CLIMATE NEUTRAL AGRICULTURE IN EUROPE AND POLAND IN 2050

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Dictionary

CDR – Polish Agricultural Advisory Centre

CH_4 – methane

CO_2 – carbon dioxide

CO_2eq – carbon dioxide equivalent, a unit that facilitates comparison of the climate impact of CO_2 and other greenhouse gases, (1 t CO_2eq = 0,27 t CO_2)

EU ETS – European Union Emission Trading System

EUR – Euro currency

GHG – greenhouse gases

GWP – global warming potential

IOŚ – PIB – Institute of Environmental Protection – National Research Institute

IPCC – Intergovernmental Panel on Climate Change

IUNG – Institute of Soil Science and Plant Cultivation in Pulawy

KOBiZE – National Centre for Emissions Management

LULUCF – Land Use, Land-Use Change and Forestry

Mt – megaton, 1 Mt = 1,000,000 tons

N_2O – nitrous oxide

NH_3 – ammonia

non-ETS – sectors not covered by the European Emissions Trading System

PLN – Polish zloty (Polish currency)

Direct payments – subsidy granted to farmers under the Common Agricultural Policy, consisting of payments in Pillar 1

Payment for eligible actions – subsidy given to farmers for undertaking a specific action (e.g. sowing secondary crops)

Payment for results – a subsidy given to farmers for achieving specific, measurable and reportable results (e.g. increasing soil organic carbon levels)

ppm – parts per million

Agri-environment-climate programmes – a measure under RDP aimed at promoting practices contributing to sustainable land management (in order to protect soil, water, climate), protection of valuable natural habitats and endangered bird species, landscape diversity and protection of endangered genetic resources of crops and livestock

RDP – Rural Development Programme

SDGs – Sustainable Development Goals

EU – European Union

UNFCCC – United Nations Framework Convention on Climate Change

CAP – Common Agricultural Policy of the European Union

Summary

In view of the progressive warming of the climate caused by human activity, **world leaders, by signing the Paris Agreement in 2015, expressed their desire to strive for net carbon neutrality by 2050 at the latest. The European Union was the first continent in the world to commit to this goal.**

The political aspiration to achieve carbon neutrality by 2050 is undeniable. Therefore, **the question we must face is not "if" but rather:**

"how will we achieve net carbon neutrality by 2050"?

The agricultural sector – as the largest emitter of GHG after the energy industry and the manager of the world's largest non-oceanic carbon store located in agricultural soils, **can and should play a key role in achieving the EU's objectives.**

Currently, however, the agricultural sector is not on track to achieve climate neutrality before or by 2050 at the latest. Moreover, existing EU agricultural support instruments, with the Common Agricultural Policy (CAP) at the forefront, are not delivering sufficient environmental results, which partly explains the agricultural sector's lack of readiness for the net-zero reality.

In the light of the EU's ambitions, it is clear that this situation must change, as outlined in the European Green Deal – the EU's flagship document on the future we are working towards together and in the **Farm to Fork** and **Biodiversity Strategies**, which place particular emphasis on agriculture.

Regenerative agriculture, which allows the restoration of natural cycles in nature is a model that not only allows **agriculture to adapt to the new reality**, but can also successfully operate/function in it. It embraces the carbon cycle and thus places farmers at the centre of efforts to prevent and adapt to climate change in a way beneficial for them.

However, **even the most drastic efforts to avoid, reduce and sequester GHGs at the individual farmer level will not allow for achieving carbon neutrality by the deadline. Only by thinking systemically**, starting with farming input producers, through the farmer, processor and distributor to the consumer, not forgetting agricultural support systems, economic policy, or demographic factors, **will we be able to achieve climate neutrality by 2050**.

The authors and publisher of this brochure strongly **encourage undertaking this effort** at EU and Polish level, especially in the year of **the United Nations Summit on Food Systems**. We hope that **this publication will be the starting point for a debate** and, most importantly, of **systemic measures to help our agriculture to become climate-neutral by 2050 at the latest, and to put farmers and their interests at the centre of this transition.**

Key calls for the EU and Poland

In order to ensure consistency and give clear and optimal direction to agricultural policy, the Common Agricultural Policy must become an instrument for achieving the EU's climate, energy and biodiversity objectives and be linked to the framework documents for climate policy. The CAP should reward farmers more for agricultural and environmental outcomes, rather than just the activities themselves.

The **next CAP should lead to the implementation of sustainable farming practices** throughout the EU by putting in place conditions that safeguard environmental and social objectives and strengthen climate-, nature- and animal-friendly farming practices by offering effective support. It is also important to ensure transparency and measurability of effects by Member States during preparation and implementation of CAP national strategic plans.

In order to co-ordinate Poland's achievement of climate neutrality, while at the same time developing the country's natural capital, **it is necessary to set up advisory bodies on climate change and natural capital at the Chancellery of the Prime Minister**. The task of these bodies should be to support, monitor and evaluate the Government's actions taken to achieve carbon neutrality by 2050 and to develop policies in line with planetary boundaries. Within these institutions, a Working Group should be established consisting of at least representatives of the Ministry of Agriculture and Rural Development and the Ministry of Climate and Environment to implement the same goal: carbon neutrality of agriculture in Poland.

To achieve climate neutrality, decisions need to be taken at the level of economic policy: **one ton of CO_2eq emissions in Poland should cost at least EUR 100**. The same price per unit of emission should be postulated at the EU borders under the carbon border emission tax (CBAM) mechanism. This will enable the agricultural sector to rapidly develop demand for carbon sequestration services, such as carbon credits, which will support domestic farmers in their activities. It will also make it possible to effectively incentivise the EU's trading partners to reduce emissions to at least the same extent as in the European Union.

At the level of individual agricultural holdings **it is necessary to take action to increase the average level of organic carbon in agricultural soils**, which is currently 21.0 g/kg in Poland, whereas the European average is 43.1 g/kg. Support mechanisms for the development of regenerative agriculture practices, which are comprehensively described in this brochure, should be implemented.

It is necessary to include the agricultural sector in the process of complete decarbonisation of the energy sector. The agricultural sector has resources, such as the area of its farms, or the waste from agricultural production, which are essential in the decarbonisation of the energy sector. They enable many farms to become energy self-sufficient and the power system to be supplied with stable electricity or local heat from e.g. biogas.

Analysis of the current situation

Global warming is caused by human activity

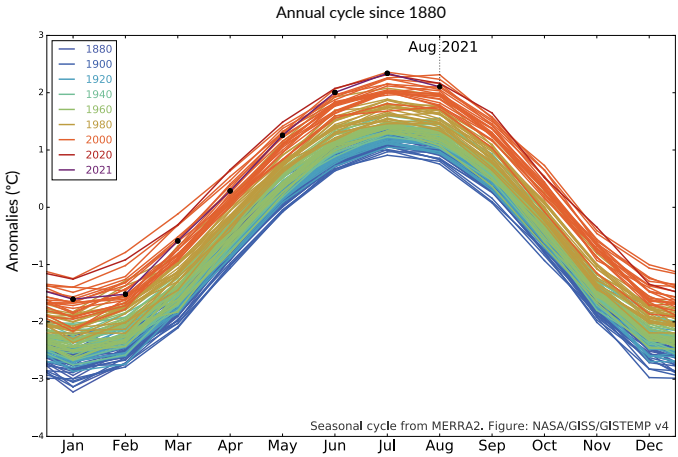


Figure 1: Earth's average temperature over the year with variations compared to 1880

NASA: https://data.giss.nasa.gov/gistemp/graphs_v4/

Global warming is a fact confirmed by the long-term increase in the Earth's average temperature since the Industrial Revolution (the period between 1850 and 1900)[1], as shown in Figure 1.

The long-term rise in the Earth's average temperature is linked to human activity. This leads to increasing levels of greenhouse gases (GHG) in the atmosphere, in particular due to the burning of fossil fuels. The relationship between GHG emissions and their concentration in the atmosphere is shown in Figure 2.

In the debate on progressive climate change, we must remember that if we want to keep the global temperature rise below 2°C, we cannot emit more than 2500-3000 billion tons of CO_2 into the atmosphere, it is the so-called **carbon budget**, and we have already used up over 80% of this limit[2].

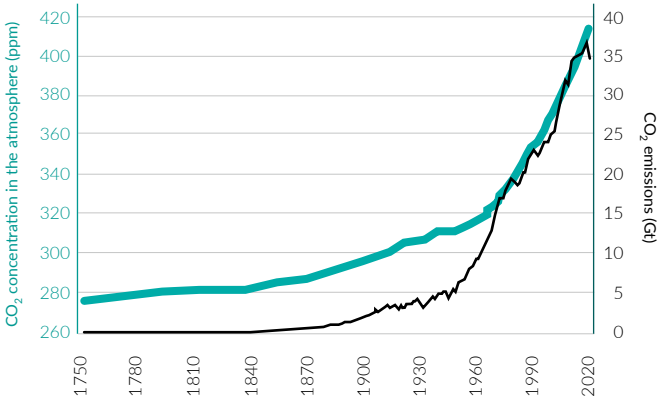
After the energy sector, accounting for 73.2% of global GHG emissions, **agriculture and land use (LULUCF) are the largest contributors**, accounting for 18.4% of emissions. This consists mainly of emissions from: livestock breeding (5.8% of total global GHG emissions), agricultural soils (4.1%), rice cultivation (1.3%), crop residue burning (3.5%) and deforestation (2.2%). The use of inputs for agricultural production, such as fertilisers and fossil fuels is also associated with GHG emissions that are counted in the emission inventories of other economic sectors (e.g. petrochemicals industry).

1 NASA. (2021). Overview: Weather, Global Warming and Climate Change. https://climate.nasa.gov/resources/global-warming-vs-climate-change/ [access: 30.05.2021]

2 Energia od Nowa. (2018). Przyjazny rozwój Polski. Ludziom – gospodarce – środowisku. Raport merytoryczny. https://energiaodnowa.wwf.pl/wp-content/uploads/2019/04/druk_final_2018_mala_wersja.pdf [access: 30.05.2021].

Figure 2:
CO_2 ppm level in the atmosphere and CO_2 emissions into the atmosphere

NOAA – Climate.gov: https://www.climate.gov/news-features/understanding-climate/climate-change-atmospheric-carbon-dioxide



NOAA Climate.gov
data: NOAA, ETHZ, Our World in Data

Agriculture is the second most important contributor to global warming

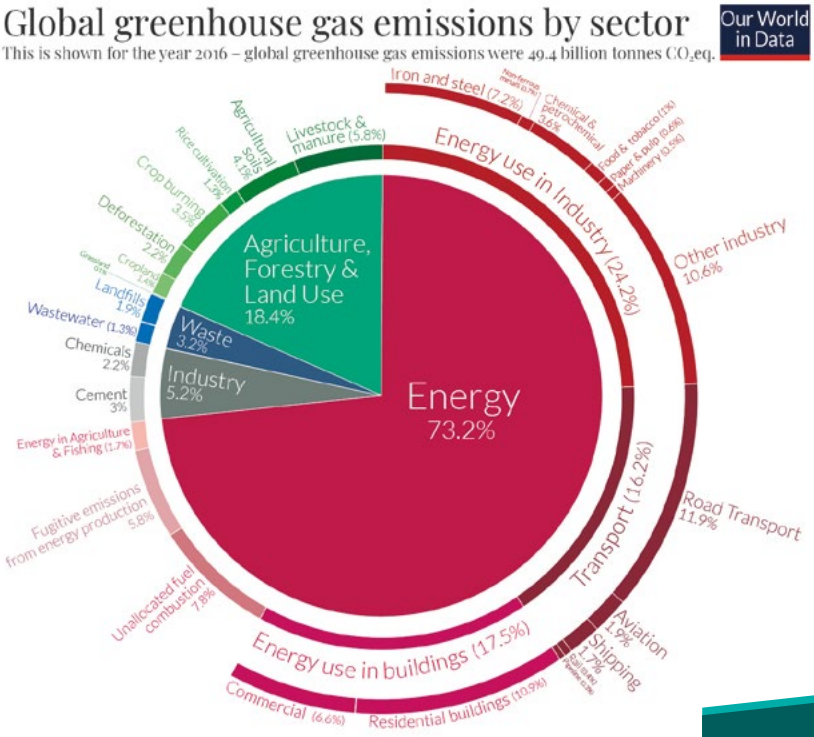
GHG EMISSIONS FROM AGRICULTURE – WORLD

According to the World Bank data, agricultural areas cover 36.9% of the total land area, of which a third is arable land[3]. **Between 2007 and 2016, agriculture together with LULUCF was responsible for about 23% of global GHG emissions**. Emissions from the agriculture sector were responsible for 13% of global CO_2 emissions, 44% CH_4 and as much as 82% of N_2O[4].

