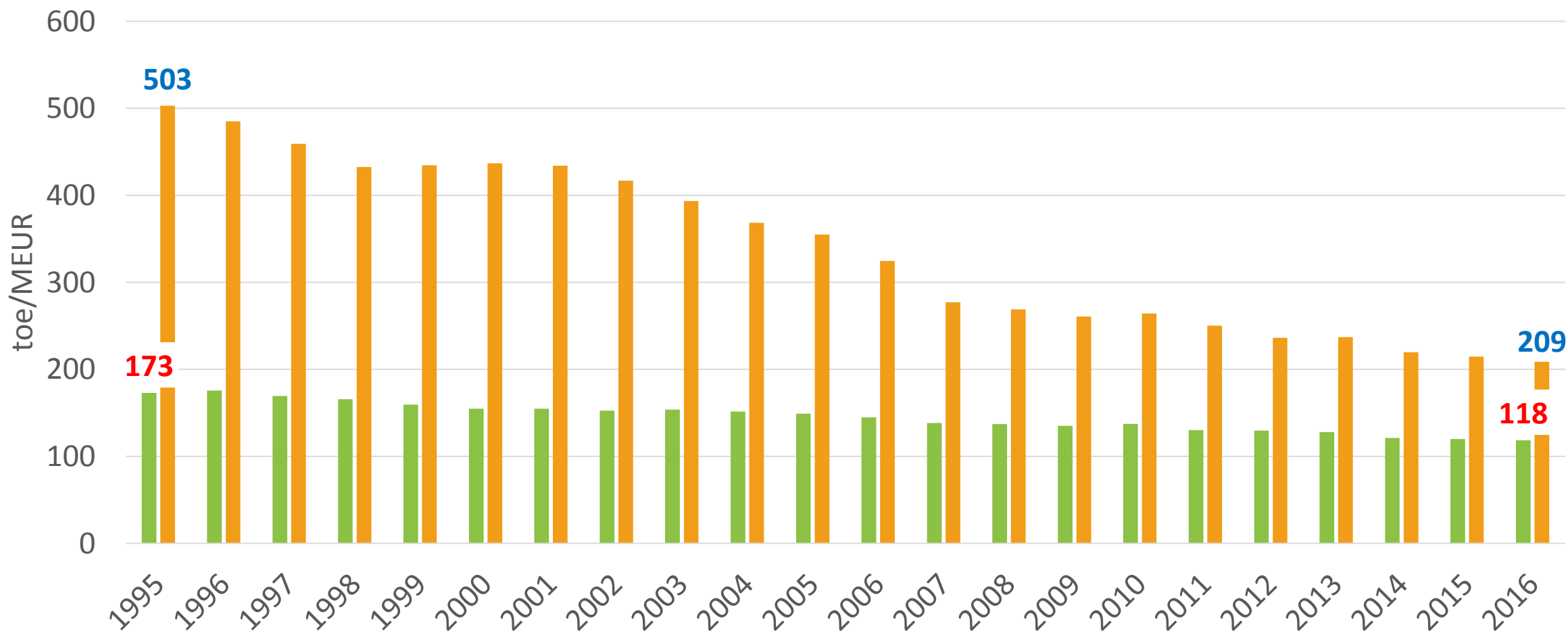


Slovakia's progress in energy intensity still leaves it lagging EU averages

Energy intensity in the EU and Slovakia

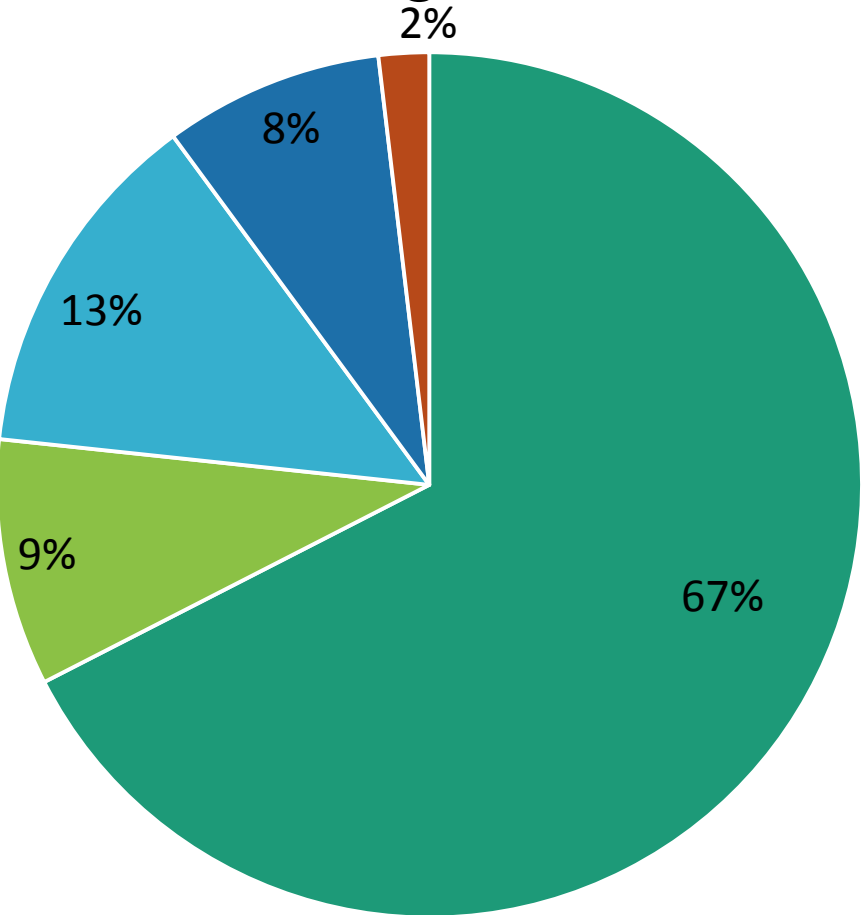
■ Energy/GDP EU28

■ Energy/GDP Slovakia

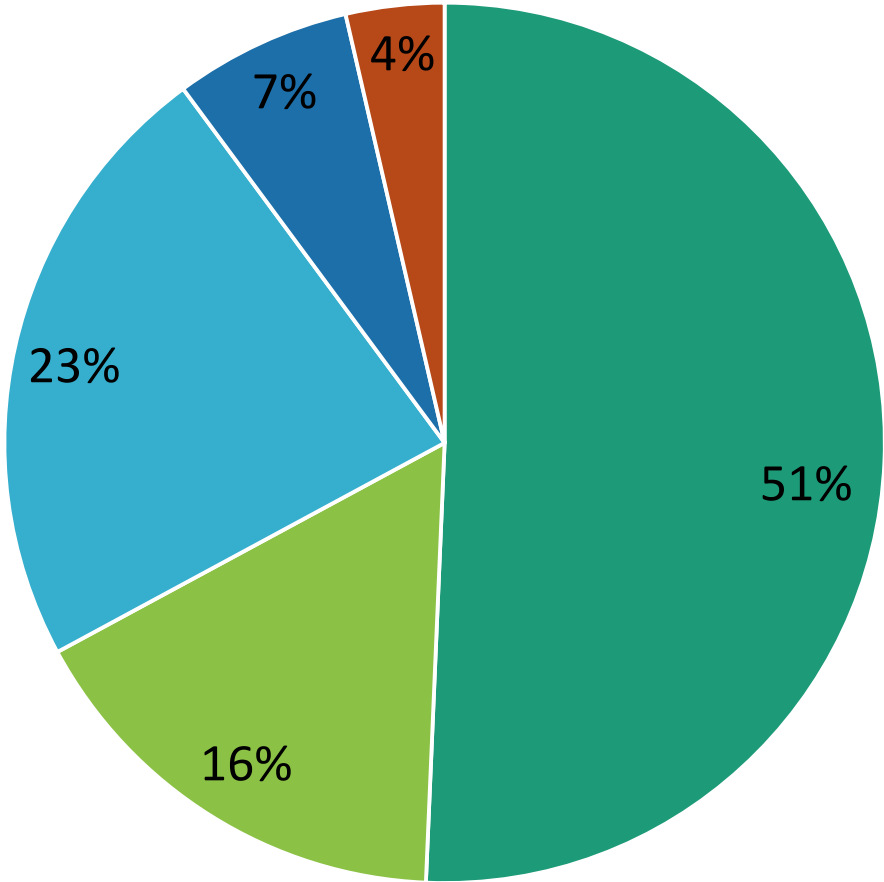


Industry and transport emissions have grown in importance

Greenhouse gas emissions by sector



1990

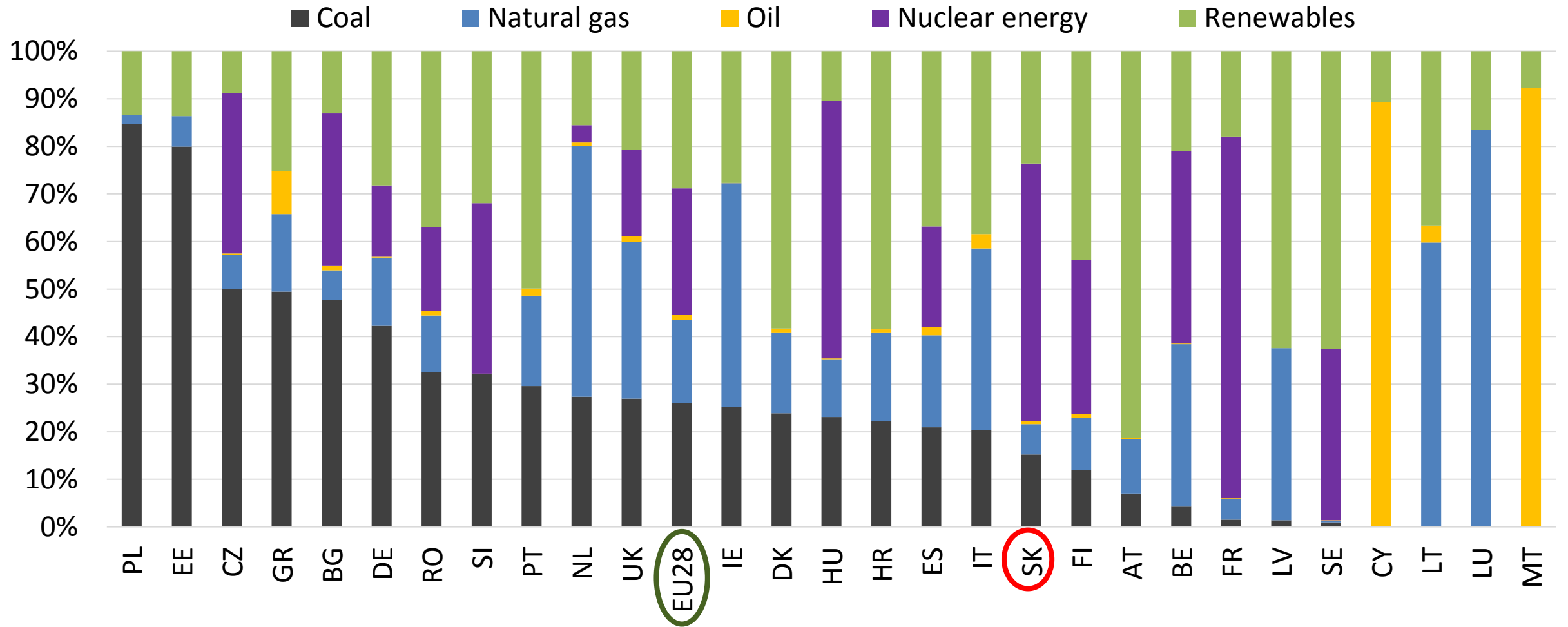


2016

- Energy excl. transport
- Transport
- Industrial processes
- Agriculture
- Waste

