



Centre for Climate
and Energy Analyses



POLAND NET-ZERO 2050

SELECTED INSTRUMENTS FOR CLIMATE POLICY IMPLEMENTATION IN AGRICULTURAL SECTOR IN THE 2050 PERSPECTIVE

#Summary

Authors:

Adam Wąs, Paweł Kobus, Jan Witajewski-Baltvilks, Vitaliy Krupin, Maciej Pyrka,
Robert Jeszke, Maciej Cygler

LIFEClimateCAKEPL



Warsaw, June 2022



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Adam Wąs, Paweł Kobus, Jan Witajewski-Baltvilks, Vitaliy Krupin, Maciej Pyrka, Robert Jeszke, Maciej Cygler

This summary presents key points of the full report published in Polish language:

Wąs, A., Kobus, P., Witajewski-Baltvilks, J., Krupin, V., Pyrka, M., Jeszke, R., Cygler, M. (2022). Polska net-zero 2050: Wybrane instrumenty wdrażania polityki klimatycznej w sektorze rolnictwa w perspektywie roku 2050. Instytut Ochrony Środowiska - Państwowy Instytut Badawczy / Krajowy Ośrodek Bilansowania i Zarządzania Emisjami (KOBiZE), Warszawa.

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This document was prepared in the Centre for Climate and Energy Analyses (CAKE) established in the National Centre for Emissions Management (KOBiZE), while KOBiZE is a part of the Institute of Environmental Protection - National Research Institute (IOŚ-PIB).

This document was prepared within the scope of the project: "The system of providing and disseminating information in order to support the strategic implementation of the climate policy (LIFE Climate CAKE PL)" - LIFE16 GIC/PL/000031 – LIFE Climate CAKE PL.

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The document was completed in June 2022.

Project and editing: Robert Jeszke, cover photo: pikisuperstar, Freepick.com

Contact:

Address: Chmielna 132/134,
00-805 Warszawa
WWW: www.climatecake.pl
E-mail: cake@kobize.pl
Tel.: +48 22 56 96 570
Twitter: @climate_cake



The project "The system of providing and disseminating information in order to support the strategic implementation of climate policy (LIFE Climate CAKE PL)" is co-financed from the EU LIFE programme and the resources of the National Fund for Environmental Protection and Water Management.



Main conclusions:

- ❖ Assuming **the use of current production technologies**, achieving the ambitious EU targets for **reducing greenhouse gas (GHG) emissions in the agricultural sector is difficult** and in the 2050 perspective (relative to 2015) leads to 50% reduction in production volumes and a consequent doubling of agricultural prices. **Farmers' incomes** in the climate neutrality scenario without implementation of additional mitigation instruments **are strongly dependent on how climate policy is enforced**.
- ❖ **Application of emission payments**, under the climate neutrality scenario in the agricultural sector, based on current technologies, **may lead to a significant reduction in farm profitability** and consequently threaten the country's food security.
- ❖ **Applying emission reduction subsidies** in the climate neutrality scenario without mitigation instruments **would require a 7-fold increase in public budget transfers to agriculture**. This approach for implementation of climate policy in agriculture generates the highest transition costs.
- ❖ **The use of instruments mitigating the GHG emission in agriculture facilitates the achievement of objectives of the climate policy** and reduces its negative impact on the market situation and income of farms. Through the use of instruments limiting the GHG emission in agriculture, such as afforestation of agricultural land, raising the level of groundwater on used organic soils, or construction of agricultural biogas plants, the **negative effects of the implementation of the climate policy in the agricultural sector**, as described above, **can be significantly reduced**.
- ❖ Depending on the option of implementation of the climate policy, the results of the models indicate that it is reasonable to implement the following instruments: **afforestation** of 1.5-2.5 million hectares of agricultural land, **restoring natural peatlands on** 350 to 700 thousand hectares of agriculturally utilized organic soils, and **generation** of ca. 3 TWh of **electricity from agricultural biogas** in 2050.
- ❖ With the application of these instruments limiting GHG emissions from agriculture, the increase in prices of agricultural products oscillates within 40% in relation to the base year. At the same time, regardless of the applied option of climate policy implementation, the average income of farmers is positive, but mostly lower than in the base year (40-100% of the 2015 level). Thus, in order to reduce GHG emissions from agriculture, **the implementation of instruments reducing GHG emissions is economically more justified than reducing agricultural production**.
- ❖ Among the analysed options of climate policy implementation, the **mixed option seems to be the most adequate**, as it assumes: 1) mandatory emission reduction in all farms (to ensure that half of the reduction target in agriculture is achieved), and 2) subsidies for voluntary reduction of the remaining GHG emissions. Within this option, the costs of climate policy are relatively low and are borne mainly by consumers and taxpayers, **ensuring that farmers' incomes remain unchanged**. Thus, such implementation of climate policy ensures national food security.

