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Climate change as a source of risk in the financial sector

"The financial sector must be at the heart of tackling climate change"

Mark Carney (*Bank of England*)
François Villeroy de Galhau (*Bank of France*)
Frank Elderson (*Dutch Central Bank*)

Abstract

The article addresses new risks in the financial sector connected with climate change. With greenhouse gas emissions, temperatures will continue to rise and thus increase the financial risk arising from the physical consequences of climate change. The prevention of such consequences will increase the financial risk of the transition to a low-carbon economy, and will lead to changes in business models, to the phenomenon of stranded assets, etc. At the same time, the growing awareness of the need to prevent further climate change and to adapt to the changes already happening intensifies the pressure of various entities and environments on the financial sector to become involved in such activities, and to run its business responsibly and in accordance with the sustainable development concept. All this opens the financial sector to new risks (in addition to the physical risk and the transition risk), in the management of which it has no experience. Both the hedging and especially the materialisation of such risks will affect the stability of the financial sector. Moreover, such new conditions in the functioning of the financial sector, caused by climate change, generate new obligations and challenges for regulators and financial supervisors.

Key words: financial sector, climate risks, physical risk, transition risk, ESG, climate initiatives in the financial sector

JEL: F64, G18, G28, G32, Q54

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Introduction

The effectiveness of fighting the threats related to climate change is affected and determined by the paradox referred to as the "tragedy of the horizon,"[1] which means that the substantial costs connected with climate change will be by nature borne by future generations. As a result, the current generation does not have a sufficiently powerful incentive to prevent them. The catastrophic consequences of climate change will be felt beyond the horizon of activity of most business and political entities or financial sector regulators and financial supervisors, who are additionally often bound by charters or mandates which, being defined or established in the past, completely fail to address the issues of climate change.[2] This also applies to financial sector institutions: banks, investment fund companies, insurance companies, other financial intermediaries and various financial service providers. Once climate change becomes a clear and present threat to financial stability, it may already be too late to stabilise the atmosphere, especially since the threats and risks to financial stability are a function of accumulated rather than day-to-day greenhouse gas emissions to the atmosphere.

Another paradox, this time specific mostly to the financial sector, is that "success can be a failure", which means that too quick actions towards a low-carbon economy may seriously affect financial stability. If the business entities that are customers of financial sector entities (e.g. as borrowers) suddenly and all at once start accounting for their climate risks and revalue their assets and their development prospects, this could destabilise markets, reveal the imbalance of the business model, reveal losses and necessary write-offs, and result in permanently stricter financial terms. This, in turn, may lead to a climate Minsky moment.[3] Such a moment may seem far off for now, but the absence of gradual progress in greenhouse gas emission reduction and of actions spread over time increases the risk of a climate Minsky moment in the future.

1 For more, see the speech given by Mark Carney, Governor of the Bank of England and Chair of the Financial Stability Board at Lloyd's of London, in London on 29 September 2015: "Breaking the tragedy of the horizon – climate change and financial stability." The speech is perceived as a breakthrough moment in the recognition of the role of the financial sector in fighting off climate change and the threats it poses to the stability of that sector.

2 However, it must be noted that the climate risk is currently a recognised source of financial risk, which is why it falls within the mandates of central banks and regulatory bodies, whose role is to make the financial system immune to those risks. Such interpretation of the mandate has been confirmed in the NGFS report published in October 2018.

3 A classic Minsky moment (named after Hyman Philip Minsky, the author of a financial instability hypothesis which attempted to explain the nature of financial crises in a developed economy) is a point in time when, due to destabilisation and speculation, the financial pyramid falls or the speculative bubble breaks. At that stage, the destabilisation of financial markets reaches a point where only global actions of governments addressing the root cause of the instability may prevent the banking system from collapsing. Minsky moment became a popular hypothesis in the period following the outbreak of the global financial crisis in 2008.

The objective of the article is to identify and define the risks related to climate change in the financial sector[4] and to define the challenges which the financial sector faces in connection with the need to manage those risks. Major changes observed in the financial market as a result of the emerging new (climate-related) risks include the growing pressure on the financial sector to become involved in climate change prevention and the trend of increasingly climate-conscious and responsible investing, with institutions adapting to those changes worldwide.

Analysis of the main channels through which climate change impacts the financial sector will make it possible to define those new risks in the financial sector. Climate risks for the financial sector arise primarily from the impact of climate change on the customers of that sector – on the real economy. There are a number of channels through which climate change affects the real economy; their synthetic presentation is available in Chart 2 further in the article.