Slovakia depends mostly on nuclear power for electricity

Gross electricity generation by source (GWhe), 2015





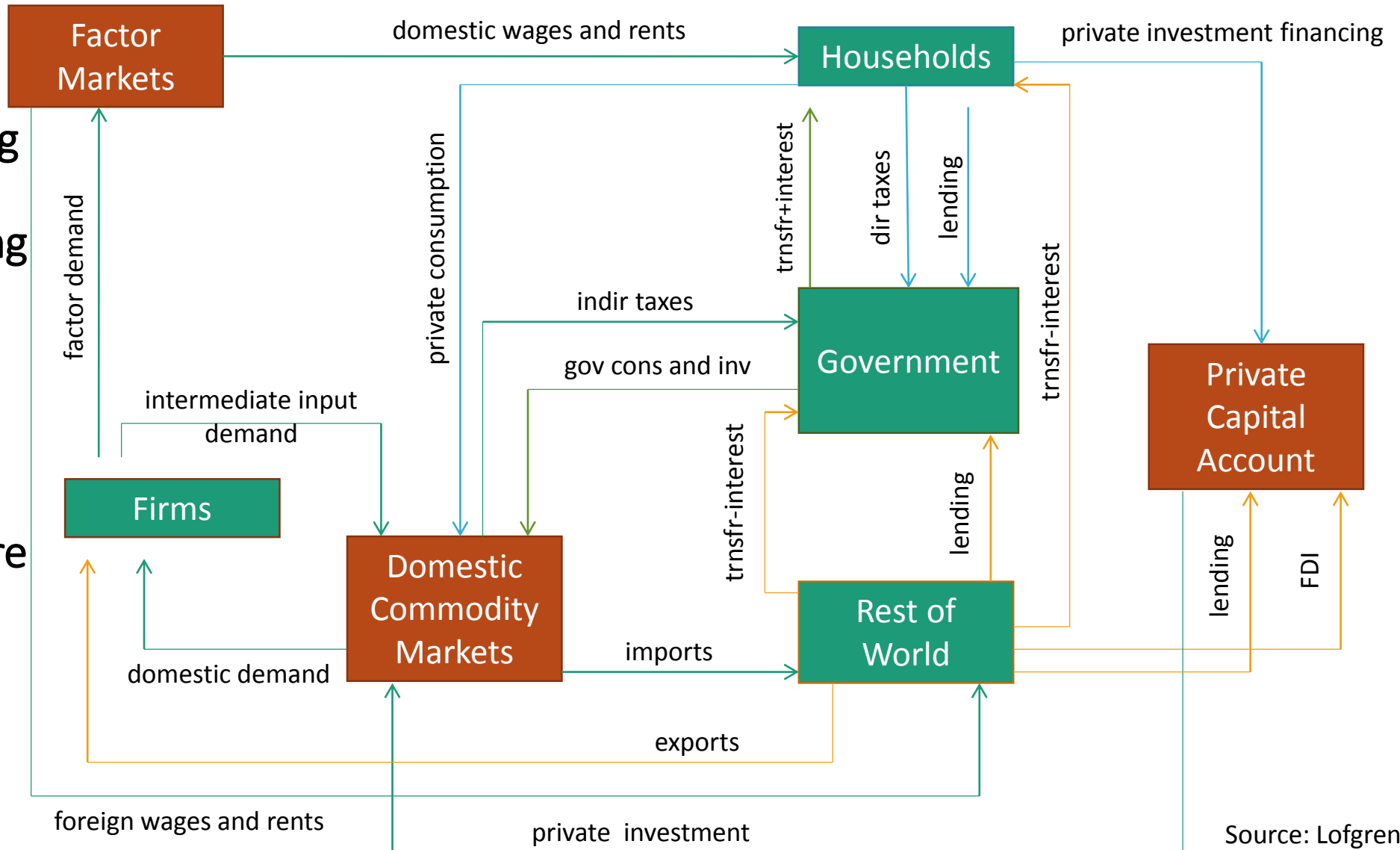
Using modelling to find low carbon options for Slovakia

An introduction to an energy model and a macroeconomic model

Modelling impact across the economy

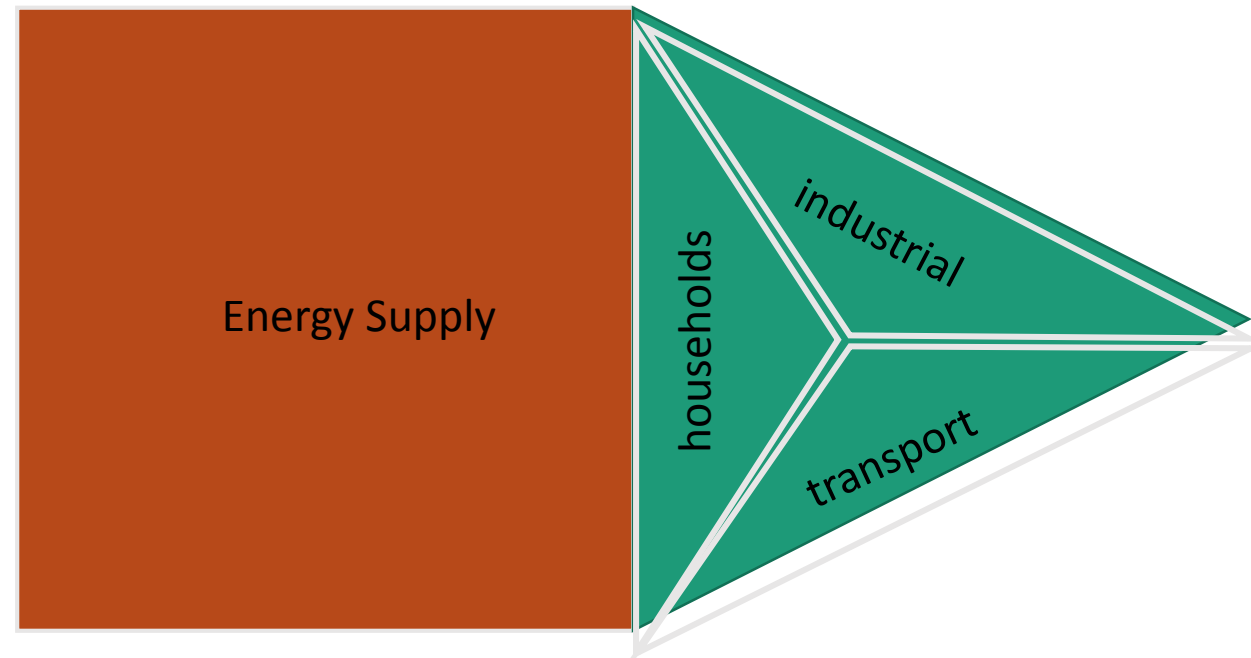
ENVISAGE-Slovakia Applied General Equilibrium Model

Firms respond to costs when making production decisions, including the amount of energy to use...
... higher energy costs encourages investment in more energy-efficient technologies



