LIFE Climate CAKE PL

System of providing and disseminating information in order to support the strategic implementation of climate policy







Objectives

The main objective of the LIFE Climate CAKE PL project is to build a sustainable comprehensive system for creating and delivery of information on the climate and energy policy impacts in order to improve the effectiveness and efficiency of its implementation. Due to the undertaken activities it was possible to create a sustainable mechanism to support the decision-making process and to increase the potential of knowledge and competence of the national administration involved in climate and energy policy.

As a result of the project, the Centre for Climate and Energy Analysis (CAKE) was established - that is, above all, a team of experts who, developing and applying analytical tools, networks and communication channels, then in sustinable manner can continuously and permanently produce and deliver knowledge to support the decision-making process.

LIFE Climate CAKE PL 2017 - 2022

During the five years of the LIFE Climate CAKE project, due to the commitment of the entire Team, we managed not only to achieve the objectives defined at the beginning, but also have proved to our stakeholders, both domestically and internationally, the quality and suitability of our work. The Centre for Climate and Energy Analysis (CAKE) has become an important center of scientific knowledge in the field of modelling the effects of climate and energy policies.

Since the beginning of the project we have been focusing on providing substantive support to the public administration and delivery of knowledge in the development and implementation of climate and energy policy. The results of our analytical work could precisely meet the needs and demands due to the close cooperation established by important platform of Steering Committee that brings together the representatives of the administration which allows for indication and definition of analytical objectives and monitoring the progress of work during the project.

Initially, the LIFE Climate CAKE PL project was supposed be finished in November 2020, however due to the new ambitious goals and measures proposed by the European Commission in the "European Green Deal" and the high value of work and positive

assessment of our activities recognized by the European Commission, the LIFE Climate CAKE PL project was extended for two more years, until 2022, therefore the potential created could serve longer to meet the demand for knowledge.

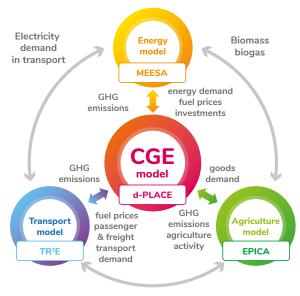
Team

The CAKE team currently consists of 19 people, including 13 modeling experts and people responsible for administration, promotion and settlements. Our team includes specialists permanently employed in IOŚ-PIB and KOBiZE, as well as experts and scientists from universities and research centers collaborating with us. The entire project implementation would not have been successful without the engagement all the people involved in the project over five years.

Analytical

Toolkit

Construction and the continuous improvement of analytical toolkit, that is crucial to generate knowledge about the climate and energy policy impacts, remains an essential component of the project. The CGE general equilibrium model is at the heart of the toolbox and works with three sectoral models covering energy, transport and agriculture. This comprehensive and coherent set of models allows for the accurate impact assessment of planned measures, in particular targets of both climate and energy policy as well as sector policies.



Biofuels

The d-PLACE (CGE) model

- a global general equilibrium model enables comprehensive assessment of the of climate and energy policies economic impacts.

MEESA Energy Sector Model (Model for European Energy System Analysis)

– the model enables detailed simulation of different transformation options of the energy sector in Poland and EU.

Transport sector model TR3E (Transport European Economic Model)

– the model enables the analysis of different variants of options for reducing CO₂ emissions, including the implementation of new technologies in the transport sector.

Model of the agricultural sector EPICA (Evaluation of Policy Impacts

- Climate and Agriculture)

- the model enables the analysis of the impact of various climate policy measures on emissions, changes in production and farm structure and income in the agricultural sector in Poland.

All documentation for models developed under LIFE Climate CAKE PL are available at:

www.climatecake.pl

LIFE Climate CAKE PL studies and reports

During the five years of the project implementation CAKE team has made a several number of analyzes, the most important we present below. All CAKE reports are available in Enlish and Polish on the: www.climatecake.pl

1. "The Risk of carbon leakage in the context of increasing the EU greenhouse gas emission reduction target" (June 2019)

The main purpose of the analysis is to assess the possible magnitude of the carbon leakage applying various assumptions and policy scenarios, including the impact on emission levels, GDP and the economic sectors' condition

Key findings:

- Differences in the production structure and emission intensity in sectors contribute to a similar extent to the carbon leakage scale, therefore the EU should reduce emissions mainly by energy mix transformation (e.g. promoting fuel and emission efficient technologies), and by changing the sectoral structure (e.g. by free allocation or by adjusting border taxes).
- External technology development also affect the results it is assumed that the fossil fuels use will be gradually decreasing, regardless of the adopted reduction targets. Such an assumption allows for a better simulation of the changes in real life.