Considering the entire food production chain, including emissions associated with the manufacture of inputs for agricultural production, agri-food processing and processes associated with food production, the sector's contribution to total GHG emissions is estimated at 26 to 39%[5].

It is worth emphasising that GHG emissions are also connected with wasting food. On the global scale, we waste one third of produced food[6], which accounts for 7% of global GHG emissions – 3.3 billion t CO_2eq[7]. They are already included in the previously presented values of GHG emissions from agriculture.

3 World Bank. (2021). Agricultural areas. https://data.worldbank.org/indicator/AG.LND.AGRI.ZS [access: 30.05.2021].
4 Karaczun Z., Kozyra J. (2020). Wpływ zmiany klimatu na bezpieczeństwo żywnościowe Polski. Warszawa: Wydawnictwo SGGW.
5 IPCC (2019). Special Report on Climate Change, Desertification, Land Degradation, Sustainable Land Management, Food Security, and Greenhouse gas fluxes in Terrestrial Ecosystems Summary for Policymakers. https://www.ipcc.ch/site/assets/uploads/2019/08/4.-SPM_Approved_Microsite_FINAL.pdf [access: 29.05.2021].
6 Energia od Nowa. (2018). Przyjazny rozwój Polski. op.cit.
7 FAO. (2013). Food wastage: Key facts and figures. http://www.fao.org/news/story/en/item/196402/icode/ [access: 30.05.2021].



OurWorldinData.org: https://ourworldindata.org/ghg-emissions-by-sector

Figure 3: Global greenhouse gas emissions by sectors

GHG EMISSIONS FROM AGRICULTURE SECTOR – THE EUROPEAN UNION

Agriculture currently accounts for 12% of all GHG emitted by the European Union[8]. GHG emissions from the agricultural sector in the EU have declined more slowly than from other sectors of the economy and have remained constant since 2009. The reduction in GHG emissions from the LULUCF sector in the EU between 1990-2018 was 20.1%. Between 2005 and 2018 the reduction was only 0,1%.

One hectare of agricultural land emits on average 2.5 t CO_2eq, and one livestock calculated unit: 2.7 t CO_2eq[9]. Estimated emissions from mineral soils are 27 Mt CO_2eq[10].

Emissions from food waste are also important. On average, one European wastes 180 kg of food per year, **in total we waste as much as 90 million tonnes of food in the EU**.

8 European Commission. (2020). CAP Brief: Agriculture and Climate Mitigation. https://ec.europa.eu/info/sites/default/files/food-farming-fisheries/key_policies/documents/cap-specific-objectives-brief-4-agriculture-and-climate-mitigation_en.pdf [access: 24.05.2021].

9 European Commission. (2020). Communication COM(2020) 846 final.

10 European Commission. (2021). Operationalising an EU carbon farming initiative. https://op.europa.eu/en/publication-detail/-/publication/b7b20495-a73e-11eb-9585-01aa75ed71a1/language-en [access: 23.05.2021].

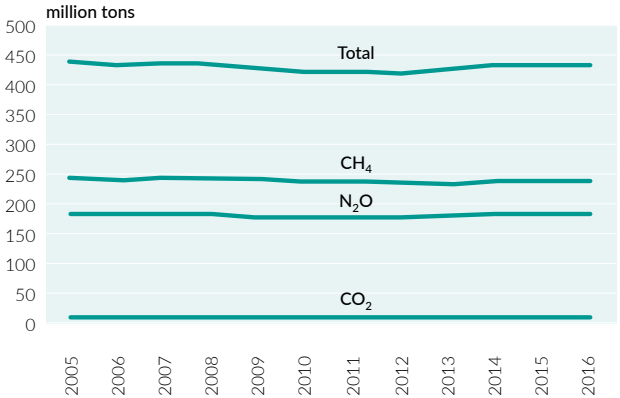


Figure 4:
GHG emissions from agriculture in the EU

CAP Reform: http://capreform.eu/the-ghg-emissions-challenge-for-agriculture/

GHG EMISSIONS FROM THE AGRICULTURE SECTOR – POLAND

In 2017, agriculture was responsible for 11% (44 $MtCO_2eq$) of Poland's emissions, 75% of which came from CH_4 and N_2O, mainly arising from the use of inorganic fertilizers for soil fertilization, organic soil cultivation and enteric fermentation in dairy and beef cattle[11]. **Agriculture is the largest emitter of N_2O in Poland accounting for 78% of this gas and the second largest source of CH_4 emissions accounting for 30% of its total emission**[12].

It is worth placing the agricultural sector emissions in the context of Poland's total GHG emissions. In total, 414 Mt CO_2eq, was generated in Poland in 2017, of which 34 Mt CO_2eq was offset by carbon sequestration within the LULUCF sector[13]. CO_2 z sequestration in the forestry and soils sector is projected to fall from around 34 million tonnes today to around 10 million tons CO_2eq in 2040. **A large proportion of emissions are process-related**, – they are related to e.g. soil cultivation, fertilisation, livestock breeding or forestry operations, which means that it is extremely difficult to reduce them[14].

Figure 5 helps us distinguish between combustion-related and non-combustion-related CO_2 emissions and non-CO_2 GHG emissions. McKinsey experts point out that despite the achieved progress, in 2017 Poland ranked third from the last place among EU countries in terms of GHG emissions relative to GDP (800 g CO_2eq for every euro of GDP)[15].

11 McKinsey & Company. (2020). Neutralnie emisyjnie Polska 2050. https://www.mckinsey.com/pl/~/media/mckinsey/locations/europe%20and%20middle%20east/polska/raporty/carbon%20neutral%20poland%202050/neutralna%20emisyjnie%20polska%202050_raport%20mckinsey.pdf [access: 30.05.2021].
12 Wąs A., Kobus P., Krupin V., Witajewski-Baltvilks J., Cygler M. (2020). Assessing climate policy impacts in Poland's agriculture – Options overview, Institute of Environmental Protection – National Research Institute / National Centre for Emissions Management (KOBiZE), Warszawa.
13 McKinsey & Company. (2020). Neutralnie emisyjnie Polska 2050. op.cit.
14 WWF Polska. (2020). Zeroemisyjna Polska 2050. https://www.wwf.pl/sites/default/files/inline-files/Raport_Zeroemisyjna_2050.pdf [access: 29.05.2021].
15 McKinsey & Company. (2020). Neutralnie emisyjnie Polska 2050. https://www.mckinsey.com/pl/~/media/mckinsey/locations/europe%20and%20middle%20east/polska/raporty/carbon%20neutral%20poland%202050/neutralna%20emisyjnie%20polska%202050_raport%20mckinsey.pdf [access: 29.05.2021].

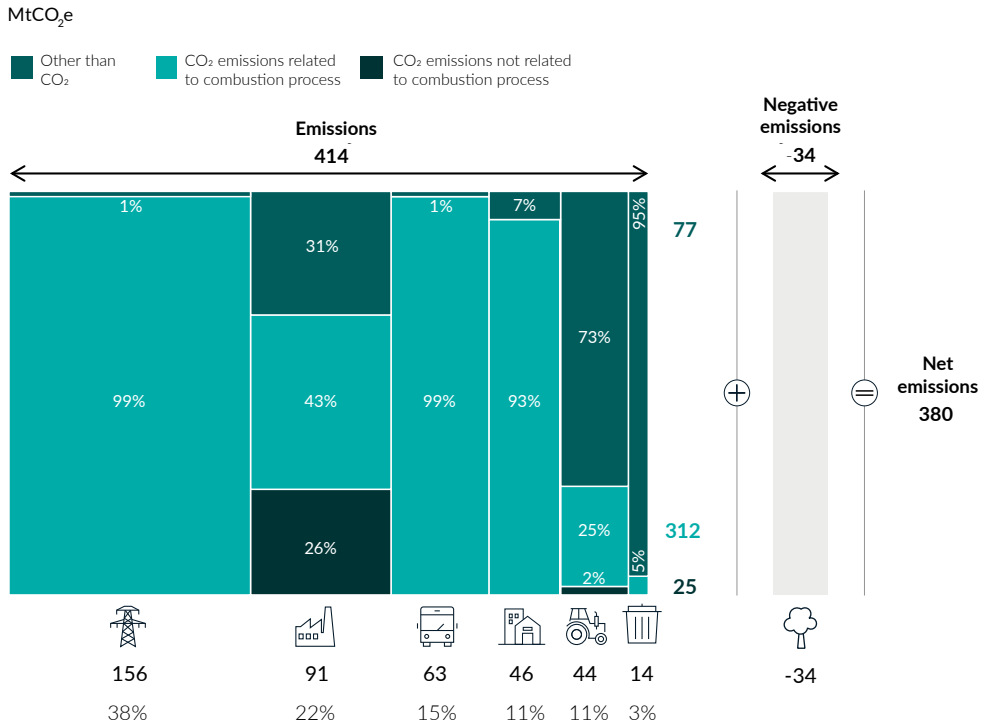


Figure 5:
Poland's net GHG emissions for 2017

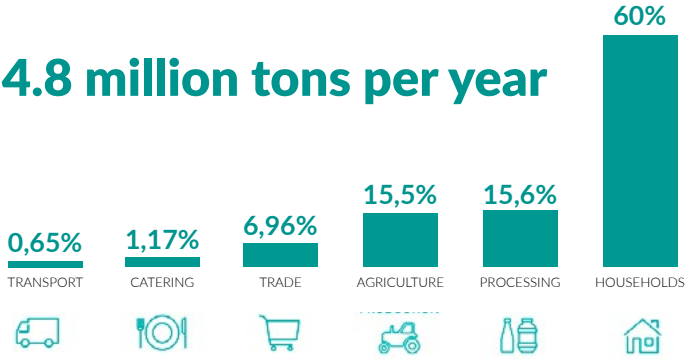
McKinsey & Company: https://www.mckinsey.com/pl/~/media/mckinsey/locations/europe%20and%20middle%20east/polska/raporty/carbon%20neutral%20poland%202050/neutralna%20emisyjnie%20polska%202050_raport%20mckinsey.pdf

GHG emission reductions in the LULUCF sector in Poland between 1990 and 2018 were 33.2%. In contrast, emissions from these sectors increased by 5.5% between 2005 and 2018. On average, one hectare of agricultural land in Poland emits 2.2 t CO_2eq, and one livestock calculation unit emits 2.9 t CO_2eq[16]. On average, cereal production in Poland is more emission efficient than the EU average, but animal production in Poland is on average less emission efficient than the EU average.