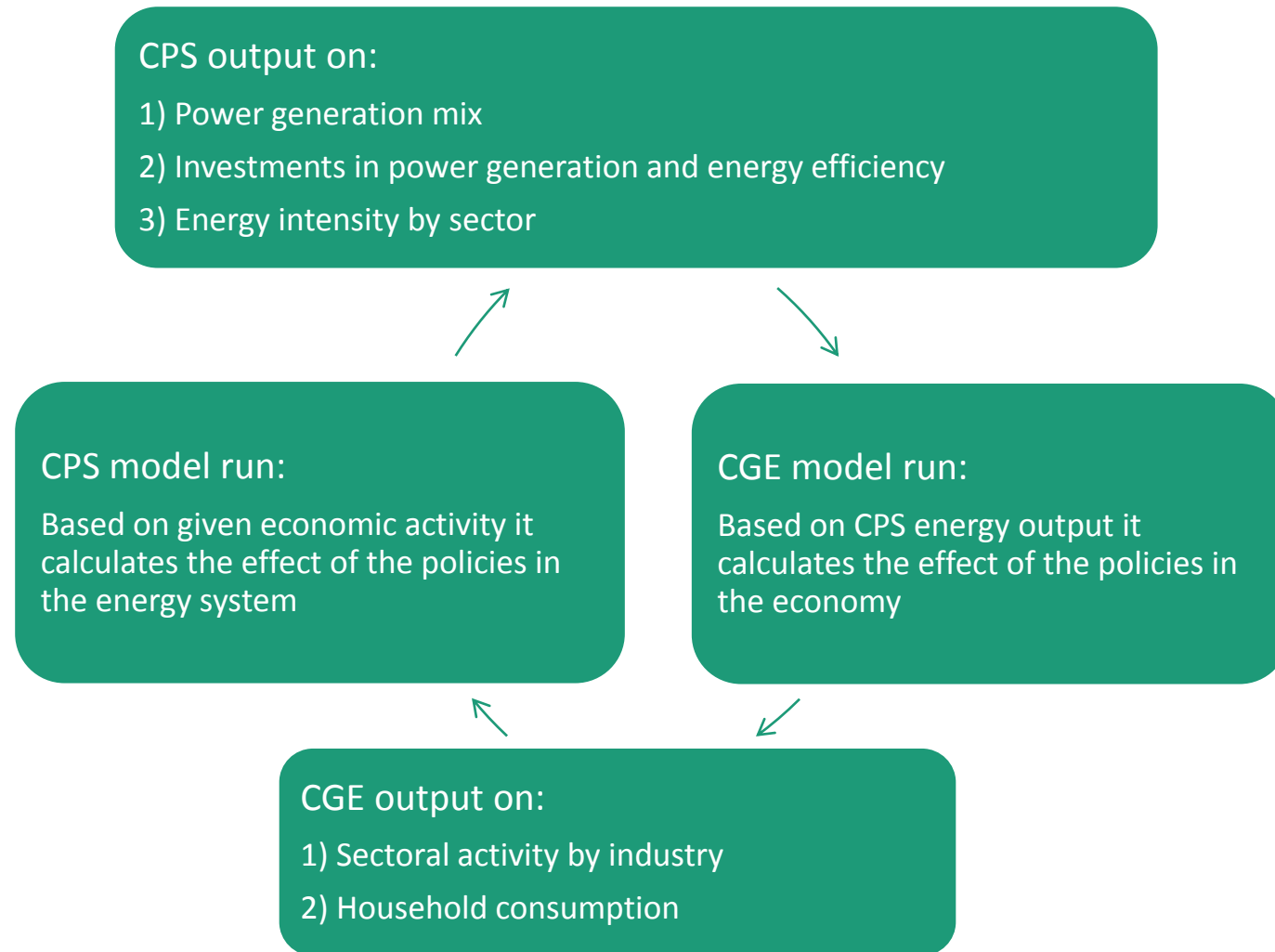
Modelling Slovakia's energy sector

Compact PRIMES for Slovakia (CPS model)



CPS was developed by E3M, in collaboration with the World Bank and Institute of Environmental Policies

Linking CPS and CGE models to assess policy



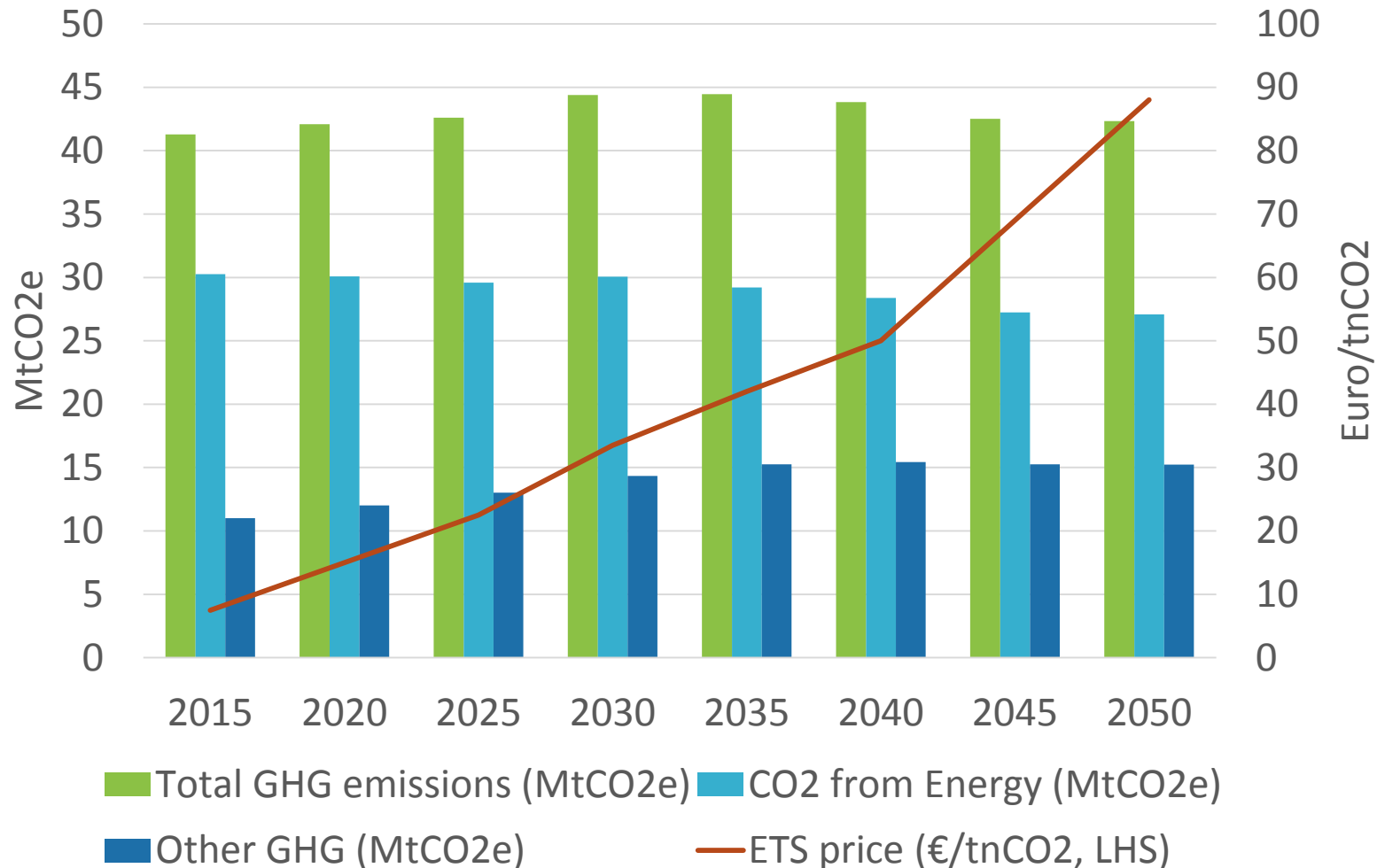


Baseline or reference scenario

A starting point to understand policy options

ETS price alone drives only a small reduction in emissions

Reference assumes that there are no supporting policies after 2020



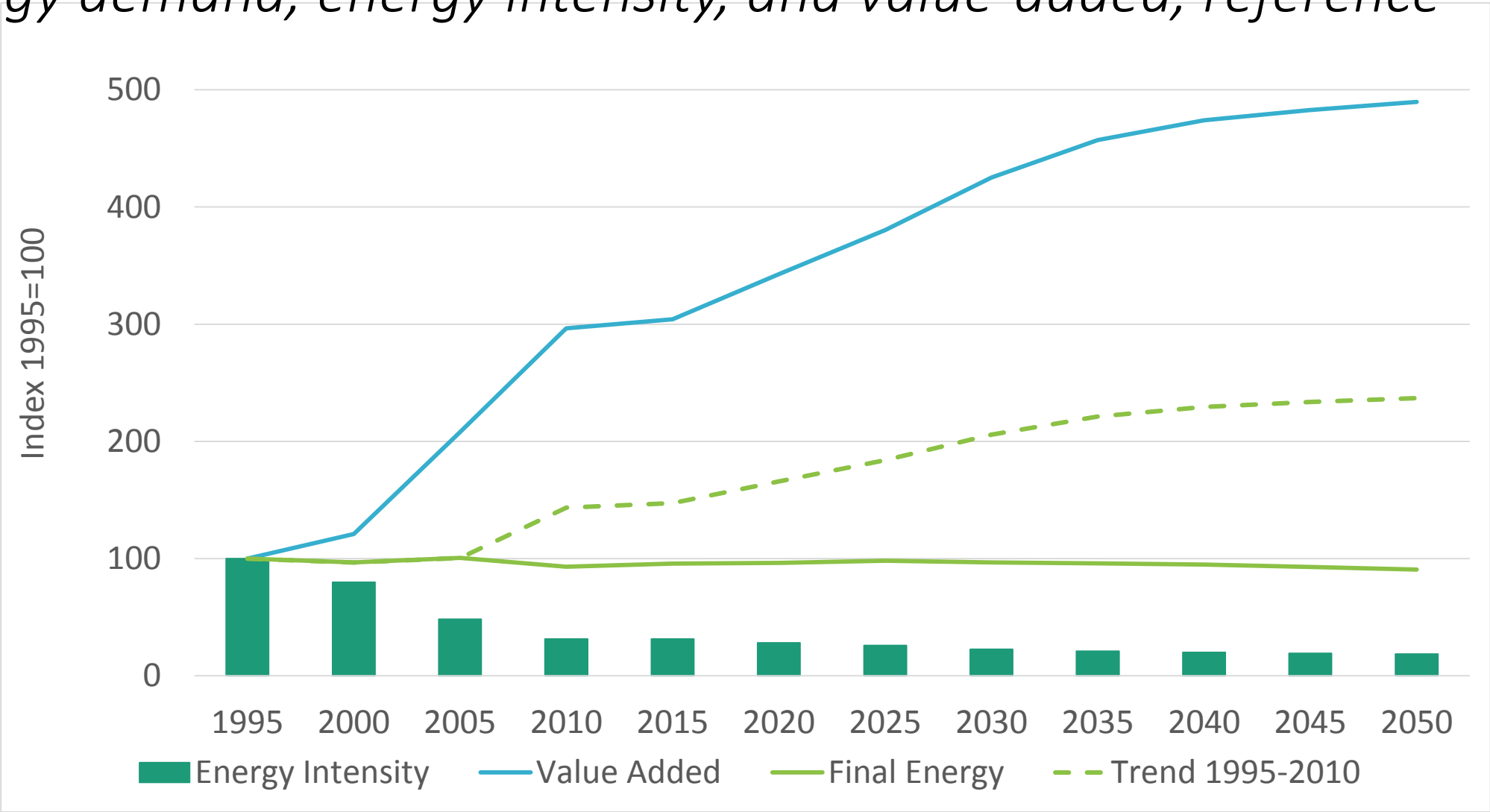
Economic growth slows, driven by fall in population...