2. "CO₂ emissions reduction potential in Transport sector in Poland and the EU until 2050"

(October 2019)

Paper presents examination of different emission reduction pathways in transport sector in Poland and in the EU up to 2050. In 2015, transport was responsible for almost a quarter of GHG emission in non-ETS in Poland – thus significant emission reduction without efforts in this sector is practically unachievable.

- The total emission reduction in the transport sector in Poland ranges from 36% in the "Low" scenario to 66% in the "Forced electromobility" scenario, while in the EU the total emission reductions in 2050 vary between the scenarios from 45% in the "Low" to 67% in the "Forced electromobility" scenario.
- Total results for Poland show that, depending on the scenario, the net financial effect in the transport sector may range from EUR 18.1 billion in benefits in the "Low" scenario to over EUR 167 billion in loss in the "Forced electromobility" scenario.



3. "Scenarios of low-emission energy sector for Poland and the EU until 2050" (October 2019)

Assuming the policy focused on systematic reduction of CO_2 emissions and an increase in renewable energy share (up to a minimum of 50% of electricity demand in each of the analysed countries by 2050), four scenarios for the low-emission EU electricity and district heating sector have been examined.

Key findings:

- The total reduction of CO₂ emission in the energy sector in Poland in 2015-2050 ranges from approx. 35% in the scenario without forced reductions to approx. 95% in scenarios with deep emission reduction.
- Reducing CO₂ emissions from electricity generation is more feasible than in district heating, what can result in replacing district heat production by individual sources electric heat and heat pumps. Then the emission is "shifted" to the electricity generation.
- In all forced reduction scenarios, Poland's electricity imports exceed its exports.
- In all scenarios for Poland, lignite use is rapidly decreasing in 2025-2030 and wind farms are subject to dynamic development.
- Nuclear units play an important role in reducing costs in the EU in all forced reduction scenarios.
- All deep reduction scenarios involve extremely high unit costs of CO₂ emission reduction.

4. "The European Green Deal impact on the GHG's emission reduction target and the EUA prices" (March 2020)

Report examines the question how the increase in reduction target from 40% to 50% and 55% in 2030 may change the real change in emissions. This concerns sectors covered by the EU emissions trading system (EU ETS) as well as sectors outside this system, i.e. non-ETS. Impact of new reduction targets on the EUA prices has been also examined.

Key findings:

- Adopting a 50% reduction target in the EU will rise the price of emission allowances in the EU ETS up to 34 euro/EUA and 52 euro/EUA in 2025 and 2030 respectively. The 55% reduction target will rise the price of allowances to 41 euro/EUA in 2025 and 76 euro/EUA in 2030
- New reduction targets will also reduce the number of allowances to zero around 2042-2045 (for a 50% and 55% reduction target respectively). This is the effect of increase of the linear reduction factor (LRF) from 2,2% to 3,2% or to 3,7%.
- Average decrease in non-ETS limits in Member States's would account for 9% and 14% over the 2021-2030 period (for a 50% and 55% reduction target respectively). In case of Poland, the average decrease in the non-ETS emission limit in this period will be 2% and 5%, respectively.

5. "Assessing climate policy impacts in Poland's agriculture" (July 2020)

Different attitudes to greenhouse gasses emission reductions in the agricultural sector have been examined, including: (1) induced general reduction targets for agricultural GHG emissions, (2) introducing taxes on nitrogen-based fertilisers in crop production, and (3) introducing price on emissions from agriculture.



- Forcing the GHG reduction by 20% leads to decline in value of produced market commodities by ca. 9.5% and farm income by ca. 14%. Decline in production following the forced GHG emission reduction to the greatest extent affects the production of cattle for beef (by 35%), milk (by 16%), maize for grain (by 21%), and sugar beets (by 21%).
- Assuming implementation of the EUR 20 emission tax, the potential emission costs would rise to PLN 2,78 bn at country scale, which would mean an expense of PLN 1 960 per average farm and PLN 195 per ha of Utilised Agricultural Area (UAA). These are close to nearly 10% of average farm income.
- Introducing the N-tax and accordingly rising the N-fertiliser prices by 20% leads to increase of fertiliser costs by 3,95% and at the same time resulted in 10,3% decline in their use, while the farm income decreases by 5,5% and emission reduction is as low as 1,6%.