GHG emissions related to food waste in Poland are also important. They amount to 4.4 million tonnes of food and place Poland in the fifth position in the ranking of the biggest food wasters in the EU. **Food losses in Poland occur mainly at the consumer level, where 60% of total food losses are wasted.**

16 European Commission. (2020). Communication COM(2020) 846 final.

How much food is wasted in Poland?



Results of PROM 2020 study by IOŚ-PIB (Institute of Environmental Protection – National Research Institute) and SGGW (Warsaw University of Life Science)

Figure 6:
Food losses and waste in Poland in different parts of the food processing and consumption chain

European Commission: https://ec.europa.eu/newsroom/sante/items/703095

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A new deal – the net-zero target by 2050

PARIS AGREEMENT

In light of ongoing global warming and the indisputable role of human activities in this process, with the particular importance of the agricultural sector and LULUCF, and the awareness of the existence carbon budget, it is imperative to achieve climate neutrality as soon as possible and no later than 2050. These aspirations are enshrined in the **Paris Agreement**, which was signed by 196 countries on 12 December 2015 at COP21: the twenty-first meeting of the session of the parties to the UNFCCC[17].

DEFINITION OF CLIMATE NEUTRALITY

Climate neutrality is the state in which human activities have no net impact on the IPCC climate system, it is defined as achieving net-zero emissions, thus balancing GHG emissions with absorption from the atmosphere of the equivalent amount of GHG emitted[18]. **In the booklet, *the term climate neutrality is synonymous with net-zero emissions and the term net-zero.*** Similarly, climate neutrality for agriculture means net-zero balance of GHG emissions within that sector, and carbon neutrality for an individual farm means.

17 UNFCCC. (2015). The Paris Agreement. https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement [access: 30.05.2021].
18 IPCC. (2018). Special Report: Global Warming of 1.5°C – Glossary. https://www.ipcc.ch/sr15/chapter/glossary/ [access: 30.05.2021].

THE EUROPEAN UNION'S AMBITIONS IN THE LIGHT OF PARIS AGREEMENT AND THE AGRICULTURAL SECTOR

The European Union is the first continent with an ambition to achieve climate neutrality by 2050[19]. Achieving this goal is one of the main priorities of the European Commission written in the European Green Deal, presented by European Commission President Ursula von der Leyen in December 2019[20]. The Green Deal also assumes a 55% reduction in EU-wide GHG emissions by 2030, compared to 1990 GHG emissions[21].

It also assumes undertaking simultaneous action to adapt to climate change, which is progressing and cannot be stopped by emissions neutrality[22]. The European Commission stresses that nature-based solutions, i.e. largely concerning the agricultural sector, when implemented on a large scale, will increase resilience to climate change and contribute to achieving many of the objectives of the Green Deal[23].

19 European Commission. (2020). 2050 long-term strategy. https://ec.europa.eu/clima/policies/strategies/2050_en [access: 30.05.2021].
20 European Commission. (2019). European Green Deal. https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en [access: 30.05.2021].
21 European Commission. (2021). 2030 climate & energy framework. https://ec.europa.eu/clima/policies/strategies/2030_en [access: 30.05.2021].
22 European Commission. (2021). Forging a climate-resilient Europe – the new EU Strategy on Adaptation to Climate Change. https://ec.europa.eu/clima/sites/clima/files/adaptation/what/docs/eu_strategy_2021.pdf [access: 23.05.2021].
23 European Commission. (2021). Forging a climate-resilient Europe – the new EU Strategy on Adaptation to Climate Change. https://ec.europa.eu/clima/sites/clima/files/adaptation/what/docs/eu_strategy_2021.pdf [access: 23.05.2021].

It is important to underline that, despite the key ambition of the European Union to achieve carbon neutrality by 2050, the aspirations are much broader and concern the achievement of the 17 Sustainable Development Goals enshrined in the so-called 2030 Agenda. The EU played a leading role in the creation of these goals. The EU's European Green Deal is intended to provide the appropriate legal framework for putting these goals into practice and mobilising the resources needed to achieve them[24].

The political decision that net zero emissions must be achieved for the entire EU economy, and therefore also for the agricultural sector, has been taken.

Therefore, the question is no longer "Will we achieve carbon neutrality by 2050?", but rather "How do we achieve this goal?"

EUROPEAN UNION POLICY IN THE LIGHT OF THE PARIS AGREEMENT AND THE AGRICULTURAL SECTOR

Although the ambition is set and the political decision has been taken, current EU policies are not sufficient to achieve the net-zero target by 2050 in line with the Paris Agreement commitments[25]. This goal concerns the whole economy and affects each of its sectors. In this reality, the situation of the agricultural sector is unique, as the sector not only can and should reduce GHG emissions, but at the same time it should become a sequestration site for GHGs already emitted into the atmosphere and thus have a key role in achieving climate neutrality at the EU level.

The evolution of this policy can be seen in official European Commission documents. As recently as 2011, they did not include the goal of achieving zero net emissions[26].

In recent documents, this target is already clearly stated, although in the official plans to achieve carbon neutrality in 2050, the Commission allows for non-CO2 GHG emissions in the agricultural sector in 2050[27].

In order to adapt the agricultural sector to achieve net carbon neutrality by 2050 while increasing the sector's resilience to progressive climate change **the European Commission is revising existing initiatives and proposing a number of new ones to guide and support changes in the agricultural sector in a manner consistent with the ambitions enshrined in the European Green Deal**.

24 SDG Watch Europe. (2020). Time to reach for the moon. https://www.sdgwatcheurope.org/report-time-moon/[access: 30.05.2021].

25 CAN Europe. (2020). Final CAP briefing. https://caneurope.org/content/uploads/ 2021/01/Final-CAP-briefing.pdf [access: 30.05.2021].

26 European Commission. (2011). A Roadmap for moving to a competitive low carbon economy in 2050, Communication from the Commission to the European Parliament, The Council, The European Economic and Social Committee and the Committee of the Regions, KOM(2011) 112, final version, Brussels, 8.03.2011.

27 European Commission. (2021). EIP-AGRI workshop 'Towards carbon neutral agriculture'. https://ec.europa.eu/eip/agriculture/en/event/eip-agri-workshop-%E2%80%98towards-carbon-neutral [access: 30.05.2021].

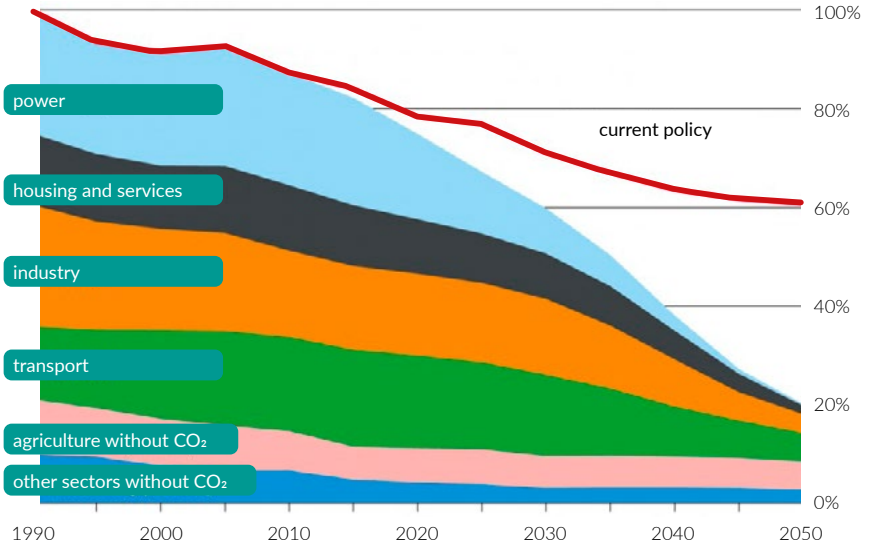

Figure 7:
EU domestic greenhouse gas emissions reduction pathway up to 80% (100% = 1990)

European Commission, KOM(2011) 112

The most important initiatives in this regard are:

- From Farm to Fork Strategy[28],
- Common Agricultural Policy[29],
- Biodiversity Strategy[30],
- European Carbon Farming Initiative[31],
- European Mission area: Soil health and Food[32].

28 European Commission. (2021). From Farm to Fork. https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal/actions-being-taken-eu/farm-fork_en [access: 30.05.2021].
29 European Commission. (2021). Sustainable agriculture in the CAP. https://ec.europa.eu/info/food-farming-fisheries/sustainability/sustainable-cap_en [access: 30.05.2021].
30 European Commission. (2021). EU Biodiversity strategy for 2030. https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal/actions-being-taken-eu/eu-biodiversity-strategy-2030_en [access: 30.05.2021].

31 European Commission. (2021). Commission sets the carbon farming initiative in motion. https://ec.europa.eu/clima/news/commission-sets-carbon-farming-initiative-motion_en [access: 30.05.2021].
32 European Commission. (2021). Mission area: Soil health and food. https://ec.europa.eu/info/research-and-innovation/funding/funding-opportunities/funding-programmes-and-open-calls/horizon-europe/missions-horizon-europe/soil-health-and-food_en [access: 30.05.2021].

CONSEQUENCES OF EU POLICIES FOR AGRICULTURE IN POLAND

Achieving carbon neutrality at the EU level is connected with achieving the same goal within Poland. **Agriculture in Poland, similarly to agriculture at the EU level, is not yet ready for this perspective.**

According to the latest KOBiZE analysis, achieving a 20% reduction of GHG emissions in the agricultural sector will lead to a decline in agricultural production of around 9.5% and a drop in farm income of around 14%. Enforcing emission reductions will lead to the biggest drops in production in the sectors of beef cattle (by 35%), corn for grain (by 21%), sugar beets (by 21%) and milk production (by 16%)[33].

According to KOBiZE, a similar level of emission reduction (20%) can be achieved through fiscal instruments, but it will be less effective and will strongly affect farmers' income[34].

The introduction of a tax of EUR 20/tCO_2eq will lead to costs at national level of PLN 2.78 billion, and at the level of the conversion hectare of PLN 195, which is more than 11% of average farm income in Poland.

In order to properly understand the demanding task we face, let us remember that the goal of carbon neutrality means net zero emissions, not just a 20% reduction as simulated in the study. At the same time, in spring 2021, prices of 1 ton of CO_2eq on the EU ETS market exceeded EUR 50[35], i.e. two and a half times more than in the KOBiZE analysis.

KOBiZE concludes that achieving emission reductions in the agricultural sector using currently available technologies will be very challenging[36].

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33 Wąs A., Kobus P., Krupin V., Witajewski-Baltvilks J., Cygler M. (2020). Assessing climate ..., op.cit.
34 Ibidem.

35 Ember Climate. (2021). Daily EU ETS carbon market price (Euros). https://ember-climate.org/data/carbon-price-viewer/ [access: 30.05.2021].
36 Wąs A., Kobus P., Krupin V., Witajewski-Baltvilks J., Cygler M. (2020). Assessing climate ..., op.cit.

Leading agriculture in Europe to climate neutrality together with farmers

Achieving the Green Deal's carbon neutrality of agriculture by 2050, in line with the EU's ambition, requires coordinated action at the level of entire agri-food systems, not just within an individual farm.

In the following paragraphs we present selected actions that should be taken by stakeholders to change agri-food systems: from current ones, inconsistent with the climate neutrality goal, to ones that are consistent with this goal in the 2050 perspective.

