

Greenhouse Gas Emission Trading System in Poland – analysis of functioning

Anna Bluszcz

Faculty of Mining and Geology, Silesian University of Technology, Akademicka 2,
44-100 Gliwice, Poland

anna.bluszcz@polsl.pl

Abstract. The article presents the analysis of the impact of carbon leakage phenomenon on Polish economy. The key objectives of the climate package were discussed, along with the tool concerning the emission reduction, such as: European Union Greenhouse Gas Emission Trading System (EU ETS). The phenomenon of emission leakage is presented, which may pose a threat to the coal industry development in Poland. The article also shows the influence of the decarbonization policy of energy sector on the economic competitiveness of the member states in comparison to other countries where there are no emission limits.

1. Introduction

Poland has been the signatory to the United Nations Framework Convention on Climate Change (UNFCCC) since 1994 and to its Kyoto Protocol since 2002 thus joining the international efforts aiming at combating climate change. One of the main obligations resulting from ratification of the Kyoto Protocol by Poland is to reduce the greenhouse gas emissions by 6% in 2008–2012 in relation to the base year and by 20% in 2013–2020 jointly with the European Union. The European Union (EU) and its Member States, and Iceland have agreed (agreement under Article 4 of the Kyoto Protocol) to fulfil jointly their quantified emission limitation and reduction commitment (QELRC) for the second commitment period of the Kyoto Protocol. The joint QELRC for the EU is 80% (Annex I to the Doha Amendment) what relates to 20% emission reduction on a yearly average comparing to the base year during the period 2013 – 2020. Poland's Assigned Amount is 1.592.338.962 tonnes CO₂eq and relates only to the non-ETS emissions, as Poland is going to fulfil its emission reduction target jointly with the EU. Poland's AA is equal to the annual emission allocations (AEAs) as established under the EU Effort Sharing Decision (406/2009/EC) and determined in the Commission decision 2017/1471 and adjusted in the decision 2013/634/EU for 2013–2020. The Poland's commitment period reserve (CPR), calculated as 90% of annual emission allocations given above, amounts to 1.433.05.066 tonnes CO₂ eq [1].

Emission reductions included in the Energy Roadmap 2050 and adopted by the member states assume decarbonization of the electrical energy sector and emission reduction by 80–95 % in 2050 in comparison to 1990 [2]. The way to reach these goals is developing renewable energy resources, which include biomass and wastes, water, wind and geothermal energy. The framework of the climate and energy package until 2030 was adopted by the EU states' leaders in October 2014. They will become a prime mover for constant improvements towards a low-emission economy and will prove the EU ambitious goal to counteract climate changes during international negotiations. The objectives of the policy framework are to build an energy system which will provide consumers with affordable energy prices, to increase the security of energy supplies to the EU, to lower the EU dependence on



energy import, to reduce the greenhouse gases emissions and to create new opportunities for green growth and new environmentally friendly workplaces.

European Union Greenhouse Gas Emission Trading System (EU ETS) is an instrument to reduce emissions in EU member states, which was implemented in three stages: stage 1 (2005-2007), stage 2 (2008-2012) and stage 3 (2013-2020). In the first stage the system covered installations of the energy and heating industry with a high level of carbon dioxide emission. The second stage included additional installations emitting nitrous oxide as a result of nitric acid production. Currently, the third stage of ETS system is in progress and it covers carbon dioxide (CO₂) emission from power plants, energy-consuming sectors and commercial airlines as well as nitrous oxide emission connected with production of certain acids and emission of perfluorocarbons due to aluminium production [3].

The aim of the article is to analyse and evaluate the functioning of the emission allowance trading system in Poland. An attempt was made to compare the impact of the ETS on the Polish economy in relation to the situation of other EU Member States.

2. ETS in Poland

EU ETS has been in force since 2005 and covers more than 11 thousand installations in energy and industry sectors in the EU and Norway. In Poland currently about 750 installations are covered by the system. Since 2012 the airlines sector has also been included in the EU ETS system. The system operates on the 'cap and trade' basis. The acceptable emission limit (cap) is determined for the system participants and gradually it is being lowered until the EU reduction level, according to which in 2020 the emission from the installations covered by the EU ETS shall be 21% lower than in 2005. Within the determined limit system participants receive emission allowances free of charge or buy them. One emission allowance gives an owner a right to emit one tonne of CO₂ or an equivalent quantity of other greenhouse gas (greenhouse gases covered by the ETS system are mainly carbon dioxide but since 2013 they have also included nitrous oxide and perfluorocarbons, whose emission is expressed in the equivalent of carbon dioxide).