6. "The effects of the implementation of the Border Tax Adjustment in the context of more stringent EU climate policy until 2030" (September 2020)

Report examines the impact of CBAM introduction (Carbon Border Adjustment Mechanism) on the EU Member States' economies, including price levels, changes in the production value, exports and imports, and macroeconomic indicators such as GDP and household consumption. The GHG55 scenario has been examined assuming an increase in the reduction target of greenhouse gas emissions to 55% in 2030, compared to the level from 1990, and the BTA scenario assuming the implementation of the GHG emission tax on products imported to the EU (Border Tax Adjustment). The emission border tax covers imports to the EU in sectors covered by the EU ETS.

Key findings:

- An increase in the prices of imports into the EU - according to the projection, the prices of imported goods in the sectors subject to border tax adjustment would be higher by about 1,6% on average in 2030.
- A change in the value of imports an increase in the prices of imported goods to the EU would cause a change in the value of imports by about -3.4% in the sectors subject to border tax adjustment. The largest changes occur in the sector of ferrous metals, by -11.6%.
- An increase in prices of products exported from the EU and a decline in the value of exports – as the result of an increase in prices of goods manufactured in the EU, the prices of goods exported from the EU to the other regions of the world will grow. The prices of export goods in the sectors covered by the border tax adjustment would grow by about 0,2%. The increase would be the largest in the sector of ferrous metals, by 0,4%. The value of exports from the EU in the sectors subject to border tax adjustment would be -1 1%
- The average change in exports to the regions outside the EU would be about -0.7%, considering all sectors, while the largest are expected in Bulgaria, -1,3%, and the Baltic States, -1,2% (about -1% for Poland).
- The introduction of the border tax adjustment in the EU would cause a reduction in the global GHG emissions by about 24 Mt CO₂ eq.
- The implementation of the border tax adjustment within the EU would bring in 2030 additional revenues estimated at about EUR 7,61 billion (USD 10,6 billion) in constant 2011 prices.

7. "The CO₂ emissions reduction paths in the transport sector in Poland in the context of the **European Green Deal"**

(October 2020)

This study attempts to answer the question of how the carbon prices imposed on conventional vehicles and technological progress may affect emissions from this sector in Poland in 2050 perspective. The dynamics of historical CO₂ emissions from the transport sector in Poland compared to the average of the European Union is substantially different. In Poland, in the years 2005-2017, a significant increase in emissions was observed (by 76%), while in the EU a 3% decrease in emissions was visible in the same period.



- The increase in the operating costs of ICE-powered cars (levy on CO emissions) and the decrease in prices of low-emission vehicles (electric and hybrid) will result in a dynamic increase in the number of electric vehicles in Poland – around 350 000 vehicles per year.
- The structure of the passenger car fleet in Poland would change: 7% share of electric cars and 5% hybrid cars in 2030 and 54% electric cars and 10% hybrid cars in 2050.
- Changing consumer preferences regarding the vehicle purchase, as well as an increase in rail transport use would lead to a decrease in emissions up to 52 Mt CO₂ in 2030 and 31 Mt CO₂ in 2050.
- The development of electromobility would increase the total demand for electricity in road transport in 2050 by approximately 35 TWh, which would account for approximately 15% of the national electricity demand in that year (additional CO₂ emissions from electricity production would represent 1,3% of emissions from the road transport sector).

8. "Poland net-zero 2050: The roadmap toward achievement of the EU climate policy goals in Poland by 2050" (July 2021)

In this report, options of transition towards climate neutral economy in Poland in accordance with the climate policy goals declared in the European Green Deal were examined. The study attempts to assess necessary transformation of all sectors of the economy with particular emphasis on energy, transport and agriculture.

The report is aimed at supporting the process of defining short and long-term actions to build a climate-neutral Polish economy, to estimate barriers and conditions, and in particular to support the preparation of a national low-emission strategy until 2050, including individual sectors of the economy in building their own sectoral voluntary action plans to achieve the EU the goal of climate neutrality by 2050.



