IFC Workshop on "Addressing climate change data needs: the global debate and central banks' contribution"

6-7 May 2024

Climate risk in the polish banking sector – analysis of dirty and green industries[1]

A Kosztowniak,
Narodowy Bank Polski

[1] This contribution was prepared for the workshop. The views expressed are those of the authors and do not necessarily reflect the views of the Central Bank of the Republic of Türkiye, the BIS, the IFC or the other central banks and institutions represented at the event.

Climate risk in the Polish banking sector – analysis of dirty and green industries

Aneta Kosztowniak, Narodowy Bank Polski and SGH Warsaw School of Economics

Abstract

The aim of the study is to estimate credit exposures and their changes in banks' portfolios in terms of sectors important for climate policy in Poland in 2013-2023. The research concerned the analysis of changes in the structure of the loan portfolio in terms of sectors relevant to climate change (CPRS) divided into groups (green, black, brown and dirty), industries (fossil fuels, electricity, manufacturing, production, transport and agriculture) and sections. The CPRS methodology was used (Battiston et al., 2017-2022). The research results showed that in the entire banking sector in Poland the share of dirty exposures decreased (to 53%) and green exposures increased (to 47%). Due to the intersectional connection, the three pillars of industries with the highest transformation risk among CPRS were: buildings, transportation, and manufacturing.

Keywords: climate risk, CPRS, credit portfolio, NACE, ESG, Poland.

JEL classification: G210, Q500, Q540, Q590.

Contents

1. Introduction

The changes introduced in connection with the implementation of Basel IV in the EU (Regulation (EU) No 575/2013 of the European Parliament and of the Council, Directive 2013/36/EU of the European Parliament and of the Council) imposed on banks the obligation to proceed with climate risks in the risk management system. The ESG climate risk is also treated as a challenge for financial stability. The European Systemic Risk Board *(ESRB*) and the European Central Bank (ECB) are actively involved in analysing and monitoring the impact of climate risk on the financial system, identifying it as one of the main systemic risks in the European Union (EU). These risks also require banks to develop appropriate strategies and change business models to minimise climate risks.

The climate risk can affect the financial system and the real economy through two risk channels (types):

- *The physical risk* includes the economic costs and financial losses resulting from the increasing severity and frequency of extreme weather events caused by the climate change. It has been at the core of the empirical literature in this field for years[1].
- *The transition risk* is related to the costs generated by the need to adapt the economy to a more sustainable and low-carbon development path. Transition risks will materialise before a significant part of the physical risk materialises, as there are adjustments to the value of financial assets that investors do not fully anticipate or hedge against. In contrast, the transition risk has received much less attention in the past, but the political and economic debate about costs and benefits of the transition to net zero carbon emissions has intensified.

According to Monasterello and Battiston (2020, pp. 52-72), there are several reasons why the risk of transfer is revealed, e.g., if the transition is late and sudden (ESRB, 2016) and thus "disordered" (NGFS, 2019).

The results of determining the value and structure of credit exposures sensitive to climate change in the banking sector in Poland fill a research gap in the scope of empirical research to date. These results also add value to the work on improvements to estimating the scale of sectors important for climate policy and their possible impact on the risk of transformation in financial institutions, specifically, in banks.

The results are important for:

1) Banks in assessing, limiting, and monitoring the ESG risk management process or disclosures of these exposures (SFDR Regulation, TCFD guidelines under CRR2).
2) The supervision of the financial market in the banking market segment.
3) The EU and national legislative institutions in the legislative and regulatory procedure.

The aim of the study is to estimate credit exposures and their changes in banks' portfolios in terms of sectors important for climate policy, which exposes

[1] A comprehensive overview of the current state of climatological research is provided, for instance, in the regular reports of the Intergovernmental Panel on Climate Change (IPCC).

them to the risk of ESG transition in Poland in 2013-2023. To achieve the aim of the study, it is important to obtain answers to the following questions:

1. How did the loan portfolio of exposures sensitive to the climate transition risk change?
2. What changes took place in the share of green and dirty industries in the composition of the entire banking sector?
3. In which groups, industries, and sections of economic activity (NACE) are concentrated exposures sensitive to the risk of climate transition?

The following research hypotheses were formulated:

H1. In Poland, the structure of the loan portfolio in the field of green groups slowly improves and impaired loans (NPLs) in sectors important for climate policy fall, considering the initial period of economic transformation in this area.

H2. Intersectional links can be a source of risk if disruptions in individual sections affecting entire industries (spillover effects) are revealed, such as in buildings, transportation, and manufacturing.

2. Sectors Relevant to Climate Policy (CPRS) – methodology

An important method for determining exposure by groups, sectors, and sections sensitive to climate change is the Climate Policy Relevant Sectors (CPRS) method developed by S. Battiston and I. Monasterelo (2017), improved at the turn of 2019-2022, and used in the studies of EIOPA (2018), ECB (2019), and EBA (2020).

To identify the CPRS, guidelines have been prepared for the qualification of various operations according to the economic activity codes (NACE) (at the level of classes and subclasses), covering some different levels of disaggregation:

I. Groups:

- black (fossil fuels);
- brown (electricity + manufacturing + transportation),
- brownish (agriculture + buildings),
- dirty (black + brown + brownish),
- and green.

II. CPRS Main: CPRS1-fossil-fuel, CPRS2-utility-electricity, CPRS3-manufacturing, CPRS4-buildings, CPRS5-transportation, CPRS6-agriculture.

III. Individual sections – CPRS2.

IV. CPRS Granular.

The CPRS classification is widely used by practitioners and policymakers, based on the use of a classification of economic activities that is reproducible and comparable across portfolios and jurisdictions (Table 1).

The list of sectors relevant for climate policy by code classification

Table 1

CPRS sectors	NACE rev. 2, 4 codes
1 Fossil-fuel	05, 06, 08.92, 09.10, 19, 35.2, 46.71, 47.3, 49.5
2 Utility-electricity	35.11, 35.12, 35.13
3 Manufacturing	07.1, 07.29, 08.9, 08.93, 08.99, 10.2, 10.41, 10.62, 10.81, 10.86, 11.01, 11.02, 11.04, 11.06, 13, 14, 15, 16.29, 17.11, 17.12, 17.24, 20.12, 20.13, 20.14, 20.15, 20.16, 20.17, 20.2, 20.42, 20.53, 20.59, 20.6, 21, 22.1, 23.1, 23.2, 23.3, 23.4, 23.5, 23.7, 23.91, 24.1, 24.2, 24.31, 24.4, 24.51, 24.53, 25.4, 25.7, 25.94, 25.99, 26, 27, 28, 32
4 Buildings	23.6, 41.1, 41.2, 43.3, 43.9, 55, 68, 71.1
5 Transportation	29, 30, 33.15, 33.16, 33.17, 42.1, 45, 49.1, 49.2, 49.3, 49.4, 50, 51, 52, 53, 77.1, 77.35
6 Agriculture	01, 02, 03

Sources: Battiston *et al.* (2022).

Explanation: The table illustrates selected NACE codes for the first 6 CPRS Main categories. Note that when a 2-digit (or 3-digit) NACE code is indicated, it means that all 4-digit NACE codes contained in that code are mapped to the same CPRS.

The CPRS can be applied to all types of financial assets (e.g., stocks, loans, bonds) and geographic jurisdictions, thus making possible comparisons across investors. The CPRS is also fully in line with the EU taxonomy for sustainable activities. Moreover, the CPRS shall provide a standardised and practical classification of activities (at NACE Rev2 level, 4-digit) on which revenues may have a positive or negative impact in a disorderly low-carbon transition, based on their energy technology (e.g., based on fossil fuels or renewable energy). For this reason, the CPRS classification is considered a benchmark for assessing the financial risks associated with climate change and has been used by several international financial institutions to assess investors' exposure to climate transition risks. The use of CPRS methodology can be found in several reports, among other places.