We divide and analyse the stakeholders according to the structure shown in Figure 8.

Due to the purpose of the study: **(1)** we put most emphasis in the description of solutions on the individual farm level and the system perspective, **(2)** we discuss agricultural policy and agricultural financing and support systems extensively, and less extensively: **(3)** the other elements of agri-food system.

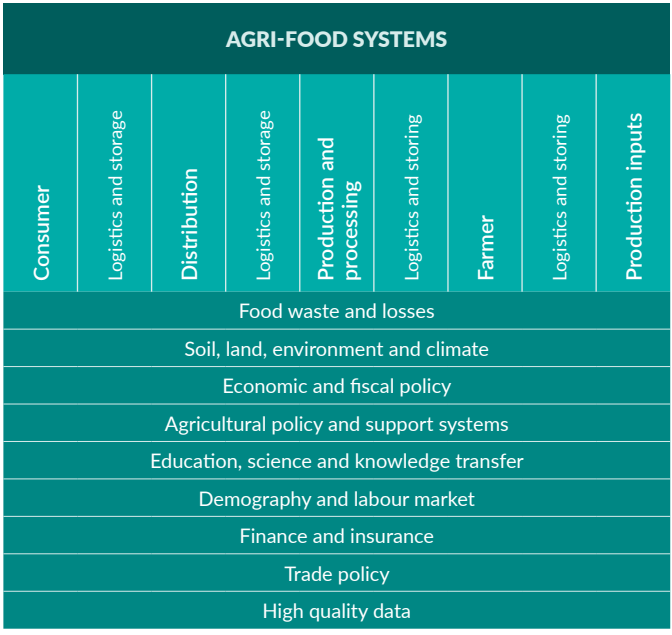


Figure 8:
Food System(s)

Mateusz Ciasnocha

FARMER

At the level of an individual agricultural holding, simultaneous action is needed in three areas:

- **avoiding emissions** that are not necessary;
- **reducing emissions** where possible;
- **sequestration of already emitted GHG into the atmosphere** to balance emissions that we cannot eliminate using currently available technologies.

In order to present a comprehensive range of actions that can be taken at the individual holding level to (1) **avoid**, (2) **reduce** and (3) **absorbe GHG emissions**, we present Figure 9, where we see the circulation of GHGs (in particular CO_2, CH_4 and N_20) in the ecosystem managed by the farmer.

The system for managing farms is called **regenerative agriculture**[37], which consists of two main elements:

- **restoration** and
- **regeneration**.

Restoration means a series of actions that a farmer undertakes to run his farm activities in harmony with the cycles of nature, including the **carbon cycle** which is the focus of this booklet.

37 Ciasnocha M. (2021). From Conventional to Regenerative Agriculture through Carbon Farming: Assessing Global Opportunities & Challenges. https://escp.eu/events/conventional-regenerative-agriculture-through-carbon-farming-assessing-global-opportunities-challenges oraz https://bit.ly/3yKRkTM [access: 30.05.2021].

Figure 9:
The need for triple action in the agricultural sector to achieve climate neutrality

European Commission: https://ec.europa.eu/eip/agriculture/en/event/eip-agri-workshop-%E2%80%98towards-carbon-neutral

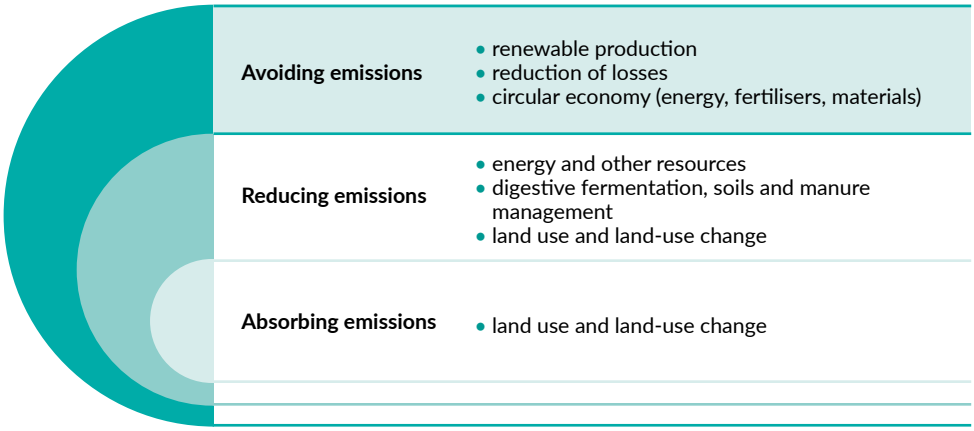
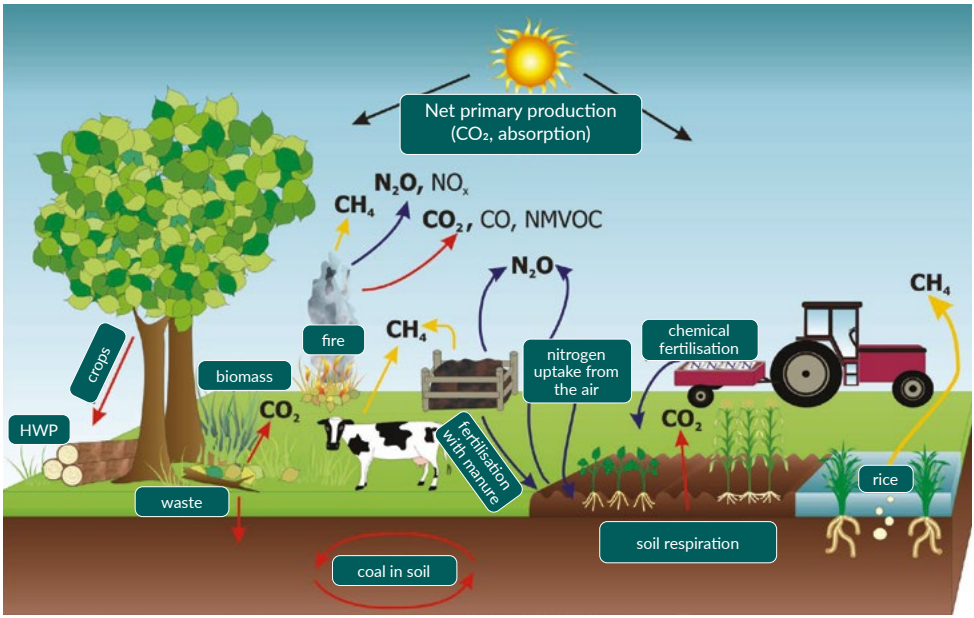


Figure 10:
GHG circulation cycle in the ecosystem managed by the farmer

IPCC (2006): https://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/4_Volume4/V4_01_Ch1_Introduction.pdf



Regeneration is when nature takes control of an ecosystem, after the farmer has allowed it to do so, in order to provide a range of ecosystem services, including increasing the carbon cycle.

The range of activities that a farmer can (and should) undertake in the field of restoration consists of five areas:

1. **Optimising the use of agricultural inputs**, i.e. seeds, plant protection products and fertilisers. It leads to an optimal yield with the least inputs and thus to the lowest possible carbon footprint of the product. Of the three measures, optimising fertiliser use, leading to reduced N_2O emissions, has the greatest impact on reducing GHG emissions. This can be achieved by accurate soil fertilisation and precise location of fertiliser application to further reduce its agricultural use per hectare. An example of localisation is the application of fertiliser directly under the future root of the plant at sowing rather than over the entire crop area after sowing. This practice reduces application rates, and hence costs, and reduces GHG emissions. A key measure is the use of fertiliser inhibitors, the two main ones being nitrification and urease. A farmer may consider substituting a liming treatment with crushed rock to achieve the same agrotechnical effect while allowing CO_2 sequestration as part of the process[38].

38 Carbon Brief. (2018). Guest post: How 'enhanced weathering' could slow climate change and boost crop yields. https://www.carbonbrief.org/guest-post-how-enhanced-weathering-could-slow-climate-change-and-boost-crop-yields [access: 14.06.2021].

2. **Minimising soil tillage with the cessation of ploughing, that is**, the habit of turning the soil over 180 degrees. This practice leads to a reduction in the oxidation of organic carbon stored in the soil, which enters the atmosphere as emissions. This practice also prevents soil erosion.
3. **Covering the soil with vegetation with a living root system 365 days a year,** or for as long as possible. This is possible by integrating secondary crops into the crop rotation. This practice, in combination with the previous one, protects the soil's organic carbon stock and also increases it through the photosynthetic process by which new portions of the carbon absorbed by the plants from the atmosphere are transferred to the agricultural soil.
4. **Enhancing biodiversity** in and around the field and within the overall environment in which the farm is embedded. This practice contributes to the resilience of the ecosystem with the farm. For example, the introduction of atmospheric nitrogen-fixing crops into the crop rotation leads to a reduction in fertiliser purchases, thereby reducing direct emissions within the farm and indirect emissions associated with the production and distribution of fertiliser.
5. **Designing the farm to best fit in with the territory**. This practice allows for the renewal of existing and creation of new GHG stores, e.g. by reforestation of land excluded from uneconomic agricultural production, restoration of peat bogs, etc.

In addition to the practices outlined **above for livestock farms, there are a number of other actions that optimise the carbon footprint**. The most important of these are as follows: increasing feeding efficiency leading to a reduced carbon footprint per unit of product, and creating circular systems that increase the value of what is currently seen as waste (manure and animal slurry), particularly through methods of producing agricultural biogas from these substrates. The action not only directly reduces GHG emissions, but also leads to a reduction in emissions associated with the generation of electricity needed for production within that farm. Methods of capturing methane from livestock facilities are also possible in the future.

Although renewable energy technologies from sources such as solar, wind or biogas are successfully operating in many parts of the world, the lack of a stable policy to support these technologies in Poland means that farmers do not currently play a large role in the decarbonisation of the energy sector, which could be a good entry point for farmers to participate in the more comprehensive changes needed to achieve the net-zero target by 2050.

To sum up: introducing environmental measures to adapt a farm to the reality of climate neutrality not only reduces production risks in the face of climate change, but also increases the production potential of such farm[39].

39 European Environment Agency. (2021). Nature-based solutions in Europe: Policy, knowledge and practice for climate change adaptation and disaster risk reduction. https://www.eea.europa.eu/publications/nature-based-solutions-in-europe/ [access: 24.05.2021].

An example of regenerative agriculture in practice: Ciasnocha Family Farm

Ambitious policy goals endorsed by the scientific community are necessary, but as SDG Watch Europe notes**, examples of best practices at the local level are also needed**[40]. **Therefore, in order to illustrate the implementation of regenerative agriculture measures at the individual farm level, let us use the example of the Ciasnocha Family Farm, with an area of 700 ha of permanent farmland, located in Żuławy Wiślane**.