Each year a system participant, under penalty of a high fine, has to settle an account for the real emission by remitting a certain number of emission allowances. In the case when an installation reduces emission, they are allowed to retain a part of their allowances in order to cover their future needs or, for instance, sell them to another installation which has too few allowances [4]. The EU ETS Directive envisions a possibility for using a derogation for the energy sector, i.e. a temporary exception to the above rule and a possible granting of free emission allowances to electrical energy producers.

Poland has submitted a required application for free allowances allocation to emit greenhouse gases for the period of 2013-2020 in order to modernize electrical energy production (the so-called derogative application) and to take advantage of the transition period. The application has been approved by the European Commission. In concordance with the premises of the transition period, Polish power plants may obtain as many as 70% of free allowances for greenhouse gases emission in 2013. The number of free emission allowances is to gradually decrease until 2020. Only then will the representatives of the energy sector be obliged to purchase 100% of emission allowances at auctions [5].

In the auctioning system of trading allowances for greenhouse gases emission 88% of allowances are split proportionally between all EU countries, based on the emission share of individual member states in the verified EU ETS emission in 2005 or between 2005-2007 (the higher of the values will be assumed). The remaining allowances will be distributed according to the following rules:

- 10% of all allowances will be divided between those EU countries which are characterized by low GDP per capita (it also refers to Poland),
- 2% of allowances will be obtained by countries whose emission in 2005 was lower by at least 20% than the emission in the base year of the Kyoto protocol (Poland also belongs to this group).

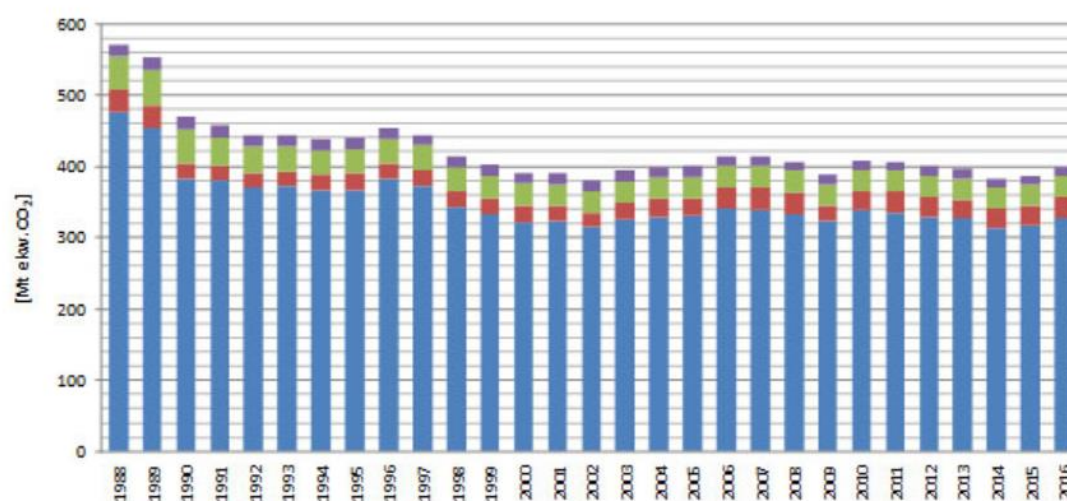


Figure 1. Trend of aggregated GHGs emissions for 1988–2016 according to source categories.

In all categories in figure 1 such as: blue – energy, red-industry processes, green- agriculture, and waste emission reduction has been observed while in LULUCF sector increase in carbon sink has been noted. The highest drop in emissions has occurred in Agriculture (by 37.1%) what was caused by significant structural and economic changes after 1989 in this sector, including diminishing animal and crop production (i.e. cattle population drop from 5.9 million to 5.9 or sheep population from 0.2 million to 239 thousand in 1988-2016). Next category with high emission reduction in 1988-2016 is Energy (by about 31.0%) what was caused by transformation of heavy industry in Poland as well as by decreasing coal use and mining and energy efficiency measures implemented (table 1).

Table 1. GHG emissions according to main sectors in base year and in 2016 [1].

