IOŚ-PIB

Centre for Climate and Energy Analyses

KOBiZE

Poland net-zero 2050

Sectoral transformation towards climate neutrality

LIFE Climate CAKE PL

LIFE VIIEW 2050

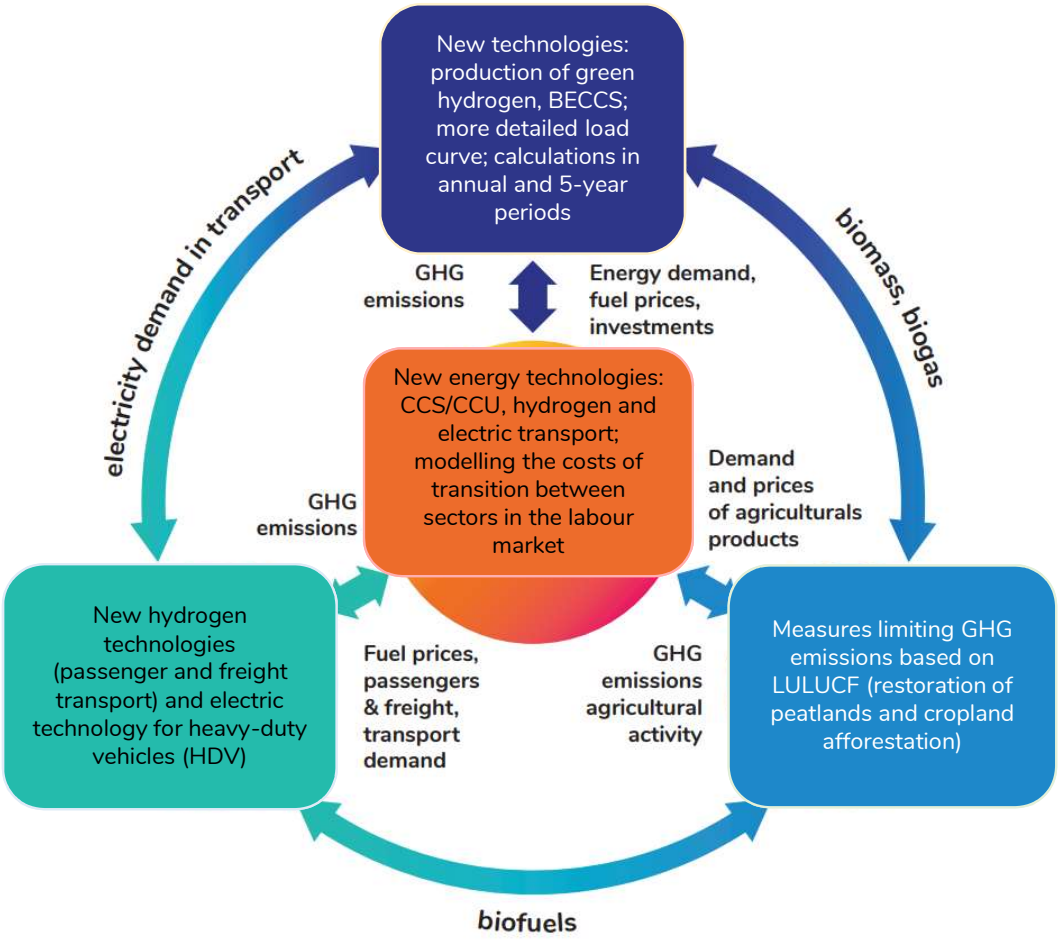
Transformation challenges in perspective of achieving the climate neutrality target in Poland and the European Union by 2050

21 June 2022

NFOŚiGW

Project LIFE16 GIC/PL/000031 is co-financed from EU funds from the LIFE program and from the funds of the National Fund for Environmental Protection and Water Management.

ANALYTICAL TOOLBOX



- **Model d-PLACE (CGE)** – the global macroeconomic general equilibrium model allows for a comprehensive assessment of the climate and energy policy economic impacts.
- **Energy model MEESA (*Model for European Energy System Analysis*)** – the model allows for a thorough simulation of various transformation options of the energy sector in the EU.
- **Transport model TR3E (*Transport European Economic Model*)** – the model allows for the analysis of various options to reduce CO_2 emissions in the transport sector, including the new technologies implementation.
- **Agriculture model EPICA (*Evaluation of Policy Impacts – Climate and Agriculture*)** – the model enables analysing the impact of various climate policy measures on agriculture, including emissions, production volume and structure, and farmers income in Poland.

New climate neutrality (NEU) scenario for the EU

Year	GHG emission reduction target for EU-27			BRT ETS emission reduction target vs. 2005
	Total GHG emission reduction vs. 1990	EU ETS emission reduction target vs. 2005	Non-ETS emission reduction target vs. 2005	
2030 (Fit for 55 package)	**53%** (netto 55%*)	**61%**	**40%** (17.7% in PL)	**43%**
2050	**90%** (netto 100%*)	**93%**	82% (74.8% in PL)	**87%**

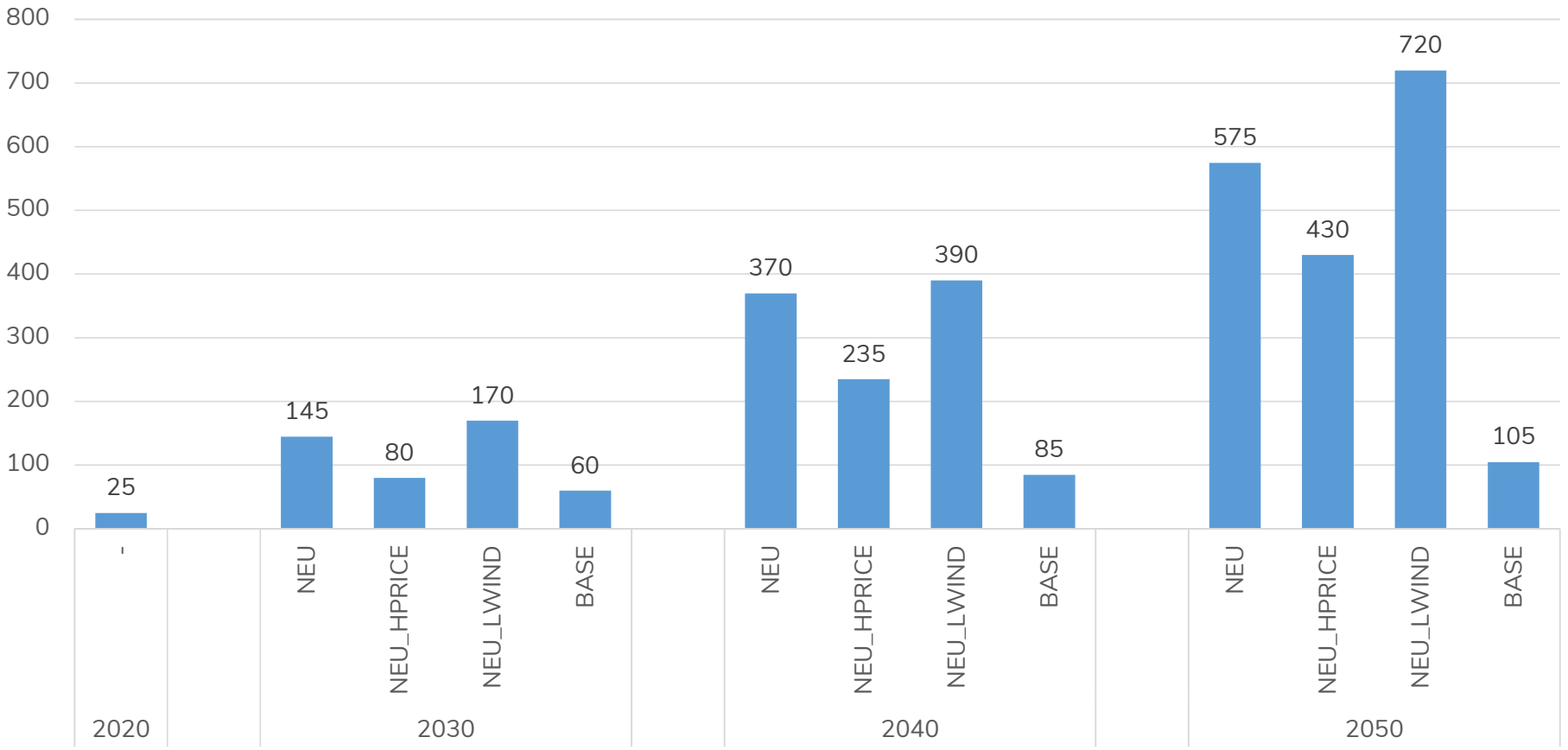
Source: CAKE/KOBiZE

Transformation of energy sector

Scenarios

- **NEU:** the net-zero scenario, assuming ca. 90% emission reduction in 2050 vs 1990, and achievement of net-zero emission levels by inclusion of the land use, land use change and forestry (LULUCF) sector.
- **NEU_HPRICES:** the net-zero scenario, with the same GHG reduction targets and energy technology potentials as in the NEU scenario, but based on higher fossil fuel price projections and reduced availability of natural gas.
- **NEU_LWIND:** the net-zero scenario with the assuming the same GHG reduction targets but with lower potential of offshore wind farms.
- **BASE:** the baseline scenario assuming a 60% emission reduction in 2050 vs. 1990, excluding the land use, land use change and forestry (LULUCF) sector.

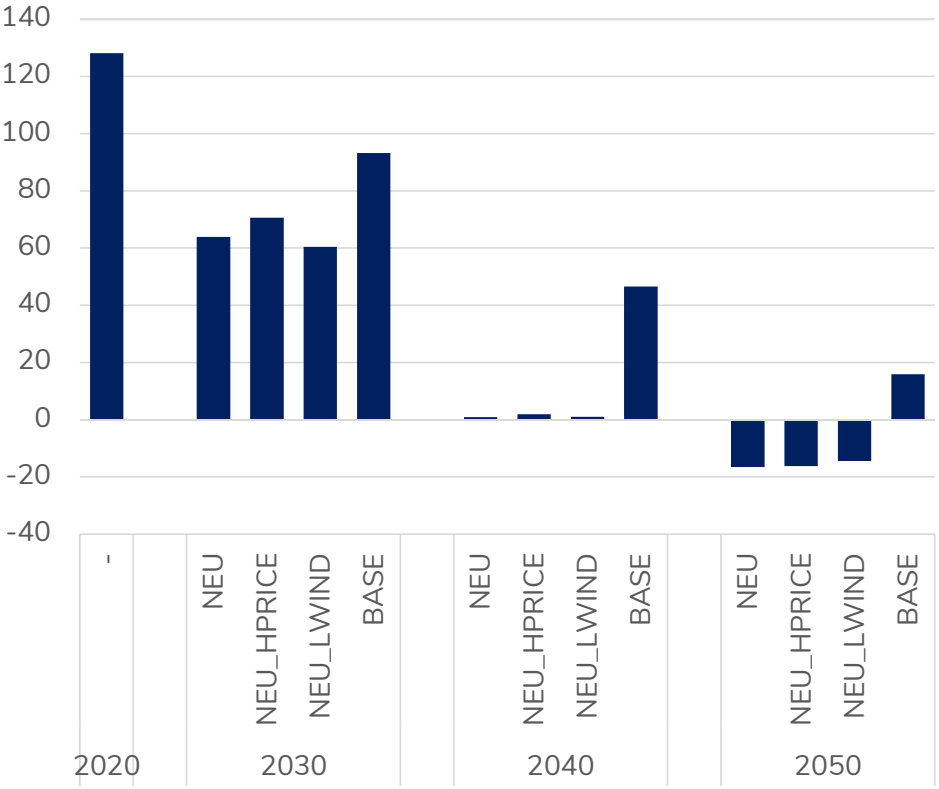
Marginal emission cost [EUR'2015/tCO_2]