Since 2004, when Poland joined the EU, the farm, thanks to support from the CAP agri-environment and climate programmes, has changed its agricultural land management profile from cereal production based on intensive soil cultivation to management of permanent agricultural land. The change that our family farm underwent was motivated by an understanding of the primary cycles of nature in the wetland ecosystem we care for. It has brought beneficial results in each of the restorative areas within regenerative agriculture:

1. **Land use change was a fundamental action towards reconstructing the cycles of nature in the ecosystem**. Due to the risk of partial flooding of the managed land that was historically dedicated to forage production, we returned to it in 2008. **This decision allowed us to no longer fight nature's cycles, but to cooperate with them.**
2. **In the area of optimising the use of agricultural production inputs** we have completely eliminated plant protection products since 2008. Moreover, we drastically reduced the use of fertilisers up to one dose of urea in the amount of 50 kg/ha applied in the spring at the same time as the grassland swarding process. This change ensured a higher precision of fertilizer application compared to using a standard seeder, thus reducing costs and N_2O emissions. Regular reseeding of the meadows (once every three years) with new seed material allows us to maintain the production potential of our farm.
3. **The change in the production profile of our farm has allowed us to completely eliminate soil tillage with the cessation of ploughing. This action, combined with maintaining year-round vegetation cover on the soil for the past twenty years, has led to the sequestration of 6.5 t CO_2eq/ha**[41]. In the future, we plan to experiment with reseeding meadows with secondary crops mixtures to improve the health and fertility of our soil and increase levels of carbon sequestration in our soil.
4. **In the area of increasing biodiversity of the ecosystem,** we have introduced a grass mixture to increase biodiversity of the crop. By eliminating plant protection products, we allow natural species of grasses, herbs and flowers to rebuild their populations. In addition, late mowing of the meadows (after 15 June) creates breeding habitats for birds (e.g. corncrake) and resting areas for wildlife: roe deer, wild boar and hares. The actions undertaken by us, i.e. creation of rows of trees naturally occurring in our ecosystem (i.e. willows), also lead to an increase in biodiversity by providing nesting opportunities and at the same time to reduction of the problem of strong winds in Żuławy Wiślane.

40 SDG Watch Europe. (2020). Time to reach for the moon. https://www.sdgwatcheurope.org/report-time-moon/ [access: 30.05.2021].

41 European Carbon Farmers. (2021). Obliczenia poziomu sekwestracji GHG dla Ciasnocha Family Farms. https://bit.ly/3vAPbbm [access: 30.05.2021].

THE FARM WORK PROCESS THROUGHOUT THE YEAR:

Photo 1. Swarding, Ciasnocha Family Farms

Photo 5. Pressing, Ciasnocha Family Farms

Photo 2. Mowig, Ciasnocha Family Farms

Photo 6. Logistics, Ciasnocha Family Farms

Photo 3. Tedding, Ciasnocha Family Farms

Photo 7. Storing (1), Ciasnocha Family Farms

Photo 4. Raking, Ciasnocha Family Farms

Photo 8. Storing (2), Ciasnocha Family Farms

To sum up, **by working in harmony with nature rather than fighting it**, we have not only increased the level of ecosystem services generated by the ecosystem we care for, but at the same time we are producing top quality hay for horse feed, dairy cattle and a substrate in the paper recycling process.

An example of regenerative agriculture in practice: the farm of Tomasz Jakiel

Regenerative breeding farm: Lubuskie Angusowo[42]

The pioneer in creating a regenerative livestock production method is **Allan Savory**[43], who created and popularized the **Holistic Management** method promoted by **the Savory Institute**[44] and a network of partner organizations, the so-called hubs.

One of the farms operating in accordance with the Holistic Management method is the Lubuskie Angusowo agricultural holding founded by Tomasz Jakiel in 2015. The farm is located on 18 ha, it is divided into 31 plots, and specialises in the pedigree breeding production of Angus cattle. Following the methods developed by Allan Savor, the farm uses rotational grazing of cattle and also integrates grazing of goats and poultry. The farm also has Mangalica pigs, but due to ASF (African swine fever) restrictions, rotational grazing is not possible (Photo 1-3).

One of the main methods of reconstructing environmental cycles in the ecosystem managed by Tomasz Jakiel is "*bale grazing*", a method of grazing cattle with hay and straw from outside the farm. This aims to regenerate life cycles in the soil. The method involves grazing a plot and then sowing in the residue after "*bale grazing*" with a biodynamic mixture that increases the biodiversity of the pasture. Tomasz Jakiel sows 45 kg/ha of a mixture consisting of the following plants: Alexandrian clover (5%), crimson clover (5%), Japanese radish (3%), flax (10%), field peas (10%), vetch (15%), field bean *Vicia faba* (10%), oats (30%), sunflower (2%), mustard (4%) and fodder radish (*Raphanus sativus L. var. oleiformis*) (6%). Once the biodynamic mix has grown, it is reused as animal feed (Photo 4-6).

All products: beef, poultry and eggs, produced in Lubuskie Angusowo are sold directly to the consumer, thus the owners receive a higher price per unit of product.

42 Ciasnocha M. (2021). Warsztaty: odtwarzanie potencjału plonotwórczego gleby – rolnictwo regeneratywne w praktyce. *https://bit.ly/3xV27td* [access: 25.06.2021].
43 TED. (2013). Allan Savory: How to fight desertification and reverse climate change. https://www.ted.com/talks/allan_savory_how_to_fight_desertification_and_reverse_climate_change?language=en [access: 25.06.2021].
44 Savory Institute. (2021). Official website. https://savory.global/ [access: 25.06.2021].

Photo 1. Pedigree Angus breeding herd, Lubuskie Angusowo

Photo 2. Integration of goats in rotational grazing, Lubuskie Angusowo

Photo 3. Integration of poultry in rotational grazing, Lubuskie Angusowo

Photo 4. A plot prepared for bale grazing, Lubuskie Angusowo

Photo 5. Angus herd during bale grazing, Lubuskie Angusowo

Photo 6. Effect after bale grazing, Lubuskie Angusowo

Photo 7. Sales stand, Lubuskie Angusowo

An example of regenerative agriculture in practice: the farm of Hanna and Krzysztof Kowalscy

Regenerative agricultural holding with cereal and livestock production: Hanna and Krzysztof Kowalscy[45]

The 130-hectare farm of Hanna and Krzysztof Kowalscy, located in Winniki in the Nasielsk commune in Mazovia is a real life example of best agricultural practice. The farm has been producing flax and pressing oil from it for generations. Currently, it also produces rapeseed oil from seeds of its own production. Only the quantity of seeds demanded by the direct distribution channels of the product is processed into oil, the rest is sold unprocessed. Oil cake from oil production is used to feed one of Poland's largest herds of Zlotnicka Biała pigs, which are slaughtered in a nearby slaughterhouse and the top quality meat is served at leading restaurants in Warsaw.

The Kowalscy family run an open farm and host numerous school trips. In the Mazovian Village Museum in Sierpc, they show visitors how oil was pressed on 19th century equipment. On the farm, openness to people is combined with care for the environment, which is expressed in the creation and maintenance of buffer zones by watercourses, planting groups of trees and the exclusion of

45 Ciasnocha M. (2021). Warsztaty: odtwarzanie potencjału plonotwórczego gleby – rolnictwo regeneratywne w praktyce. https://bit.ly/3xV27td [access: 25.06.2021].

Photo 1. Krzysztof Kowalski in the Mazovian Village Museum Sierpc

Photo 2. A range of products from the Kowalski family farm

Photo 3. A group of visitors to the Kowalski family farm

stagnant water from production and giving it back to nature.

For their efforts to protect the Baltic Sea catchment area, Mr and Mrs Kowalski were awarded a title in the prestigious competition organised by WWF: **Baltic Sea Farmer of the Year 2018**[46].

46 WWF. (2018). WWF awards Polish farmer for efforts to reduce nutrient leakage to the Baltic Sea. https://wwf.panda.org/discover/knowledge_hub/where_we_work/baltic/?337051/WWF-awards-Polish-farmer-for-efforts-to-reduce-nutrient-leakage-to-the-Baltic-Sea [access: 25.06.2021].

PRODUCTION INPUTS

Among the means of agricultural production we can distinguish fixed assets (having the life span of many years) and usable assets (having the life span of less than a year).

The most important category in the group of fixed assets are **agricultural machines and equipment, the production and use of which is connected with GHG emissions**. In the perspective of climate neutrality of agriculture, it is necessary to develop production technologies of materials supplied to the agricultural sector (e.g. steel) which do not generate emissions or generate as little as possible of them. There is also a need to develop low- or zero-emission technologies for use at farm level. Currently, agricultural machinery corporations are experimenting with such technologies. Among them there are a tractor powered by agricultural biogas[47] and methods of replacing agricultural chemicals with the use of electricity[48]. The electrification revolution has also reached the agricultural sector, where leading agricultural machinery manufacturers are experimenting with the use of electric propulsion technology in agricultural machinery[49].

It is crucial to reduce GHG emissions within the production and distribution process in the group of applied products: **fertilizers, plant protection products, fuels, oils**. It is also necessary, as soon as possible, **to change production processes of these products from those based on chemical processes to those based on mechanisms naturally occurring in nature**.

47 New Holland. (2021). T6 Methane Powered Tractors. https://agriculture.newholland.com/eu/en-uk/equipment/products/agricultural-tractors/t6-methane-power [access: 27.05.2021].
48 AgExtend. (2021). xPower. https://agxtend.com/products/xpower [access: 28.05.2021].
49 John Deere. (2021). Future of Farming. https://www.deere.co.uk/en/agriculture/future-of-farming/ [access: 28.05.2021].

SOIL, LAND, ENVIRONMENT AND CLIMATE

The two most important management actions to achieve climate neutrality by 2050 in the area of soil are:

1. **Cessation** (legal ban) of drainage and dewatering of wetlands, especially peatlands, which despite occupying only 3% of the earth's surface store almost twice as much organic carbon as all forests in the world[50]. The potential of restoring wetlands in Poland is estimated at 132 thousand ha[51].
2. **Increasing the average level of organic carbon in agricultural soil in Poland**, which is currently 21 g/kg, whereas the European average is 43.1 g/kg[52]. For this purpose, the practices of regenerative agriculture, described in the scope of activities at the level of an individual agricultural holding, are recommended. At the same time, these practices lead to the restoration of biodiversity, which is crucial to the recovery of a field bird population that has been reduced by 50% (since 1980)[53].

At a whole-climate level, a rapid and complete decarbonisation of the energy sector, currently responsible for over 70% of global GHG emissions[54] is absolutely necessary.

50 SDG Watch Europe. (2020). Time to reach for the Moon. https://www.sdgwatcheurope.org/report-time-moon/ [access: 28.05.2021].
51 McKinsey & Company. (2020). Neutralnie emisyjnie Polska 2050. https://www.mckinsey.com/pl/~/media/mckinsey/locations/europe%20and%20middle%20east/polska/raporty/carbon%20neutral%20poland%202050/neutralna%20emisyjnie%20polska%202050_raport%20mckinsey.pdf [access: 28.05.2021].
52 Ministerstwo Rolnictwa i Rozwoju Wsi. (2021). Konsultacje społeczne Planu Strategicznego dla WPR. 2021 z: https://www.gov.pl/web/wprpo2020/konsultacje-spoleczne-planu-strategicznego-dla-wpr [access: 28.05.2021].
53 Bird Life International. (2012). 300 million farmland birds lost since 1980 – how many more must we lose before changing course on the CAP? https://www.birdlife.org/europe-and-central-asia/news/300-million-farmland-birds-lost-1980-how-many-more-must-we-lose [access: 28.05.2021].
54 Our World in Data. (2021). Greenhouse gas emissions. https://ourworldindata.org/greenhouse-gas-emissions [access: 28.05.2021].

Apart from the key role of decarbonisation of the sector in achieving carbon neutrality by 2050, this process allows farmers to increase and diversify their income in the process of reaching the reality of climate neutrality. The agricultural sector has resources, such as the area of its farms or the waste from agricultural production, which are often essential in the decarbonisation of the energy sector. They enable many farms to become self-sufficient in energy. It is important to highlight that over and above its potential to be a key element in achieving carbon neutrality, the agricultural sector provides numerous ecosystem services[55].