.. but continued export-driven expansion of selected manufactures and rise of services sector

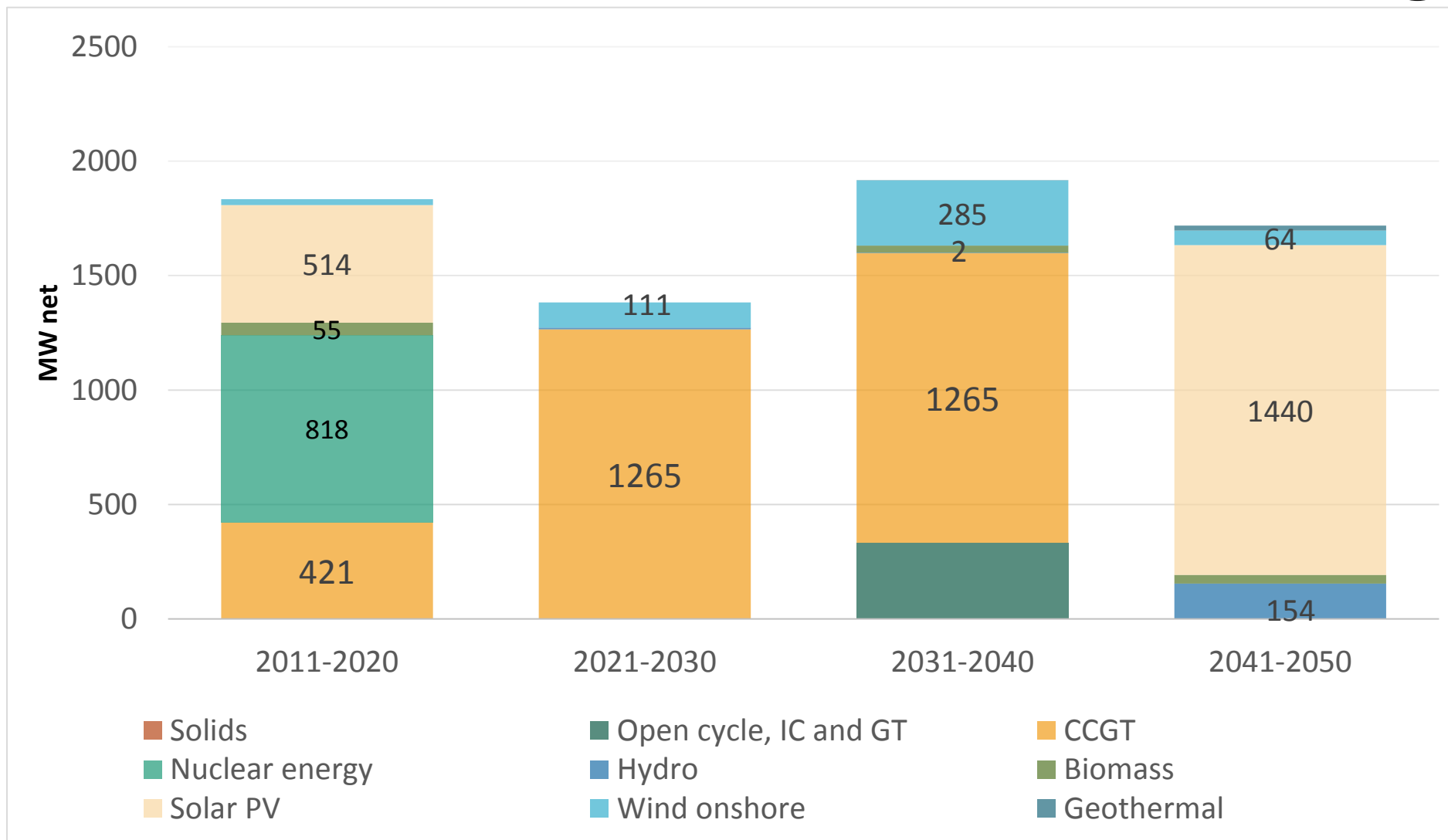
Average annual growth rate (% p.a.)	2020	2025	2030	2035	2040	2045	2050
GDP	3.1	2.7	2.7	1.8	1.1	0.6	0.6
Iron & Steel	1.7	1.2	0.9	0.6	0.2	-0.5	-0.7
Non Ferrous	2.1	1.4	1.1	0.9	0.2	-0.4	-0.5
Chemicals	1.8	1.5	1.6	0.9	0.5	0.2	0.1
Building Materials	2.5	2.4	2.5	1.2	0.5	0.2	0.1
Paper & Pulp	2.0	2.1	2.0	1.3	0.7	0.3	0.2
Food,Drink,Tobacco	2.4	2.2	2.1	1.4	0.7	0.1	-0.1
Engineering	3.0	2.5	2.7	1.9	1.0	0.8	0.8
Textiles	-0.1	-0.1	0.0	-0.7	-1.1	-1.5	-1.5
Other Industries	2.0	1.8	2.1	1.1	0.4	-0.3	-0.4
Services	3.3	2.9	2.9	1.9	1.3	0.8	0.7
Agriculture	1.8	1.4	1.8	0.8	0.2	-0.5	-0.6

Energy efficiency improvements continue although with a slowing pace

Energy demand, energy intensity, and value-added, reference

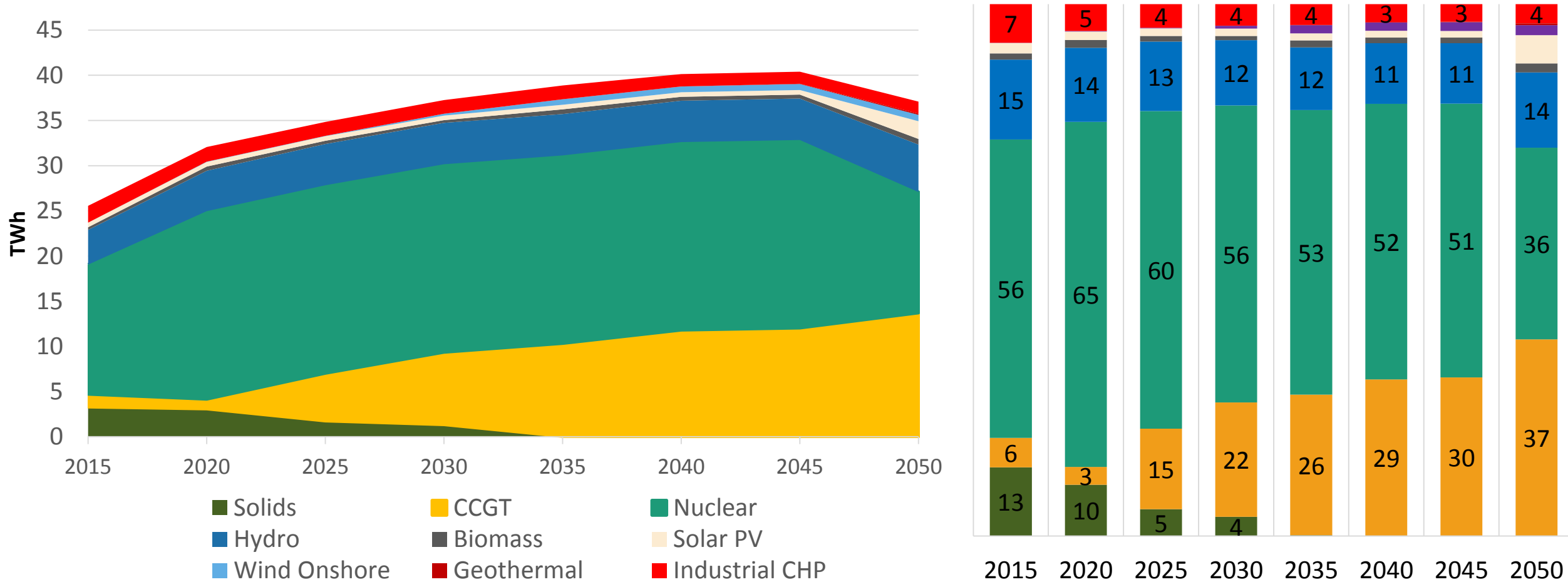


Investment in electricity capacity is concentrated in CCGT in medium term and solar in the long term



These investments drive the power generation mix

Net electricity generation by plant type, in TWh and shares

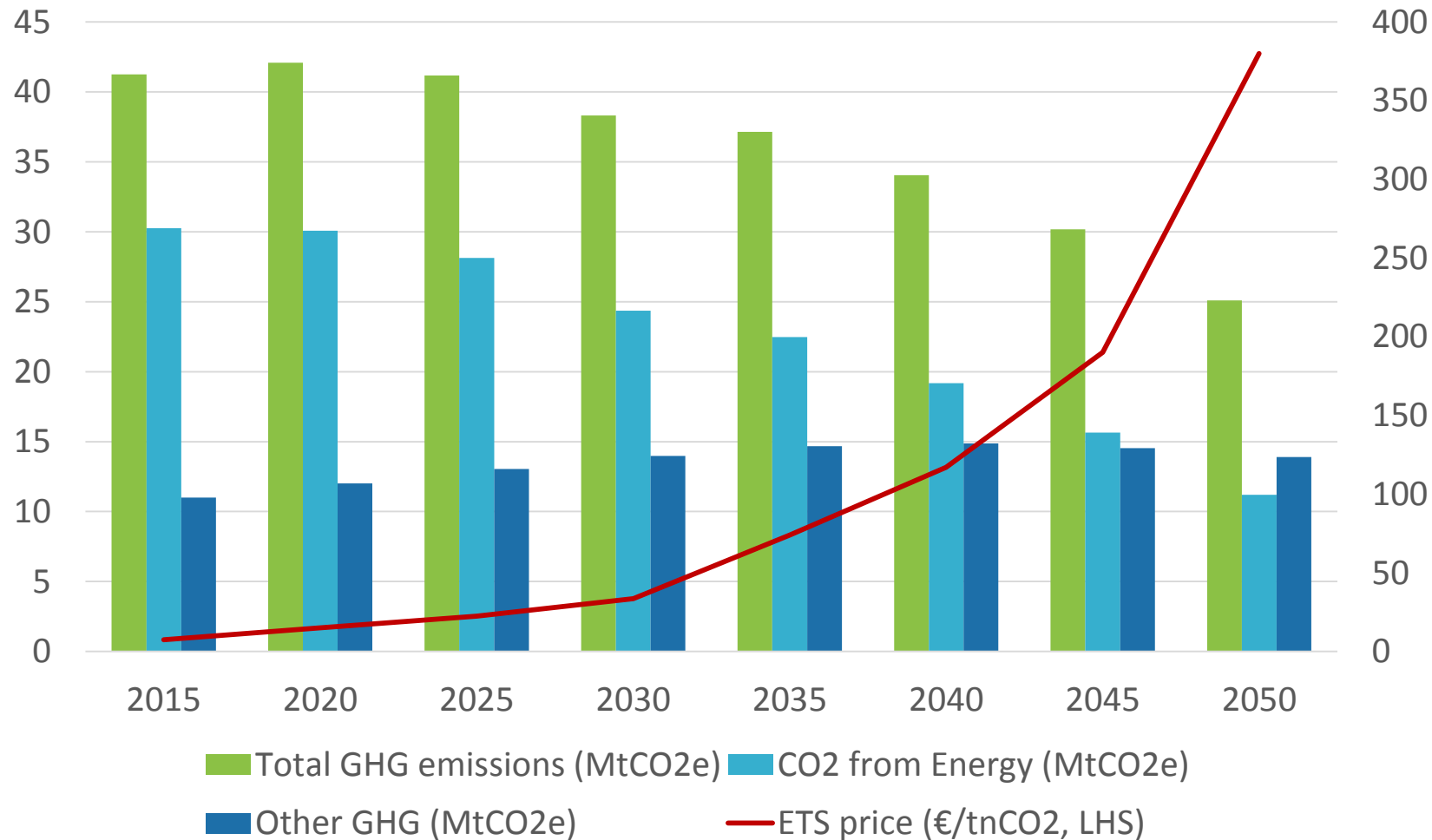




Policy scenarios

Options to move Slovakia towards a low emission future

Supporting policies and a high ETS price drive substantial reduction in emissions