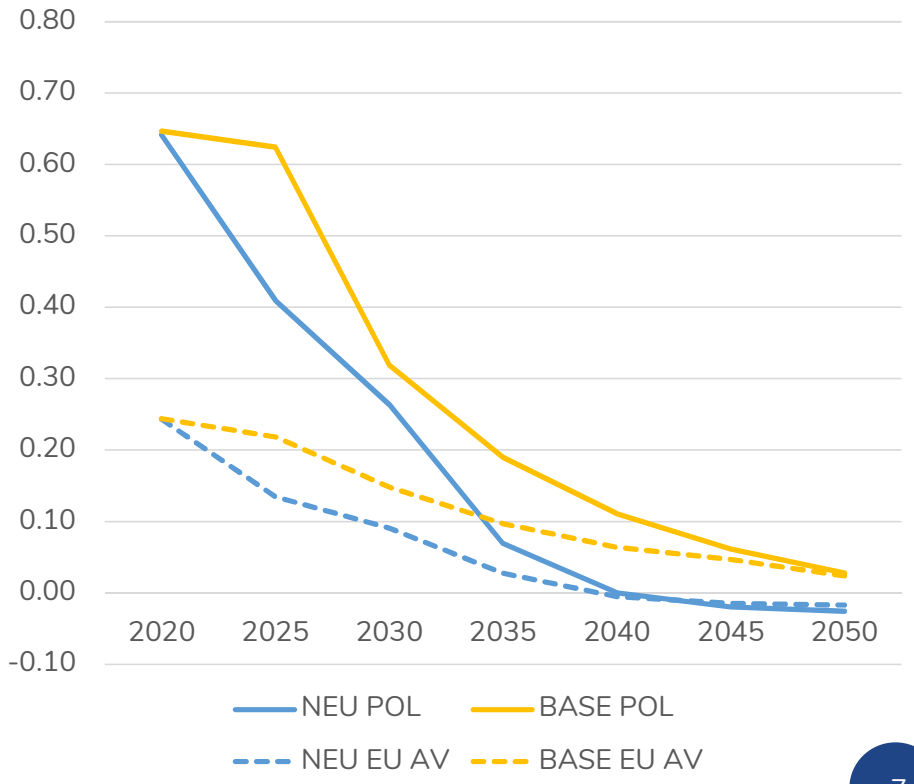
Source: CAKE/KOBiZE

CO_2 emissions in Poland

Emissions in energy sector in Poland 2020-2050 [$MtCO_2$]

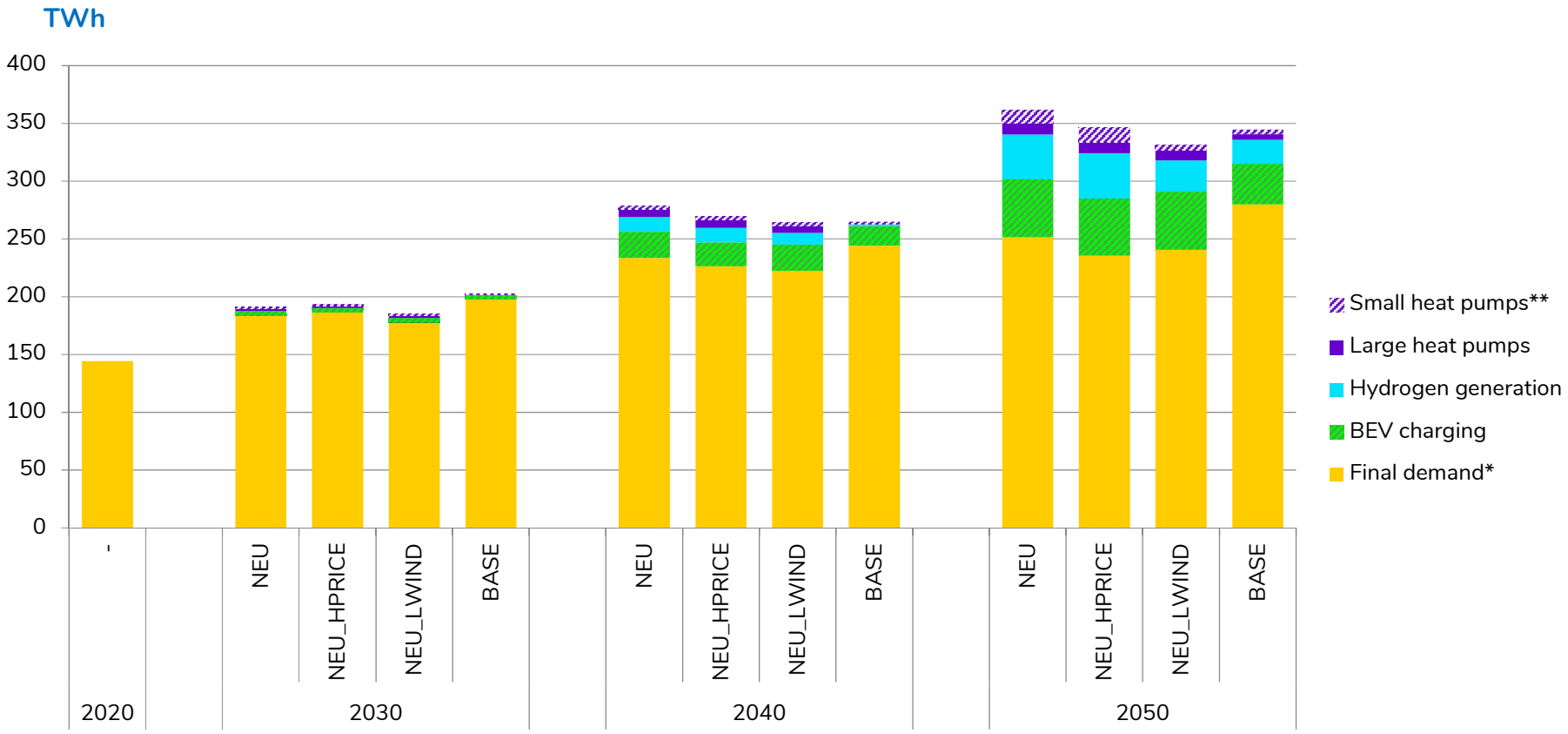


Emission factor in electricity generation in Poland and the EU – scenarios NEU and BASE [tCO_2 / MWh]



Source: CAKE/KOBiZE

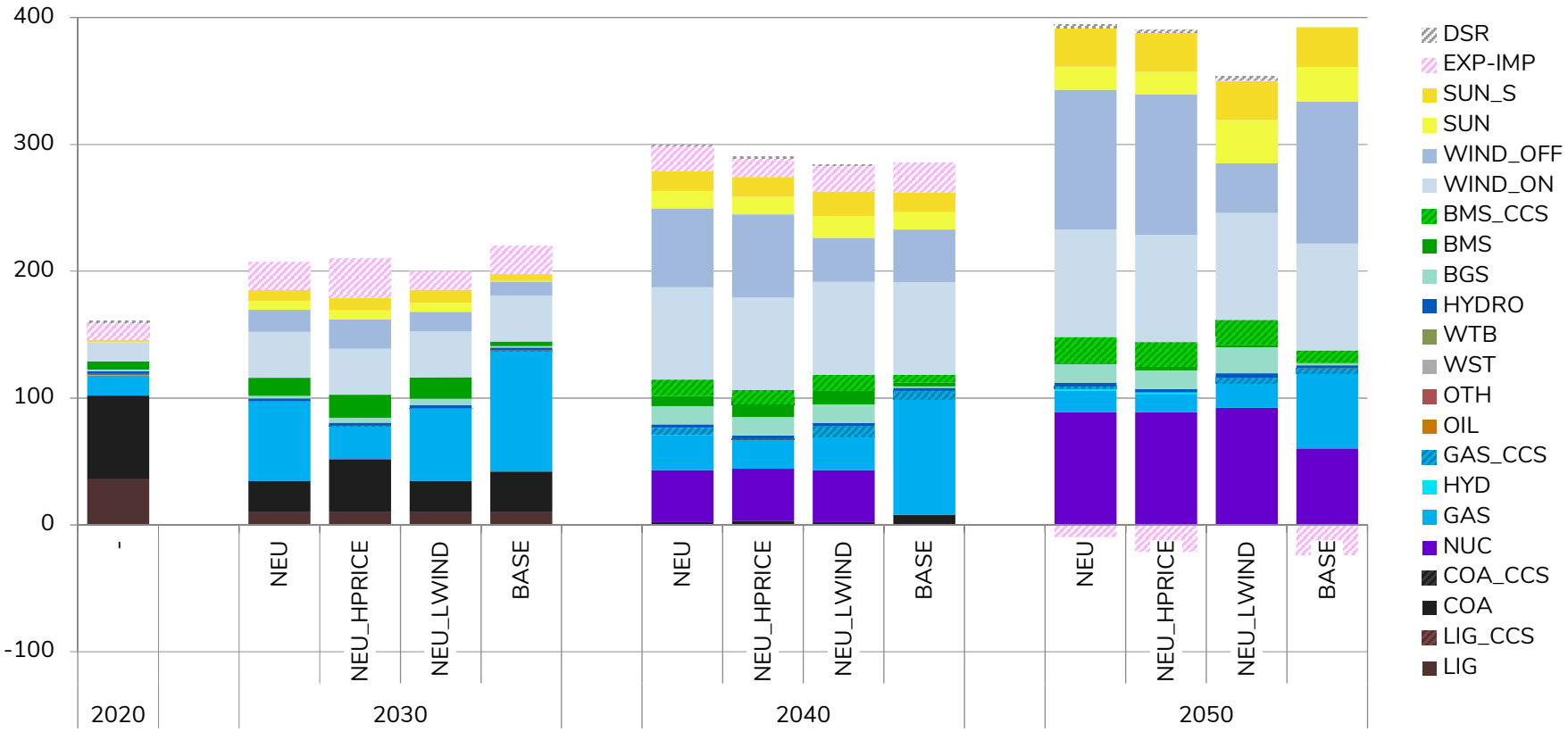
Electricity demand in Poland [TWh]



*final consumption (including part of the energy sector – rafineries and coking plants)
**only replacing district heat