- The European Central Bank (2019) provided in its June 2019 Financial Stability Report some preliminary estimates of financial institutions' aggregate exposures to the CPRS, relative to their total shares in debt securities, ranging from 1% for banks to around 9% for mutual funds.
- The European Insurance and Occupational Pensions Authority, (EIOPA, 2018, pp. 1-88) reported the aggregated CPRS exposures of EU insurance companies of approximately 13% of their total securities shares.
- The European Banking Authority (EBA, 2020), in its assessment of the financial risk of the banking system of December 2020, used the CPRS methodology to analyse the temporary risk associated with €2.4 trillion of EU bank loans.

According to the results of the studies by Battiston *et al.* (2022) for the EU countries and non-financial corporations in 2013, 2015 and 2018, based on the CPRS methodology for the equity and bond portfolio, the highest degree of the transition risk was shown by the following sectors: industry, followed by transportation and fossil fuels; electricity and buildings were exposed to the risk to a lower degree.

It is worth emphasizing that by identifying credit exposures by groups, sectors and sections (CPRS), banks can estimate their exposure to climate (ESG) risks and make decisions regarding capital requirements and reserves.

3. Empirical data

In this study of loan portfolio exposure, the methodology developed by Battiston *et al.* (2022), that is, a mapping from the NACE codes of economic activities into Climate Policy Relevant Sectors (CPRS) and into the variables of the process-based Integrated Assessment Models (IAM), is used by the Network for Greening the Financial System (NGFS) to provide its climate scenarios (according to Table 1) standards ISIC, NACE or NAICS and refers to a production process, e.g., electric power generation. Data on credit exposures come from the databases of the National Bank of Poland (NBP, 2023; NBP300).

The empirical analysis uses NBP reporting data, including the NBP300 database, i.e., banks' reports on loans to non-financial corporations. The time series included quarterly data for Q4 2013 to Q2 2023 (39 quarters). The Stata statistical package was used to calculate individual CPRS disaggregations. Data descriptive statistics are provided in the Annex (Table A.1).

The identification of credit exposures according to the CPRS methodology included three steps of the calculation:

1. The values and dynamics of CPRS exposure in total and broken down into groups: black, brown, dirty, and green.
2. Bank exposures by six main industries: CPRS1-6.
3. The exposures of CPRS exposures by NACE sections.

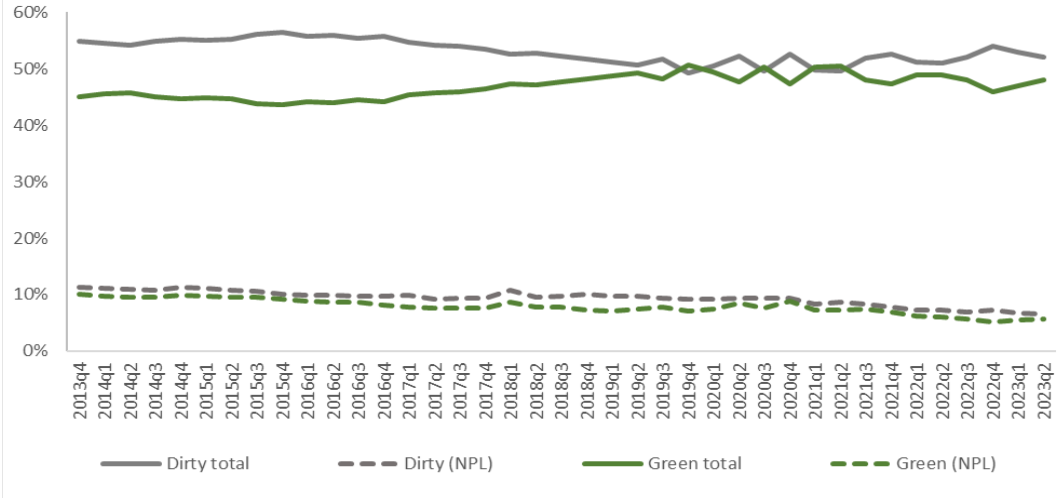
3.1. CPRS exposures according to groups

In Poland, in the years 2013-2023, the value of CPRS exposures increased by 45%, including dirty exposures by 34%, black exposures by 69%, brown exposures by 30% and green exposures by 57%. On the other hand, the average share of dirty exposures in CPRS exposures was 53% vs. 47% share of green exposures.

Comparing dirty exposures to the exposures of the entire banking sector, their share fell from 55% in 2023 to 52% in 2023, and green exposures from 11% to 9%, respectively. A noticeable trend of some improvement was also noticeable in impaired exposures (NPLs), which also showed declines (Kosztowniak, 2023a). Accordingly, the share of dirty loans (NPLs) in the banking sector exposure fell from 11% to 9%, while the share of green loans (NPLs) fell from 10% to 8% (Figure 1).

The share of dirty and green groups in the exposure of the banking sector in Poland in Q4 2013 - Q2 2022 (%)

Figure 1

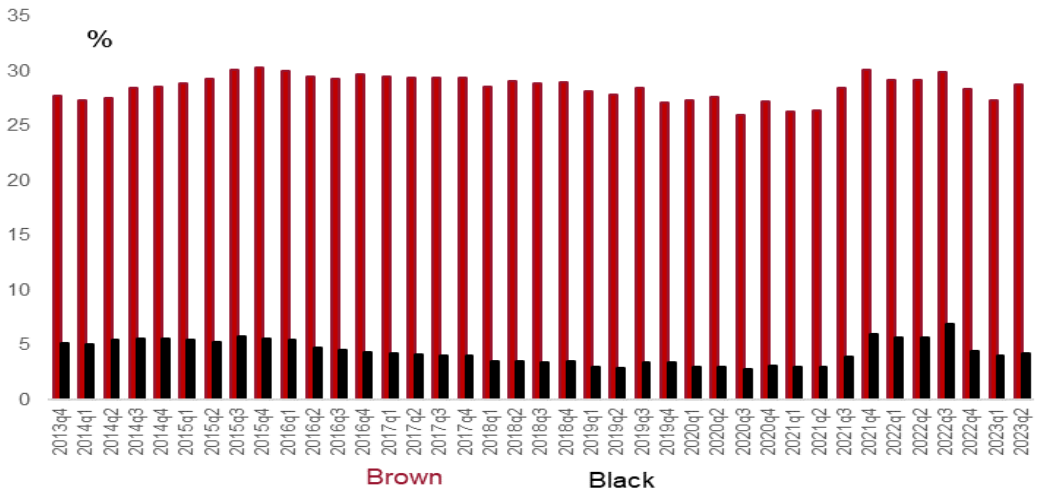


Sources: Author`s compilation based on NBP (2022), NB300 (2023).

On the other hand, when comparing credit exposures from individual climate groups to total corporate loans, their share in the years 2013-2023 remained at a similar level, with some deviations in individual years. For example, the share of brown loans in corporate loans increased from 28% in 2013 to 29% in 2023, while the share of black exposures to corporate loans fell from 5.2% in 2013 to 4.3% in 2023 (Figure 2).

The share of brownd and black sectors in corporate loans in Poland in Q4 2013 - Q2 2023 (%)

Figure 2



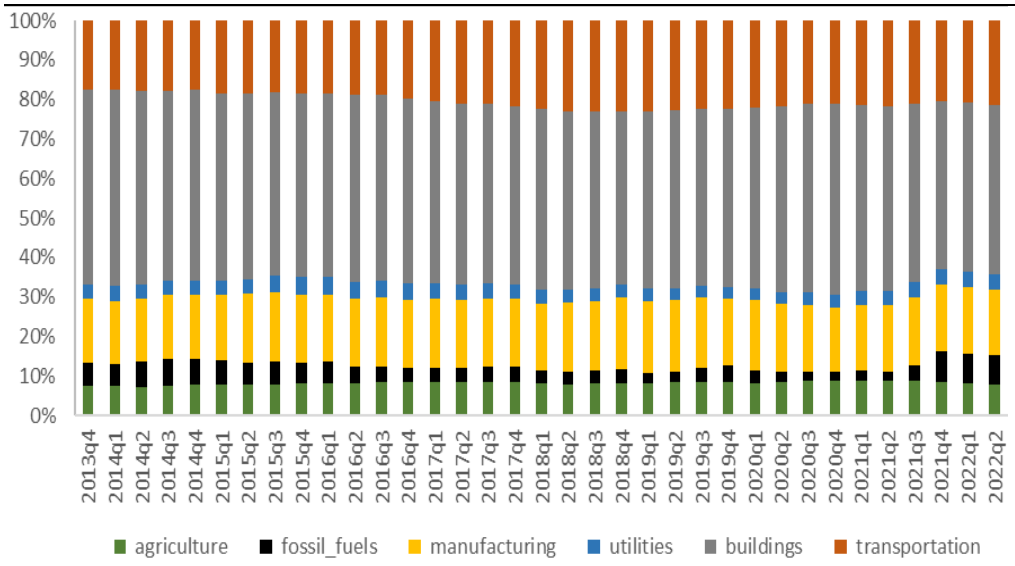
Sources: Author`s compilation based on NBP (2022), NB300 (2023).