Meeting the new requirements of the Winter Package: Clean Energy for All European”, launched by the European Commission in November 2016

Decarbonization scenarios: energy efficiency and renewable energy

- Reference shows all committed policies and additional policies needed to reach 2020 targets.
 - Post 2020, only the ETS remains in place
- Decarbonization scenarios are based on EUCO
 - Substantial freedom in national targets for renewables, energy efficiency and overall GHG emission reductions
 - Scenarios designed to investigate the various ways Slovakia can meet its EUCO commitments
- Scenarios consist of similar policy levers, but vary in intensity.

Decarbonization implies specific policies

Key actions to achieve energy efficiency or renewables targets

- Energy efficiency is driven by:
 - Renovation (e.g., insulation of buildings)
 - Eco-design regulations
 - Best available techniques in industries such as iron & steel, cement, and aluminum
 - Transport electrification and energy efficiency standards
- Renewables target is achieved through:
 - Policies promoting renewables in the medium term such as mandatory legislation, infrastructure, easing site access and connections
 - Significant rise in ETS price in the long-term

Four combinations of policies were assessed

Shorthand description of policy scenarios

- Scenarios are distinguished by the efforts made by industry, households in energy efficiency and the penetration of renewables.
- **Decarbonization 1:** Focus on Energy Efficiency policies, featuring strong uptake of energy efficiency improvements by industries and housing renovation by households
- **Decarbonization 2:** Balanced targeting of both Renewables and Energy Efficiency
- **Decarbonization 3:** Focus on Renewables policies, featuring strong uptake of biomass in both electricity generation and heating and cooling
- **Decarbonization 4:** Achieve Renewables target through Electricity which leads to higher penetration of onshore wind and Solar PV

Renovation, industrial heat recovery and electrification of transport allow Slovakia to meet energy efficiency targets

Indicators of energy efficiency measures

		2015					2030					2050				
Investments (M€)		Ref	Dcarb1	Dcarb2	Dcarb3	Dcarb4	Ref	Dcarb1	Dcarb2	Dcarb3	Dcarb4	Ref	Dcarb1	Dcarb2	Dcarb3	Dcarb4
		Heat Recovery	-	115	954	292	116	85	126	1178	984	847	809			
Processing Equipment & Appliances	970	1555	1457	1470	1488	1490	1957	2234	2197	2198	2202					
Building renovation	3429	7811	7865	7855	7856	7850	9811	9704	9698	9697	9702					
Building renovation	-	462	4266	1661	1067	1307	508	9531	4305	2251	2397					
Passenger cars (thousand of vehicles)																
Electric & Fuel Cell	-	37	56	56	56	56	284	1991	1993	1992	1992					
ICE Plug ins	-	69	99	99	99	99	263	371	370	371	370					
ICE	1754	2409	2357	2357	2357	2357	2561	1211	1211	1209	1212					

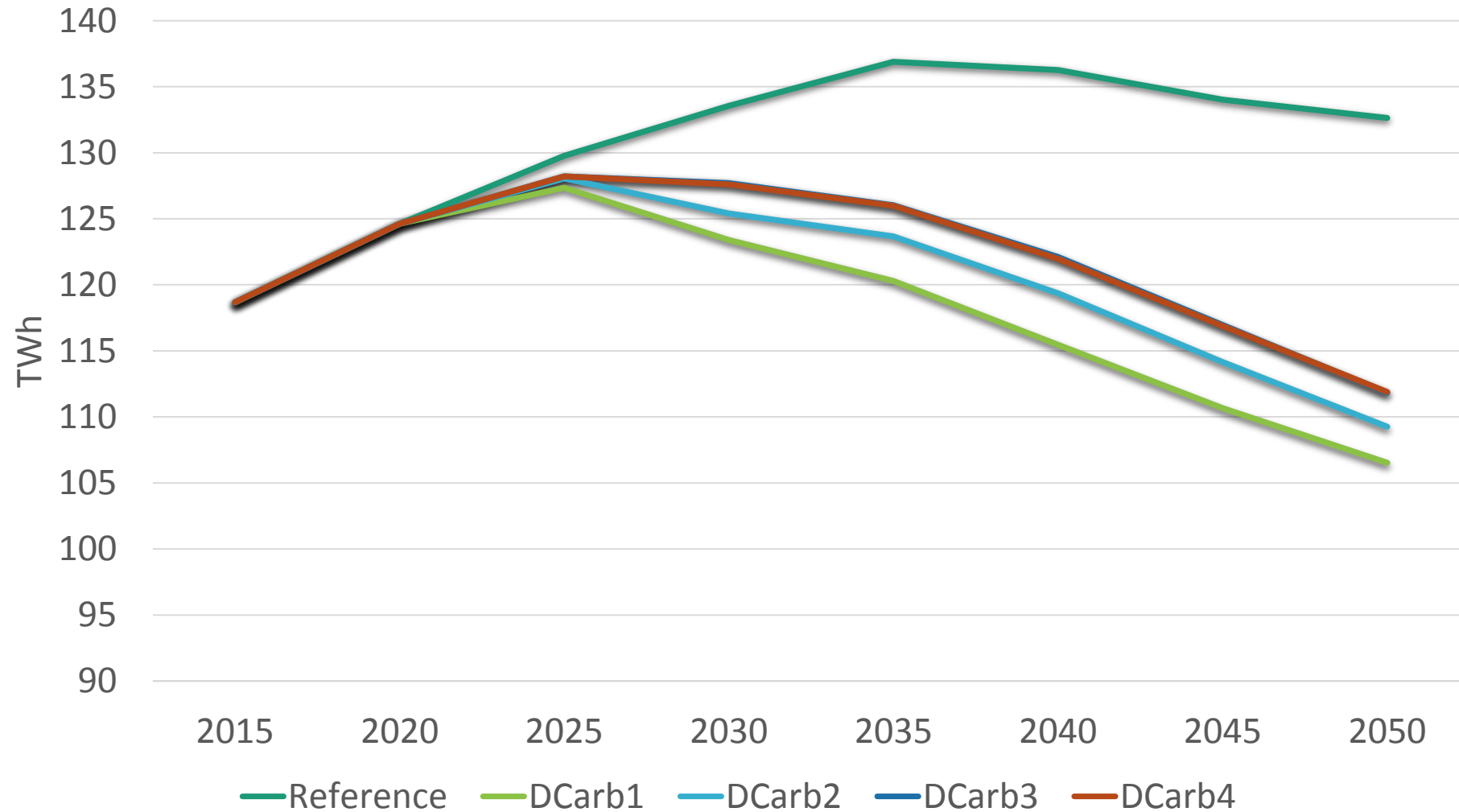
Decarbonization scenarios differ on targets for renewables and energy efficiency

Key policy targets and outcomes by scenario

	2015	2020	2030				
<i>Policy targets:</i>			Reference	DCarb1	DCarb2	DCarb3	DCarb4
Overall RES share	14.0	14.5	14.3	16.3	18.9	19.8	21.9
RES-Electricity share	19.4	23.4	21.3	22.6	24.8	25.3	36.8
Primary energy savings	0.0	-20.2	-24.9	-30.3	-28.4	-27.3	-28.9
<i>Outcomes:</i>			Reference	DCarb1	DCarb2	DCarb3	DCarb4
Total GHG emissions (MtCO₂e)	41.3	42.1	44	39.5	38.8	38.8	38.3
CO₂ emissions from energy (MtCO₂e)	30.3	30.1	30	25.4	24.6	24.7	24.4