Summary

1. The report analyses the possibilities to reduce greenhouse gas (GHG) emissions from the agricultural sector in Poland and structural changes which may occur as a result of the implementation of EU climate policy objectives declared in the European Green Deal and resulting from the Fit for 55 package presented by the European Commission. The results of the analysis present possible paths for the transformation of Polish agriculture. The report develops the analyses carried out by the LIFE Climate CAKE PL project team and presented in the document "Poland net-zero 2050: The roadmap toward achievement of the EU climate policy goals in Poland by 2050"^{1,2} (hereinafter - Roadmap).
2. As part of the analysis of potential transformation pathways, the following scenarios defining the EU climate policy objectives and the resulting targets for Poland were developed:
 - **NEU (climate neutrality scenario)** assuming that the EU will achieve climate neutrality by 2050, i.e. zero net emissions (including removals). Agricultural sector in Poland belongs to the non-ETS, where the implementation of the EU climate policy plans to reduce emissions by ca. 70% compared to 2015. The scenario was substantiated in the Roadmap and assumes the use of current production activities and techniques in agriculture.
 - **NEU+** assuming the implementation of additional instruments aimed at reduction of GHG emissions in the agricultural sector, including: 1) afforestation on agricultural land, 2) raising the level of groundwater on utilized organic soils to restore peatlands, and 3) use of biogas plants to reduce emissions from manure management.
3. Achievement of both abovementioned climate neutrality scenarios have been tested within four policy options:
 - **CARBON PRICE (CP)** – assuming the implementation of GHG emission payments at farm level in the amount equal to the marginal abatement costs in the non-ETS sector in Poland.

¹ Pyrka, M., Jeszke, R., Boratyński, J., Tatarewicz, I., Witajewski-Baltvilks, J., Rabięga, W., Wąs, A., Kobus, P., Lewarski, M., Skwierz, S., Gorzałczyński, A., Tobiasz, I., Rosłaniec, M., Cygler, M., Sekuła, M., Krupin, V. (2021). Polska net-zero 2050: Mapa drogowa osiągnięcia wspólnotowych celów polityki klimatycznej dla Polski w 2050 r. Instytut Ochrony Środowiska - Państwowy Instytut Badawczy / Krajowy Ośrodek Bilansowania i Zarządzania Emisjami (KOBiZE), Warszawa.

² Pyrka, M., Jeszke, R., Boratyński, J., Tatarewicz, I., Witajewski-Baltvilks, J., Rabięga, W., Wąs, A., Kobus, P., Lewarski, M., Skwierz, S., Gorzałczyński, A., Tobiasz, I., Rosłaniec, M., Cygler, M., Sekuła, M., Krupin, V. (2021). Poland net-zero 2050: The roadmap toward achievement of the EU climate policy goals in Poland by 2050. #Summary. Institute of Environmental Protection - National Research Institute / National Centre for Emissions Management (KOBiZE), Warsaw.

- **LIMIT (LIM)** – implementing a GHG emissions limit (30% of 2015 emissions) in each modelled farm type.
 - **SUBSIDIES (SUBS)** – assuming subsidies for farmers for voluntary reduction of GHG emissions.
 - **MIXED (MIX)** – combination of the LIM and SUBS options.
4. The changes taking place in the agricultural sector (Table 1) will be, to a large extent, conditioned by the macroeconomic environment. This is due to the growing importance of innovative production techniques and the increasing role of capital and external financing in the agricultural sector.

Table 1. Key modelling results at macroeconomic and agricultural sector's levels.