3.2. The involvement of banks in CPRS industries and their structure

The credit exposures result of the Polish banking sector for the next degree of disaggregation, i.e., for the level of industries, prove that three industries (pillars) of CPRS, i.e. buildings, transportation and manufacturing, were of major importance in the years 2013-2022. The largest share of exposure was concentrated in the construction industry, despite its reduction by 7 pp (from 49% to 43%). The second pillar was the transportation industry, for which the exposure climbed by 4 pp (from 17% to 21%), while the third pillar of manufacturing maintained a stable share of 17% in the total CPRS (Figure 3). It is worth noting here that the three industries in Poland were also key to CPRS exposures according to the results of research for the EU countries in 2013, 201 5 and 2018 (Battiston *et al.,* 2022).

Industry exposures in total CPRS exposure in Poland in Q4 2013- Q2 2022 (%)

Figure 3

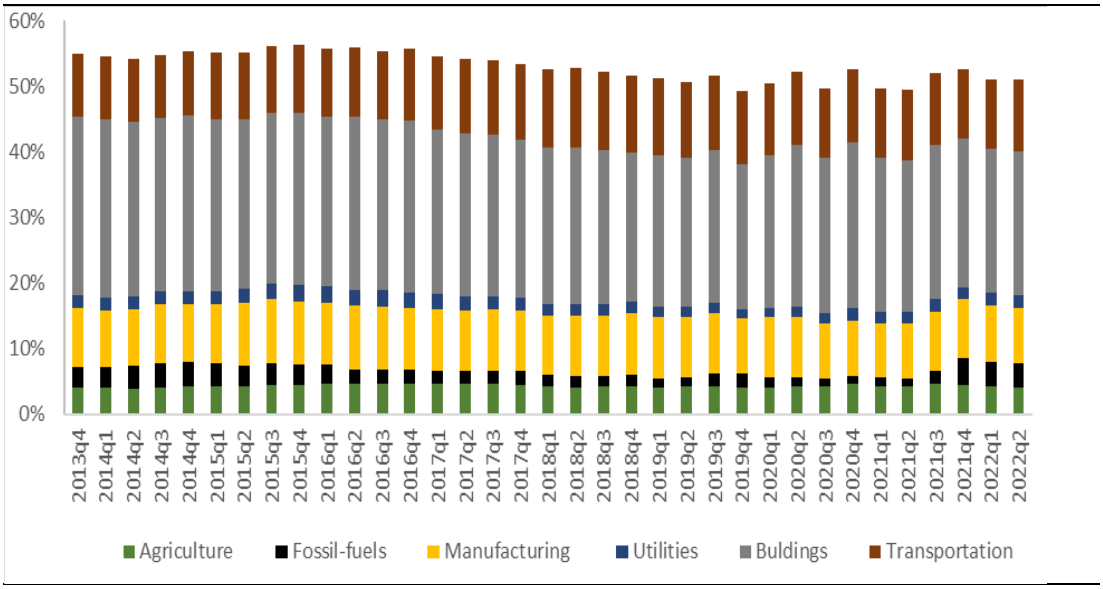


Sources: Author`s compilation based on NBP (2022), NB300 (2023).

Referring CPRS exposures to the exposures of the entire banking sector in Poland, it appears nearly 60% of the exposures relate to the transition risk. What this means is that the majority portfolio is sensitive to changes in ESG transformation risk and requires careful monitoring and supervision. Between 2013 and 2022, the buildings sector accounted for the largest share of this exposure, despite showing a contraction of 5 pp (from 27% to 22%), against an increase of 1 pp. in the transportation sector (from 10% to 11%) and a stable 9% share of the manufacturing sector (Figure 4).

The shares of CPRS industries in the banking sector exposure in Poland in Q4 2013- Q2 2022 (%)

Figure 4

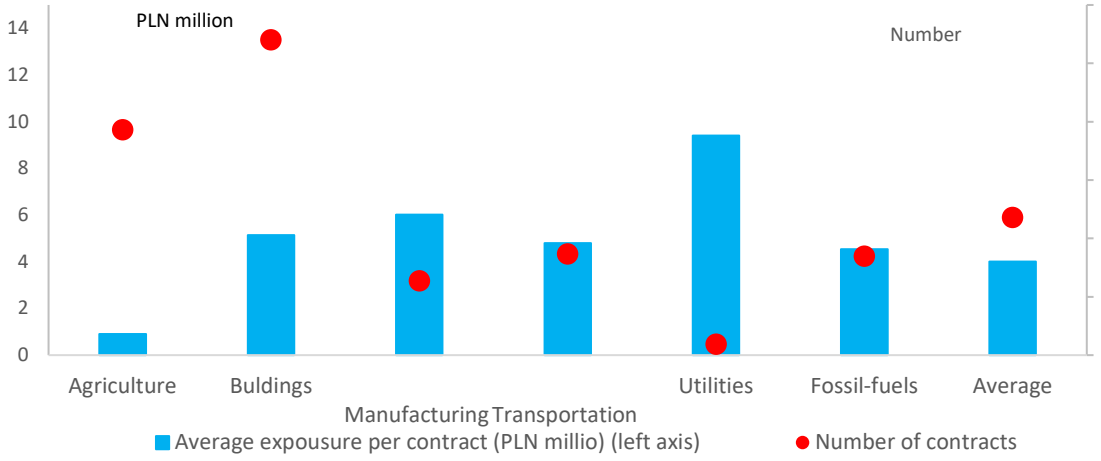


Sources: Author`s compilation based on NBP (2022), NB300 (2023).

In the analysis of transition risks, their concentration is an important issue. One of the ways to identify it is the value of credit exposure for 1 contract. In Poland, the utilities (utility-electricity) industry maintained the highest average exposure value for 1 contract in Q2 2022 (approx. PLN 9.4 million). Other unit exposures under a contract corresponded to manufacturing sector (approx. PLN 6.0 million) and buildings (approx. PLN 5 million), respectively, compared to the lowest in the agricultural sector (below PLN 1 million) (Figure 5).

Average exposure by CPRS group and number of contracts for Q2 2022 (PLN million, number)

Figure 5



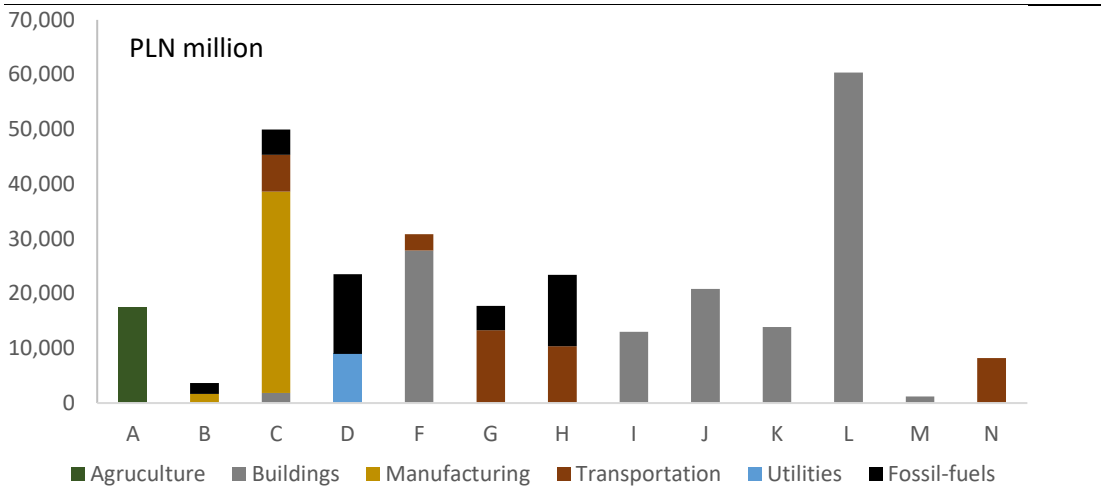
Sources: Author`s compilation based on NBP (2022), NB300 (2023).