	Total [kt eq CO ₂] emissions (2016 – base)/base [%]		
	Base year	year 2016	
TOTAL with LULUCF	555 408	369 753	-33.4
TOTAL without LULUCF	571 335	397 705	30.4
1.Energy	474 966	327 545	-31.0
2.Industrial processes and Product Use Energy	31 386	28653	-8.7
3. Agriculture	47 835	30 073	-37.1
4. Land use, Land use change and forestry	-15 927	-27 951	75.5
5. Waste	17 146	11 433	-33.3

The trend of aggregated GHG emissions follows the trend of emissions of CO₂ alone, which is the primary greenhouse gas emitted in Poland. The GHGs trend for period between 1988 and 1990 indicates dramatic decrease triggered by significant economic changes, especially in heavy industry. This drop in emissions continued up to 1993 and then emissions started to rise with a peak in 1996 as a result of development in heavy industry and other sectors and dynamic economic growth. Slow decline in emissions (up to 2002) characterized the succeeding years, when still energy efficiency policies and measures were implemented, and then slight increase up to 2007 caused by animated economic development. In 2008-2011 stabilisation in emissions has been noted with distinct decrease in 2009 related to world economic slow-down. Since 2012 GHG emissions in Poland do not exceed 400 Mt CO₂ eq.

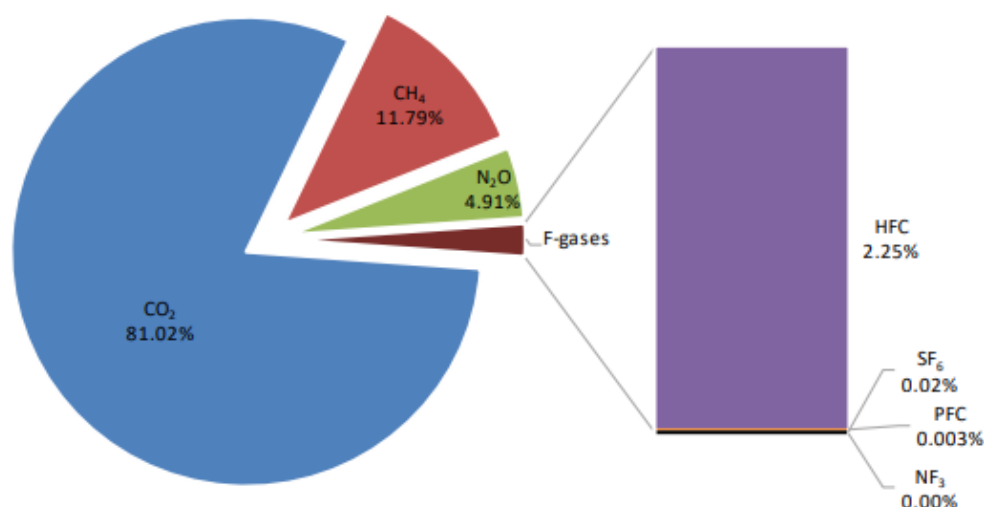


Figure 2. Percentage share of greenhouse gases in national total emission in 2016 (excluding category 4. LULUCF).

3. Emission leakage phenomenon

The obligation of purchasing emission allowances at auctions presented in EU ETS programme may lead to a significant increase in production costs, while price disproportions between EU manufacturers and those from outside the Community (who are not restricted by such regulations and use 'dirty' technologies) may lead to a failure in competitiveness of some industrial sectors in the European Union. Such a situation may be a reason for replacing the production in the European Union with import from third countries or for transferring production outside the European Union. Such a phenomenon is called Carbon Leakage. It means transferring energy-consuming and high-emission production from countries which have a policy of reducing the emission of greenhouse gases to countries which do not undertake such actions. This means increasing the emission of greenhouse gases in third countries in which industry is not subjected to emission restrictions similar to those in the EU.

An example of an emission leakage rate may be the so-called leakage rate 1, which determines the percent reduction of emission in the countries from Annex I to the Climate Convention (UNFCCC) in relation to the increase in emission in the countries outside Annex I. The phenomenon of emission leakage carries a number of negative economic consequences for the European Union. Reducing or resigning from production in the Community area caused by this phenomenon might lead to a transfer of jobs to other world regions ('jobs leakage') as well as capital transfer ('capital leakage') resulting in a rise in the unemployment rate and negative social attitudes [6].