The main challenges connected with climate risk management in the financial sector and with the necessary, inevitable involvement of regulators and financial supervisors in preparing the financial sector to overcome climate risks will be presented in the final part of the article, in the conclusions.

Changes in the financial sector and in financial markets arising from climate change.

There are several factors relevant for or inherent in the financial sector that should be presented as contributing to the current transformations dictated by climate change and as causing the accumulation of pressure to implement further, deeper transformations of the financial sector:

- unsatisfactory progress in the reduction of greenhouse gas emissions,
- increasingly cheaper and better "green" technologies,
- a large investment gap in terms of economic transition towards low emissions,
- a growing number of climate-related national and international initiatives,
- climate awareness growing and spreading in society,
- dynamic development of financial associations, standards, and codes related to ESG factors,
- the evolving preferences of investors (and consumers of financial services).

Unsatisfactory progress in the reduction of emissions

Despite the growing awareness, the progress in greenhouse gas emission reduction is unsatisfactory. Actually, it is non-existent. Carbon dioxide emission in 2018 increased by 2% to reach a record level of 37 billion tonnes of CO_2. Global emissions still cannot be said to have reached their maximum level, despite their growth rate being lower

[4] Climate change currently has a top priority among ESG problems. While sustainable finance covers a wide range of issues, the awareness of the climate-related financial risk has increased over the past years enough to encourage a more serious approach to ESG (Environment, Social, Governance) factors. ESG issues other than climate change only reinforce the need to draw more attention to the problem in question. The article focuses on the impact of climate change on the financial sector.

than that of the global economy. Current trends in the economy and in the energy sector suggest that emissions will remain at least as high in 2019. Even if the global economy decarbonised at the same rate as it has over the past 10 years, global emissions would still be growing. Nationally Determined Contributions (NDCs)[5] are anticipated to reduce global emissions in 2030 by as much as 6 GtCO2e[6] when compared to current practices. There are voices that this ambition should be even tripled if the 2°C limit is to be met, and it must be increased by about 5 times to ensure compliance with the 1.5°C limit.[7] Unconditional implementation of NDCs, with the assumption that climate-friendly activities are continued consistently throughout the whole 21st century, would lead to global growth of the average temperature from 2.9°C to 3.4°C by 2100 versus the levels from the pre-industrial era. If the NDC ambitions are not increased and supported with actions in the nearest future, the exceedance of the 1.5°C target will be inevitable. If the emission gap is not bridged by 2030, the temperature increase target well below 2°C is also very unlikely to be attainable.[8]

Growing accessibility of green technologies

Green technologies are becoming more and more viable and available. They try to compete in the market with traditional energy production technologies, which additionally drives growth and innovation. Further development of energy storage installations and systems may help overcome one of the greatest obstacles to the common use of renewable energy sources. New advancements will make green technologies more popular, and their accessibility will no longer be perceived as an economic and technological barrier to green economy transition.

Investment gap

The current investment level is insufficient to support an economic system sustainable from an environmental or social perspective. Only in the case of Europe, an annual investment gap of almost EUR 180 billion must be bridged to allow the achievement of the EU climate and energy targets.[9] According to the estimates of the European Investment

5 Before the Paris climate summit, the countries presented their voluntary emission reduction plans referred to as INDCs (Intended Nationally Determined Contributions).

6 GtCO2e means gigatonnes of equivalent carbon dioxide, a universal unit used to measure the emissions of greenhouse gases, which reflects their different global warming factors.

7 This is about keeping the average global temperature growth below 2°C or 1.5°C when compared to the pre-industrial era.

8 For more information, see the report "United In Science. High-level synthesis report of latest climate science information convened by the Science Advisory Group of the UN Climate Action Summit 2019" prepared by the World Meteorological Organisation.

9 Those estimations refer to the average annual investment gap for the 2021–2030 period and they are based on the PRIMES model forecasts used by the European Commission to evaluate the results of the proposal regarding the energy efficiency directive (2016).

Bank (EIB), the total annual investment gap in the transport, energy and resource management infrastructure sectors is EUR 270 billion.[10] The Intergovernmental Panel on Climate Change (IPCC) estimates that the required additional investments for the 1.5°C scenario are around USD 830 billion per annum for the 2016–2050 period. Lack of clarity among experts on what represents sustainable investment is a significant factor behind the investment gap and an obstacle in the financing of the social infrastructure required to eliminate inequalities and ensure social inclusion.