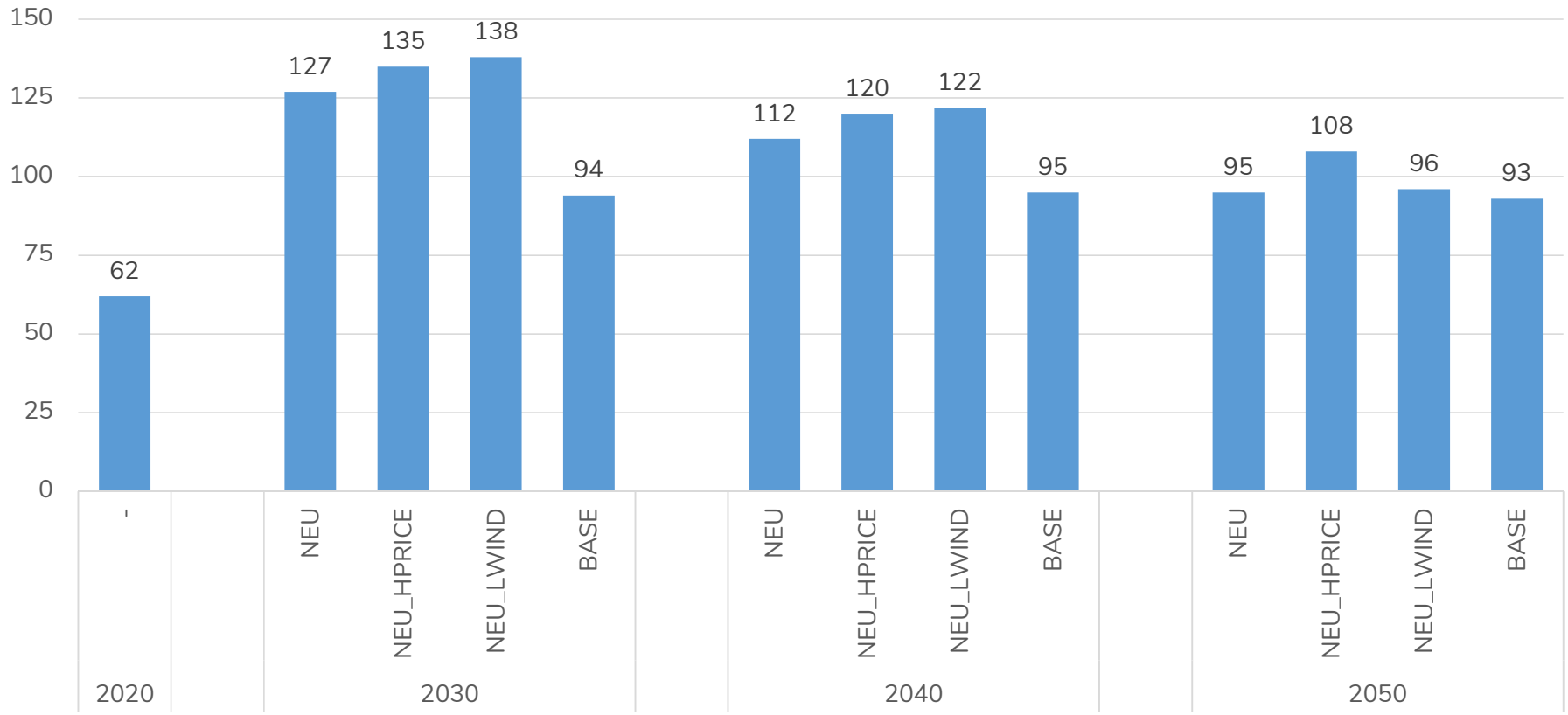
Source: CAKE/KOBiZE

Electricity supply in Poland by fuel type [TWh]



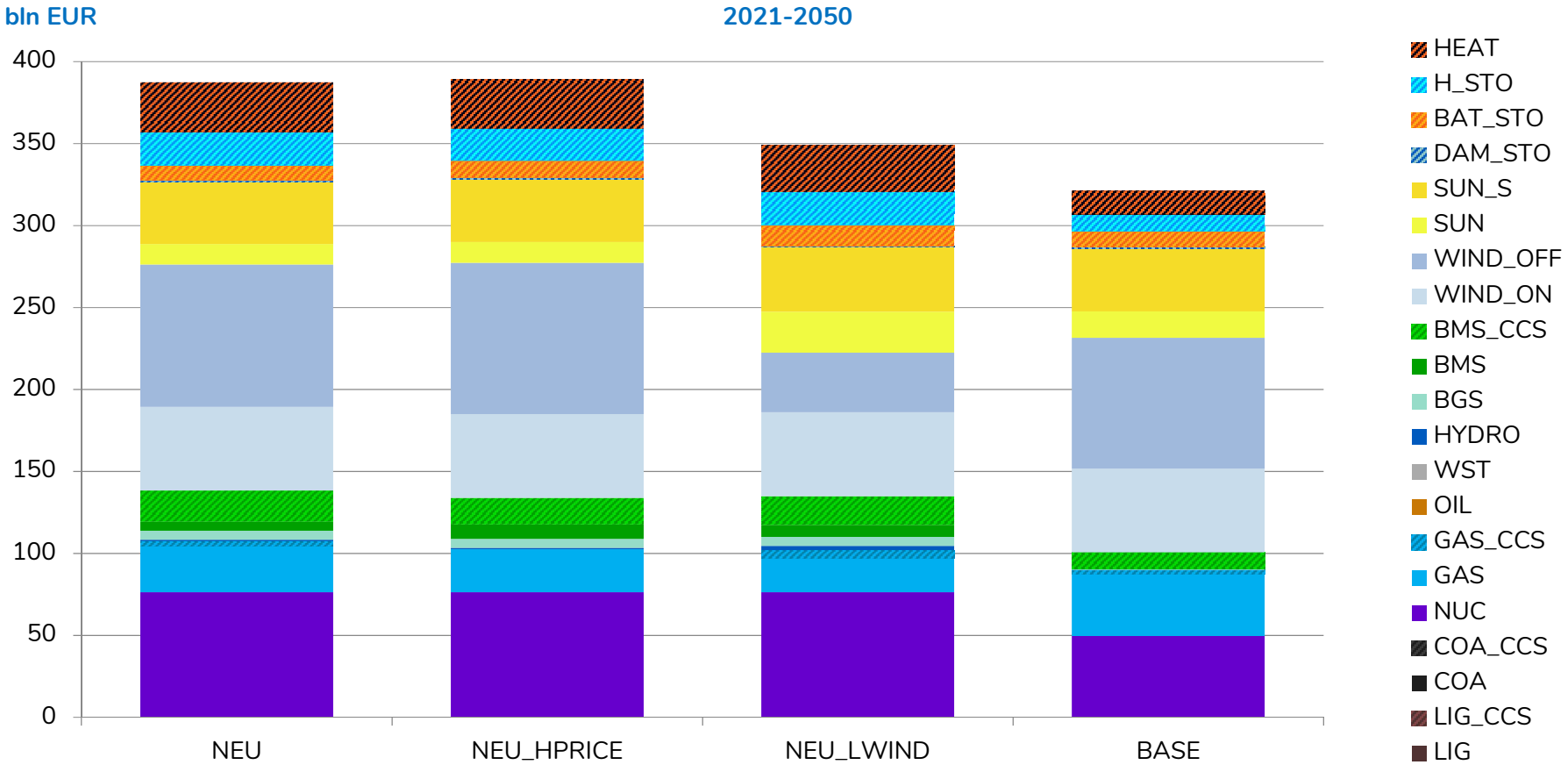
Source: CAKE/KOBiZE

Electricity generation cost in Poland [EUR'2015/MWh]



Source: CAKE/KOBiZE

Total investment in electricity and district heating sector in Poland, within 2021-2050 [bln EUR'2015]



Source: CAKE/KOBiZE

Conclusions

- To achieve the net zero target, **the energy sector needs to be completely rebuilt**.
- The optimal direction of development are **renewable energy sources supported by nuclear energy**. Natural gas will be used mainly for backup.
- The fastest increase in energy costs will take place in the next decade. After 2030 costs can be reduced, provided that there is significant investment in low and zero-emission sources.
- The **largest investment expenditure** expected in the **2030-2050** period.
- **Hydrogen production, energy storage and electric cars** will play an important role in balancing the load profile.

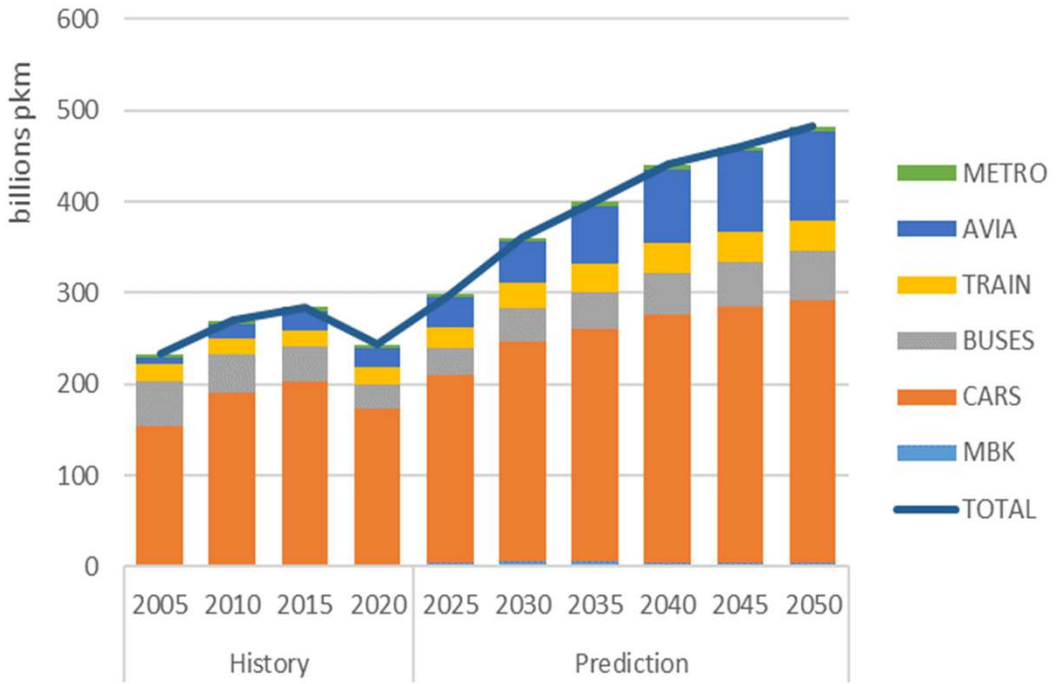
Transformation of transport sector

Emissions in the transport sector and dynamics of passenger activity development in Poland

Passenger activity growth within **2015-2050** [**NEU scenario**] averages **1.5%,** along economic growth of **2.4%**