Key findings:

- Reduction of fossil fuels and increasing share of RES is not sufficient to achieve climate neutrality targets in EU and Poland by 2050. These measures will need to be supplemented with, among other things, large scale implementation of BECCS, CCS and CCU technologies, electrification of industry, adoption of hydrogen technologies, and expansion of electromobility and reduction of livestock production in agriculture.
- Most of emission reduction in Poland takes place in the energy sector, its role in the overall decarbonisation effort decreases over time. The sector is responsible for 80% of total emission reduction by 2030 (relative to 2015) and 55% of the reduction by 2050.
- The transformation of the energy sector in Poland involves significant investment costs. In the NEU scenario, the total expenditure in the energy sector in 2021-2050 will reach approx. EUR 295 billion (excluding expenditures related to the expansion and modernisation of the transmission and distribution grid or the modernisation of the existing units). These expenditures are almost 60% higher than in the BAU scenario (approx. EUR 185 billion).
- The costs of increasing climate ambitions are reflected in the difference in household consumption between scenarios. In the NEU scenario, the decrease in consumption for Poland relative to BAU is approximately USD 249 billion'14 (/ EUR 188 billion'14) in 2021-2050. Consumption drops are caused by declines in competitiveness of the economy and increased investment needs, for instance, in the energy sector.

- Low-carbon transition requires development of electric and hydrogen technologies. In 2030, 21% of freight will use means of transport based on electricity or hydrogen. In 2050, this share will reach the level of approx. 65% of total freight. The transition will require investment in infrastructure: charging stations, hydrogen fuelling stations and traction network for lorries.
- The results of the analysis indicate that achieving significant GHG emission reductions in the agriculture sector cannot be fully compensated by a reduction in unit emissions and leads to a reduction in the volume of agricultural production, especially livestock production.

9. "Poland net-zero 2050. Guidebook of energy transition for local governments." [in Polish]

(October 2022)

The guide has been realised to present in one place the most important policies, measures and support instruments in the field of low-emission economy development, which are the responsibility of local authorities. It is local authorities that have the greatest potential in terms of integration of measures for distributed energy generation, energy efficiency, air protection and many other elements that are part of the sustainable development strategy.

Initiating and implementing changes to protect the climate is an opportunity for the development of cities and municipalities and a number of benefits, such as: improvement of air quality and modernization of energy and transport infrastructure, which continue to materialize over the next decades.

Key findings:

• The guidebook contains many valuable tips and advice on the directions of actions that may be taken by local governments as part of the energy transformation, in particular a description of available sources of financing or co-financing of projects in this area (provided that they relate to competitions currently underway under the current financial perspective). The anticipated changes in the next financial perspective are also outlined,



however, conditions and support mechanisms were not finalized at the time of issuing the guidebook, therefore updating should be considered in the future.

• The guidebook also presents the results of analyzes carried out as part of the LIFE Climate CAKE PL project in terms of the potential for greenhouse gas reduction in individual sectors for scenarios assuming reduction levels consistent with the EU objectives. This analysis can be helpful in assessing the steps needed to achieve climate neutrality by 2050.

10. "Reform of the market stability reserve (MSR) in the "Fit for 55" package" (January 2022)

The purpose of this analysis includes assessing the impact of the changes in the EU ETS proposed by the European Commission as a part of the Fit for 55 package, in particular infuence of changes

in the functioning of the market stability reserve (MSR) on the volumes of emission allowances available for installations and to estimate the impact of these changes on the annual average prices of emission allowances in the EU ETS. Additionally, the report presents the economic consequences of changes in the prices of emissions allowances on volumes and changes in production prices in the European Union.

