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Dr Iskra Sokolovska

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1505 Ljubljana
Tel.: 01/+386 1 47 19 680
E-mail: krd@bsi.si
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Carbon emissions are a global problem and are rising sharply. Physical and transition risks are set to increase during the energy transition and the green recovery from the crisis. Asia's share of global emissions is increasing, while the EU's share is falling. EU emissions are also declining in absolute terms. This is a reflection of the EU's ambitious environmental targets, which will be further tightened. As part of the EU, such risks are undoubtedly relevant for Slovenia, regardless of it currently meeting certain environmental targets.

For the purpose of climate analysis, we define climate-sensitive sectors as sectors with the highest carbon footprints and climate-relevant sectors. These include the household sector, with a 23% share of emissions, and the non-financial corporations sector, most notably manufacturing, electricity, construction and transport (63% of all emissions). The broader definition of climate-sensitivity includes all segments and sectors, while the narrower definition encompasses households and the most polluting sectors within the manufacturing, electricity, construction and transport sectors.

Climate sensitivity also depends on macro factors, such as the economic growth model, the structure of the economy, and environmental policies. These are mainly amplification factors for climate sensitivity. Although Slovenia is achieving economic growth while simultaneously reducing emissions, the structure of the economy is still relatively energy-intensive. There is also great room for progress in greening fiscal policy, in terms of improving the distribution of the tax burden and reforming environmentally harmful subsidies. The volatility of carbon prices further exacerbates the risks.

Physical risks are increasing at the global level and the high share of uninsured damages will increase the burden of physical risks. Physical risks are relatively low and manageable for insurers in Slovenia. At the global level, there is a discernible increasing trend in the number of weather-related loss events, with a simultaneous increase in the estimated losses, most of which are uninsured. This will exacerbate climate risks. Physical risks are manageable for insurers in Slovenia, due to a rise in premiums and claims, a stable share of premia and claims in GDP, and a stable share of weather-related claims in total claims.

A review of exposures, NPEs and profitability ratios suggests that the climate sensitivity of the banking system's credit portfolio is moderate. The share of exposures to the most climate-sensitive sectors is low to moderate, with solid creditworthiness based on the NPE shares in these sectors and their solid profitability. The share of exposures of the most climate-sensitive sectors generally ranges from 36% to 44%, depending on the definition of climate sensitivity. NPEs in climate-sensitive sectors are declining, similarly to the NPE trajectory in other sectors. The profitability of climate-sensitive sectors is also solid, with a systematic gap between the profitability of climate-sensitive and other sectors. The latter suggests manageable climate risks.

Emissions data at the firm level show a high concentration of climate risks in a small number of firms and relatively low climate risks due to lower shares of exposures to the largest polluters (ETS registry). Factors from the international environment contribute to assessing climate risks as moderate. The share of exposures to the top ten polluters in the NFC portfolio, which accounted for 38% of total emissions in 2018, stood at 2% in March 2020. The share of exposures to all ETS firms increased to 9% in March 2020. Both estimates are indicative of low climate risks, which could still be high, due to the profitability of all firms in the registry, the pace of the transition in the EU, and the volatility of carbon prices.

This report also presents the first carbon footprint and intensity metrics at the bank and systemic level. There is an improvement in carbon intensity at the systemic level, while decarbonisation can be observed through a reduction in the carbon footprint and intensity at certain banks. The carbon footprint is calculated by assigning emissions to each sector at the bank level. The systemic carbon footprint is increasing in line with the rise in emissions in all sectors. Growth in lending is improving the carbon intensity of the system and most banks. The indicators improve further when calculating the carbon footprint based on fixed emissions, though generally most banks show an improvement in at least one indicator.

The carbon footprint and intensity metrics show increased concentration of climate risks at O-SIIs and a mitigating role of other institutions. The growth in lending at O-SIIs contributes to an improvement in their carbon intensity, while their carbon footprint is still increasing. Other institutions recorded improvements in both indicators over the three year period March 2017- March 2020.

The current assessment of climate risks in Slovenia is low to moderate, based on the physical and transition risks indicators. In terms of physical risks, there is an increase in weather-related premiums and claims, whose shares remain relatively stable through time. Additional risks could arise from the insurance protection gap. In terms of transition risks, climate risks are assessed as moderate, due to a stable and moderate share of climate-sensitive exposures, solid creditworthiness based on the NPE shares and profitability indicators, and the partial process of decarbonisation.

Factors at the macro level, such as changes in environmental targets or the impact of the crisis, could significantly increase climate risks in the future. Climate-sensitive sectors (manufacturing and transport) are among the hardest hit by the crisis. The potential acceleration of the energy transition and the resulting increase in transition risks will increase credit risks which are already elevated. The recovery from the crisis could contribute significantly to a banking system lock-in. It should be noted that climate risks can also be regarded as an opportunity, in light of the green growth initiatives, such as the European Green Deal and the recovery and resilience facility.