Historical emissions in transport

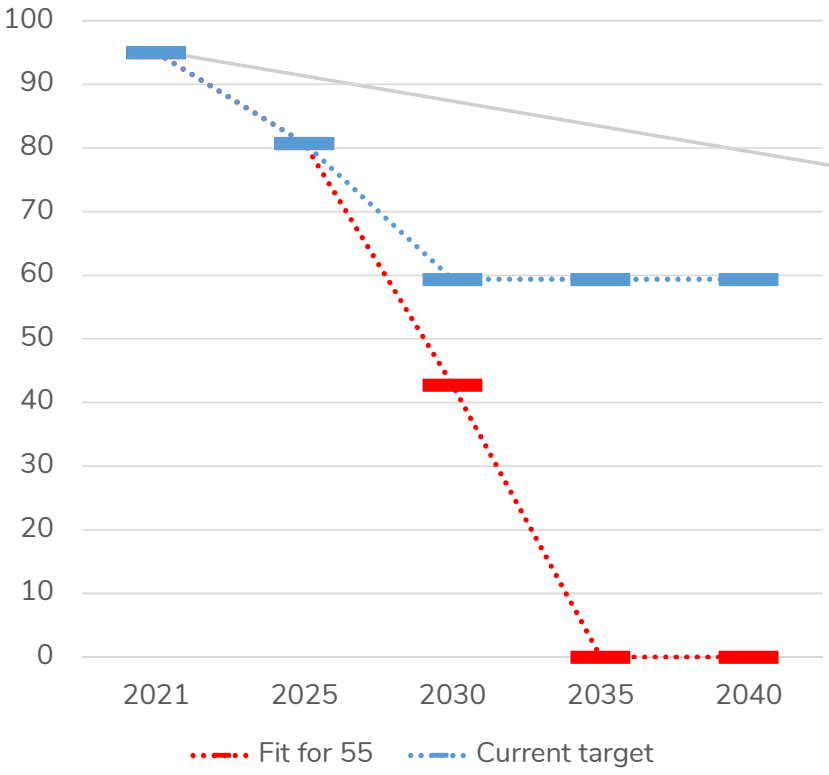
Activity in passenger transport



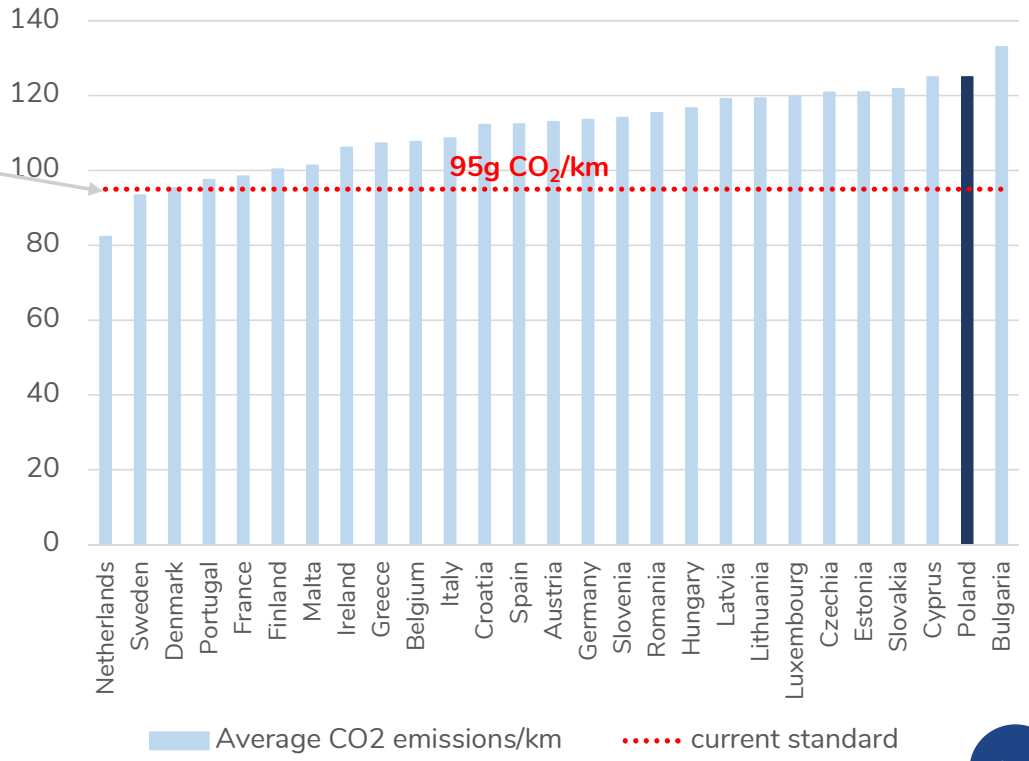
Source: CAKE/KOBiZE

“Fit for 55” package legislation vs. current levels of emissions

CO_2 emission standards for new passenger cars (current target vs. “Fit for 55” package)



Average CO_2/km emissions for new passenger cars in the EU-27 in 2020



Source: CAKE/KOBiZE

Scenarios

- **NEU** – neutrality scenario with reduction targets arising from the "Fit for 55" package, inclusion of the transport and housing sector in the emissions trading scheme (emission reductions are achieved by imposing marginal abatement costs on users of emitting vehicles).

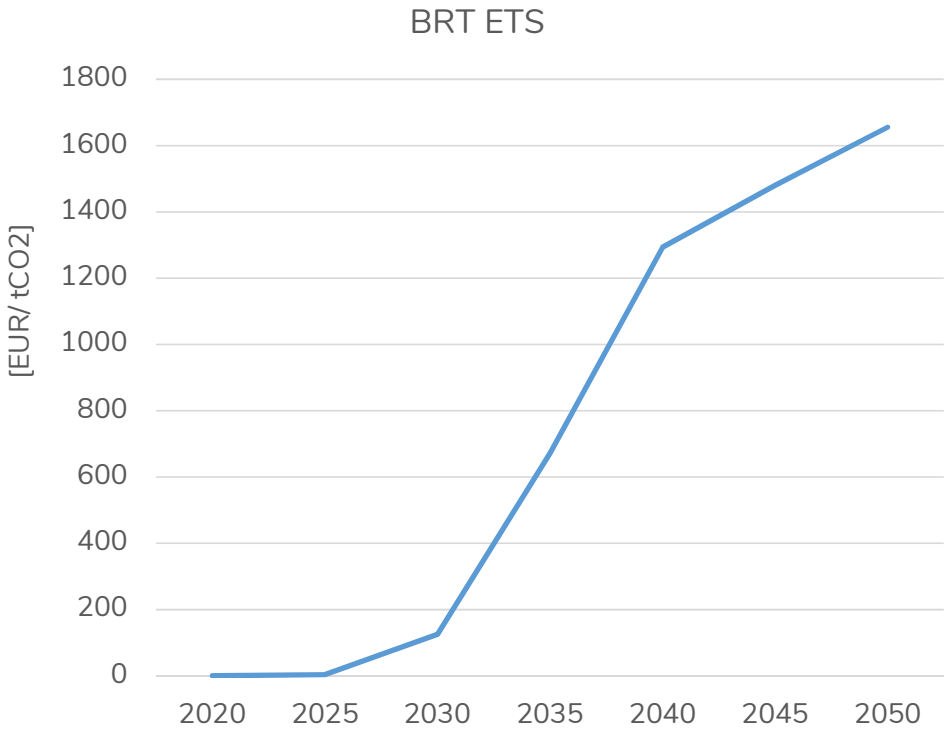
- **NEU_55** – Extension of the NEU scenario assumptions to include a ban on the sale of internal combustion passenger cars and light commercial vehicles starting from 2035.

- **NEU_PUBLIC** – Extension of the NEU scenario assumptions to promote public transport, by lowering the operating costs of buses and trains, without banning the sale of combustion vehicles from 2035.

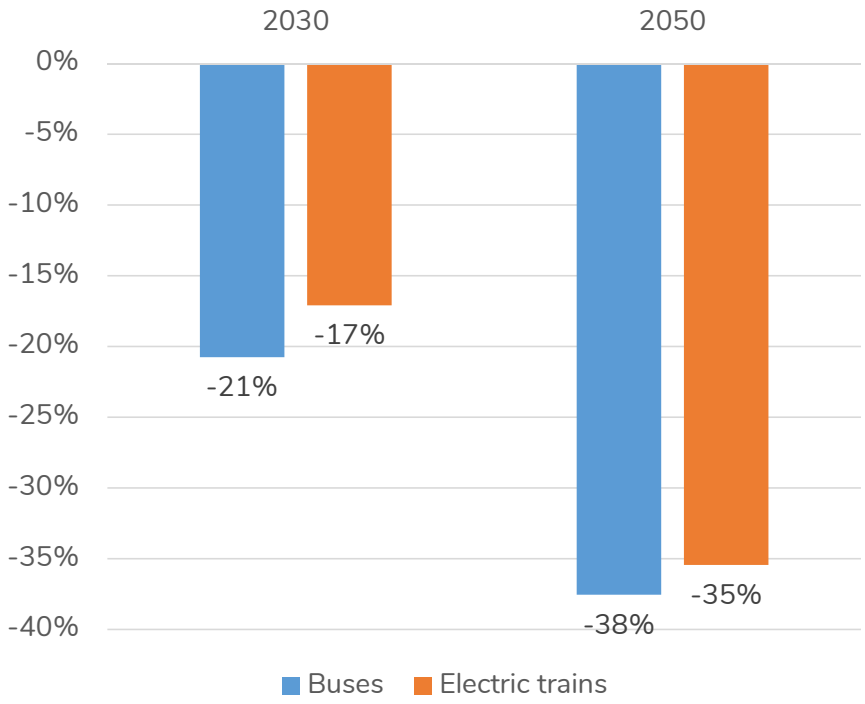
- **NEU_PUBLIC_55** – Combining the NEU_55 and NEU_PUBLIC_55 scenarios.

Scenario assumptions, inclusion of the road transport sector in the emissions trading scheme (BRT), reduction of public transport costs in Poland