Climate-related initiatives

There are a number of national and transnational initiatives for climate change. Particularly noteworthy in the context of this article are the Paris Agreement, the European action plan on financing sustainable growth, the Network for Greening the Financial System (NGFS), and the International Platform on Sustainable Finance (IPSF):

- During the climate conference in Paris in 2015, 195 countries adopted the world's first legally binding global agreement on climate. The agreement defined a worldwide action plan to protect us from the risk of a far-reaching climate change by limiting global warming to values well below 2°C. Before and during the climate conference in Paris, the participating countries presented extensive national action plans to reduce emissions.
- In 2018, the European Commission announced its "Action Plan: Financing Sustainable Growth,"[11] recognising the need for immediate actions to adapt public political strategies to the new reality of the disastrous and unpredictable consequences of climate change and depletion of resources. The key role is played in this context by the financial system, which may form a part of a solution for a greener and more sustainable economy. However, orienting private capital towards investments more conducive to sustainable development requires changing the functioning of the financial system. The EU Action Plan proposes 10 specific actions in this respect, partially entailing legislative proposals:
  - Action 1: Establishing an EU classification system for sustainable activities
  - Action 2: Creating standards and labels for green financial products
  - Action 3: Fostering investment in sustainable projects
  - Action 4: Incorporating sustainability when providing financial advice
  - Action 5: Developing sustainability benchmarks
  - Action 6: Better integrating sustainability in ratings and market research
  - Action 7: Clarifying duties of institutional investors and asset managers
  - Action 8: Incorporating sustainability in prudential requirements
  - Action 9: Strengthening sustainability disclosure and accounting rule-making
  - Action 10: Fostering sustainable corporate governance and attenuating short-termism in capital markets

[10] Estimates by 2020 include investments in the modernisation of transport and logistics and of power grids. See EIB "Restoring EU competitiveness," 2016.

[11] See European Commission, (2018): "Action Plan: Financing Sustainable Growth".

- central banks, along with regulators and financial supervisors operating within the Network for Greening the Financial System (NGFS), also issued their recommendations of the necessary changes in the financial sector. In April 2019, the group published its first report calling for actions in response to the recognition of climate change as a source of financial risks.[12] The first four recommendations are addressed to central banks and supervisory bodies, while the remaining two – to the competent political institutions and authorities whose compliance with those recommendations would facilitate the work of central banks and of financial supervision and regulatory institutions.
  Recommendation 1: Integrating climate-related risks into financial stability monitoring and micro-supervision
  Recommendation 2: Integrating sustainability factors into own-portfolio management
  Recommendation 3: Bridging the data gaps
  Recommendation 4: Building awareness and intellectual capacity and encouraging technical assistance and knowledge sharing[13]
  Recommendation 5: Achieving robust and internationally consistent climate and environment-related disclosure[14]
  Recommendation 6: Supporting the development of a taxonomy of economic activities
- on 18 October 2019, during the annual meetings of the International Monetary Fund (IMF) and World Bank in Washington DC, the European Union – together with competent authorities of Argentina, Canada, Chile, China, India, Kenya and Morocco – started the International Platform on Sustainable Finance (IPSF). The purpose of the IPSF is to increase the mobilisation of private capital for the financing of environmentally-friendly investments. The IPSF is a forum aimed at reinforcing international cooperation and, where appropriate, coordinating approaches and initiatives in international markets (such as taxonomies, information disclosure, standards, and etiquettes) which are fundamental to private investors in defining and capitalising on environmentally sustainable investment opportunities.

The discussion about climate-related initiatives relevant to the financial sector should be concluded with a mention of the first policy document by Ursula von der Leyen "Political guidelines for the next Commission (2019–2024)," where the new head of the European Commission presents priorities for the next 5 years, with the European Green Deal as the top priority. It is to include the strategy for green financing, the Sustainable

[12] See Network for Greening the Financial System "A call for action. Climate change as a source of financial risk", First comprehensive report, April 2019, Paris.

[13] This is of course about knowledge and technical assistance in terms of climate change impact on financial risks and opportunities.