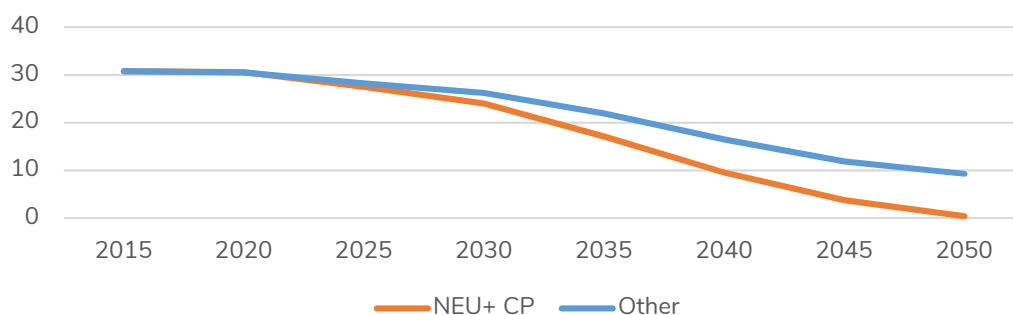
Macroeconomic indicators		Poland 2030		Poland 2050		
		NEU	NEU+	NEU	NEU+	
Emission reduction target vs. 2005 for non-ETS [%]		18		75		
Marginal abatement costs in non-ETS [EUR'2015/tCO ₂ ekw.]		65		1210		
GDP [bln EUR'2015]*		634		861		
Household consumption [bln EUR'2015]		355		523		
Policy options	Changes in agriculture					
Carbon Price (CP)	GHG emissions [Mt CO ₂ eq.]	26.2	23.9	9.3	0.4	
	Prices of agricultural products [2015 = 100%]	104	104	201	185	
	Changes in output structure [2015 = 100%]					
		Crop	100	101	82	100
		Livestock	92	92	44	40
Limit (LIM)	GHG emissions [Mt CO ₂ eq.]	26.2	26.2	9.3	9.3	
	Prices of agricultural products [2015 = 100%]	104	102	197	140	
	Changes in output structure [2015 = 100%]					
		Crop	99	101	73	95
		Livestock	92	94	42	60
Subsidies (SUBS)	GHG emissions [Mt CO ₂ eq.]	26.2	26.2	9.3	9.3	
	Prices of agricultural products [2015 = 100%]	104	102	202	140	
	Changes in output structure [2015 = 100%]					
		Crop	100	101	82	94
		Livestock	92	94	43	51
Mixed (MIX)	GHG emissions [Mt CO ₂ eq.]	26.2	26.2	9.3	9.3	
	Prices of agricultural products [2015 = 100%]	104	102	201	143	
	Changes in output structure [2015 = 100%]					
		Crop	100	101	82	94
		Livestock	92	94	44	75

Source: CAKE/KOBiZE.

5. Analysis of the NEU scenario shows that agriculture is a sector with limited emission reduction possibilities due to technological limitations. An optimal reduction of emissions in the NEU scenario in the perspective of 2050 amounts to 70% (Figure 1). Exception is the CP

option in the NEU+ scenario, as in view of rising emission allowance prices; it is rational at the farm level to reduce GHG emissions below the set reduction target, as this reduces the total amount of payments for GHG emission allowances (thus leading to 98.8% decrease of GHG emissions).

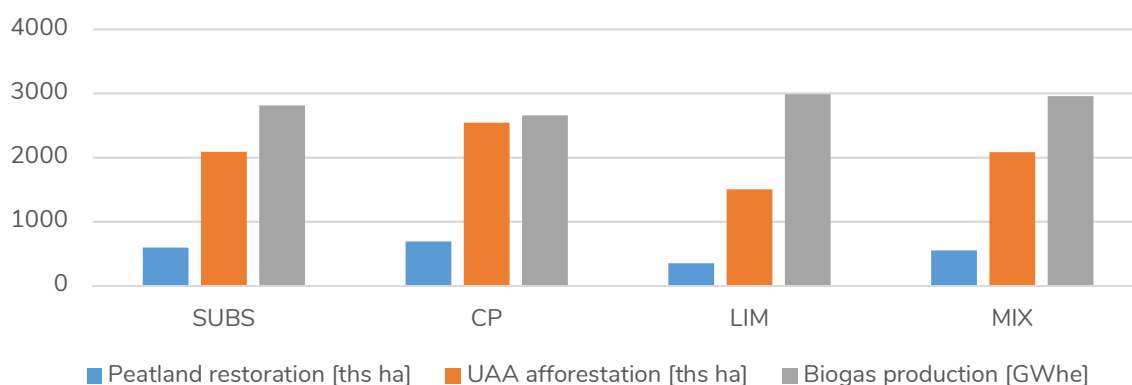
Figure 1. GHG emissions within scenarios and options of agricultural development in Poland [Mt CO₂ eq.].



Source: CAKE/KOBiZE.