.3.3. CPRS exposure engagement by NACE sections

Since, according to the CPRS methodology, there is a permeation of the effects of a section's activities within sectors (CPRS-1-6), in the case of rising CO2 emissions, transfer and physical risks may escalate as part of the dispersion effect (*spillovers*).

According to calculations, the total level of credit exposures in Q2 2022 in section L amounted to PLN 60.4 billion, while for the entire CPRS sector - buildings – to PLN 139.0 billion, in the transportation section to PLN 13.0 billion, and for the entire transportation sector, to PLN 41.6 billion, whereas in section C, it reached nearly PLN 50.0 billion, and for the entire CPRS manufacturing sector, nearly PLN 38.5 billion, due to its dispersion to other industries, e.g. transportation, fossil fuels or buildings. It should be emphasized that the highest exposure value among the CPRS sectors was absorbed by buildings, because it is disclosed in several sections (C, F, I, J, K, L, M, N). High exposures were also maintained by the CPRS sectors in the fields of transportation (sections: C, F, G, H, N) and manufacturing (B, C) (Figure 6).

The dispersion of CPRS sectors in NACE sections, i.e. links between sections in Poland in Q2 2022 (PLN million) Figure 6



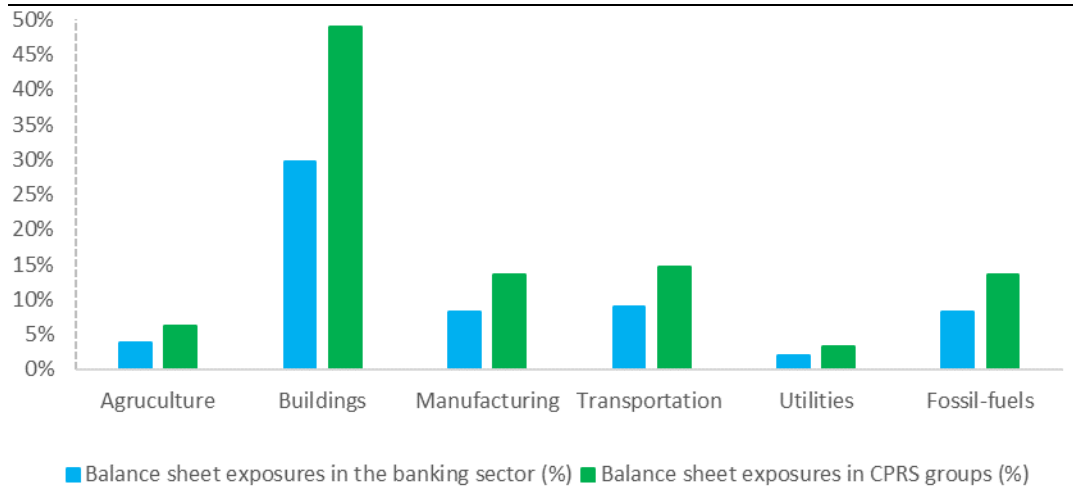
Sources: Author`s compilation based on NBP (2022), NB300 (2023).

Note: NACE sections: A - Agriculture, forestry, hunting and fishing, B - Mining and quarrying, C - Manufacturing, D - Electricity, gas, steam, hot water and air conditioning generation and supply, E - Water supply; sewage and waste management and remediation activities, F - Buildings, G - Wholesale and retail trade; repair of motor vehicles, including motorcycles, I – Activities R - Activities related to culture, entertainment and recreation related to accommodation and food services, J - Information and communication, K - Financial and insurance activities, L - Activities related to real estate services, M - Professional, scientific and technical activities, N - Administrative and support services activities.

Among bank balance sheet exposures in the CPRS industries, as well as in the entire banking sector, buildings retained the largest share. The share of banks' balance sheet exposures in CPRS in the field of buildings amounted to nearly 50%, compared to the share in the field of transportation (15%) and manufacturing and fossil fuels (14% each). The total share of other industries was less than 10%, i.e., agriculture (6%) and electricity-related activities (3%). In relation to CPRS exposures to banking sector exposures, buildings (30%), followed by transportation (9%) and manufacturing and fossil fuels (8% each) also held the largest shares (Figure 7).

Balance sheet exposures in CPRS sectors and the entire banking sector in Q2 2022 (%)

Figure 7



Sources: Author`s compilation based on NBP (2022), NB300 (2023).

4. Discussion

Climate change is associated with a substantial increase in various types of risks. One of them is the transition risk. It can be thought of as the risk resulting from the process of adjustment towards an economy with net zero carbon emissions. As this process unfolds, assets may lose value, which in turn can have repercussions for the aggregate economy. Industries with higher carbon emissions will tend to be more exposed to the transition risk as their production processes are affected more strongly by the transition. To date, however, the measurement of the transition risk is still fragmented.

There are two key challenges regarding the definition and measurement of the transition risk: (i) typically, economists measure the transition risk only by isolating certain prominent drivers, such as fiscal policies that support the reduction in carbon emissions, (ii) consequently, the associated implicit definition of the transition risk encompasses only its one or two features.

The growing attention to the transition risk has uncovered key challenges for empirical research. As Medering *at al.* (2023) point out, firstly, a precise definition of the transition risk that may guide analyses is still missing. Broadly speaking, the transition risk can be thought of as the risk resulting from the process of adjustment towards an economy with net zero carbon emissions. But this total definition is hard to operationalize. Therefore, economists typically resort to defining the transition risk by isolating drivers, for instance, fiscal policies that support the reduction of carbon emissions, but also technological change or shifts in household preferences that can render certain industries, products, or firms obsolete (NGFS, 2020). Secondly, the lack of a precise definition makes the measurement of the transition risk challenging. It is impossible to directly quantify it because the expected path (or the distribution of paths) towards a lower-carbon economy is unobservable. Rather, it must be inferred. For another part, a variety of factors shape the transition risk. As a result, a vast

majority of (both theoretical and empirical) researchers rely on proxies that typically capture only one or two features of the transition risk. For instance, Ciccarelli and Marotta (2021) resort to a climate policy stringency index and the amount of green patent filings as proxies. Kaenzig (2022) relies on carbon price data from the EU ETS futures markets. In theoretical macroeconomic research, like integrated assessment models in the spirit of Nordhaus (2018), the transition dynamics are often embodied in a single variable called the social cost of carbon. In spirit, perhaps closest to our paper is Moench and Soofi-Siavash (2021), who extract shocks that explain the maximum share of variation in emission intensity at a 20-year horizon from country-level carbon emissions data.

In tandem with this risk (fiscal and transitional), it is not clear how these surrogate factors, probably endogenous, relate to the path to a low-carbon economy (Metcalf and Stock, 2020). Neither of the challenges apply to the physical risk, easily defined, and measured. Specifically, the observation of extreme weather events and the achievements of climatological research provide detailed information about physical risks. The situation is different in the case of the transition risk, for which there is no common calculation methodology. So far, different methods are used depending on the portfolio of stocks, bonds, or loans (e.g., Battistion *et al.* 2022, Meidering *et al.*,2023).