Key findings:

- Study shows that the strengthening LRF with one-off rebasing of the cap presented in "Fit for 55" package makes a significant impact on tightening the supply of allowances on the market and leads to a higher EUA price in 2030.
- Extension of the current 24% intake rate until 2030 would result in a much faster tightening of supply by increasing EUA transfers to MSR and accelerating emissions reduction by 2025. This combined with a strengthened LRF and one-off reduction of the cap in 2024 would imply an extremely tight supply in 2025 which could result in a higher EUA price in 2025 (EUR 76). However, when the surplus is between the new thresholds introduced in the Fit for 55 package (1096-833 million), the intake rate drops below 24% easing the path of EUA price increases until 2030.
- In all scenarios with MSR the EU meets the 2030 target (61% reduction in 2030 vs. 2005) and significantly reduces the surplus of allowances close to upper MSR threshold (eliminating the historical structural surplus). In without MSR scenario, the EU is close to reach the reduction target to 2030 (a few % points were missing).
- Implementation of the "Fit for 55" package as proposed by the European Commission would increase EUA price to approx. EUR 130 in 2030 (medium price scenario). Depending on hedging needs parameters (EU ETS participants behaviour) EUA prices could achieve almost EUR 200 in the most extreme Fit for 55 price scenario.
- The increase in the EUA price in 2030 makes serious effects that are reflected in the increase in the cost of producing energy from fossil fuels and the increase in production prices in energy and emission intensive sectors in the EU. The most sensitive are the prices of electricity, water and air transport, ferrous metals and non-metallic minerals. In all analysed options of MSR after implementation of Fit for 55 package the variation of average EU electricity prices in MSR scenarios is between –4% and +4% in 2030. However, the effects of changes in the allowances price could be very different between EU countries and in regions with a high share of hard coal and lignite in energy mix, the consequences could be many times greater than those observed at the EU level.





11. "How to estimate the cost for workers within the "Just Transition" to a low-carbon future?" (April 2022)

In this paper CAKE proposes a novel methodology that allows to calculate the loss of workers throughout the low-carbon transition. CAKE uses microeconomic theory supported with empirical evidence to argue that for many workers in mining sector their current payoff is significantly larger than their potential payoff in other sectors. Next, CAKE incorporates framework in a numerical economic model to calculate the loss of workers throughout the low-carbon transition in Poland. Results of the paper shows that the costs of transition in Poland will be increasing over time and reach 1% of labour compensation in 2040. The cost associated with the loss of workers who were previously employed in the mining sector would amount to more than US\$1.1. billion, close to 0.5% of total labour compensation in Poland in 2040.

- Low carbon transition requires a radical drop in production of coal and employment in the mining sector.
- We expect that workers in mining who are forced to move to other sectors will receive lower wages than they receive currently.
- First workers who leave mining are those who are indifferent between jobs in mining and jobs in the other sectors. Those who wait are those who expect that their future payoff in the other sectors is significantly lower than their current payoff in mining.

- We use the shape of sectoral labour supply curves to calculate the loss of workers throughout the transition.
- The costs of transition in Poland will be increasing over time and reach 1% of total labour compensation in 2040.
- The cost associated with the loss of workers who were previously employed in the mining sector would amount to 0.5% of total labour compensation in Poland in 2040.

12. "POLAND NET-ZERO 2050: Transformation of the Polish and EU energy sector by 2050" (June 2022 r.)

The publication analyzes scenarios relevant to the challenges facing Poland and EU countries, as well as taking into account risks related to fuel market turbulence in the current geopolitical situation resulting from Russia's aggression against Ukraine.

Key findings:

- In all scenarios, renewable sources will be the dominant technologies in the 2050 perspective. Primarily onshore and offshore wind farms and photovoltaics.
- In the scenarios assuming implementation of the "Fit for 55" package, the modelling results indicate that, from the point of view of optimising energy system costs, the share of RES sources in electricity production should be increased even to ca. 50% already in 2030 and to 70% or more in 2050
- Of the scenarios considered, only the BASE scenario is characterised by a clearly slower rate of RES development in the next decade to a share of around 30% in 2030 as a result of the lack of "Fit for 55" pressure. But even in this scenario, in the longer term the rate of RES development increases and in 2050 the RES share in electricity generation reaches more than 65% slightly less than in the climate neutral scenarios. This shows that even with moderate CO₂ costs, RES technologies in 2040-2050 will be competitive.





• Taking into account the common emission reduction target in the neutrality scenarios and the interconnected electricity market, Poland will have to meet with the EU average to remain competitive, bringing the emission factor from about 0.65 tCO₂/MWh (about 2.5 times the EU average) to near zero.