[14] The recommendation expresses support for the recommendation of the Financial Stability Board (FSB) appointed at the end of 2015 under the name Task Force on Climate-related Financial Disclosures to develop the rules of reporting voluntary, consistent information about the climate-related financial risk to be used by businesses for the purpose of supplying information to investors, lenders, insurers and other concerned parties.

Europe Investment Plan and transformation of the European Investment Bank to Europe's climate bank. Ursula von der Leyen also undertook to prepare the European Green Deal during her first 100 days as the President of the European Commission.

Growing climate awareness

Present for years but recently intensifying, the discussion about climate change draws more and more attention to the consequence of such a change and to the need to prevent it and mitigate its outcomes. The range of people, institutions and other entities joining the discussion is also growing. It is no longer limited to ecologists and various types of scientists who deal with the environment, with greenhouse gas emissions, and with conventional and renewable energy sources. It is no longer just the voluntary sector, with which environmental and ecological activities are very often associated.[15] The topic of climate change and environmental protection has become important to practically everyone: to the society, in particular to young people (school strikes for climate change), politicians, opinion leaders, representatives of culture and the media, the church (the 2015 encyclical letter *Laudato Si* or the concept of "ecological sin"). The appointment of a climate minister in November 2019 in Poland (and before that – in many other countries) is yet another sign of our times. At the end of 2017, central banks and financial supervisors joined the discussion,[16] and in 2019, the Coalition of Finance Ministers for Climate Action was created. Those are just some examples of growing awareness.

Development of ESG codes and standards

Efforts to promote ESG issues in finance started about 30 years ago[17], but it was in the past 5–6 years that they considerably accelerated. The selected initiatives presented below show the extent of the changes in the way of thinking about climate in finance and present the expected, either voluntary or forced, changes in the functioning of the financial sector.

[15] According to the results of the study "Condition of the NGO sector in Poland 2015." Polish people believe that ecology and environmental protection represent one of the most important areas of activity of NGOs. While in fact ecological organisations, i.e. ones for whom ecology and environmental protection is a primary area of activity, constitute just 2% of the NGO sector! This is because ecological organisations usually receive considerable publicity.

[16] During the One Planet Summit in Paris in December 2017, eight central banks and supervisory bodies established the Network for Greening the Financial System (NGFS). The network has been growing dramatically ever since, with 48 members and 10 observers from five continents on 15 October 2019.

[17] MSCI KLD 400 Social Index is a capitalisation weighted index of 400 US companies with positive Environmental, Social and Governance (ESG) ratings which excludes companies whose products have negative social or environmental impacts.

Table 1. Selected standards, codes, regulations promoting ESG

Supported by the United Nations	
Principles for Responsible Investment	• Functioning since 2006 • Developed by investors for investors • A voluntary and aspirational set of 6 investment principles which offer a range of 35 possible actions to incorporate ESG issues in investment practice • Signed by over 2,600 investors (as at 30 September 2019)
Principles for Sustainable Insurance	• Functioning since 2012 • A voluntary and aspirational set of principles: the 4 main principles are: embedding ESG in the business, raising social awareness, working together with governments and regulators to support ESG issues, and demonstrating transparency regarding the impact on climate and the impact of climate on business • Membership has its benefits
Principles for Responsible Banking	• Functioning since 2019 • Developed by 30 global banks • A voluntary and aspirational set of 6 main principles • Implementation divided into 3 steps (impact analysis, target setting, and accountability), for 4 years (maximally) • A signatory may count on the support of the UNEP FI Secretariat, the Banking Committee and other banks in terms of experts, training, tools, and regular information
Supported by the EU	
Action Plan: Financing Sustainable Growth,	• 10 areas of activity • 3 legislative proposals (frameworks to facilitate sustainable investments, disclosure of information about sustainable investments and risks to sustainable development, low-carbon reference indices and sustainability benchmarks) • Environmental (green) taxonomy of economic activities • European Green Bond Standard
EBA, ESMA, EIOPA	• technical advice and guidelines as regards sustainable development in the market of credit ratings, as regards money lending, and as regards the monitoring and integration of sustainable development risks and factors in the delegated acts Solvency II and Insurance Distribution Directive