However, the CPRS method used in this study combines many economic activities (NACE) showing specific CO_2 emissions at different levels of disaggregation. Therefore, this method is multi-threaded and universal due to the availability of statistical data and can be calibrated. The empirical results of Battiston *et al.* (2022) for the EU countries on a group of non-financial enterprises in terms of market capitalization (stocks and bonds) showed that the highest degree of risk transition applies to the following industries: manufacturing, transportation, fuels, electricity, and finally buildings.

The results of research for the Polish banking sector presented in this study for the years 2013-2022 confirm the concentration of the transition risk in the following sectors: buildings, transportation, and manufacturing. Thus, the results are consistent in terms of key climate-sensitive industries, although in a slightly different gradation, which reflects the specificity of the market for Poland.

5. Conclusion

The changes introduced in connection with the implementation of Basel IV in EU countries imposed on banks the obligation to proceed with climate risks (ESG) in the risk management system in the scope of assessment, mitigation, disclosure, and monitoring of exposures sensitive to these risks. Currently, legal regulations regarding ESG can be found, among others, in the SFDR Regulation, EU Taxonomy or TCFD Guidelines.

The literature on climate risk is wide-ranging. However, regarding financial institutions, including banks, it focuses on the types of ESG risks, their modelling, supervision, or impact on financial stability. In terms of theoretical literature (as already noted), both physical risk and the results of empirical research are more extensively presented. In the case of transition risk, both theoretical and empirical analyses are at the initial stages.

One of the methods of identifying sectors relevant to climate policy and allowing to estimate the risk of transition is the methodology developed by Battiston *et al*. (2022) and used by EiOPA, the ECB, and the EBA. The advantage of this method is the identification of groups, industries, and sections of activities sensitive to climate risk exposures, enabling to determine? the risk price for the portfolio of loans of a bank or an entire domestic banking sector.

This study uses the CPRS methodology for the loan portfolio of the Polish banking sector in the years 2013-2022. Similar results were achieved in this study as according to Battiston *et al.* (2022) for the market capitalization (stocks and bonds) of non-financial companies in the EU countries. It is about confirming the existence of the highest transition risk in certain industries, i.e., manufacturing, transportation, and buildings.

The results of the study indicate that the portfolio of credit exposures in Poland, according to CPRS, showed an increase in value by 45% in 2023 compared to 2013. Almost half of the sectors important for climate policy belonged to the so-called group of dirty exposures, including mostly industry, buildings, and transportation. Nevertheless, in the involvement of the entire banking sector, there was a decrease in exposures from the dirty group (from 55% to 53%) with an increase in the share of exposures from green groups (from 45% to 47%). The share of impaired dirty exposures (NPLs) showed a slow decline from 11% to 9%, respectively, and the share of green exposures (NPLs) from 10% to 8%, indicating an improvement in loan servicing (Figure 1). These developments point to a positive trend towards a reduction in the risk of the transition if it continues in the coming years. At the same time, these results confirm the validity of ***H1***. In Poland, there are slow changes in the improvement of the structure of the loan portfolio in sectors important for climate policy, which are in the initial period of transformation in this area.

In Poland, nearly 60% of the exposures of the entire banking sector are classified as CPRS groups. These CPRS groups divided on buildings (43%), transport (21%) and industry (17%) account for the largest share of this exposure, followed by agriculture (8%), fossil fuels (7%) and electricity (4%) (Figure 3). Per 1 loan agreement, the utilities have the highest concentration of exposures in Poland (Figure 5), which is also confirmed by the EU-wide results (Batiston et al., 2022).

An analysis of CPRS exposures by activity section (NACE) showed a dispersion and thus numerous links, e.g. of the buildings with numerous sections (C, F, I, J, K, L, M, N), transport (C, F, G, H, N) and manufacturing (C and B). These results support ***H2***, i.e. that intersectional linkages can be a source of risk when distortions in individual sections affecting entire industries (*externalities*), i.e. real estate activities (Section L) or manufacturing activities (Section C), are revealed due to their broad impact on other sections (Figure 6).

Reassuming, the results of the study showed that in the years 2013-2023 the share of dirty exposures decreased (from 55% to 53%) while the share of green exposures (from 45% to 47%) of the entire banking sector increased in Poland. Buildings played a key role in shaping the exposure, due to its dominant share in CPRS groups (49%) and in the entire banking sector in Poland (30%). Due to the intersectional link, the three pillars of the industries with the highest risk of transformation among CPRS were: buildings, transportation, and manufacturing. The empirical results are important for commercial banks in the process of disclosing climate exposures, as well as for central banks monitoring these areas of activity, including potential risks of financial destabilization of the banking sector.

6. Challenges and economic policy recommendations

In assessing the exposure to climate risks, including mainly the transition, the following conditions are addressed:

1) weakening: e.g., short maturities of loans taken out, considering environmental factors already at the stage of credit analysis of projects, monopolistic position of most high-emission entities with a dominant role of the state as owner and regulator,

2) as well as strengthening: failure to consider energy-intensive entities and industries in the analysis, indirect impact on the banking sector through a change in macroeconomic factors, e.g., an increase in energy prices, job losses or an increase in public debt as a factor strengthening the *sovereign-bank nexus* risk.

Among the challenges for banks in monitoring the ESG risk in loan portfolios, the climate interactions of physical and transition with other types of risks should also be mentioned (Table 2).

Climate risks and interactions with other risks

Table 2

Risk type	Physical risk – severe weather events and long-term changes in weather patterns can contribute to:	Transition risk – new climate regulations, technologies and market sentiment can contribute to:
Credit	Decrease in the value of collateral, which in turn increases credit risk through higher LGD.	The emergence of the so-called "stranded" assets in industries with high CO_2 emissions, which in turn increases the probability of default default (through lower debt sustainability) and LGD (through lower collateral value).
Market	Impairment of assets and growth in volatility of e.g., commodities and/or FOREX.	The emergence of "stranded" assets in industries with high CO_2 emissions, which cause a sudden need to reassess e.g., equity and/or the bond market.
Operating	Destruction of real estate (e.g., bank branches), data center and operations.	Increase operational risk, e.g., by outsourcing selected activities or processes.
Other	Macroeconomic shocks increasing liquidity risk.	Negative impact on the reputation of an institution, e.g., in connection with the so-called "green washing".

Sources: Kosztowniak (2023b).

In the EU countries, including Poland, a comprehensive assessment of the transition risk for the banking sector, in addition to the ESG risk indicated in the management process and sectors important for the CPRS climate policy, would require taking into account a number of other factors such as: energy intensity of the economy, the risk of impairment of assets of the insurance sector and investment funds, or the impact of the rising price of fossil fuels and electricity on the macroeconomic situation.

The importance of estimating the transition risk stems from several facts, e.g., (i) it raises the valuation of green firms over brown firms and (ii) is accompanied by important public information e.g., changes of property taxes, etc.

The transition to a more sustainable and low-carbon economy can lead to challenges for financial stability. Administrative decisions, such as increasing the cost of carbon dioxide emission allowances or promoting cheap, low-emission technologies, will cause the operating costs of some industries to increase strongly and their profitability to fall. Financial institutions with significant exposures to carbon-intensive sectors such as energy, mining and fossil fuel processing, transportation, and buildings, for example, may experience losses due to the impairment of loan collateral, company value or even solvency.

As part of ESG risk monitoring, a group of central banks associated in the NGFS and the ESRB have formulated their recommendations for banks and other financial institutions (insurance companies, investment funds, etc.). These proposals underline the need to integrate ESG risks into risk management and prudential supervision (Kosztowniak, 2023c). These recommendations are valid because work on their development and implementation and their implementation process is still ongoing (Table 3).