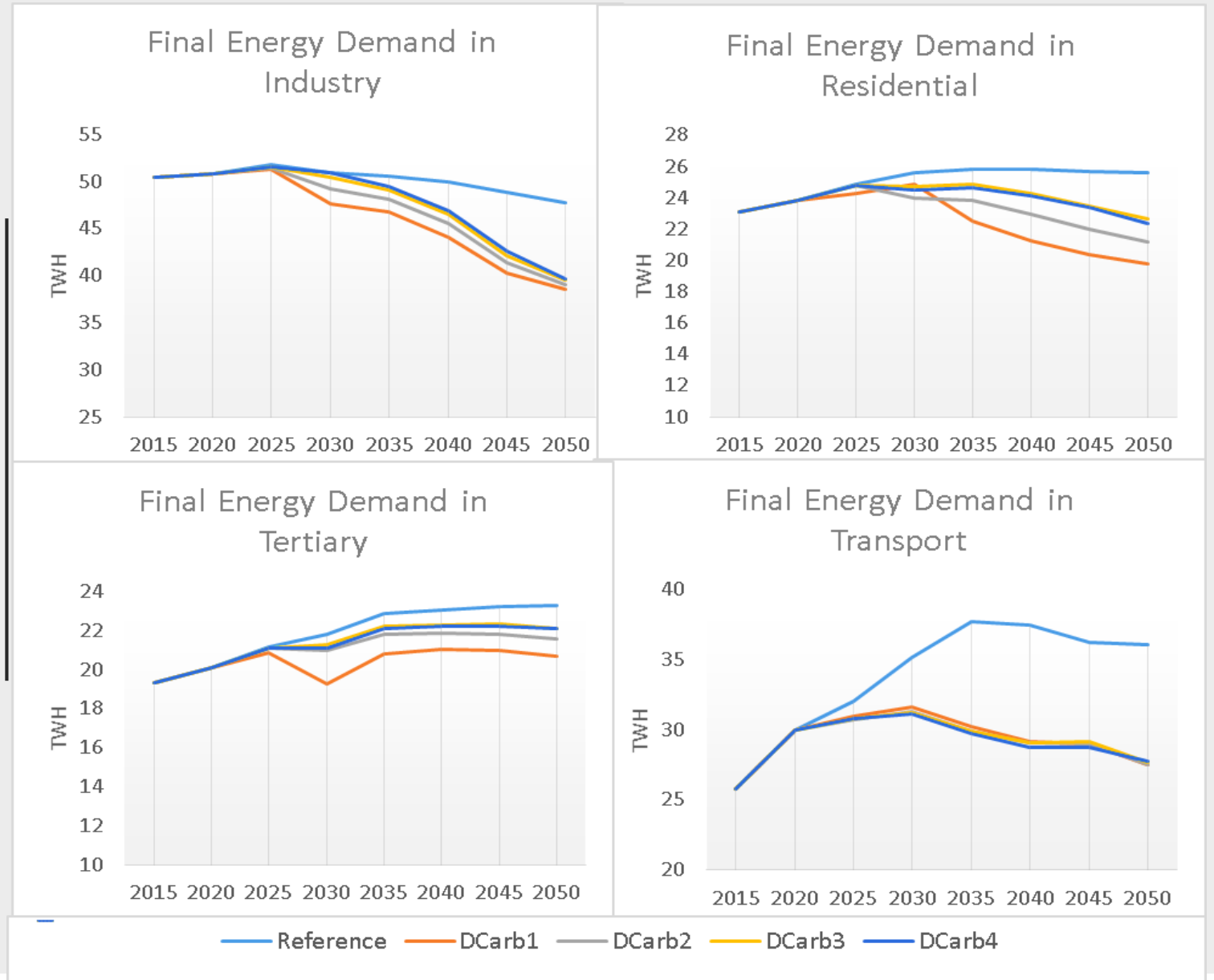
All policy scenarios save on energy consumption

Final energy demand, TWh



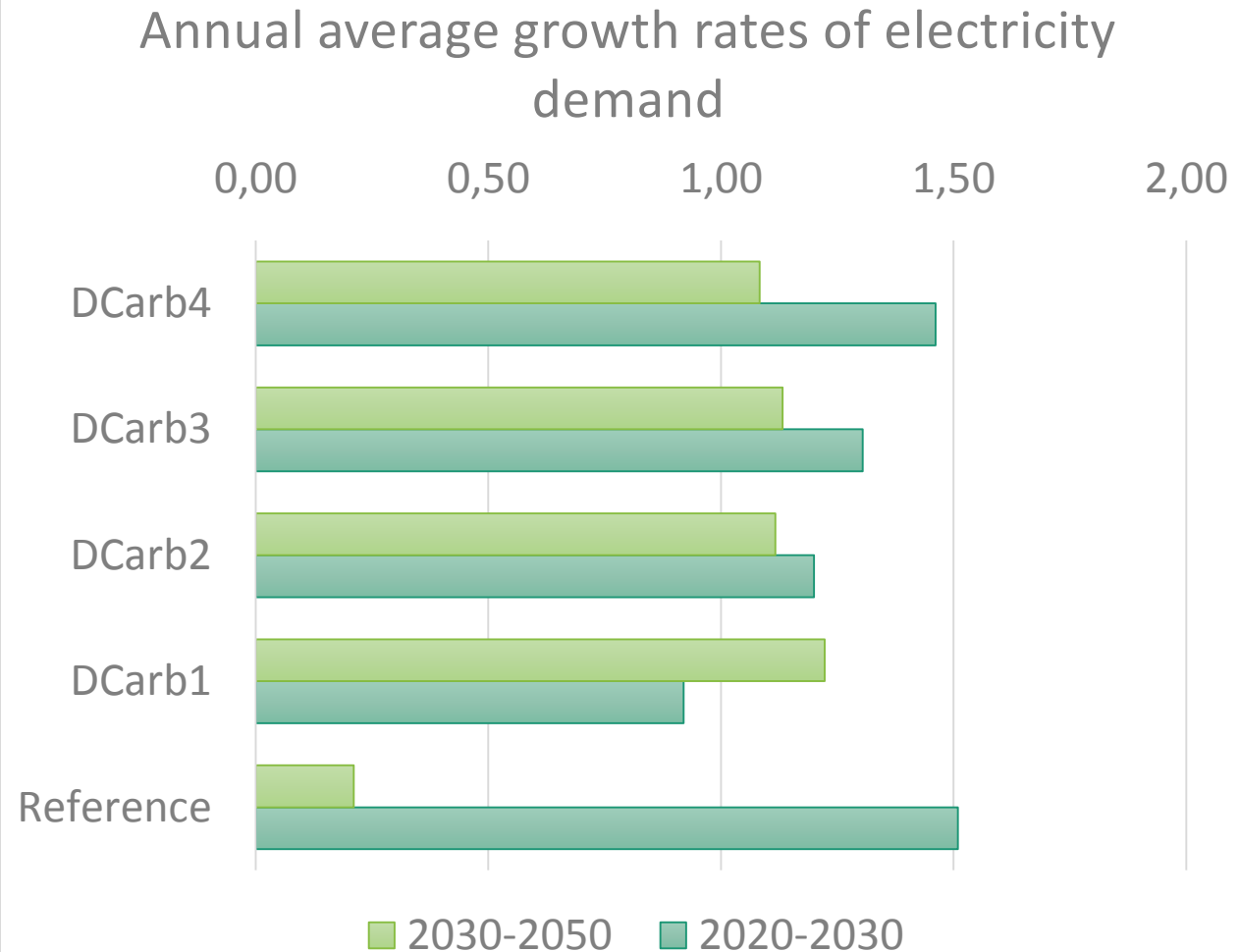
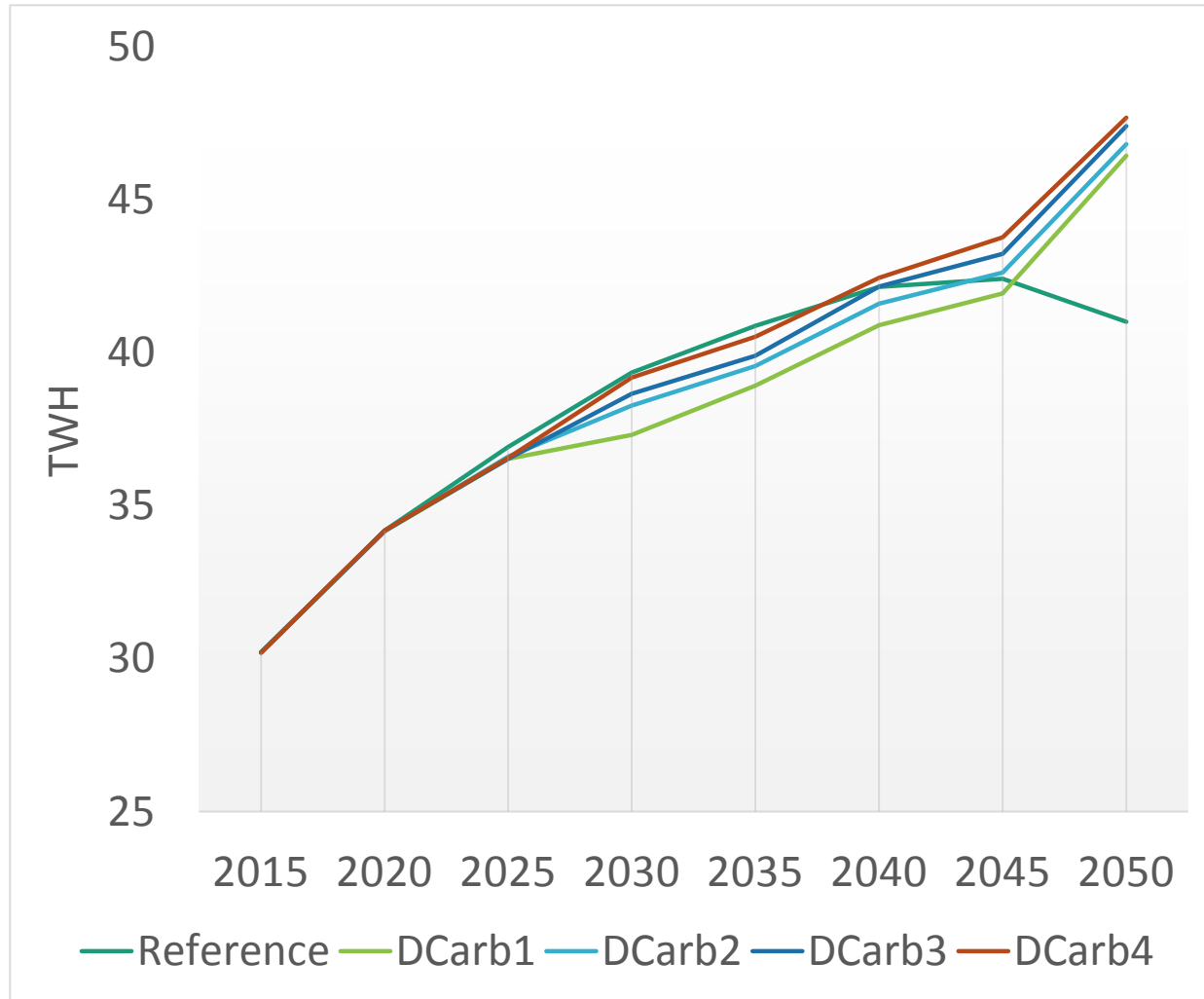
All sectors
reduce
energy
demand