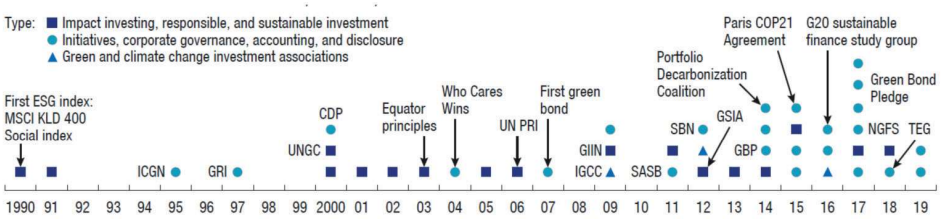
Table 1 – cintinued

European Green Deal	• New, more ambitious climate objectives • European Climate Pact • Green Financing Strategy • Sustainable Europe Investment Plan (EUR 1 trillion) • EIB as a "climate bank"
Other	
Green Bond Principles Social Bond Principles Sustainability Bond Guidelines	• Principles of issuing green, sustainability and social bonds developed by the International Capital Market Association • Those principles became the world's leading frameworks for the issue of green, social and sustainability bonds • Green, social and sustainability bonds are types of bonds where the money coming from their issue is used exclusively for eligible environmental and/or social projects
TCFD[a] recommendations	• Recommendations regarding the incorporation of climate risks in the strategies of companies and their disclosure to investors and other concerned parties • The TCFD was created by the Financial Stability Board (FSB) in response to a proposal of G20 ministers of finance and presidents of global banks • The recommendations are based on four major areas which represent the basic elements of an organisation's operation: corporate governance, strategy, risk management, and emission metrics & targets • A total of 785 organisations currently support the TCFD, including the world's largest banks, asset management entities and pension funds in charge of assets worth 118 trillion dollars.[b]
Network for Greening the Financial System (NGFS)	• 6 recommendations for central banks, financial sector supervisors/regulators and their environment • 3 working groups continuing the work on climate issues in macro-supervision and in micro-supervision and on financial sector greening instruments
Coalition of Finance Ministers for Climate Action	• It gathers ministers of finance from 50 countries • It developed and signed the "Helsinki Principles" – a set of six aspirational principles that promote national actions for climate, especially through fiscal policy and using public funds

[a] Task Force on Climate-Related Financial Disclosures.
[b] According to the "TCFD: 2019 Status Report" published in June 2019.

Source: Own compilation.

Chart 1. Evolution of ESG codes and standards[18]



Source: *Global Financial Stability Report*, International Monetary Fund, October 2019.

The changing preferences

Even though there is no evidence of better results of investment strategies oriented towards investing in sustainable development, the interest of investors in ESG factors has been increasing dynamically in recent years. And this is despite the lack of transparency as to how the ESG factors are incorporated and lack of consistent frameworks and standards for ESG disclosures, which remain voluntary, partial and rare due to associated costs. Sustainable stock investment began for real after the introduction of the UN Principles for Responsible Investment in 2006 and the issue of first green bonds in 2007. Investors started to assess their investment policies from the perspective of the growing awareness of the threats connected with climate change, especially after the Paris COP21 and the adoption of the UN Sustainable Development Goals in 2015, when the majority of countries undertook to limit CO_2 emissions. The information provided below, to show the scale and dynamics of sustainable investments, comes from the fourth edition of the two-year "Global Sustainable Investment Review 2018" report,[19] which compiles sustainable investment market research results from Europe, the United States, Japan, Canada, Australia and New Zealand. The report provides a brief overview of sustainable investment in those markets at the beginning of 2018. Globally, sustainable investment assets in the main five markets totalled USD 30.7 trillion, which is 34% more than two years before.

[18] Explanation of the acronyms used in the timing chart: CDP = Carbon Disclosure Project; COP21 = 21st Conference of the Parties; ESG = environmental, social, and governance; GIIN = Global Impact Investing Network; GBP = Green Bond Principles; GRI = Global Reporting Initiative; GSIA = Global Sustainable Investment Alliance; ICGN = International Corporate Governance Network; IGCC = Investor Group on Climate Change; NGFS = Network for Greening the Financial System; SASB = Sustainability Accounting Standards Board; SBN = Sustainable Banking Network; TEG = EU Technical Experts Group on Sustainable Finance; UNGC = UN Global Compact; UN PRI = UN Principles for Responsible Investment.

[19] The Global Sustainable Investment Review 2018, prepared by the Global Sustainable Investment Alliance, uses a fairly general definition of sustainable investment. According to that definition, sustainable investment is an investment approach that includes environmental, social and governance (ESG) factors in the choice and management of its portfolio. For more see Global Sustainable Investment Review 2018, p. 7.