NGFS and ESRB regulatory recommendations and proposals in the dimension of climate risk

Table 3

Scope	NGFS recommendations	EU and ESRB regulatory proposals
Climate risk monitoring	Central banks and supervisors are encouraged to develop methodologies for assessing climate risks (including stress tests)	A proposal by the ESRB that the ESAs integrate climate risk into their regular stress tests.
Preparation of new legal acts (taxonomy)	Regulators should develop a climate risk taxonomy to: (a) facilitate climate risk management, (b) assess the differences between "green" and "dirty" assets, (c) mobilize capital flows to "green" investments."	The European Commission is developing a taxonomy, which will be included in several initiatives, to encourage investors to channel their capital towards sustainable development activities.
Promoting strengthened disclosure requirements	Financial and non-financial institutions should consider in their activities recommendations regarding the climate risk, including TCFD (*Task Force on Climate-related Disclosures*) recommendations.	New regulation on climate disclosures and the introduction of low-carbon benchmarks
Integration of climate risk into prudential supervision structures	Central banks should integrate the climate risk into supervision and: (a) promote climate risk awareness among financial institutions, (b) set supervisory expectations, (c) integrate climate risk into prudential supervision.	Integration of climate risk management procedures with risk management policy (including the calibration of possible capital requirements as part of CRR/CRD)

Source: ECB (2019).

7. Limitations and expected future research

Among the limitations of estimating banks' credit exposures taking into account the industry approach (CPRS) are:

- They abstract from systemic consequences, more macroeconomic effects of the transition risk, e.g., the effects of an increase in energy prices, depending on its degree and timing, which may have a negative impact on the competitiveness of the entire economy (higher production costs), inter alia. This aspect may be particularly important, for example, in Poland due to the structure of energy sources. Taking this aspect into account would broaden the range of banks' assets whose valuation may be sensitive to transition risks.
- They also do not consider the impact of transition risk on state debt (the cost of measures to reduce climate risk and the consequences of its materialisation) and the valuation of Treasury securities (EPZ), as well as the limited availability of statistical data in the financial and non-financial sectors considering the impact of climate change.

When assessing the risk generated by the exposures of industries, certain limitations should be noted, e.g., in the Polish banking sector. According to the available data from the published financial statements of the largest emitting companies (*greenhouse gas*, GHG), in Poland most of the loans currently taken out will be repaid in the next 2-3 years, which leaves some freedom for the banking sector in shaping its exposure to these sectors and switching to financing low-emission projects.

In the case of Polish data collected by the NBP under the NB300 banks' reporting program, although the data allow for the selection of a specific entity (according to REGON) or the declared dominant industry or business (according to PKD), high-emission entities may be assigned to industries not related to greenhouse gas emissions, and in high-emission industries there may be low-emission entities[2]. In addition, the number of positions on carbon-intensive sectors in the Polish banking sector varies, although in some banks, including some from the OSII group,[3] it may be higher than the average in the entire sector.

It is worth emphasizing that although the costs incurred for the transition to a low-carbon economy will reduce GDP and global consumption, they can also stimulate the development of new industries and technologies, making the final impact of the green transition on GDP and consumption uncertain.

The expected research should concern the analysis of transition risk shocks and the main transmission channels, perhaps using more detailed micro data, but perhaps also through the prism of theoretical models. Research would be valuable, firstly, in the scope of a wider set of credit portfolios of banks from many countries,

[2] The NB300 reporting package includes banks' reporting to the NBP, whose total commitment amounts to: ≥ PLN 500,000 for banks in the form of joint-stock companies, state-owned banks, branches of credit institutions, branches of foreign banks and non-affiliated cooperative banks that have obtained the consent of the PFSA to operate independently, and ≥ 100 thousand PLN for other banks, respectively. Statement complementary package NB300, (NB300, 2022).

[3] OSII banks are recognised by the PFSA as other systemically important institutions (*other systemically important institutions*). The list of OSII banks is published on the website: NBP (2023).

e.g., in the form of panel models of transition risks, on the other hand, revealing the differences between the banking sectors of individual countries.

Annex

Summary Statistics, using the observations Q4 2013 – Q2 2023

Table A.1.

Variable	Mean	Median	Minimum	Maximum
CPRR	362.88	367.25	287.14	414.94
Dirty	192.21	195.25	157.88	212.01
Black	8.4387	7.5896	4.5084	15.970
Brown	79.369	82.194	58.877	90.414
Green	170.68	174.07	129.26	204.37
Variable	Std. Dev.	C.V.	Skewness	Ex. kurtosis
CPRR	35.563	0.098002	-0.47263	-0.94217
Dirty	13.267	0.069023	-1.0464	0.36113
Black	3.0440	0.36071	0.97019	0.37596
Brown	8.9961	0.11335	-0.94281	-0.17412
Green	23.558	0.13802	-0.13584	-1.4202
Variable	5% Perc.	95% Perc.	IQ range	Missing obs.
CPRR	295.81	410.71	58.444	0
Dirty	161.51	209.93	13.032	0
Black	4.5780	15.714	3.9223	0
Brown	59.899	89.913	11.622	0
Green	134.31	203.22	47.912	0

Source(s): Own calculations used StataSE 16.

References

- Battiston S., A. Mandel, I. Monasterolo, F. Schütze, G. Visentin (2017), "A Climate stress-test of the financial system", *Nature Climate Change,* No. *7*(4), pp. 283–288.
- Battiston S., Jakubik P., Monasterelo I., Riahi K., Ruijven B. (2019), "Climate Risk Assessment of Sovereign Bonds' Portfolio of European Insurers", In: *EIOPA* Financial Stability Report, December, available at: https://pure.iiasa.ac.at/id/eprint/16238/.
- Battiston, S, Monasterolo, I., van Ruijven B. and Krey, V. (2022), "The NACE – CPRS – IAM mapping: A tool to support climate risk analysis of financial portfolio using NGFS scenarios", September 19, available at SSRN: https://ssrn.com/abstract=4223606 or http://dx.doi.org/10.2139/ssrn.4223606, pp. 1-24.
- EBA (2020), "Joint Committee Report On Risks And Vulnerabilities In The EU Financial System", No. 67, JC 2020 67 Autumn 2020 Report on Risks and Vulnerabilities.pdf (europa.eu),
- ECB (2019), "Financial Stability Review", June.

- ECB (2022), "Financial Stability Review":, November, https://www.ecb.europa.eu/pub/financialstability/fsr/html/ecb.fsr202211~6383d08c21.en.html#toc2.
- EIOPA (2018), "Financial Stability Report", December, pp. 1-88, https://www.eiopa.europa.eu/document-library/financial-stability-report/financial-stability-report-december-2018_en.
- Kaenzig, D. (2022), "The unequal economic consequences of carbon pricing", *Working Paper*, London Business School.
- Kosztowniak (2023a), "Changes in the lending activity of banks in Poland, including the portfolio of non-financial corporate loans", IFC Bulletin No 59, October 2023, pp. 406-4366.
- Kosztowniak A. (2023b), "Climate Policy Relevant Sectors in the Polish commercial bank", Central European Review of Economics & Finance, Vol. 42, No 1(2023), pp. 50-70, https://cer.uniwersytetradom.pl/wp-content/uploads/sites/26/2024/05/CEREF-1-2023.pdf.
- Kosztowniak A. (2023c), "The impact of ESG regulation on macroprudential policy and bank activities in the EU", Central European Review of Economics & Finance, Vol. 45, No. 4 (2023), ISSN 2082-8500, e-ISSN 2083-4314, pp. 50-70, https://cer.uniwersytetradom.pl/wp-content/uploads/sites/26/2024/05/CEREF-4-2023.pdf.
- Meinerding C., Schüler S.Y., Zhang P., "Shocks to transition risk, Discussion Paper, Deutsche Bundesbank, No. 04/2023, pp. 1-65.
- Metcalf, G. and J. Stock (2020), "Measuring the macroeconomic impact of carbon taxes", AEA Papers and Proceedings, No. 110, 101–106.
- Moench, E. and S. Soofi-Siavash (2022 1, "What Moves Treasury Yields", Discussion paper, CEPR, Great Britain, pp. 1-65, https://books.google.pl/books/about/What_Moves_Treasury_Yields.html?id=ZdRgzgEACAAJ&redir_esc=y.
- Monasterolo I., S. Battiston (2020), "Assessing forward-looking climate risks in financial portfolios: a science-based approach for investors and supervisors", NGFS Occasional Paper. Case Studies of Environmental Risk Analysis Methodologies, pp.52–72.
- Monasterolo, I. (2020), "Climate change and the financial system", Annual Review of Resource Economics, No. 12, pp. 299-320, https://www.annualreviews.org/doi/abs/ 10.1146/annurev-resource-110119-031134.
- NB300 (2023), "Base NB300", https://www.nbp.pl/home.aspx?f=/statystyka/sprawozdawczosc/form/formularze.html.
- NBP (2023), "Statistics, Reporting", https://www.nbp.pl/statystyka/sprawozdawczosc/form/instruction-NB300.pdf.
- NGFS (2019), "Network for Greening the Financial System, first comprehensive report, A call for action. Climate change as a source of financial risk", April, https://www.ngfs.net/sites/default/files/ medias/documents/synthese_ngfs-2019_-_17042019_0.pdf.
- NGFS (2020), "Guide to climate scenario analysis for central banks and supervisors", June, available at: https://www.ngfs.net/en/guide-climate-scenario-analysis-central-banks-and-supervisors.
- Regulation (EU) No 575/2013 of the European Parliament and of the Council of 26 June 2013 on prudential requirements for credit institutions and investment