13. "POLAND NET-ZERO 2050: The role of public transport in the light of the "Fit for 55" package and the 2050 perspective" (June 2022)

Achieving climate neutrality requires tighter targets for reducing CO₂ emissions performance standards. Proposals in the "Fit for 55" package assume that

 ${\rm CO}_2$ emission standards will be reduced by 55% for passenger cars and 50% for commercial vehicles in 2030 compared to 2021, and a ban on the sale of combustion engine cars will be introduced from 2035.

The study considers analytical scenarios that take into account the "Fit for 55" package legislation and promote public transport.

- The implementation of the scenario taking into account the ban on the sale of combustion passenger cars from 2035 (Fit for 55 package) requires the introduction of an additional number of electric cars. In 2050, this number may reach over 17 million units. Vehicle purchase costs will be an additional burden on consumers and businesses.
- The transformation of the passenger transport sector should assume a dynamic development of public transport. The number of rail journeys in scenarios promoting public transport may increase to about 80 billion pkm in 2050 (more than 3 times as compared to 2020). Rail travel will replace domestic and intra-EU flights over short distances and reduce traffic on Polish roads.
- Electrification and hydrogenation of the bus fleet may reach 9% in 2030 and 73% in 2050.



14. "POLAND NET-ZERO 2050: Selected climate policy measures in the agricultural sector in the 2050 perspective" (June 2022)

The new publication shows that the implementation of ambitious reduction targets in the agricultural sector, while preserving the currently applied production methods (NEU), results in a significant reduction in agricultural production and leads to a significant increase in agricultural prices compared to the scenario assuming the continuation of the current policy (BAU). It should be noted that the change in the level of farmers' income resulting from the reduction of GHG emissions is strongly dependent on the manner of implementation of the climate policy. Implementation of the mechanism of payments for GHG emission leads to a drastic fall in farmers' income which threatens food security. Achieving the same goal with subsidies seems to be ineffective due to the amount of payments necessary to achieve the reduction target.

Key findings:

• The feasibility of GHG mitigation measures, i.e. afforestation of agricultural land, reduction of emissions from organic soils and production of agricultural biogas from animal manure (NEU Plus) in agriculture enables the implementation of reduction targets by significantly less impact on the food market and farmers' income.

This involves excluding nearly 20% of the land from agricultural production and increasing the intensity of cultivation on the remaining acreage. Despite the exclusion of part of the land, the observed decrease in agricultural production is noticeably smaller than in the NEU scenario.

• At the same time, the agricultural sector is able to provide biomass with an energy value of 66 PJ and electricity to cover part of its own needs, leading to a reduction in GHG emissions in other sectors.

• In case of application of mitigation measures, the impact of GHG emission reduction on farmers' income also depends on the way the climate policy is implemented. The mixed variant which assumes obligatory reduction of emissions in all types of farms at the level of 50% of the assumed reduction and subsidies for voluntary reduction of the remaining part of emissions is worth noticing. As a result of the application of this variant, the income of farmers will decrease by about 20% in relation to the base year with the reduction of GHG emission from agriculture by 70%, decrease of production level by 20% and increase of prices of agricultural products by 39%.





CAKE/IOŚ-PIB/KOBiZE organized four international conferences: "Challenges of economic transformation in view of achieving the goal of climate neutrality by 2050" (Warsaw, November 2019), "European Green Deal 2050 - Challenges of transformation" (May 2020, online), "Reform of the MSR and its impact on the EU ETS & EUA prices" (March 2022, organized in partnership with the Permanent Representation of the Republic of Poland to the European Union, online) and the conference summarizing the LIFE Climate CAKE PL project entitled "Challenges of transformation in the perspective of achieving the goal of climate neutrality of Poland and the EU until 2050" (June 2022, Warsaw). Among others, the CAKE Team participated in three Conferences of Parties to the United Natons Framework Convention on Climate Change-COP24 in Katowice in 2018, COP25 in Madrid in 2019 and COP26 in Glasgow in 2021.









The LIFE Climate CAKE PL project results have been presented and quoted in the national and foreign press, including Euractiv.com, Carbon Pulse, Shekulli, African Daily, Efeverde.com, CIS, Wysokie Napięcie, Teraz Środowisko, CIRE, Business Alert, Rzeczpospolita. Representatives of the Team have also participated in many podcasts and have given interviews for radio and television (including PolskieRadio24.pl, Biznes24).





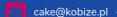




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