Another necessary actions in the context of carbon neutrality of agriculture is land use change from agricultural land to forest or agro-forestry, which will increase the level of GHG sequestration from the atmosphere, as well as maintaining permanent grassland, which is a significant store of CO_2.

55 WWF Polska. (2020). Zeroemisyjna Polska 2050. op.cit.

Agricultural policy, agricultural financing and support systems

ECONOMIC AND FISCAL POLICY

At the EU level, there is a clear political ambition: the continent will be carbon neutral by 2050. Unfortunately, this idea is currently absent from the political discourse at the national level in Poland. As a result, there is a lack of strategy and documents defining the pathway towards climate neutrality for Poland by 2050. Consequently, there is also a lack of strategy defining what role the agricultural sector should play in the future. This brochure can help to facilitate this crucial political process.

Once a specific political decision has been taken to achieve Poland's carbon neutrality by 2050, it will be necessary to set measurable emission reduction targets for individual sectors of the economy, which are at least more consistent with EU targets in this respect.

In order to co-ordinate Poland's achievement of climate neutrality with the simultaneous development of the country's natural capital, it is necessary to set up equivalents of the British **Climate Change Committee**[56] and **Natural Capital Committee**[57].

The task of these bodies should be to support the monitoring and evaluation of government activities. Within the framework of these institutions, **a Working Group should be established, consisting of e.g. representatives of the Ministry of Agriculture and Rural Development, Ministry of Climate and Environment and KOBiZE**, set up to implement the same objective – carbon neutrality of agriculture in Poland.

A necessary action at the level of economic policy is to decide on the valuation of one ton of CO_2eq emissions at minimum level of

56 Climate Change Committee. (2021). Climate Change Committee. https://www.theccc.org.uk/ [access: 28.05.2021].
57 Natural Capital Committee. (2020). The Natural Capital Committee. https://www.gov.uk/government/groups/natural-capital-committee [access: 28.05.2021].

EUR 100. In order to reduce emissions at the level of the whole economy and to create demand for the emission reductions offered by agricultural holdings, it is necessary to **carry out a carbon audit of all public institutions in Poland**, including central government institutions, local governments, public administration units and State Treasury companies, **and to develop specific paths to zero emissions at the level of each of these institutions. In the pathways developed, the purchase of emission reductions in the formula of agricultural carbon credits from Poland should play a key role**. The aim is to develop this market by sending a signal to the farming community that the Polish government is taking a serious and strategic approach to achieving climate neutrality by 2050.

AGRICULTURAL POLICY AND SUPPORT SYSTEMS

The EU Common Agricultural Policy

The EU's Common Agricultural Policy[58], divided into Pillars 1 and 2 is the most important element of EU agricultural support.

Under both Pillars, the EU requires and proposes a range of actions necessary to achieve environmental objectives consistent with its ambition. Under Pillar 1 there is cross compliance principle, which excludes a farmer from receiving a direct payment if the strategic objectives of the CAP, such as maintaining permanent pasture or areas of high environmental value, are not met. **Under Pillar 2** farmers can benefit from agri-environment-climate schemes to reduce the environmental impact of their production.

According to the European Environment Agency, despite the structure of the CAP as described above, between 2005 and 2018 the reduction in emissions in the agricultural sector was only 1%[59]. Therefore, successive versions of the CAP propose to make a larger proportion of agricultural land subject to greening, and not just 5% as is currently the case. **One of the reasons for the real lack of emission reductions in the agricultural sector is the lack of mandatory reduction targets as a result of Pillar 2 interventions at Member State level, which must be changed in the next versions of the CAP, while at the same time increasing the requirements of the CAP strategic plans 2020-2027.**

As the above figures show, it is necessary to remodel the CAP in light of the ambitions enshrined in the European Green Deal[60], in a way that encourages large-scale implementation of measurable, reportable and verifiable environmental actions in the agricultural sector to achieve climate neutrality by 2050.

The CAP should change profoundly to achieve reductions, not just maintain them at current levels. An example of such a significant change could be to force lower densities in areas of industrial livestock production, in correlation with the amount of animal food available in that geographical region.

Another, less drastic example of changes to the CAP is the proposal to include peatlands in the Pillar 1 payments of the CAP to encourage the development of this mode of CO_2 storage[61].

Actions in the new version of the CAP for 2020-2027 and beyond will be consistent with the principle of "public money for public goods" and the shift from payment for eligible actions to payment for results. We can read in the European Commission communications that **in the forthcoming budget perspective the payments available to farmers will be offered in a hybrid model: payment for action plus an additional payment for environmental results achieved.**

58 European Commission. (2021). Sustainable agriculture in the CAP. https://ec.europa.eu/info/food-farming-fisheries/sustainability/sustainable-cap_en [access: 28.05.2021].
59 European Environment Agency. (2018). National action across all sectors needed to reach greenhouse gas Effort Sharing targets. https://www.eea.europa.eu/publications/national-action-across-all-sectors [access: 28.05.2021].
60 European Commission. (2019). European Green Deal. https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en [access: 26.05.2021].
61 European Commission. (2021). Operationalising an EU carbon farming initiative. https://op.europa.eu/en/publication-detail/-/publication/b7b20495-a73e-11eb-9585-01aa75ed71a1/language-en [access: 23.05.2021].

In subsequent years, the ratio of payments will shift towards higher payments for results.

The strategic objectives of the CAP for 2020-2027 are defined by each Member State. Raising the ambitions in the CAP Strategic Plan proposed by Poland is necessary if we want to achieve climate neutrality by 2050.

In order to achieve climate neutrality by 2050, it is necessary to focus CAP-supported measures at the Polish level in the 2020-2027 period on increasing the average carbon level in agricultural soils, which is currently 21 g/kg, while the European average is 43.1 g/kg. In the future, consideration should be given to introducing conditionality for receiving agricultural subsidies under the CAP, making them conditional on maintaining or increasing soil organic carbon levels.

From Fork to Field Strategy

The aftermath of the European Green Deal is the **From Farm to Fork Strategy**[62] announced on 20 May 2020, which aims, among other things, to achieve a 50% reduction in soil nutrient losses without compromising soil quality, to reduce the use of artificial fertilisers by 20%, to reduce the use of natural fertilisers (e.g. manure) by 20% and to achieve organic production on 25% of the EU's arable land. All of the above targets are set for 2030.

Like the 2050 carbon neutrality target at EU level, the From Farm to Fork Strategy is a framework document that sets out a very ambitious but clear policy position on the EU agri-food system.

Biodiversity Strategy

The second of the strategies resulting from the European Green Deal, which strongly concerns the agricultural sector, is the **Biodiversity Strategy**[63]. Among other things, the strategy calls for the establishment of protected areas on at least 30% of EU land and waters, the expansion of ecological and highly biodiverse areas in agricultural areas, halting and reversing the decline in pollinator populations, reducing pesticide use by 50%, and planting 3 billion trees by 2030.

European Carbon Farming Initiative

One of the initiatives to be launched by the European Commission, enshrined in the From Farm to Fork Strategy, is the **European Carbon Farming Initiative**[64]. **The Commission assures that the initiative will be launched in 2021**[65] **as part of the CAP or through private initiatives linked to CO_2 emissions trading markets.** The strategy also assumes that the European Commission will create a legal framework to regulate the market for agricultural carbon credits.

In the documents published in April 2021, we see that the European Commission considers the following five areas as the most promising in the future Carbon Agriculture Initiative:

1. **peatland restoration and rewetting;**
2. **agroforestry;**
3. **maintaining and increasing organic carbon levels on mineral soils;**
4. **permanent grassland;**
5. **dairy and livestock farm audits.**

62 European Commission. (2021). From Farm to Fork. https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal/actions-being-taken-eu/farm-fork_en [access: 28.05.2021].

63 European Commission. (2021). EU Biodiversity strategy for 2030. https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal/actions-being-taken-eu/eu-biodiversity-strategy-2030_en [access: 28.05.2021].

64 European Commission. (2021). *Commission sets the carbon farming initiative in motion.* https://ec.europa.eu/clima/news/commission-sets-carbon-farming-initiative-motion_en [access: 23.05.2021].

65 European Commission. (2021). Operationalising an EU carbon farming initiative. https://op.europa.eu/en/publication-detail/-/publication/b7b20495-a73e-11eb-9585-01aa75ed71a1/language-en. [access: 23.05.2021]

European Mission area: Soil, health, and food

Another European Commission initiative to achieve carbon neutrality by 2050 in a way that involves the agricultural sector is **Mission area: Soil, health, and food**[66].

The aim of the Mission, which is part of the Horizon Europe innovation support and funding programme, is to make sure that at least 75% of EU soils are healthy for food, people, nature and climate. The Mission is currently in the process of being established, and in the event of a positive evaluation under Horizon Europe, the Mission's activities, namely the development of demonstration farms and "living laboratories", will be funded from the EU innovation budget.

We emphasise the importance of the Mission in this publication because soils, after oceans, are the largest store of carbon resources on Earth. Thus, protecting and enhancing these resources is an absolute necessity, especially in a situation where 33% of the world's soil resources are degraded and, at the level of the EU alone, 25% of soils are experiencing erosion[67].

EDUCATION, SCIENCE AND KNOWLEDGE TRANSFER

We will not achieve the goal of climate neutrality by 2050 without efforts to educate the public on climate issues and the impact of diet on the climate. The activity of young people in social movements promoting environmental protection and action on global warming shows how great the hunger for this type of knowledge is in this segment of society, which will bring us into the reality of climate neutrality. An equally important element necessary for achieving climate neutrality is science. Examples of actions that are already being taken in this area and must be continued are the breeding of new plant species resistant to the consequences of progressive climate change, or the breeding of new breeds of livestock (and pets) that emit less GHG than currently used breeds

A particularly important area of scientific research is the breeding of plant species which will allow to change the soil use from annual to multiannual. An example of such a plant is Kernza[68] – a perennial cereal developed and commercialised by the Land Institute[69] from the USA.

Even the best knowledge, if not implemented at individual farm level, will not contribute to achieving carbon neutrality. Therefore, a key element is professional, well-trained and well-resourced agricultural advisory services. Demonstration farms will play a central role in providing agricultural advice to support the transition to climate-neutral agriculture.

It is worth stressing that activities in the field of agricultural advisory services adapting agriculture to the new reality are already taking place. For example the EU level training organised by EIP-AGRI: the workshop on climate neutral agriculture (March 2021)[70] and the workshop onhealthy soil (April 2021)[71].

66 European Commission. (2021). Mission area: Soil health and food. Ostatnio otwarto 28 maja 2021 z: https://ec.europa.eu/info/research-and-innovation/funding/funding-opportunities/funding-programmes-and-open-calls/horizon-europe/missions-horizon-europe/soil-health-and-food_en.
67 Ibidem.
68 Kernza. (2021). Kernza. https://kernza.org/ [access: 28.05.2021].
69 Land Institue. (2021). The Land Institute. https://landinstitute.org/ [access: 28.05.2021].
70 EIP-AGRI. (2021). EIP-AGRI workshop 'Towards carbon neutral agriculture'. https://ec.europa.eu/eip/agriculture/en/event/eip-agri-workshop-%E2%80%98towards-carbon-neutral [access: 23.05.2021].
71 EIP-AGRI. (2021). EIP-AGRI seminar: Healthy soils for Europe: sustainable management through knowledge and practice. https://ec.europa.eu/eip/agriculture/en/event/eip-agri-seminar-healthy-soils-europe-sustainable [access: 23.05.2021].