Marginal abatement costs in the transport sector

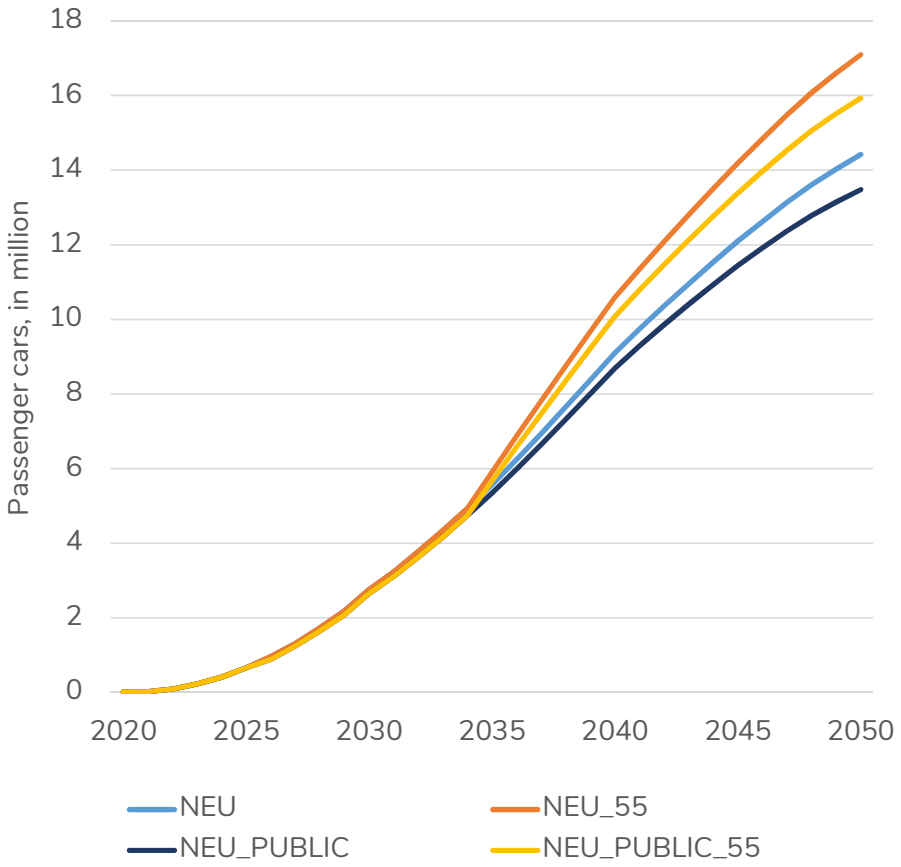


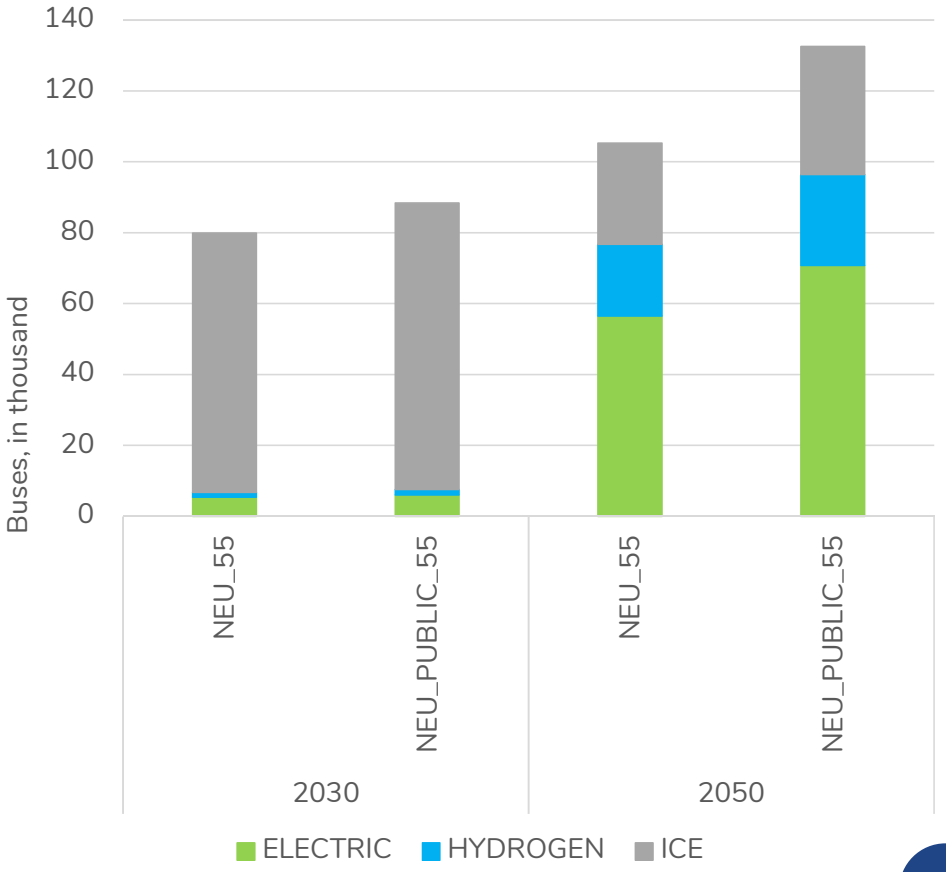
Change in operating costs in Poland



Source: CAKE/KOBiZE

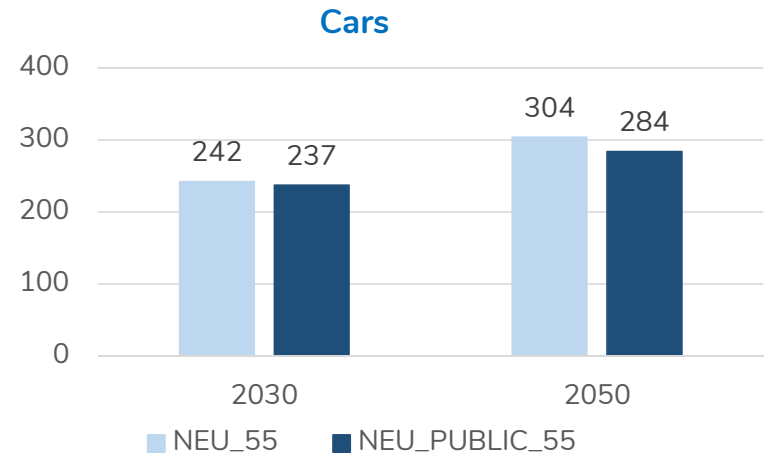
Scenario results, number of passenger electric cars and zero-emission buses in Poland

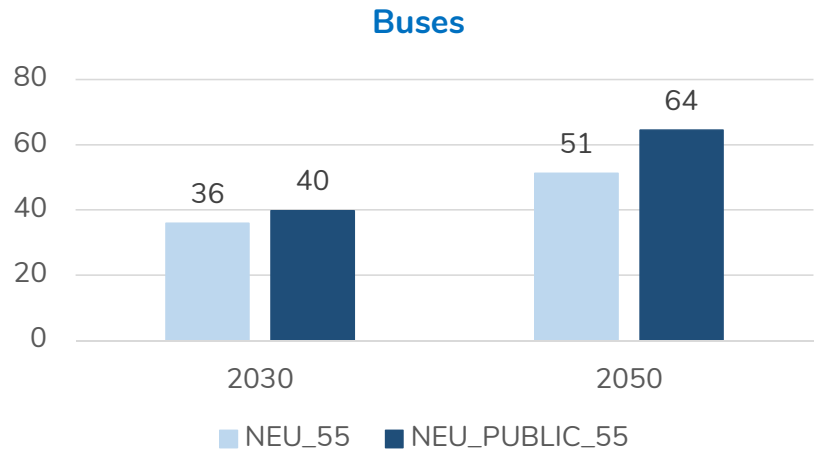


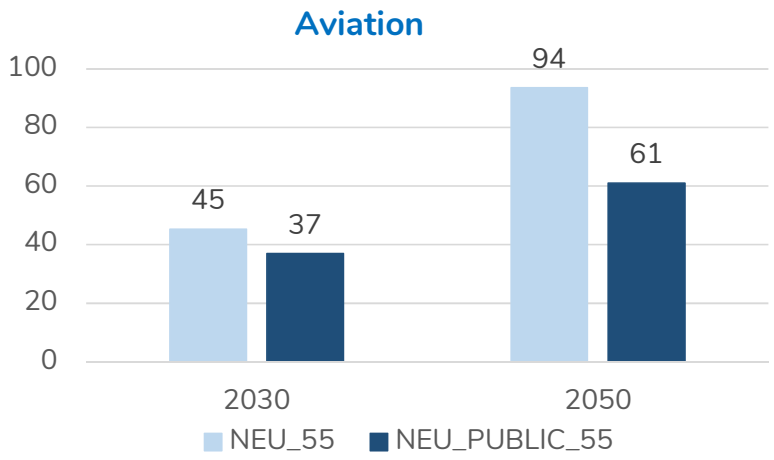


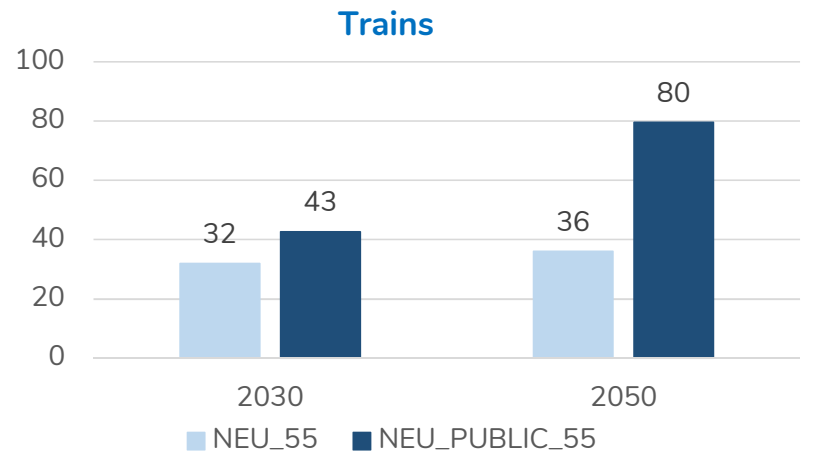
Source: CAKE/KOBiZE

Increase of the role of railroad and road public transport [in bln passenger-kilometres] in Poland