The scale of this effect is estimated to be a dozen percent of the primary reduction [7, 8], although some calculations show several dozen percent emission leaked abroad [9] or even an increase in emission in some economy branches [10]. Such industries as organic chemistry, steel and iron metallurgy, glass, cement and paper production are exposed to this phenomenon to the highest degree. According to article 10a of the ETS directive, a sector or subsector is regarded as subjected to a significant risk of emission leakage if [11]:

- the sum of direct and indirect additional costs induced by the implementation of this Directive would lead to a substantial increase of production costs, calculated as a proportion of the gross added value, of at least 5%; and
- the intensity of trade with third countries, defined as the ratio between the total value of exports to third countries plus the value of imports from third countries and the total market

size for the Community (annual turnover plus total imports from third countries), is above 10%.

In order not to limit the competitiveness of companies included in the Community system of trading emission allowances (EU ETS), sectors exposed to 'carbon leakage' risks obey less restrictive principles of allocating allowances free of charge. It is supposed to minimise the risk of transferring production to countries where industry is not subjected to any limits as far as carbon dioxide emission is concerned.

These sectors will be allocated with 100% free allowances (although 100% free allowances will be allocated only to 10% of most effective installations in a given sector, i.e. those emitting the lowest amount of CO₂ per product unit). The European Commission is obliged to determine the list of sectors or subsectors subjected to the risk of CO₂ emission leakage. In 2009 the EU Commission published the first list of sectors and subsectors subjected to the risk of leakage, which included among others: mining and hard coal enrichment, minerals mining for the chemical industry as well as other sectors. The list of sectors was updated and in 2014 there were 177 sectors left [12].

4. A risk of emission leakage effect for Poland

The scale of carbon leakage phenomenon is influenced by energy consumption of economy and the structure of energy production both in relation to sources efficiency, their general condition as well as fuels used in energy processes. The rate of economy's energy consumption is used to evaluate the effectiveness of sustainable energy policy conducted with respect for energy and environment protection. Reducing the energy consumption of economy means that less energy is necessary to produce the same value of GDP and it is connected with an increase in energy effectiveness. The rate determines energy amount used to produce a GDP unit (expressed in kilograms of the petroleum equivalent per 1000 Euro).

The rate does not reflect a real disproportion between energy effectiveness of Polish and EU economies due to differences in purchasing power, which among others mean that prices of goods as well as market-based and non-market services in individual countries are diversified (the purchasing power of Euro in Poland is higher than on average in the EU) [13]. The analysis of the energy effectiveness level shows that in Poland the level is almost twice as high as in member states. It is also worth emphasizing that since 2000 the level has been reduced by 37%, whereas in other countries, for instance Germany, the drop has only amounted to 22% and in Spain 20%. The high rate of energy consumption is mostly determined by a substantial contribution of energy intensive industries in creating the added value of a country [14, 15].

Energy consuming sectors of economy provide a relatively high volume of workplaces in Poland and the European climate policy poses a risk for the places, which, according to the European Commission, is to be compensated by workplaces in the field of the so-called green workplaces.

Poland belongs to countries with a relatively high industry share in the gross domestic product, which has a significant impact on the risk of carbon leakage hazard. According to Central Statistical Office data of 2016 industry accounted for 38% of GDP, trade 13%, construction 8%, transport and materials management 7%. The industry share in total employment and the employment share in businesses sensitive to carbon leakage determine the level of direct unemployment risk caused by the carbon leakage phenomenon, also called industry emigration. The issue of carbon leakage is essential for Poland, Finland, Romania or for Sweden, Belgium and the Czech Republic.

Poland's exposition to the carbon leakage problem (or at least to risks the labour market faces in connection with this phenomenon) cannot be unambiguously determined, based only on purely macroeconomic statistics, such as industry share in GDP. It also changes annually both in the absolute approach (i.e. the potential GDP loss and a drop in employment) as well as in the relative approach (i.e. whether Poland is less or more at risk than other EU countries). The overlap of ongoing restructuring and convergent processes with challenges of the climate protection policy undoubtedly deepens the concerns towards the European climate agenda in new member states. The anxiety results, among others, from a shortage of comprehensive studies which would objectively address the problem of carbon leakage from the Central-European perspective. The effect is unnecessary cleavage between

economic and ecological sides of the climate debate in Poland, which lacks participants trying to treat both points of view equally and not assuming automatically their internal contradiction [16].