firms and amending Regulation (EU) No 648/2012 Text with EEA relevance, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32013R0575.

Workshop “Addressing climate change data needs: the global debate and central banks’ contribution”
Hosted by the Central Bank of the Republic of Türkiye with the support of the Irving Fisher Committee on Central Bank Statistics (IFC), the Bank of France and Deutsche Bundesbank İzmir, Türkiye, 6-7 May 2024

Climate risk in the Polish banking sector – analysis of dirty and green industries

Aneta Kosztowniak, NBP, Department od Systemic Risk and Macroprudential Policy

- This presentation should not be reported as representing the views of the National Bank of Poland.
- The views expressed are those of the authors and do not necessarily reflect those of the NBP.

Overview

- Introduction
- Climate Policy Relevant Sectors – an empirical approach
- Result for Poland
- Conclusion

1. Introduction

- The aim of the study is to estimate credit exposures and their changes in banks' portfolios in terms of sectors important for climate policy, which exposes them to the risk of transformation in Poland in 2013-2023.
- The research concerned the analysis of changes in the structure of the loan portfolio in terms of sectors relevant to climate change (CPRS) broken down by: groups (green, black, brown, and dirty), industries (fossil fuels, utility-electricity, production, manufacturing, transportation, and agriculture), and types of activity divided into sections.
- The CPRS methodology was applied (Battiston *et al.*, 2017-2022), which is used in EiOPA, ECB and EBA reports for EU countries.

1. Climate Policy Relevant Sectors (CPRS)

- **The methodology for determining CPRS**, i.e. industries sensitive to climate change, was developed m.in by S. Battiston and I. Monasterelo (2017-2022) and used in studies by EiOPA (2018), ECB (2019) and EBA (2020).

- CPRS provide a standardised and practical classification of activities (at NACE Rev2 level, 4-digit) on which revenues can have a positive or negative impact in a disorderly low-carbon transition, based on their energy technology (e.g. based on fossil fuels or renewable energy).

- For this reason, the CPRS classification is considered a benchmark for assessing the financial risks associated with climate change and has been used by several international financial institutions to assess investors' exposure to climate transition risks (e.g. ECB, EIOPA).

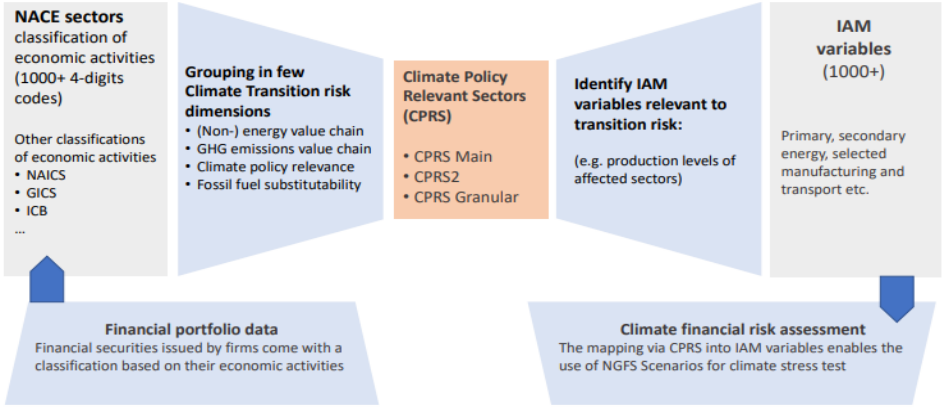
Table 1. List of sectors relevant for climate policy according to the NACE code classification

CPRS sector	NACE codes
1-fossil-fuel	05, 06, 08.92, 09.10, 19, 35.2, 46.71, 47.3, 49.5
2-utility|electricity	35.11, 35.12, 35.13
3- energy-intensive (industry)	07.1, 07.29, 08.9, 08.93, 08.99, 10.2, 10.41, 10.62, 10.81, 10.86, 11.01, 11.02, 11.04, 11.06, 13, 14, 15, 16.29, 17.11, 17.12, 17.24, 20.12, 20.13, 20.14, 20.15, 20.16, 20.17, 20.2, 20.42, 20.53, 20.59, 20.6, 21, 22.1, 23.1, 23.2, 23.3, 23.4, 23.5, 23.7, 23.91, 24.1, 24.2, 24.31, 24.4, 24.51, 24.53, 25.4, 25.7, 25.94, 25.99, 26, 27, 28, 32
4-buildings	23.6, 41.1, 41.2, 43.3, 43.9, 55, 68, 71.1
5-transportation	29, 30, 33.15, 33.16, 33.17, 42.1, 45, 49.1, 49.2, 49.3, 49.4, 50, 51, 52, 53, 77.1, 77.35
6-agriculture	01, 02, 03

Source: Battiston, S., Mandel, A., Monasterolo, I., Schütze, F., & Visentin, G. (2017). A Climate stress-test of the financial system. *Nature Climate Change*, *7*(4), 283–288; https://www.finexus.uzh.ch/en/projects/CPRS.html

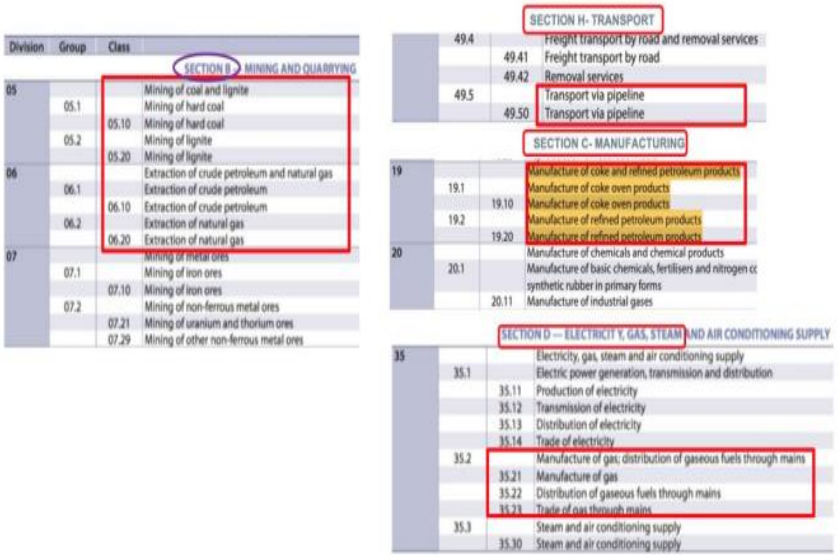
2. Climate Policy Relevant Sectors (CPRS)

Fig. 1. Mapping economic activities into IAM variables via Climate Policy Relevant Sectors



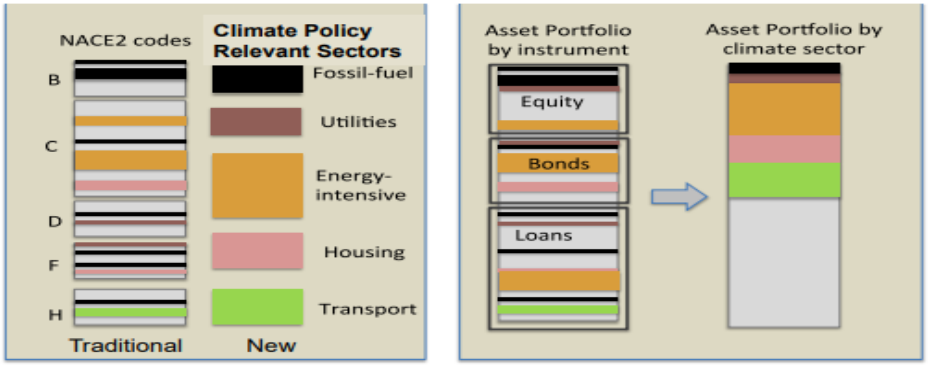
Source: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4223606.