Also at the national level, actions are being taken in this regard, e.g. the LIFE CAKE Project: Centre for Climate and Energy Analysis, which aims to build a comprehensive and coherent set of analytical tools to assess solutions proposed by Member States and EU institutions, taking into account the specificities of the most relevant sectors[72] for climate neutral agriculture. Another example is the project "Support for low-carbon agriculture capable of adapting to climate change now and in the perspective of 2030 and 2050 (LCAgri)" carried out by IUNG and co-financed by the National Centre for Research and Development as part of the "Environment, Agriculture and Forestry" BIOSTRATEG[73] programme.

If we want agriculture to play a significant role in a climate-neutral economy, independent, professional and well-trained farm advisory services must be significantly expanded.

Last but not least, well-functioning farmers' associations and unions are crucial. A prime example of such an association is the **UK's National Farmers Union (NFU), which is the first, and so far the only, farmers' union in the world to announce that it will achieve carbon neutrality by 2040**[74]! The strategy announced by the NFU consists of three elements: **(1)** reducing emissions by making agricultural production more efficient, **(2)** storing CO_2 in land that farmers manage, and **(3)** developing on-farm bioenergy production to capture, use and store GHGs.

FINANCING AND INSURANCE

is imperative to urgently stop funding actions that are inconsistent with climate neutrality, while increasing the available funding for new investment opportunities that offer the necessity to reach *net-zero* reality. This perspective offers opportunities for investors of all portfolio sizes and risk tolerances: from high-risk investment funds to pension funds. Once again, proactive communication between the agricultural sector and the investment community is crucial.

Insurers also have an important role to play in reaching the climate neutrality reality: first, they should stop underwriting processes that are inconsistent with carbon neutral economy, and second, they should encourage actions that are consistent with this reality. An example of this is offering a lower insurance rate for crops grown without the use of the plough, in line with the principles of regenerative agriculture.

TRADE POLICY

The EU's efforts to achieve carbon neutrality need to be coordinated with efforts in other parts of the world to do so. The Paris Agreement is an example of such action at the level of ambition. As within the EU, this now needs to be translated into actions that allow achieving these ambitions: in terms of trade policy the EU should implement a carbon border tax with a CO_2eq valuation of EUR 100/t, thus integrating the system for measuring GHG flows with similar systems of the EU's trading partners, and solutions to ban products that have contributed to deforestation, especially equatorial forests, from entering the EU market.

It should be stressed that it is absolutely essential to take ambitious measures within the EU to achieve climate neutrality by 2050. Uncertainty about the level of ambition of our trading partners should not paralyse the EU in achieving climate neutrality, and may even be a motivation to continue to maintain global leadership in this area.

72 Wąs A., Kobus P., Krupin V., Witajewski-Baltvilks J., Cygler M. (2020). Assessing climate policy ..., op.cit.
73 IUNG. (2018). Projekt LCAgri. http://www.lcagri.iung.pl/en/ [access: 21.05.2021].
74 National Farmers Union. (2019). Achieving Net Zero – Farming's 2040 goal. https://www.nfuonline.com/nfu-online/business/regulation/achieving-net-zero-farmings-2040-goal/ [access: 30.05.2021].

Carbon farming - the example of European Carbon Farmers

Building on the experience of the Ciasnocha Family Farm described earlier, which was profitably transformed from a net GHG emitter to a negative emission farm, the decision was made to establish **European Carbon Farmer s.**

The mission of European Carbon Farmers is to place farmers at the centre of efforts to prevent and adapt to climate change in a profitable way. This objective is put into practice by promoting carbon farming, i.e. farming that improves the carbon cycle naturally occurring in the ecosystem, and developing a carbon payment mechanism for farmers.

Agricultural carbon credit is a financial mechanism whereby a farmer changes his farming practices (notably by reducing cultivation intensity and covering the soil with vegetation 365 days a year and using secondary crops) in order to store additional carbon dioxide in the

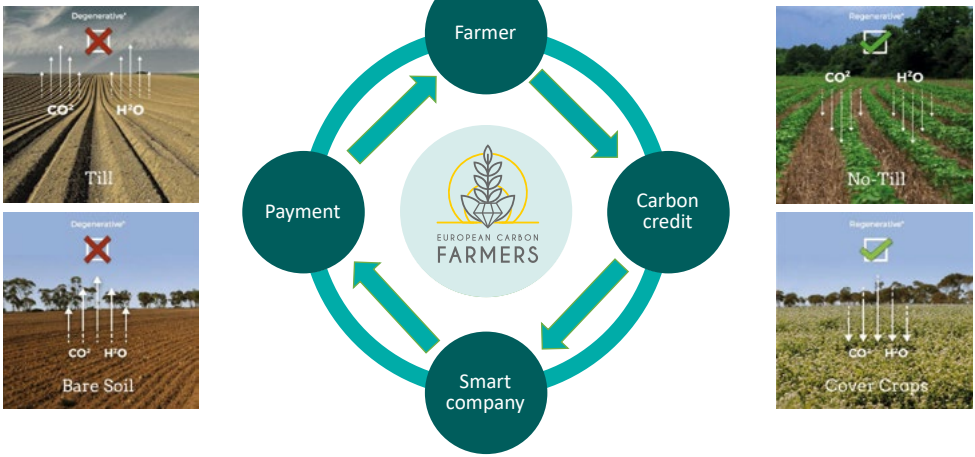


Figure 11:
Agricultural carbon credit

European Carbon Farmers

agricultural soil. This additionally stored carbon dioxide is sold to a company that wants to offset its GHG emissions into the atmosphere in a carbon credit formula.

The offsetting mechanism involves buying the amount of CO_2eq emitted, which the company cannot suddenly stop emitting, but in order to be carbon neutral it buys the carbon dioxide that would remain in the atmosphere without payment from the company. The providers of these emissions reductions are farmers who change their farming practices to ones that improve the carbon cycle. European Carbon Farmers is at the centre of this process and enables it (Figure 11).

The process of creating an agricultural carbon credit takes place annually and consists of four steps (Figure 12):

The first stage of its creation comprises measuring current soil carbon sequestration levels. **The second stage** comprises incorporating these measurements into an international methodology, in the case of European Carbon Farmers: the **Cool Farm Tool**, managed by the Cool Farm Alliance, of which European Carbon Farmers are a member. **The third stage** comprises the verification of the measurements against an international standard: in our case the **ISO14064** standard. At this stage an agricultural carbon credit is created. The final, **fourth stage** is to sell the agricultural carbon credit on the voluntary market for greenhouse gas emission reductions.

It is worth mentioning that the sequestration of CO_2 in agricultural soils is positively correlated with the generation of a number of other ecosystem services, such as water purification and the protection of breeding bird habitats. Therefore, there is clear potential to achieve higher prices for agricultural carbon credits compared to conventional carbon credits.

It should be stressed that the Cool Farm Tool is an international tool, free of charge for the farmer and already available in Polish on the European Carbon Farmers website.

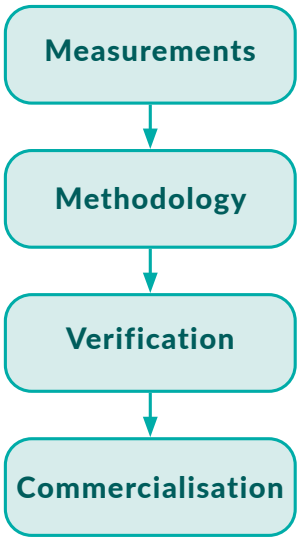


Figure 12:
Process for generating agricultural carbon credits

European Carbon Farmers

Remaining elements of agri-food systems

LOGISTICS AND STORING

Within agri-food systems we distinguish at least four subgroups of logistics and storage processes:

1. **from farm input producer to the production and the farm;**
2. **from the farmer to the processor;**
3. **from processor to distributor;**
4. **from distributor to consumer;**
5. **logistics and management of food waste and losses along the whole value chain.**

Efforts to adapt the agri-food sector to climate neutrality must be based on three pillars: **(1)** reduction of losses within the logistics and storage processes, **(2)** decarbonisation of the technologies used in the value chain stage (at their production and operational level) and **(3)** reduction of the distance and storage time between the different elements of the value chain.

PRODUCTION AND PROCESSING OF FOOD

The two most important actions to reduce GHG emissions at the level of food production and processing are: **(1)** cooperation between value chain actors, i.e. producers, processors, distributors and consumers to optimise value chains and therefore GHG emissions and **(2)** locating food processing as close as possible to the farmer and the consumer.

An example of implementation of the latter solution is provided by Franciszek Kesler, who processes rapeseed produced in his farm into rapeseed oil[75]. Another example of a similar action is the farm of Hanna and Krzysztof Kowalski[76], who process flax produced by them into linseed oil, and they were awarded in the WWF competition the Baltic Sea Farmer of the Year[77] for their pro-environmental actions.

DISTRIBUTION

Within the food distribution area, a key task is to develop food monitoring systems to reduce food waste at the value chain level. Legal solutions, such as the law introduced in France prohibiting supermarkets from throwing away food, are particularly important, although, alone, they will not solve the problem of food waste[78].

Since the direct contact between the consumer and the rest of the value chain takes place at the level of food distribution, communication with the consumer managed by the food distributor is especially important.

75 SDG Watch. (2020). I grow your food – Pan Franciszek Kesler. https://www.sdgwatcheurope.org/good-food-for-all/ [access: 21.05.2021].
76 GR Kowalski. (2021). Gospodarstwo Produkcyjne-Handlowo-Usługowe „Kowalski". http://www.olejekowalski.pl/ [access: 28.05.2021].
77 WWF Polska. (2018). Polak Zwycięzcą Międzynarodowego konkursu na rolnika roku. https://www.wwf.pl/aktualnosci/polak-zwyciezca-miedzynarodowego-konkursu-na-rolnika-roku [access: 28.05.2021].
78 Business Insider. (2019). Zakaz wyrzucania jedzenia przez sklepy nie rozwiąże problemu marnowania żywności. https://businessinsider.com.pl/finanse/handel/wyrzucanie-jedzenia-na-smietnik-skala-problemu-i-pomysl-na-rozwiazanie/9fem8m1 [access: 28.05.2021].

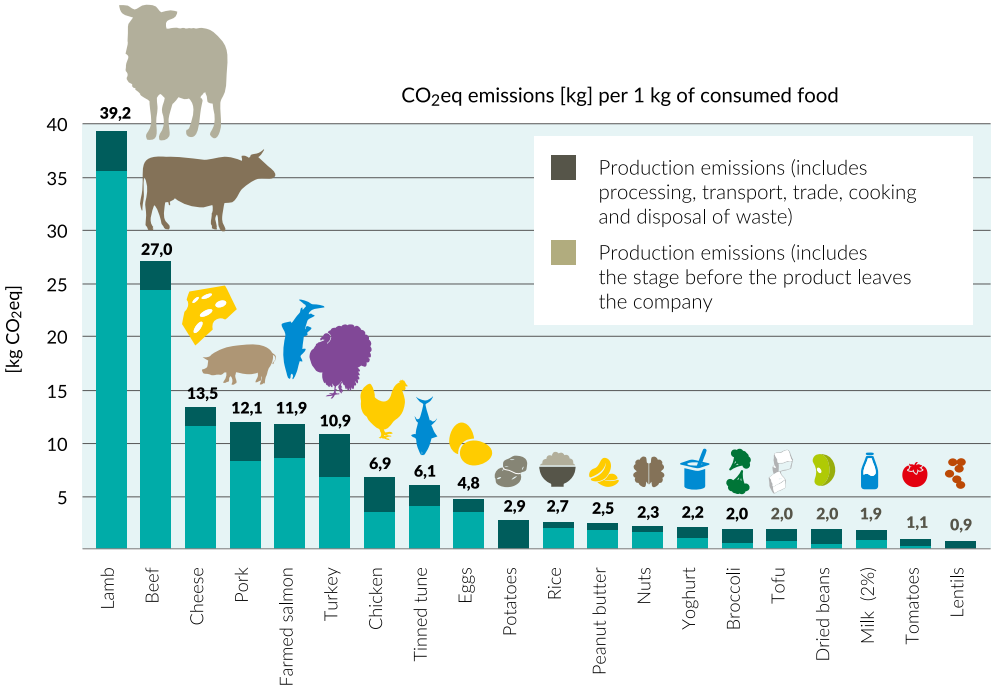


Figure 13:
CO_2eq [kg] emissions [kg] per 1 kg of food consume

ISD: Friendly development of Poland.
For people – economy – environment. Energy reNewed
https://www.pine.org.pl/wp-content/uploads/2017/08/raport_wzrost.pdf

In particular, promoting and encouraging purchases along the lines of the **planetary diet** is key to achieving climate neutrality by 2050[79]. The planetary diet is based on the consumption of large amounts of cereals, vegetables, fruits and nuts, meat and dairy are an important part of it, but in significantly smaller quantities than consumed today[80].