Final energy demand in each sector across scenarios

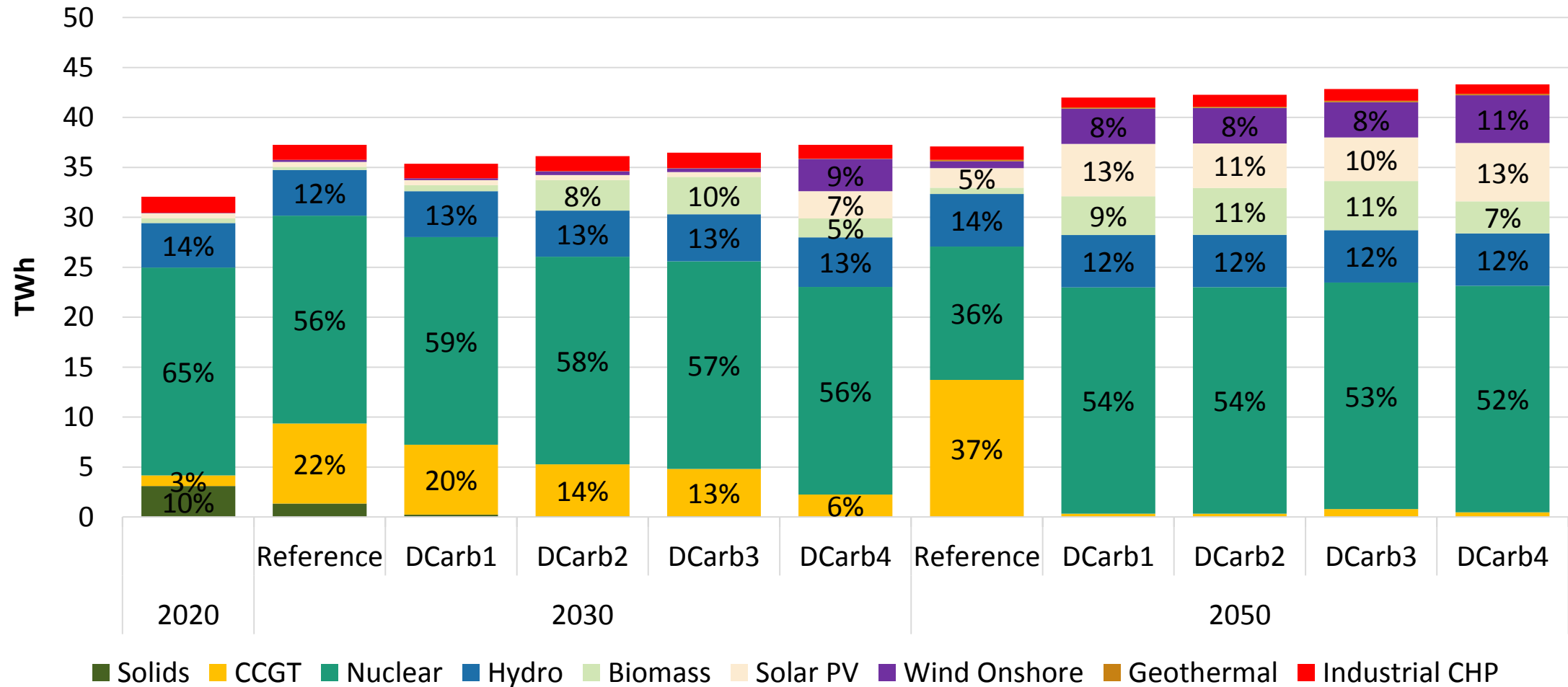


Boost in electricity demand post 2045 due to new uses of electricity

Gross electricity demand and growth of electricity demand

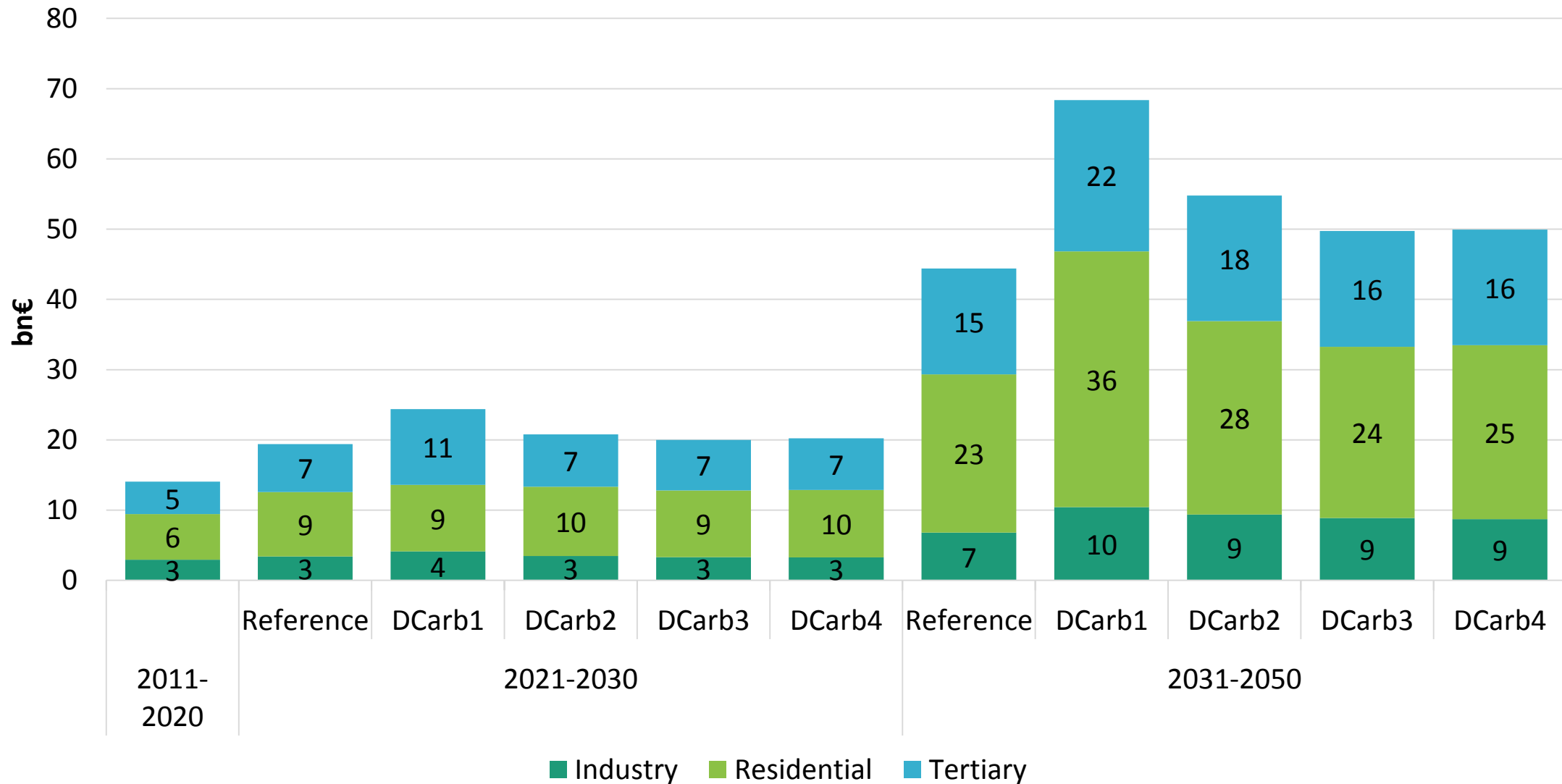


Continued importance of nuclear and increased RES in electricity generation



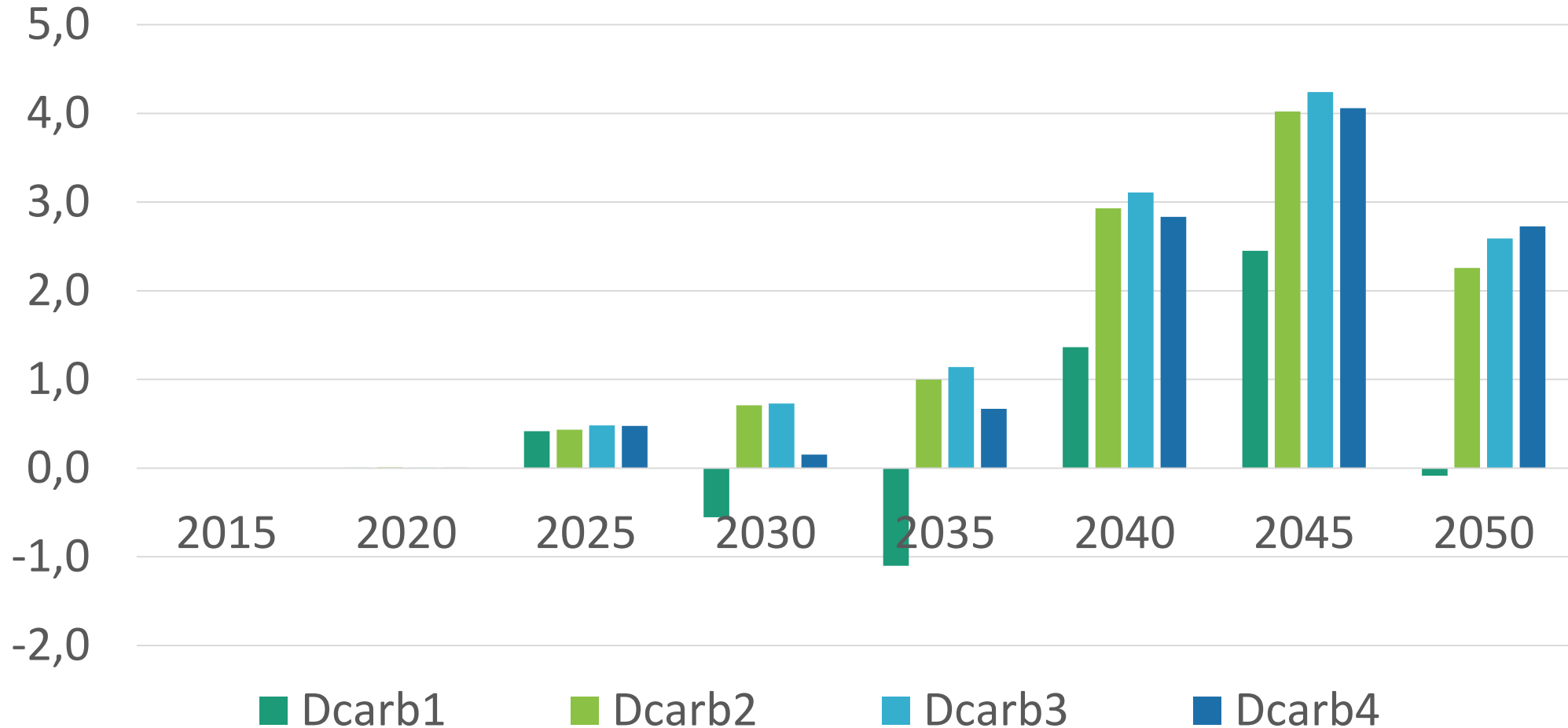
Investment in energy efficiency jump after 2030..