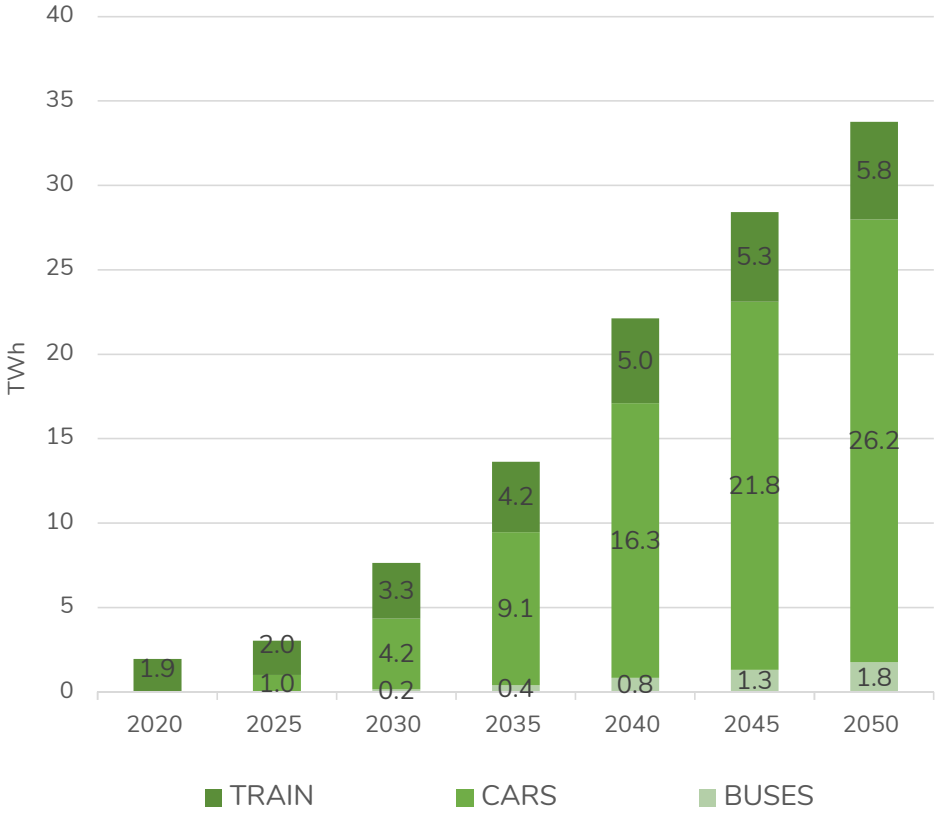




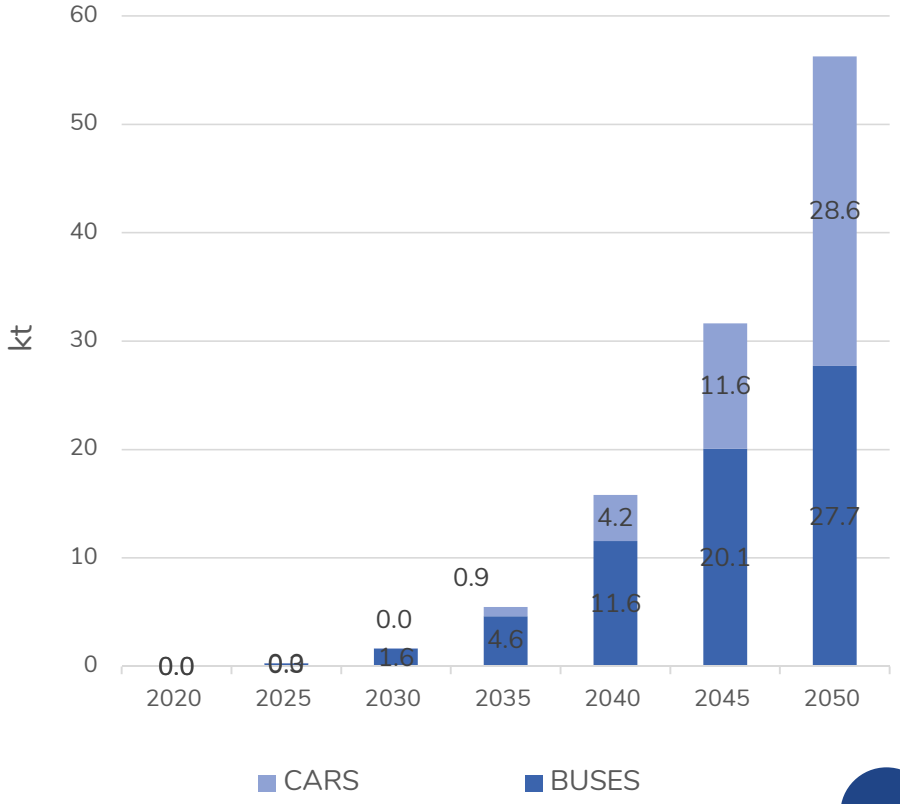
Source: CAKE/KOBiZE

Electricity and hydrogen demand in passenger transport in Poland

Electric energy

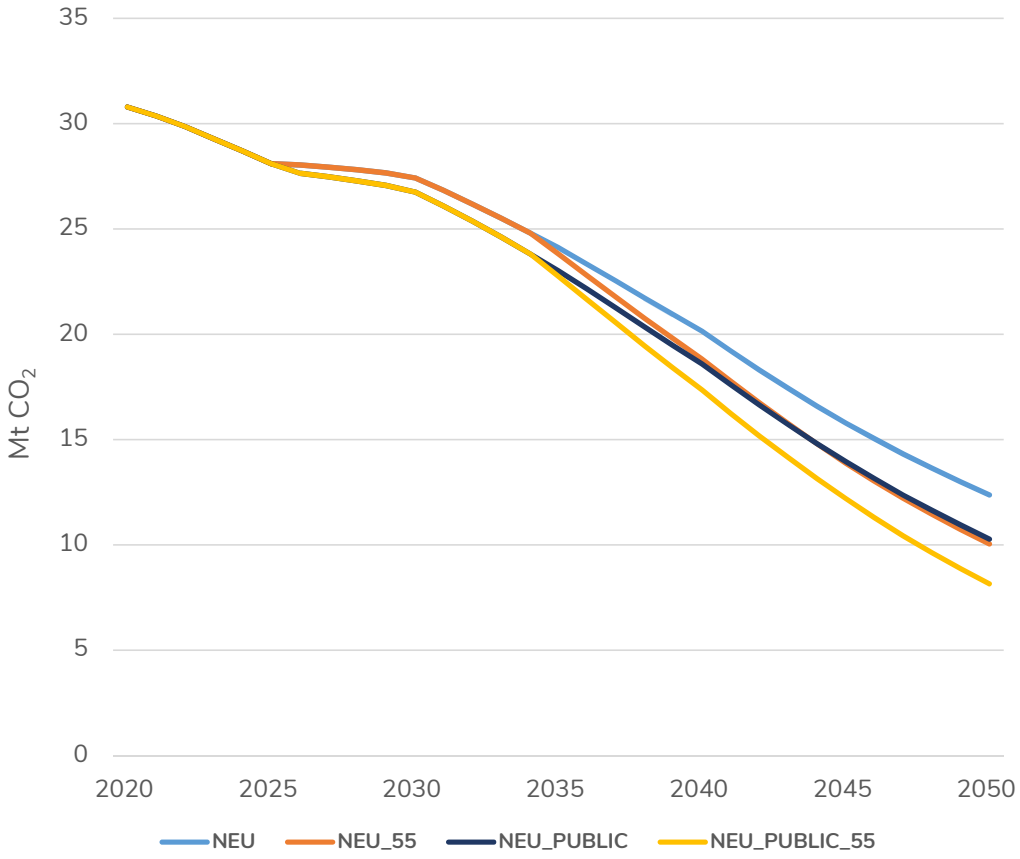


Hydrogen



Source: CAKE/KOBiZE

CO_2 emission levels and reductions in Poland



Source: CAKE/KOBiZE

		2030	2050
Emissions – Passenger transport (Mt CO_2)	NEU	27.4	12.4
	NEU_55	27.4	10.1
	NEU_PUBLIC	26.8	10.3
	NEU_PUBLIC_55	26.8	8.2
Change in the level of CO_2 emission relative to 2020 – passenger transport	NEU	-11%	-60%
	NEU_55	-11%	-67%
	NEU_PUBLIC	-13%	-67%
	NEU_PUBLIC_55	-13%	-74%

Conclusions

- Achievement of the "Fit for 55" package's reduction targets will be shifted to households and businesses through changes in fleet structure (number of electric cars).
- Development of public transport will reduce the number of electric cars that would need to be in service to meet the needs of users, and will reduce traffic on the roads.
- Electrification and hydrogenization of the bus fleet could reach 9% in 2030 and 73% in 2050.
- In 2050, air transport and passenger cars will be the ones mainly responsible for emissions.

Transformation of agricultural sector in Poland

Scenarios

- **Net-zero 2050 scenario (NEU)**
  - Achievement of ambitious GHG reduction targets in agricultural sector while keeping the current methods of production.
- **Net-zero 2050 scenario with GHG mitigation measures (NEU+)**
  - The NEU scenario expanded by measures mitigating GHG emissions: afforestation of cropland, restoration (re-wetting) of peatlands, development of biogas plants.

Options for implementation of climate policy

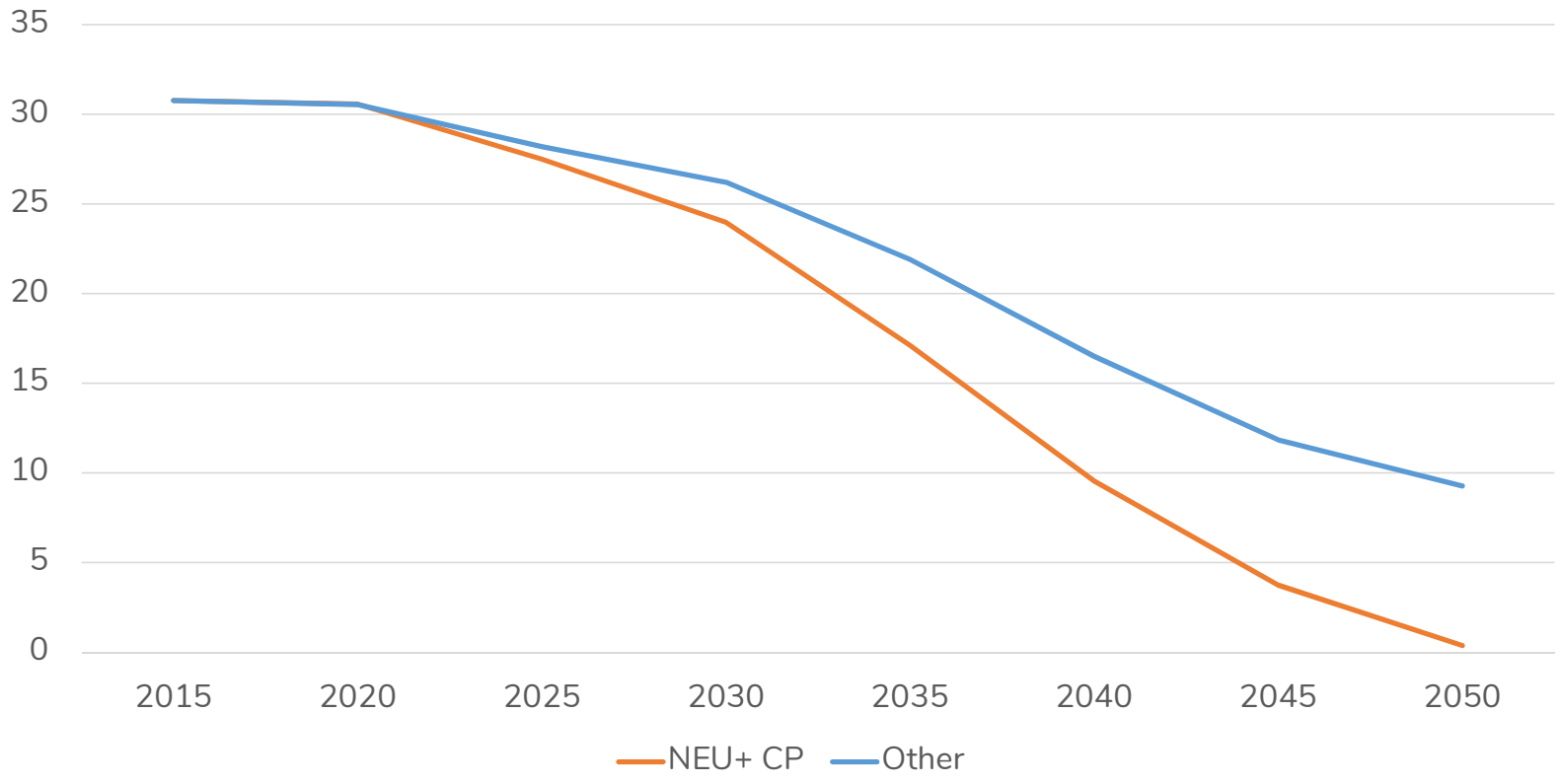
- **CARBON PRICE (CP)** – payments for GHG emission allowances at farm level,
- **LIMIT (LIM)** – administrative limit of GHG emissions at farm level,
- **SUBS** – introduction of subsidies for reduction of GHG emissions at a level sufficient to achieve target,
- **MIXED (MIX)** – combination of LIM and SUBS options.

Modelling results

Scenarios: NEU, NEU+

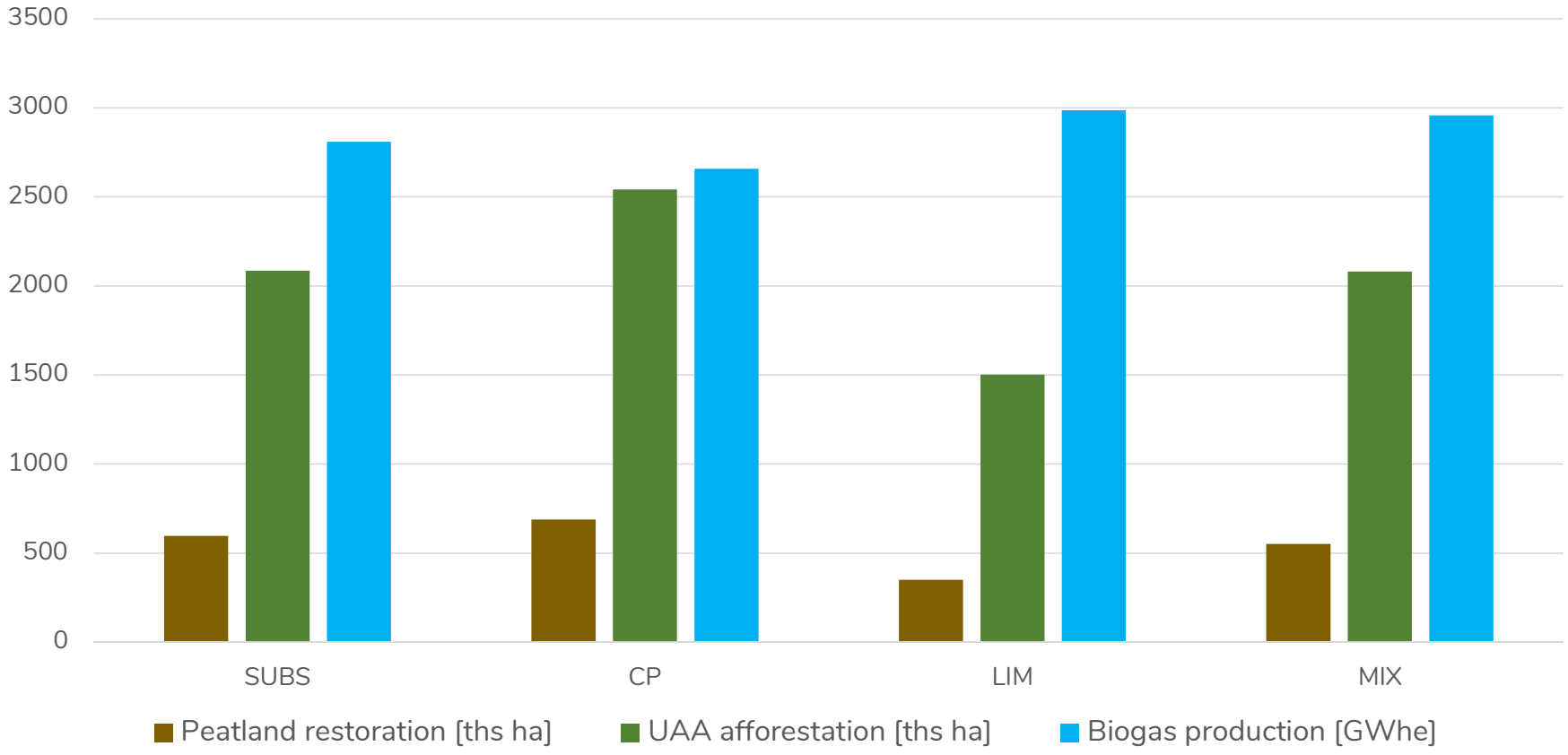
Options: CP, LIM, SUBS, MIX

Change of GHG emissions from agriculture in Poland [Mt CO_2e]