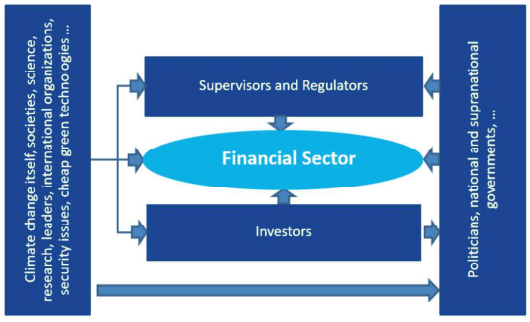
Table 2. ESG global investment assets

Region	2016 ($)	2018 ($)
Europe	12,040	14,075
United States	8,723	11,995
Japan	474	2,180
Canada	1,086	1,699
Australia/New Zealand	516	734
TOTAL	22,838	30,683

Source: *Global Sustainable Investment Alliance*, Global Sustainable Investment Review 2018. Data in billions USD.

To sum up this section, the growing awareness of and intensifying discussion about climate-related challenges, the new information about the changing climate, the potential costs of failure to implement actions and measures sufficient for the achievement of climate-related goals, and the evolving preferences of investors and consumers – all this puts an increasing pressure on politicians, governments and international institutions to take additional actions and to involve the financial sector more, and at the same time highlights the risks (and opportunities) for that sector linked to climate change. Such pressure will impact the financial sector both directly and indirectly. In the latter case, it will take the form of guidelines, standards and regulations ultimately designed to promote responsible finance. Such regulations and guidelines are currently mostly voluntary, but considering the pressure, they may be expected to evolve into strict mandatory laws. The anticipated effect is the transition to zero-emission economy resistant to climate change through climate -friendly mobilisation of private capital.

Diagram 1. Sources of pressure on the financial sector to become more involved in climate-friendly activities



Source: Own compilation.

Defining the key climate risks

Literature mentions two, sometimes three main channels through which climate change contributes to the financial risks of the financial sector.[20] Those are: physical risk, transition risk and sometimes also liability risk.

Physical risk includes the economic costs and financial losses arising from the growing harshness and frequency of extreme weather events connected with climate change (e.g. heat waves, landslides, floods, fires and storms), as well as long-term progressive climate changes (e.g. changes in precipitation, extreme changeability of weather, ocean acidification, and sea level and average temperature rise). As a result, we can identify a short-term physical risk and a chronic physical risk.

The transition risk, also referred to as a low-carbon economy transition risk, applies to the process of transitioning towards a low-carbon economy. Emissions must ultimately reach a "net zero" level to prevent climate catastrophe. The emission reduction process will most likely considerably affect all sectors of the economy with an impact on the value of assets and will upset business models. Even though urgent actions are desired, a sudden transformation may also shake financial stability (the paradox where "success can be a failure," already mentioned above). The transition risk is connected with the pressure from governments, investors and the business community to build a low-emission economy.

The liability risk may arise from the growing number of judicial cases related to climate change, as their resolution will require governments, businesses and investors to pay damages. For example, disaster casualties facing the consequences of global warming, such as droughts, heat waves, storms and hurricanes, may claim "climate justice" in courts. Sometimes the risk is not identified separately and is considered a part of the physical risk and the transition risk.

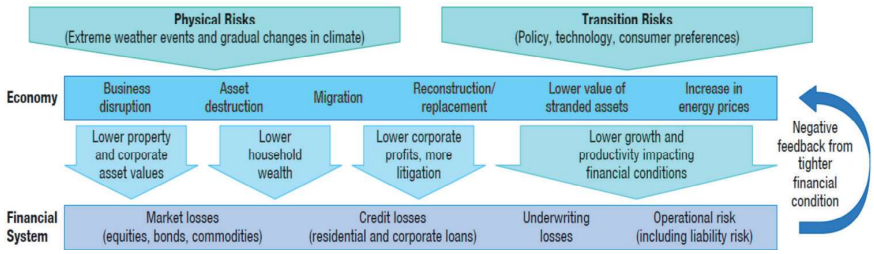
Climate change impacts the financial sector by impacting the customers of that sector, i.e. primarily the real economy. The impact takes place through multiple channels that affect the financial results and balance sheets of businesses. Climate change has an impact on:

- market terms and the demand and supply of certain goods and products, thus affecting their prices and the competitiveness and viability of investments (e.g. energy prices),
- asset performance – it may drop due to the changing climate conditions, with consequences for the revenue of businesses (e.g. stranded assets),

[20] See Campiglio, Emanuele, Dafermos Yannis, Monnin Paul, Ryan-Collins Josh., Schotten Guido, Tanaka Misa (2018), "Climate change challenges for central banks and financial regulators", Nature Climate Change, vol. 8 (6), June; Aglietta, Michel, Espagne Etienne. (2016). "Climate and Finance Systemic Risks: more than an analogy? The climate fragility hypothesis" CEPII Working Paper No 2016-10; Bank of England, Prudential Regulation Authority, (2018): "Enhancing banks' and insurers' approaches to managing the financial risks from climate change", Consultation Paper 23/18, October czy The Network for Greening the Financial System, (2019): "First comprehensive report. A call for action: Climate change as a source of financial risk", April.

- operating expenditures (OPEX), which may increase due to changes in prices, availability and/or quality of assets,
- the need to incur additional capital expenditures (CAPEX) as a result of damage to or reduction in the efficiency of resources, or the necessary modernisation required under climate protection legislation,
- asset maintenance costs,
- business or asset insurance costs,
- asset depreciation rates (effective asset depreciation rates caused by climate change may be much higher),
- business models, which will have to – for certain products or services – take into account new, stricter climate regulations or changes in the preferences of their consumers,
- employee health, safety and performance,
- unforeseeable losses (e.g. arising from more frequent violent weather events),
- risk of the countries whose GDP depends largely on climate factors,
- risk of conflicts and migration in certain countries significantly affected by the changing climate factors.

Diagram 2. The impact of physical risk and transition risk on the financial system



Source: *Network for Greening the Financial System "A call for action. Climate change as a source of financial risk"*, First comprehensive report, April 2019, Paris and International Monetary Fund "Global Financial Stability Report," October 2019.

According to estimations, if no action is taken to reduce CO_2 emissions, the physical impact of climate change on the global economy in the second half of the century will be substantial. Some studies suggest that average global income may be reduced by the end of the century by up to a quarter.[21] It must be remembered that those results are not linear, and they may considerably increase once a certain average temperature growth rate is exceeded. In addition, since the probability of mass migration or political instability and conflicts is increased in certain cases, this means that the existing economic predictions may be significantly underestimated. Financial losses may also be increased due to feedbacks, which limit for instance the

[21] Burke, Marshall & Hsiang, Solomon, (2015), "Global non-linear effect of temperature on economic production" Nature, 527(7577).

financing of reconstruction of destroyed assets. It must be added that the impact of climate change will differ for various sectors of the economy and will depend on the geographic location.

The estimated cost of transition towards a low-carbon economy may be considered as reflecting the already discussed investment gap. Please note that certain estimations mention amounts such as USD 830 billion per annum by 2050. Nonetheless, the estimated costs are probability low when compared to the costs of inaction when it comes to climate. Furthermore, those estimated costs are not generally accepted, and some claim that the economic costs of transitioning to a low-carbon economy would be balanced out by positive "green" growth.[22] The potential risk to the financial system arising from economic transformation is the biggest in scenarios where capital redirection and policy changes, such as the introduction of a carbon tax, are sudden and disorderly introduced. Especially, economic transformation entails the issue of stranded assets, i.e. assets whose useful life will be drastically shortened in pursuit of climate goals. The value of those assets will drop, reducing both the capital and the income of the owners, as well as increasing the market and credit risk for lenders and investors. Fossil fuel resources are a classic example of such assets.

The transition risk entails a number of more specific risks: regulatory and supervisory risk, technological, business (market) and reputational risks, risk of change in customer preferences or the risk of lack of data and competencies.

The regulatory and supervisory risk may arise from the need to adapt to new regulations. Such adaptation may be sudden and costly. For example, the French Energy Transition for Green Growth Act introduces the obligation for investors to verify their portfolio for conformity with the Paris Agreement. The requirement to disclose the impact on climate change and the impact of climate change on a business or a bank may prove quite a challenge. Introducing one or even a number of the discussed green instruments of pressure on the financial sector, such as additional capital or liquidity requirements for institutions with a higher climate risk or climate stress tests, may also be an example of such a risk.

Low-carbon economy development is supported by innovative technologies, which will revolutionise the shape of current business models. They will result in "creative destruction," which will have both winners and losers. The time, the pace and outcome of such a change remain uncertain, and they form a part of the technology risk.