It is worth emphasizing that the ex-ante assessment of every economic policy's impact is burdened with uncertainty. It is especially grave in the case of a climate policy which requires relatively new policy tools, for which there is not enough empirical past experience to allow us to draw precise conclusions on key relationships and impact of effects, which determine the policy influence on the economy or in particular the risk of emission leakage [17].

5. Impact analysis by means of the IBS-CLEAN Module

The IBS-CLEAN module (Carbon Leakage Analysis) is used to estimate changes in global emissions in the case of replacing the domestic production (Polish) with a foreign production, especially manufactured outside the EU area. The module allows us to evaluate how transferring a unit of a product consumed in a country from a given sector abroad changes global emissions of greenhouse gases, so it is especially used for a quantity evaluation of the predicted impact of the climate policy tools on global emissions.

The IBS-CLEAN module may also be used to assess the scale of changes in emissions connected with transferring production abroad and to identify the target countries in the case of which the production transfer will cause the biggest risk of a global increase in greenhouse gases emissions into the atmosphere [10]. The module may be used for variant analyses as well as identification of such situations in which an increase in global emissions will occur and those where the emissions will drop. We distinguish between three emission stages which contribute to a change in total emissions in the situation of emission leakage:

- direct emission connected with manufacturing a given product (both within a country and abroad);
- indirect emission connected with energy production, including electricity, necessary to manufacture a given final product (within a country and abroad);
- emission connected with transporting a given product to Poland. A net change in global emissions as a result of replacing a product manufactured in Poland with one manufactured abroad consists of the sum of changes on the individual stages mentioned before (an increase in emissions abroad and a decrease in emissions in Poland in the case of the first two stages plus the emission connected with transport). Moreover, while conducting an analysis (especially in medium and long terms) on an emission change due to introducing a policy lowering domestic emissions, it is worth considering a change (i.e. a drop) in domestic emissions which would occur as a result of ongoing production in Poland.

The change, which might be interpreted as the cost of lost opportunities in the case of emission leakage, is the last component in the net sum of global emission changes, whose analysis is possible thanks to IBS-CLEAN module [17]. The analysis contains the following sectors: PKD 2007 Code, section B – Mining industry, division C.17 paper production, division C.19 manufacturing of coke and petroleum refinement products, division C.20 chemicals production, division C.23 production of goods from other mineral non-metallic resources, divisions C.24 and C.25 production of metals and metallic goods with exclusion of machines and devices.

In the case of a full transfer of Polish technologies abroad global emissions drop despite additional emissions caused by transport because of mix emissivity of generating electrical energy. In the situation of technological differences, the net effect of emission leakage depends on the target country – for the EU members the emission drops and for China, India, Korea, Mexico, Russia, Turkey, Taiwan and Ukraine it grows.

6. Summary and final conclusion

The analysis of the impact of carbon leakage phenomenon on Polish economy is a complex and multidimensional process. Currently, it is possible to carry out scenario analyses which may show approximate development variants of the future economic situation of countries depending on changeable political and legal conditions.

In Europe and other developed economies, including Poland, there is a visible long-term de-industrialization trend occurring independently from changes in the climate policy. It is an employment shift from industry to services with no decrease in the production volume in heavy industries. It is a potential effect of production leakage to third countries as a result of introducing a climate policy in Europe, whereas its current course shows substantial technological adaptation possibilities and needs of industry to the changing economic conditions in medium and long terms. While evaluating the risk of migration of energy-consuming industries on a national level, especially while assessing the impact of this phenomenon on the labour market, it is necessary to treat carefully life cycle costs and the resulting multiplier, which increases the primary drop in employment [18].

The phenomenon of emission leakage is linked with negative economic consequences for the European Union countries. Due to growing production costs individual companies may reduce or even transfer production outside the EU borders. Such an attitude of manufacturers will result in both jobs and capital leakage, which in turn may lead to an increase in unemployment rates and social disturbances. On the other hand, it is worth remembering about a possible rise in the number of workplaces as well as influx of capital and new technologies in sectors connected with improving energy effectiveness or developing low-emission technologies. Another issue is ongoing de-industrialization of Polish economy, which is a natural process of gradual transfer of human capital from the industrial processing sector (due to technological advancement) to the services sector.