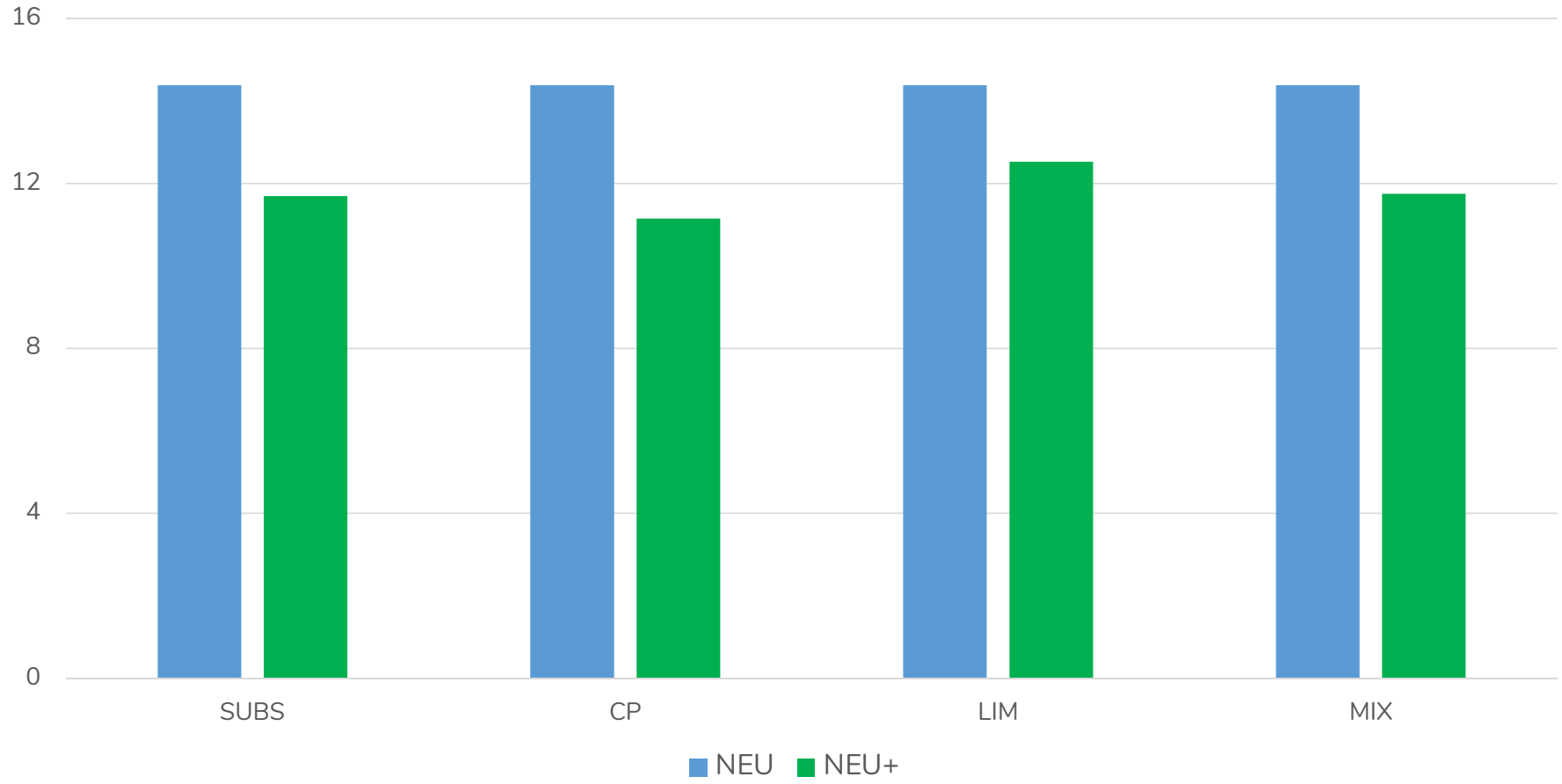
Source: CAKE/KOBiZE

Levels of implementation of measures reducing GHG emissions in agriculture in Poland in 2050



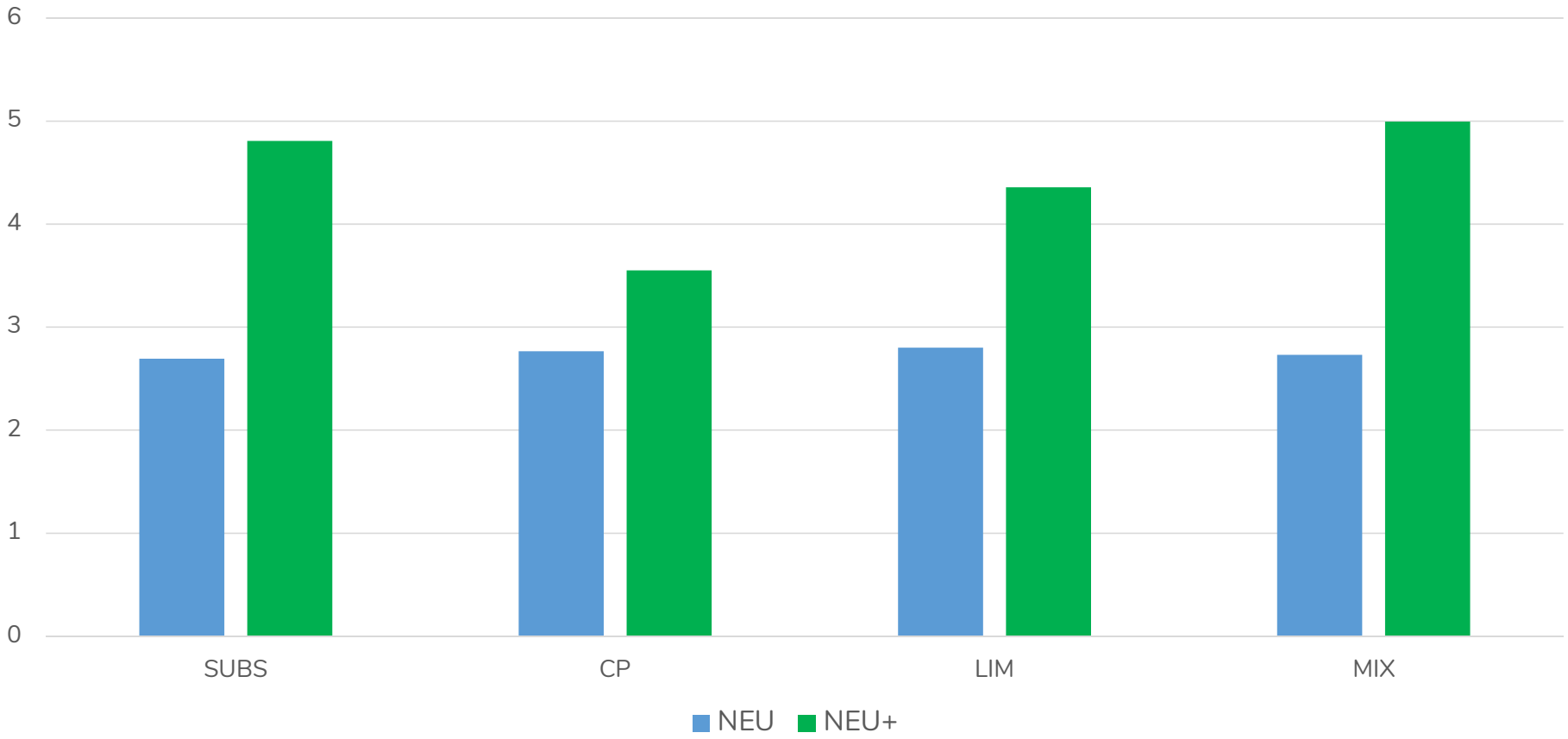
Source: CAKE/KOBiZE

Utilised agricultural area in Poland in 2050 [mln ha]



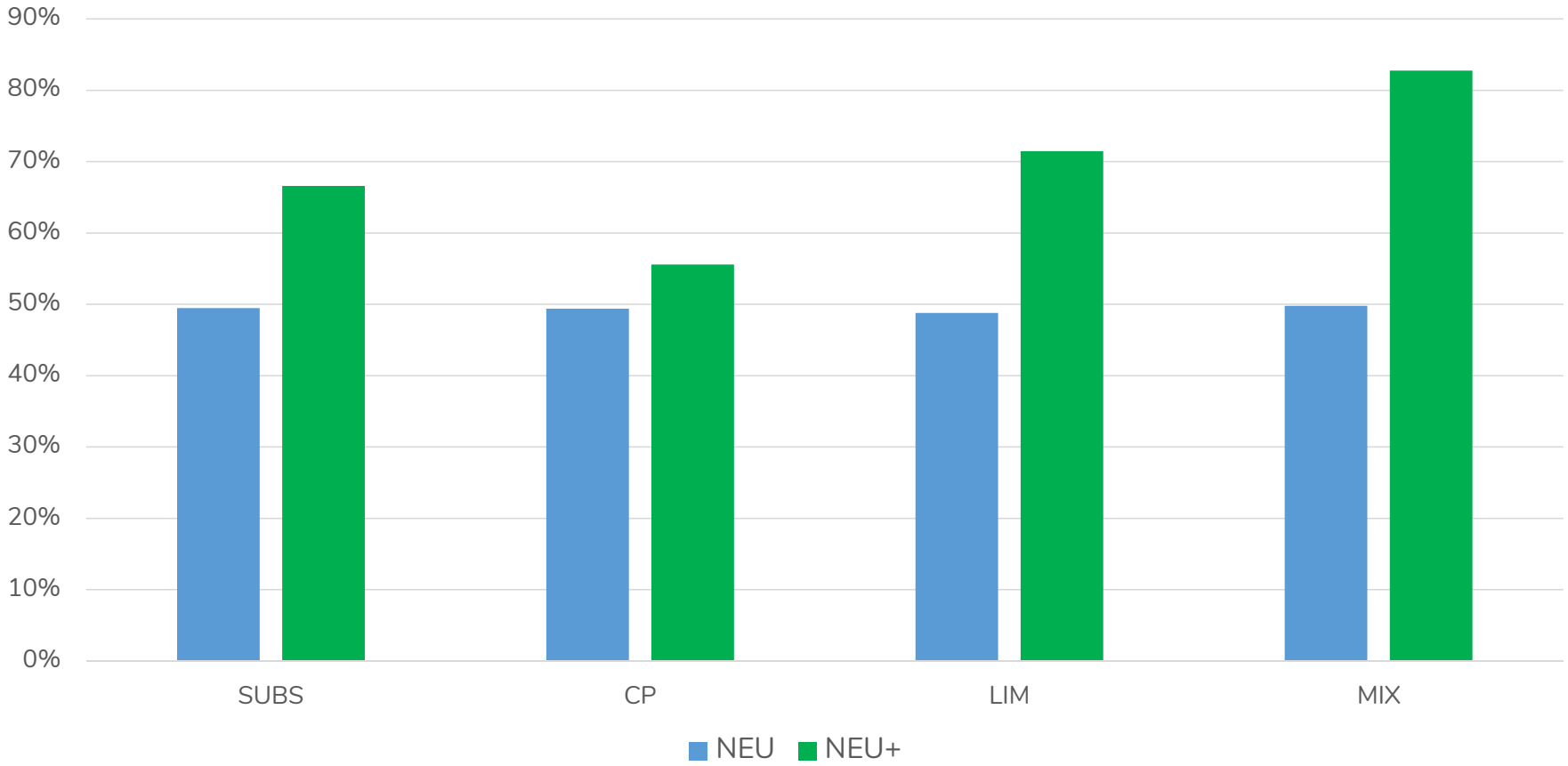
Source: CAKE/KOBiZE

Livestock population in Poland in 2050 [mln LU]