CONSUMER

In order to achieve carbon neutrality at the consumer level, it is necessary to reduce food waste. According to SDG Watch, the EU food system is not sustainable: we waste 20% of the food produced and 33 million people cannot afford a full meal every second day[81]. At the same time, most of the food wasted in the EU is fit for consumption. Hence the need to close food cycles, for example through "food banks".

79 Kongres Żywieniowy. (2020). Dieta planetarna – sposób żywienia, który pomoże zapobiec katastrofie ekologicznej. https://kongres-zywieniowy.waw.pl/dieta-planetarna-sposob-zywienia-ktory-pomoze-zapobiec-katastrofie-ekologicznej/ [access: 28.05.2021].
80 EAT Forum. (2021). The Planetary Health Diet. https://eatforum.org/eat-lancet-commission/the-planetary-health-diet-and-you/ [access: 14.06.2021].

81 SDG Watch Europe. (2020). Time to reach for the moon. https://www.sdgwatcheurope.org/wp-content/uploads/2020/10/Time-to-reach-for-the-moon-web.pdf [access: 28.05.2021].

The second element of the strategy in the consumer area should be the **internalisation of food production costs**, especially environmental costs, in order to truly value the products on offer and thus encourage the consumption of a planetary diet.

The third, and in the 2050 perspective the most important action at the consumer level is to **promote a change to a planetary diet**, i.e. one that is consistent with planetary boundaries[82]. It is necessary to reduce consumption of animal products and to stop food waste in the EU at consumer level[83]. An example of challenges that need to be addressed is to encourage the consumption of locally sourced foods that are available all year round, without the need for storage, which generates large amounts of GHGs. Therefore, it is important to shift diets towards eating foods that are currently fresh, rather than those associated with long-term storage.

FOOD WASTE AND LOSS

A wide range of interventions is needed to prevent food waste and loss. Food waste is the deliberate/intentional actions that lead to food being treated as unfit for consumption. An example is buying too much food and throwing away the food that got spoiled. Food losses are unintentional actions that lead to food being treated as unfit for consumption. An example is a farmer having to throw away fruit after failing to find a buyer for it.

In the EU, most unfit food occurs at the consumer stage and is classified as food waste. Some of the actions that should be taken to eliminate this problem have been described at the distribution level. In addition, it is necessary to develop circular systems in order to use wasted food for other production processes, thus reducing the amount of "empty" GHG emissions into the atmosphere.

DEMOGRAPHY AND LABOUR MARKET

New generations of Poles are aware of the need to achieve the goal of climate neutrality at EU level, which is encouraging. Unfortunately, there is little or no understanding of climate processes and the role of the agricultural sector in these processes, which causes unconstructive, or even destructive, tensions between representatives of the sector and the rest of society. The previously described educational activities aimed at a group of young Poles and the activities of agricultural sector organisations are particularly important in addressing these challenges. In the area of the labour market, it is crucial to acquire the competencies necessary to develop a solid career in the agricultural sector, which will have to achieve climate neutrality by 2050. Currently, the level of these skills is low or very low. It is particularly important to meet the challenge of the lack of young people in the agricultural sector.

HIGH QUALITY DATA

The last but the most important factor for the success of the EU and individual Member States in achieving climate neutrality by 2050 is that all actions related to the implementation of this ambitious goal should be based only on up-to-date, reliable and true data.

An example of inconsistency between the available data and the actions taken by different actors in the agri-food system is the promotion of small-scale farms, when larger farms have a lower carbon footprint[84].

82 Stockholm Resilience Centre. (2015). The nine planetary boundaries. https://www.stockholmresilience.org/research/planetary-boundaries/the-nine-planetary-boundaries.html [access: 28.05.2021].
83 Chrońmy Klimat. (2021). Jesz czy nie jesz – emitujesz! http://www.chronmyklimat.pl/wiadomosci/zielona-gospodarka/jesz-czy-nie-jesz-emitujesz [access: 28.05.2021].

84 Karaczun Z., Kozyra J. (2020). Wpływ zmiany klimatu..., op.cit.

Another example is building the assumptions of the CAP at the Polish level on the claim that there are 1.4 million agricultural holdings in Poland, while there is a very large "grey area" of informal agricultural land tenancy. The actual number of active agricultural holdings is significantly less than the 1.4 million on which number drafting and implementation of agricultural policy is based.

In light of the ambition to achieve climate neutrality by 2050, it is absolutely essential to develop a remote, affordable and accurate MRV system: monitoring, reporting and verification of GHG flows in the LULUCF sector at EU level, following the example of the US COMET-Farm[85].

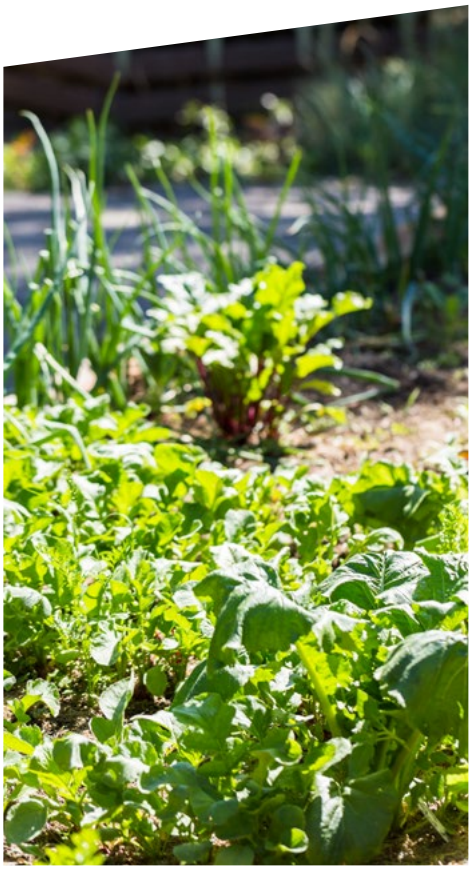
It is worth adding that the LULUCF sector was included in the EU's emission reporting system in order to maintain its emissions at the level of the base year, which is 1990 for the EU (1988 for Poland)[86].

In the next stages of development of the MRV system, emphasis should be put on measuring, reporting and verifying ecosystem services provided by the agricultural sector, and thus developing new measures of sustainable development[87].

Let us emphasise once again:

the agricultural sector can achieve climate neutrality, but only and exclusively through systemic thinking and action.

Why not use this process to achieve something more: the natural positivity of agriculture while achieving climate neutrality?



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85 USDA – NRCS. (2021). COMET-Farm. https://comet-farm.com/ [access: 28.05.2021].
86 Rada i Parlament Europejski. (2018). Regulation (EU) 2018/841 of the European Parliament and of the Council of 30 May 2018 on the inclusion of greenhouse gas emissions and removals from land use, land use change and forestry in the 2030 climate and energy framework. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L [access: 23.05.2021].
87 SGD Watch Europe. (2020). Time to reach for the moon. https://www.sdgwatcheurope.org/wp-content/uploads/2020/10/Time-to-reach-for-the-moon-web.pdf [access: 23.05.2021].

Aiming higher than climate-neutral agriculture by 2050

Climate neutrality by 2050, while constituting an extremely ambitious goal, is a conversation in a reductionist model: we want to achieve some level of negative environmental impact: in the current narrative, that level has been set at zero.

Since achieving carbon neutrality by 2050 is an extraordinary challenge that the EU is determined to achieve, it makes sense to use this aspiration to not only reach climate neutrality, but to achieve climate positivity.

In both scenarios: climate neutrality and climate positivity, the agricultural sector must play a key role, otherwise these ambitions will not be achieved.

Actions to achieve climate neutrality in the agricultural sector, and more broadly in the economy as a whole, should simultaneously be based on three groups of actions coordinated at a systemic level:

1. avoiding emissions where they are not necessary;
2. reducing emissions where possible;
3. developing natural emissions storing spaces to sequester emissions that we cannot (yet) avoid.

As we have stressed repeatedly: **only system-level action will allow climate neutrality to be achieved by 2050, including in the agricultural sector.** Focusing only on the agricultural sector and trying to achieve carbon neutrality in this sector alone, in isolation from the rest of the agri-food system and the rest of the economy, is doomed to failure and huge social protests.

The time to initiate such thinking, and, most importantly, action, has never been better. The COVID-19 pandemic has shown how vulnerable our systems are, and United Nations Secretary António Guterres is inviting us all to participate in the processes of the **UN Food Systems Summit**, especially by participating in dialogues and organising them.

Recent reports show that increasing agricultural efficiency alone, without significant changes in diet, and thus in the scale of livestock production, land-use change and concomitant reduction in food waste, is not sufficient for agriculture in Poland to achieve climate neutrality by 2050[88]. A report prepared by the Institute for European Environmental Policy shows that achieving climate neutrality must take place at the systemic level and involve simultaneous increases in production efficiency, drastic land-use change and changes in the diet of Europeans.

88 Institute for European Environmental Policy. (2019). Net-zero agriculture in 2050: how to get there. Ostatnio otwarto 28 maja 2021 z: https://europeanclimate.org/wp-content/uploads/2019/11/02-19-net-zero-agriculture-in-2050-how-to-get-there.pdf.

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a third generation farmer involved in developing a 700ha regenerative farm in Żuławy Wiślane, **with a mission to change the paradigm of the agri-food system from conventional to regenerative with the farmer at the centre**.

He puts this mission into practice by **placing farmers at the centre of efforts to prevent and adapt to climate change in a profitable for them way** thanks to **European Carbon Farmers**, a business he founded with his brother Paweł. Carbon Farmers promotes carbon farming and develops mechanisms for agricultural carbon payments in Poland.

He is actively involved in the work of the **UNFCCC COP26 – Climate Champions** as a **Regenerative Agriculture Fellow**, in the **Economy of Francesco** – where he coordinates the work of the **Farm of Francesco** project and **EIT Food** – where he manages a **project promoting regenerative agriculture** in Poland.

For his leadership in the agricultural sector, Mateusz Ciasnocha was invited to join the network of **Champions** of the **United Nations Food Systems Summit**.

He is committed to the development of Africa, especially African agriculture: he became a co-founder and **Deputy Editor-in-Chief** of **InvestAfrica.pl**, the first in Poland source of information on doing business in Africa.

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