Market risk arises from the impact of climate change awareness on customer behaviour. By analysing their climate footprint, conscious consumers (both natural persons and global corporations) may change their purchasing preferences. Such awareness may affect the popularity of some products or even render their sale impossible.

[22] According to the Porter hypothesis, companies polluting the environment may benefit from environmental policies because well designed, precise environmental regulations stimulate innovation, which in turn makes them more productive and competitive or increases product value for end users.

Business risk may arise where a supplier or recipient is prevented from or is uninterested in doing business with another entity for climate-related reasons.

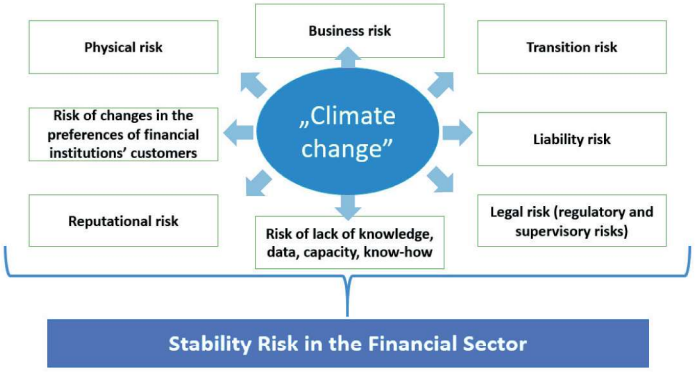
Reputational risk is connected with the consumers' changed approach to environmental protection. Negative environmental impact, lack of climate-friendly actions or pretend actions (greenwashing) may lead to the loss of customers, bad reputation, or problems with investors or funding.

The risk of change in the preferences of consumers or clients may be linked to the impact of the growing awareness or of the bad reputation earned for environmental or climate-related reasons. For financial institutions, this may mean customer outflow if they do business "irresponsibly," for instance, by lending money to entities generating large CO2 emissions.

The risk of lack of data and competencies is an internal risk of not having appropriate data for analysis and lacking the qualified staff to manage the climate risk of the organisation.

The risks presented and briefly discussed below may contribute to the financial stability risk. As a result, entities responsible for financial stability, i.e. central banks and financial supervisors, have decided that climate change is an important source of structural changes in the economy which are linked to a number of risks, also for financial institutions, and that the analysis and prevention of such risks falls within their mandate.

Diagram 3. Risks in the financial sector related to climate change



Source: Own compilation.

Conclusions: the challenges faced by the financial sector as a result of climate risks

The financial sector approaches climate change primarily from the perspective of corporate social responsibility (CSR). With the growing severity of financial consequences of the climate change and the growing external pressure, a CSR approach by itself is not enough. Climate risk assessments often focus on managing the impact of operations and finance on the environment in the context of the obligations of a financial institution as a "corporate citizen," and as such are designed to protect its reputation. As has been demonstrated above, climate change is a source of material financial risks for financial institutions and must be treated as such. Furthermore, it is expected to be treated seriously not only by the concerned institution but also by the institutions that supervise it, responsible for both macroprudence and microprudence supervision. The pressure on the financial sector to become involved in "saving the climate" will keep increasing, and so will the climate-related risks. The more delayed the effective solutions to prevent and mitigate climate change, the harder the subsequent economy adjustment and transition towards low CO_2 emissions.

Poland's problems, in addition to still low climate awareness,[23] include: lack of information and data regarding the impact on climate and the impact of climate change on financial institutions and their customers, lack of expertise (analytical tools, standards, practices), and lack of capacity and qualified staff able to manage those new risks.

At least four areas of activity of financial institutions require changes and adjustments:

- organisation of new risks management, integration with financial and non-financial risk management,
- systematic, regular monitoring of the new risks,
- development of analytical resources and tools (data about climate risks of customers, scenario analyses, methodologies, analytical tools, competencies, staff) for analysis of climate risks, and their impact on the business and on financial stability,
- determination of a reasonable scope of disclosure of climate risks and climate impact, which is the starting point for responsible finance.

Such adjustments may prove very difficult if not initiated soon.

[23] See Climate Crisis Awareness 2019, a study conducted by the Reporting Standards Foundation, Standards Reporting Foundation (Fundacja Standardów Raportowania), Polish Association of Listed Companies and Bureau Veritas.

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