Fig. 2. Activities related to the NACE 2.



Source: Eurostat, 2012

Fig. 3. Classification of the financial contracts and securities of an investor's portfolio into CPRS Main.



Source: Battiston et al. (2017)

In Poland, in the years 2013-2023, the value of **CPRS exposures** increased by 45%, including:

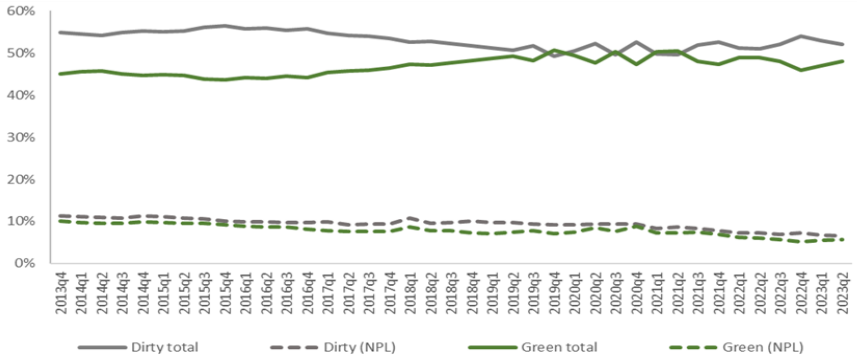
- dirty exposures by 34%,
- black exposures by 69%,
- brown exposures by 30%
- and green exposures by 57%.

On the other hand, the average share of dirty exposures in CPRS exposures was 53% vs. 47% share of green exposures.

Comparing dirty exposures to the exposures of **the entire banking sector**, their share fell from 55% in 2013 to 52% in 2023, and green exposures from 11% to 9%, respectively.

The share of dirty loans (NPLs) in the banking sector exposure fell from 11% to 9%, while the share of green loans (NPLs) fell from 10% to 8% (Fig. 4).

Fig. 4 Share of dirty and green industries in the banking sector exposure (%)



Source: Own study on NBP data.

3. Climate Policy Relevant Sectors (CPRS) – results for the banking sector in Poland

Fig. 5 Shares of CPRS groups in the exposure of the banking sector (%)

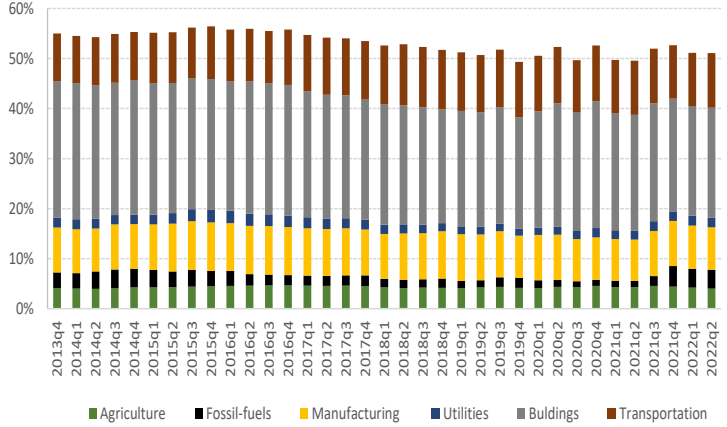


Fig. 6. Shares of individual CPRS groups in commercial and cooperative banks as of Q2 2022 (%)

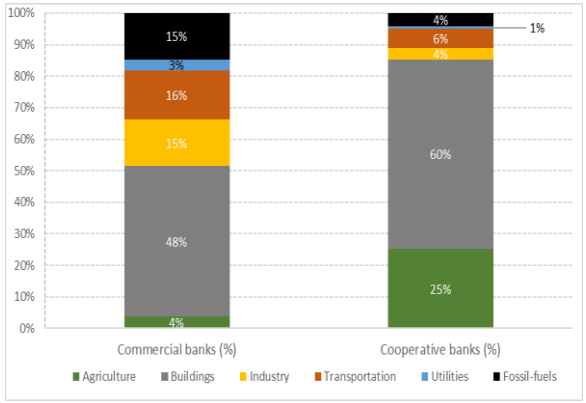
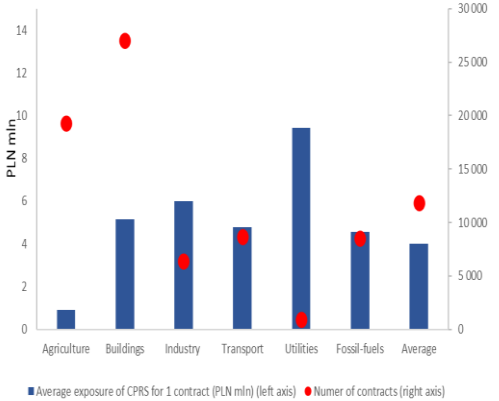


Fig. 7 Average exposure by CPRS groups and number of contracts for Q2 2022 (PLN million, number)



Source: Own study on NBP data.

- **Over 50%** of exposures of the **entire banking sector** are classified as **CPRS groups**.
- The largest share in this exhibition belongs to **the buildings industry (over 20%).**
- Nevertheless, in the analyzed period the share of this industry showed a decrease by 5 pp. (from 27% to 22%), compared to an increase of 1 pp. in the field of transportation (from 10% to 11%) or fossil fuels (from 3% to 4%).

- In commercial banks, CPRS shares are more dispersed (diversified) than in cooperative banks.
- However, in commercial banks the share of dirty industries such as fossil-fuels or transportation and industries is higher than in cooperative banks.
- These shares are determined by the financing of enterprises, which is more balanced in commercial banks than in cooperative banks (with a predominance of buildings and agriculture).

- The concentration of bank receivables per CPRS group varies:
- Most contracts concern the buildings group, but their value corresponds to the average per contract.
- A smaller number of contracts, but for high amounts, concern the utilities group.

Conclusion

1. In Poland, in the years 2013-2023, the value of **CPRS exposures** increased by 45%.
2. Over 50% of exposures of the entire banking sector are classified as CPRS groups and nearly half of these exhibitions belong to the group of so-called dirty exposures, including mostly industry, buildings and transportation. Due to the intersectional connection, the these pillars of industries with the highest transformation risk among CPRS.
3. These CPRS groups divided on buildings (43%), transport (21%) and industry (17%) account for the largest share of this exposure, followed by agriculture (8%), fossil fuels (7%) and electricity (4%).
4. Dirty exposures to the exposures of **the entire banking sector**, their share fell from 55% in 2013 to 52% in 2023, and green exposures from 11% to 9%, respectively.
5. Commercial banks have a more diversified loan portfolio in terms of CRPS than cooperative banks.
6. Reassuming, buildings played a key role in shaping the exposure, due to its dominant share in CPRS groups (43%) and in the entire banking sector in Poland (over 20%).

Thank for your attention

Aneta Kosztowniak

Advicer

Department of Systemic Risk and Macroprudential Policy

Narodowy Bank Polski

e-mail:

Aneta.Kosztowniak@nbp.pl

aneta.kosztowniak@wp.pl