6. The NEU+ scenario implements the three additional instruments aimed at reduction of GHG emissions in the agricultural sector: 1) afforestation on agricultural land, 2) raising the level of groundwater on used organic soils, and 3) use of biogas plants to reduce emissions from manure management. The scale and structure of implementation of instruments mitigating GHG emissions varies depending on the assumed option of climate policy implementation, thus achieving varying results in 2050 (Figure 2). Instruments involving the exclusion of land from cultivation (afforestation, restoring of peatlands) are most widely implemented in the CP option. A similar relation occurs in the SUBS option, in which the assumed instruments are more widely implemented after the subsidies for reduction of GHG emissions cover the costs of implementation of these mitigation instruments.

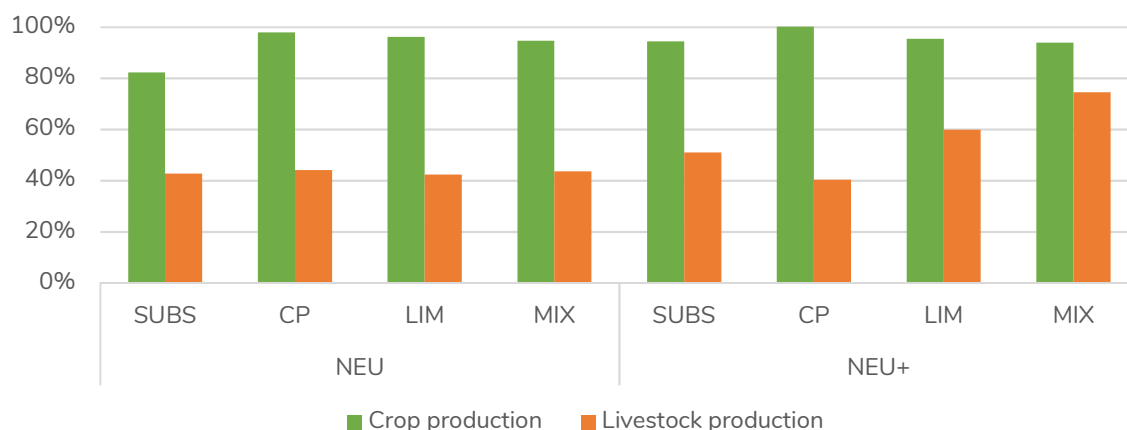
Figure 2. Implementation of additional GHG mitigation instruments in agricultural sector of Poland in 2050 (NEU+ scenario).



Source: CAKE/KOBiZE.

7. In the NEU scenario, GHG emission mitigation is conducted through reduction of production volume and changes in its structure. The significant decrease in aggregate output, to as low as 50% of the 2015 level, is also not equally distributed between crop and livestock production (Figure 3).

Figure 3. Dynamics of crop and livestock production volumes in Poland in 2050 [2015=100%].

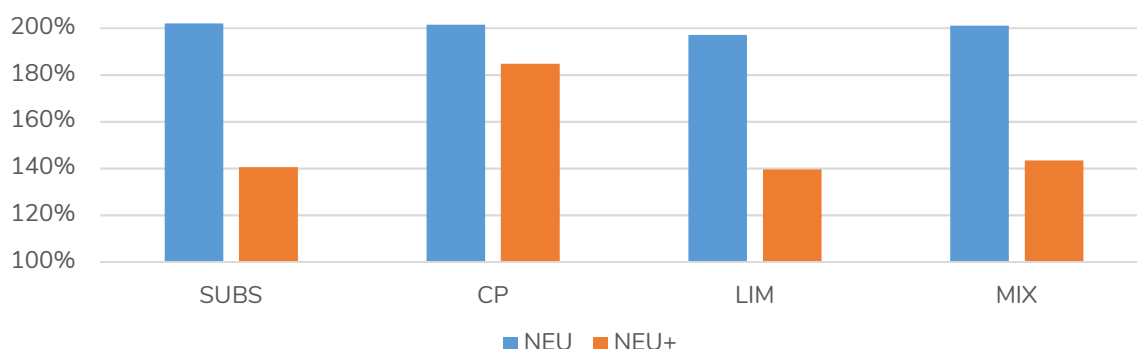


Source: CAKE/KOBiZE.