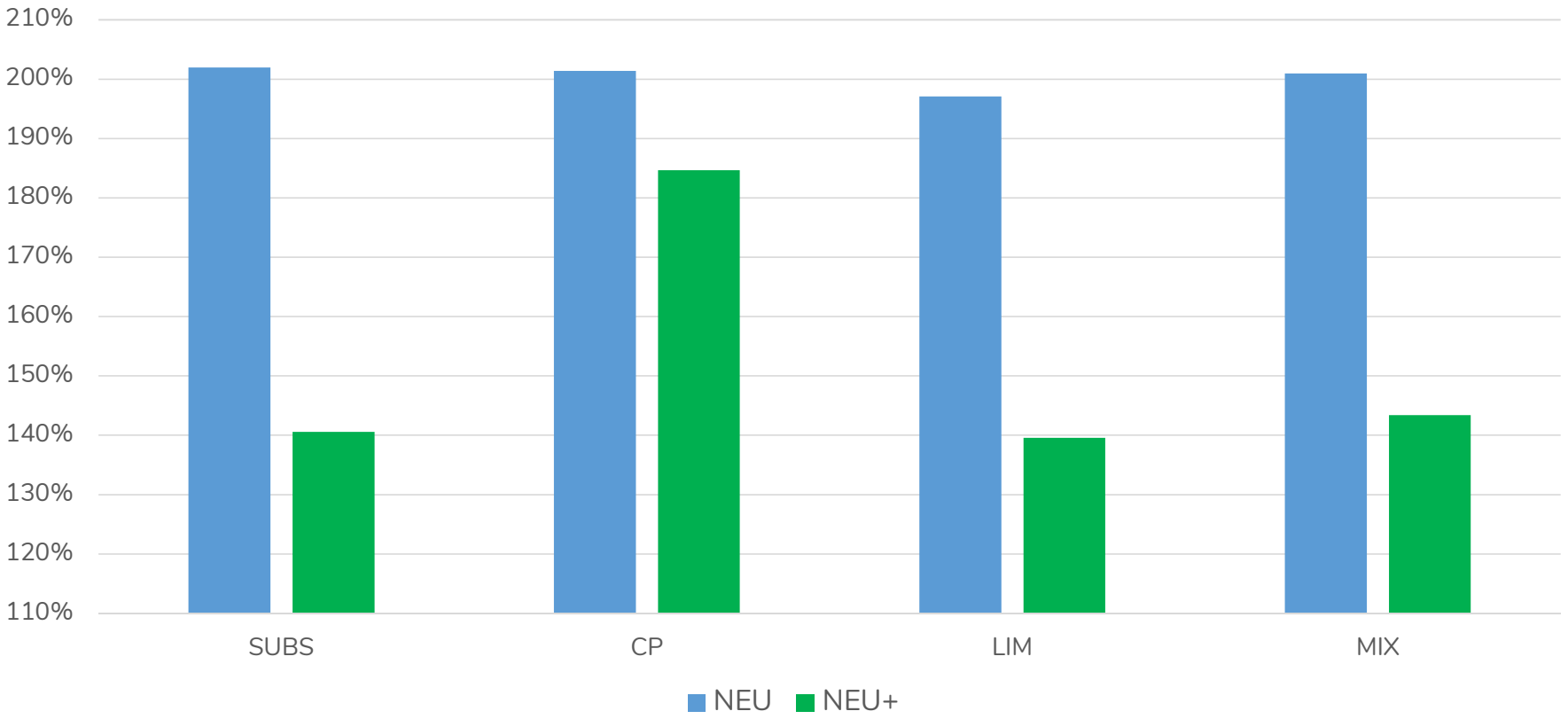
Source: CAKE/KOBiZE

Change in production volumes in Poland in 2050 [2015=100%]



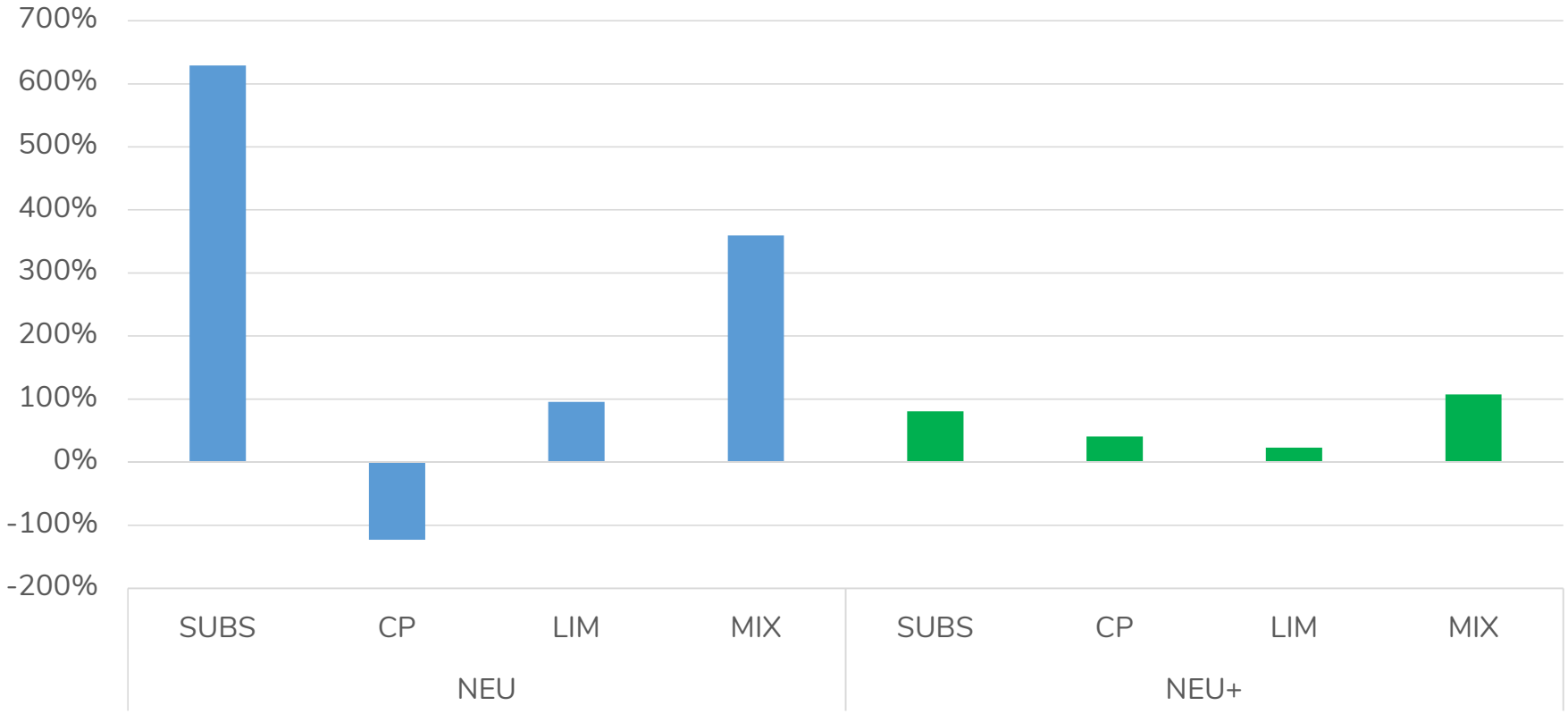
Source: CAKE/KOBiZE

Price index of agricultural products in Poland in 2050 [2015=100%]



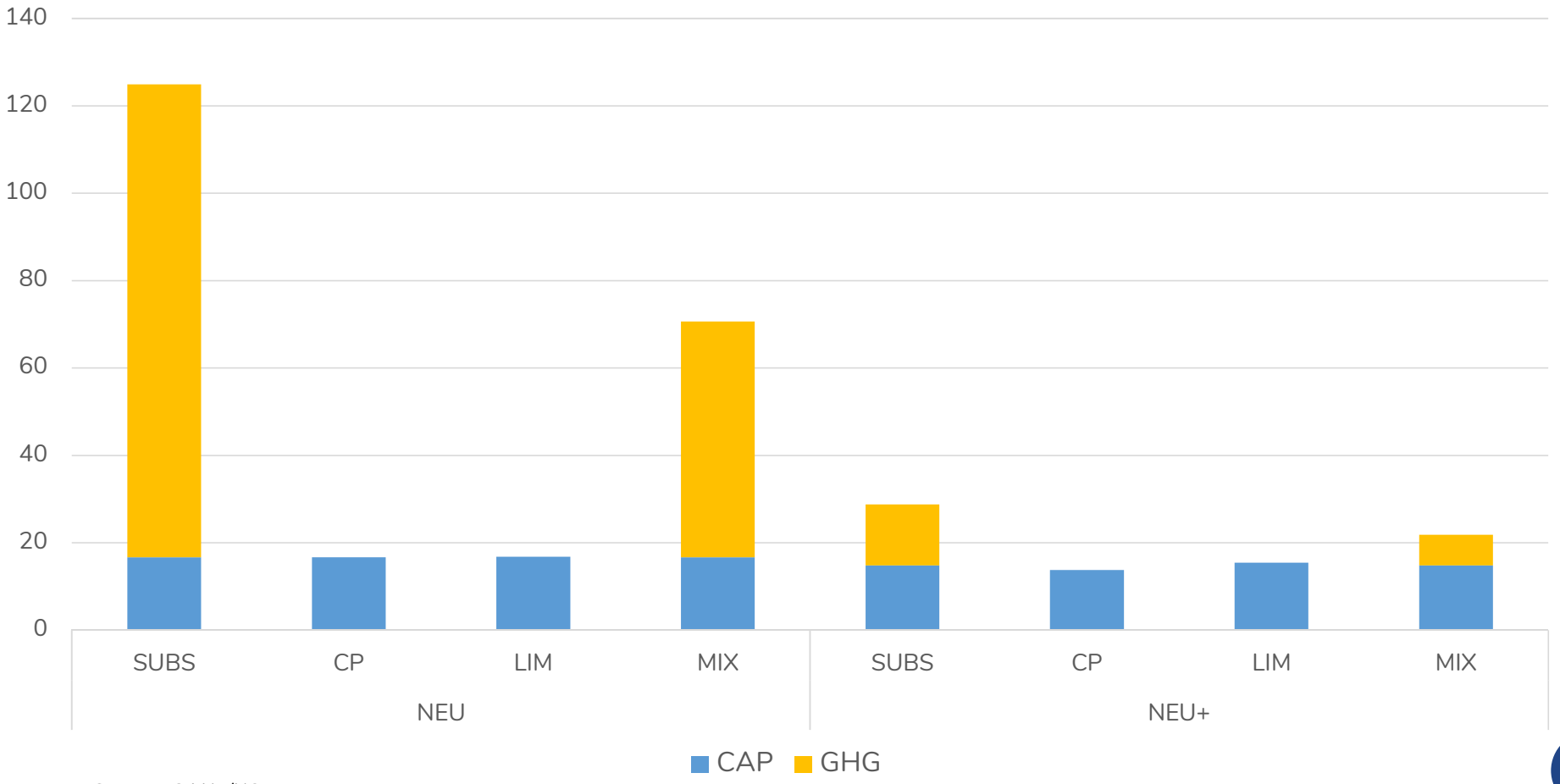
Source: CAKE/KOBiZE

Change in farm income in analysed scenarios in Poland [2015=100%]



Source: CAKE/KOBiZE

Total farm subsidies in Poland in 2050 [bln PLN]



Source: CAKE/KOBiZE

Summary [2015=100%]

Scenario	NEU			NEU+		
Option	Farmer income	Budget transfers	Prices of agricultural products	Farmer income	Budget transfers	Prices of agricultural products
SUBS	629%	701%	202%	81%	162%	141%
CP	-123%	94% (-168%)*	201%	41%	78% (68%)*	185%
LIM	96%	95%	197%	23%	87%	140%
MIX	360%	397%	201%	107%	123%	143%

* After inclusion of payments for emission allowances.

Source: CAKE/KOBiZE

Conclusions

- Assuming current production technologies, achieving ambitious reduction targets in agriculture is difficult and leads to significant reduction in production **(NEU scenario)** and consequently to an increase in the prices of agricultural products.
- The use of GHG mitigation measures **(NEU+ Scenario)** in agriculture facilitates the achievement of climate policy objectives and reduces its negative impact on market and income conditions.
- Implementation of measures aimed to reduce GHG emissions is more justified compared to reduction of agricultural production volumes.
- The type of option applied to achieve the reduction target influences the direction and scale of changes in the sector, **in the NEU+ scenario the mixed (MIX) option seems to be the most beneficial alternative.**
- In the **mixed option**, the burden of climate policy implementation is relatively equally distributed among all market participants (farmers, taxpayers, consumers).

Thank you!

The Climate CAKE team

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