Another phenomenon which might occur in the EU is transferring production within the Community. It particularly refers to energy-consuming industries because the product's cost is determined by electrical energy costs, which include the cost of purchasing emission allowances and this in turn may lead to transferring production from countries with high emissivity of the electricity industry to countries with a low emission in this sector. Such a phenomenon will be particularly disadvantageous for Poland, where coal plays an extremely important role in the domestic fuel and energy balance [19].

The development of ecological energy sources which in 2001 were only 5% in Poland's energy balance and in 2016 already 11.3% may currently be an alternative to combating the phenomenon of carbon leakage in Poland, since the development of renewable energy is also an opportunity for employment growth in these industries.

However, on the whole it should be stated that introducing emission limits in certain regions of the world, including the European Union, increases the risk of losing economic competitiveness of member states on the global market, which in a long term poses a risk of permanent transformations in the industrial structure. It has a clear-cut influence on the potential of maintaining the achieved development level in sectors threatened by the carbon leakage phenomenon.

Acknowledgments

Authors wishing to acknowledge financial support of 06/030/BK_18/0030

References

- [1] *Poland's National Inventory Report 2018* (Warsaw: The National Centre for Emissions Management) pp 1–434
- [2] https://ec.europa.eu/energy/sites/ener/files/documents/2012_energy_roadmap_2050_en_0.pdf
- [3] <http://eur-lex.europa.eu/legal-content/PL/TXT/?uri=URISERV%3A128012>
- [4] <http://www.kobize.pl/pl/article/przydzialy-uprawnien-instalacje/id/353/informacja-ogolna>
- [5] https://www.senat.gov.pl/gfx/senat/userfiles/_public/k9/komisje/2016/kgni/materialy/15pos_min_srodowiska.pdf
- [6] Pyrka M and Lizak S 2009 *Zjawisko ucieczki emisji w sektorach energochłonnych w Polsce w kontekście zmian wprowadzanych w systemie EU ETS na lata 2013-2020* IOŚ KASHUE
- [7] Paltsev S V 2001 The Kyoto Protocol: Regional and Sectoral Contributions to the Carbon Leakage *The Energy Journal International Association for Energy Economics* **4**
- [8] Sijm J P M et al. 2004 *Spillovers of Climate Policy. An assessment of the incidence of carbon leakage and induce technological change due to CO2 abatement measures* ECN

- [9] Aichele R and Felbermayr G 2011 Kyoto and the carbon Leakage: An empirical analysis of the carbon content of bilateral trade *CESifo Working Paper Series* **3661**
- [10] Babiker M H 2005 Climate change policy, market structure, and carbon leakage *Journal of International Economics* **65/2**
- [11] <http://www.kobize.pl/pl/article/przydzialy-uprawnien-instalacje/id/443/ucieczka-emisji>
- [12] <https://www.mr.gov.pl/strony/zadania/reindustrializacja/gospodarki/zrownowazony-rozwoj-gospodarczy/ucieczka-emisji-carbon-leakage/>
- [13] www.stat.gov.pl
- [14] Bluszcz A 2016 European Economies in terms of energy dependence *Quality and Quantity* **51/4**
- [15] Bluszcz A 2017 Evaluations of EU economies according to emission trends and energy intensity *Proc. Ecology, economics, education and legislation 53 Environmental economics* (Sofia: STEF92 Technology) pp 369-376
- [16] Bukowski M 2011 *Rzecz o zagrożeniu problemem carbon leakage w Polsce* (Warszawa: Instytut Badań Strukturalnych)
- [17] Hille E Lewandowski P Śniegocki A 2012 *Analiza zagrożeń carbon leakage w kontekście możliwości wywołania przez Narodowy Program Rozwoju Gospodarki Niskoemisyjnej wzrostu emisji w importowanych towarach* (Warszawa: Instytut na rzecz Ekorozwoju) http://ibs.org.pl/app/uploads/2016/03/IBS_Report_05_2012_pl.pdf
- [18] <http://www.chronmyklimat.pl/projekty/dofinansowania-i-dotacje/debata/251/zagrozenie-roblemem-carbon-leakage-w-polsce-rzeczywistosc-czy-mit>
- [19] NBP Instytut Ekonomiczny *Krótkookresowe skutki makroekonomiczne pakietu energetyczno-klimatycznego w gospodarce Polski Wnioski dla polityki pieniężnej* <https://www.nbp.pl/publikacje/pakiet/pakiet.pdf>