8. In the NEU+ scenario, the use of instruments mitigating GHG emissions allows outputs to remain higher. The reduction in the aggregate index of agricultural production depends largely on the option of climate policy implementation. The largest decrease in agricultural production in the NEU+ scenario occurs in the CP option (55% of the 2015 level), mostly due to higher reductions in GHG emissions. In the MIX option, the volume of agricultural production decreases by 18% compared to 2015. The relatively small changes in the aggregate production index in the MIX option are due to the possibility of maintaining a significant level of livestock production. Adopting the assumptions of this option results in only a few percent decrease in the volume of crop production and maintaining the volume of livestock production at 75% of the base year (2015).
9. Reduction of agricultural production volume in the face of continuous and inelastic demand for food inevitably leads to its price increase. In the NEU scenario, the average level of prices of agricultural products oscillates within 200% of the base year (Figure 4). At the same time, the use of instruments limiting GHG emissions creates opportunities to achieve the reduction target with a much lower level of impact of climate policy on the market of agricultural products. In the NEU+ scenario, prices of food products increase on average by 40% as compared to the base year 2015. Some exception is the CP option, in which prices increase by 85%, however, it should be emphasized that in this option, in view of imposing payments

for GHG emission and assuming the possibility of applying mitigation instruments in the NEU+ scenario, the level of GHG emission from agriculture approaches zero.

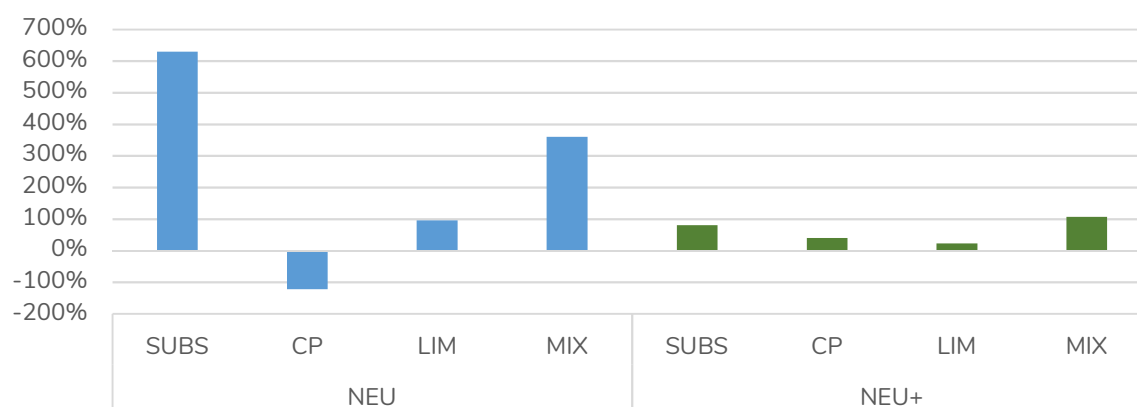
Figure 4. Indices of agricultural products price growth in Poland in 2050 [2015=100%] (NEU and NEU+).



Source: CAKE/KOBIZE.

- In the NEU+ scenario, the introduction of GHG mitigation measures largely mitigates the negative impact of imposing high GHG emission reduction targets on farmers' income situation. In all options of climate policy implementation, farmers' sector-wide income is positive in the NEU+ scenario. And in the MIX scenario, farmers are even likely to maintain their base year income levels (Figure 5).

Figure 5. Changes of farm income in Poland in 2050 [2015=100%].



Source: CAKE/KOBIZE.

- Comparing the options of climate policy implementation in the analysed NEU and NEU+ scenarios, in addition to the level of farmers' support, it is necessary to compare the level of farmers' income and the level of burden placed on consumer arising from changes in food prices (Table 2).

Table 2. Economic impact of the analysed options for emission reduction in the agricultural sector within the NEU and NEU+ scenarios [2015=100%]

Scenarios	NEU			NEU+		
Options	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

* Including payments for emission allowances.

Source: CAKE/KOBiZE.

12. Analysis shows that the choice of a policy option for achievement of climate neutrality will have a significant impact on the direction and scale of changes in the agricultural sector of Poland. Among the analysed approaches, the mixed (MIX) option in the NEU+ scenario seems to be the most advantageous alternative. In this option, while maintaining a rational level of expenditures on support for farmers and a moderate increase in prices of agricultural products, there is a possibility of maintaining farmers' income at the unchanged level. At the same time, implementation of this option means relatively small decreases in the volume of agricultural production, in particular in livestock production. This approach is also susceptible to modifications allowing to adjust the level of mandatory and voluntary reduction of GHG emissions.