.. by both households and businesses



Positive impact tempered by crowding out

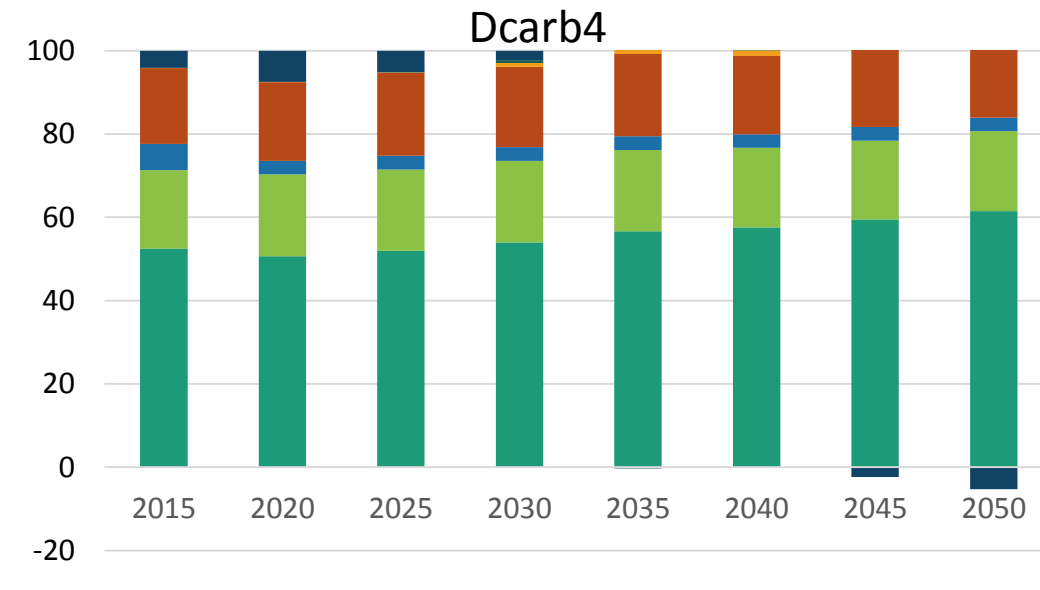
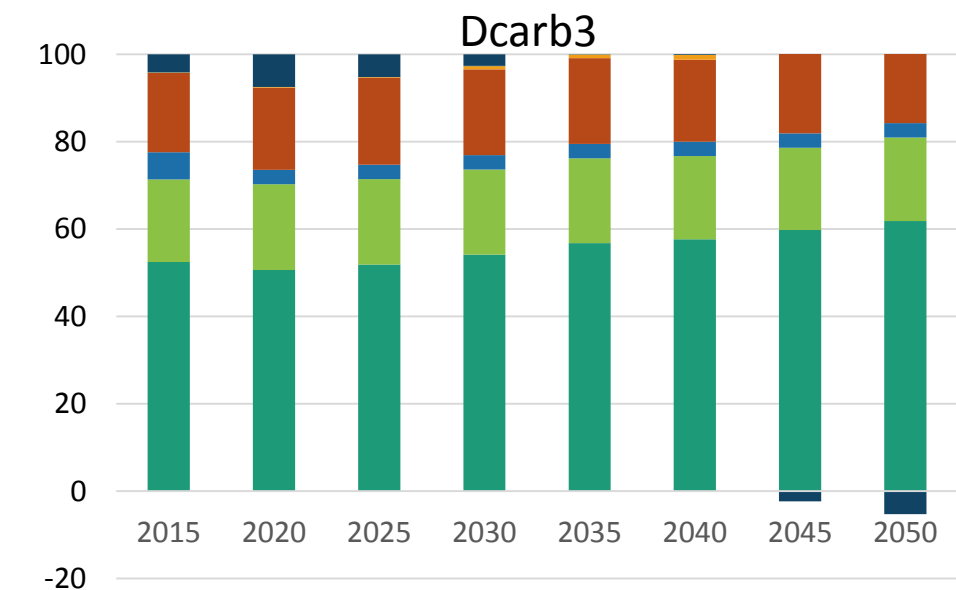
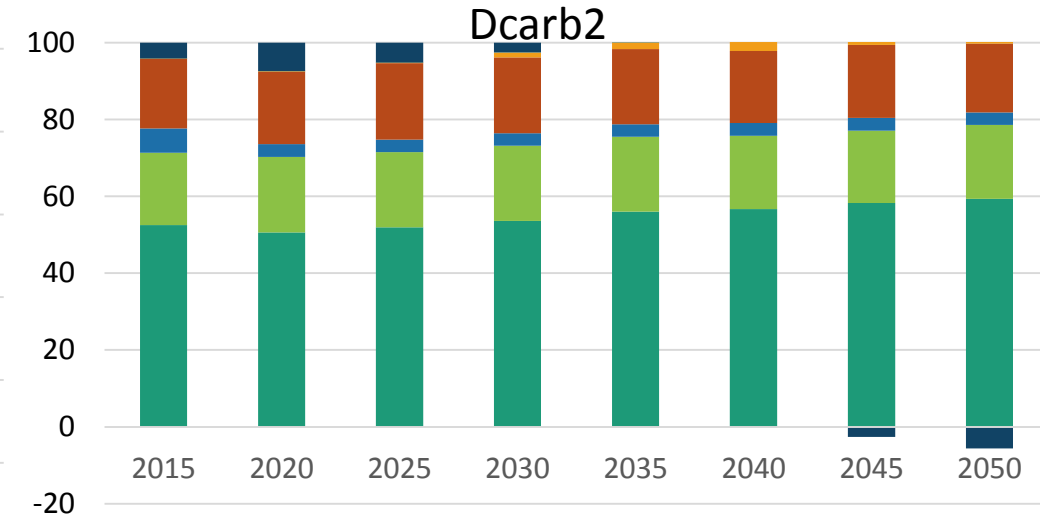
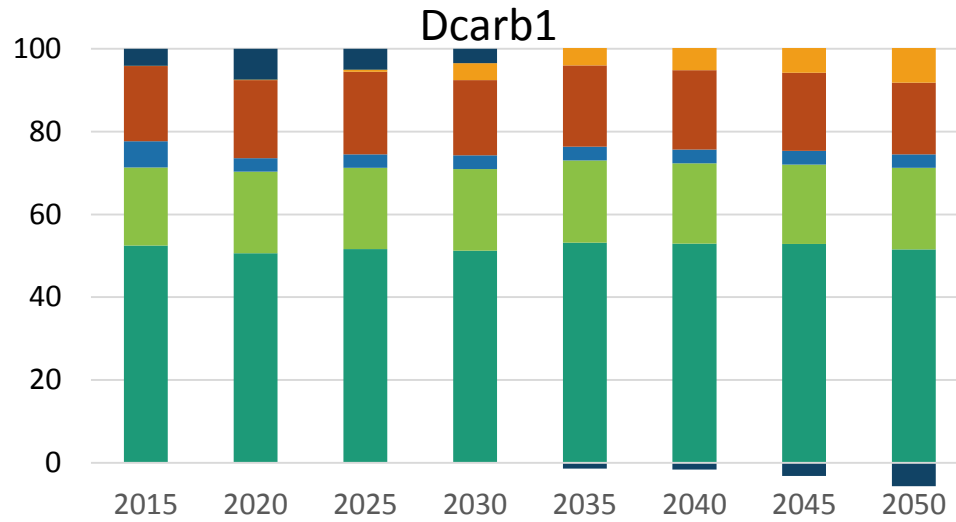
GDP level, percent deviation from baseline



The economy shifts away from consumption to fund investments in energy efficiency

Share of value added (%)

- Private consumption
- Public consumption
- Public Investment
- Private Investment
- Energy efficiency Investment
- Power Investment
- Exports net



Industries supplying investment goods are boosted by decarbonization

	2015	2030					2050				
<i>Share of value added</i>		Reference	Decarb1	Decarb2	Decarb3	Decarb4	Reference	Decarb1	Decarb2	Decarb3	Decarb4
Agriculture	2.1	1.7	1.6	1.7	1.7	1.7	1.2	1.2	1.2	1.2	1.2
Energy	4.9	4.1	4.0	4.3	4.4	4.7	3.4	4.4	4.4	4.4	4.5
Other Manufacturing Chemical, rubber, plastic	8.9	8.7	8.9	8.7	8.7	8.7	7.3	7.4	7.4	7.5	7.5
Non-metallic minerals	1.6	1.7	1.8	1.7	1.7	1.6	1.3	1.0	1.0	1.0	1.0
Iron and Steel	0.8	0.9	0.9	0.9	0.9	0.9	0.9	1.1	1.0	1.0	1.0
Non-ferrous metals	0.9	1.0	1.1	1.1	1.0	1.0	0.8	0.5	0.5	0.5	0.4
Motor Vehicles	0.4	0.4	0.5	0.5	0.5	0.4	0.3	0.7	0.7	0.6	0.6
Equipment	4.7	6.1	6.0	6.0	6.0	6.0	8.9	8.7	8.9	9.0	9.0
Construction	7.3	4.7	4.6	4.6	4.6	4.6	1.6	1.6	1.6	1.6	1.6
Transport	9.0	8.9	10.8	9.6	9.3	9.4	9.0	16.8	12.1	10.4	10.6
Non-market Services	5.1	5.3	5.2	5.2	5.3	5.2	5.5	5.4	5.5	5.6	5.5
Market Services	12.4	13.2	13.1	13.1	13.1	13.1	13.1	12.6	12.8	12.9	12.9
	41.9	43.4	41.3	42.7	43.0	42.7	46.7	38.7	42.9	44.3	44.2

A few concluding remarks

- Achieving energy efficiency targets by 2030 requires significant effort in renovation of buildings.
- Any decarbonization scenario for Slovakia requires electrification of the transport sector in the long-term.
- Decarbonization of electricity generation is achieved through additional investment in nuclear generation and renewables.
- The newly-adopted EU targets of 32% for renewables and 32.5% for energy efficiency in 2030 (both higher than the scenarios presented) suggest that development of both biomass and variable renewables will be required.
- Funding these investments will lead to a reduction in household consumption but create opportunities in industries supplying investment goods such as construction.

Thank you!