1. Introduction

The rapid economic growth and development following the last industrial revolution has been accompanied by an increase in emissions and unavoidable climate change, which is having a profound impact on the environment. The quality of the environment is a broader concept, encompassing air quality (emissions), biodiversity and resource conservation. There are increasing calls for the decarbonisation of the economy to deal with these challenges, by transforming existing business models into sustainable models. Sustainability is a concept that appeared even before the transition from planned to market economies, within the theory of sustainable development. Newer versions include the business aspect as well, by considering the corporate social responsibility of firms or investors through ESG investment. Economic growth can also be achieved through green growth, which brings economic and environmental benefits. The objective of the European Commission's wide-ranging initiative known as the European Green Deal is to achieve green growth. Accounting for sustainability and the environmental dimension in particular, is also relevant for the financial sector, due to elevated risks for investors which stem inherently from the green growth transition, i.e. the energy transition, as well as a rise in claims driven by the rising frequency of natural disasters caused by climate change. Climate risks are characterized as physical and transition risks. It should be noted that climate risks are systemic and might have a major impact on financial stability. This document presents the initial assessment of climate risks based on a climate risk monitoring framework. It provides an overview of key indicators (emissions) and amplification channels to the economy, as well as a breakdown of climate risks by type of risk with a review of the decarbonisation process as an element of transition risks.

2. Definition of climate risks and climate sensitivity

2.1 Definition of climate risks

Safeguarding the environment is an integral part of several concepts related to the sustainable management of society and businesses. Environmental protection is one of the fundamentals of sustainable development and includes economic, social and environmental benefits. Environmental protection is thus a core element of the concept. The latter appeared in the late 1980s, while its implementation is related to the broader uptake of corporate social responsibility across businesses. The term ESG is increasingly used in finance and encompasses sustainable financing and investment that account for environmental, social and corporate governance aspects. The concepts cover various aspects of sustainability.

Concepts based on the various aspects of sustainability are comprehensive, but are often difficult to implement in practice. At the same time, the pace of climate change predicates a practical need to focus on green dimensions. More contemporary versions of sustainable development, for example the concept of green growth, are based on two aspects of sustainable development and focus on achieving economic and environmental benefits. With the rising frequency of climate change events, it is increasingly clear that societies will incur high costs due to climate change, in terms of direct costs and the costs of transitioning to the green economy. Climate change has thus become a significant source of risk for financial institutions.[1]

Climate risks are characterized as physical and transition risks, i.e. the costs of climate change and the costs of adapting to climate change. Physical risks arise from the direct and indirect costs of weather-related loss events. Transition risks arise from the structural changes required in the transition to more sustainable economies based on lower energy consumption and

[1] Positively green: Climate change risks and financial stability, ESRB (2020).

environmental protection. These risks emanate from changes in consumer preferences, environmental policies, or technologies.[2]

Climate risks are systemic financial risks, which could impact financial stability significantly, due to their size and scope. The costs of climate change will be high, as a result of the increase in weather-related loss events. This will increase transition risks, due to either prevention or mitigation. Physical risks will have the largest impact on insurers and the government, due to the insured and uninsured damages incurred from loss events. Other stakeholders will be affected indirectly, via the disruption to economic activity and the duration of the recovery from loss events. Transition risks will affect all entities. Energy-intensive firms and investors will have to adapt their business models and strategies, which will increase the exposure to credit and market risk for financial institutions as a result. Households will be exposed to potential changes in prices and structural changes in economic growth and employment.

It should be noted that climate risks are also an opportunity, due to green growth initiatives. Although climate risks will lead to higher costs, they will also be an opportunity. The surge in green growth initiatives and the financial frameworks for the green transition (e.g. the European Green Deal) will present an opportunity for new real and financial sector investment to reduce climate risks significantly. Green investment can help boost economic growth (or mitigate the decline) during the transition and create new jobs. Reducing climate risks in this manner depends also on the pace of allocating funding and the pipeline of existing green projects.

A framework for climate risk monitoring is further presented, based on the definition of climate sensitivity. This is particularly important for transition risk monitoring, as physical risks depend on natural processes. A brief overview of the trends and structure of emissions is also provided in continuation.

2.2 Trends and breakdown of emissions

Climate risks arise mostly from uninternalised externalities and excess pollution. There are several types of emissions, though CO_2 emissions are the most important for climate change, as they are generally the largest component in total greenhouse gas emissions. CO_2 emissions are global, which means that a major increase in emissions in one region also has long-term consequences for other regions. This occurs due to the greenhouse effect which has a long-term impact on all regions.

Global emissions have risen precipitously in the last 100 years, primarily as a result of economic development in Asia, specifically China. The two figures below illustrate the change in emissions over time and the structure of emissions across regions. The figures show that the pronounced increasing trend has been driven by rising emissions in China, whose share in total emissions rose from 8.3% in 1960 to 28% in 2014. The emission shares of the US and the EU are declining.

[2] The definition of climate risks also used to include legal risks, which are now included under transition risks. They include the risks related to the cost of judicial proceedings due to a lack of information on climate risks (e.g. consumer lawsuits on the grounds of improper disclosure of the climate risks inherent in specific products and services).

Figure 2.1: CO_2 emissions by region, 1960 to 2014

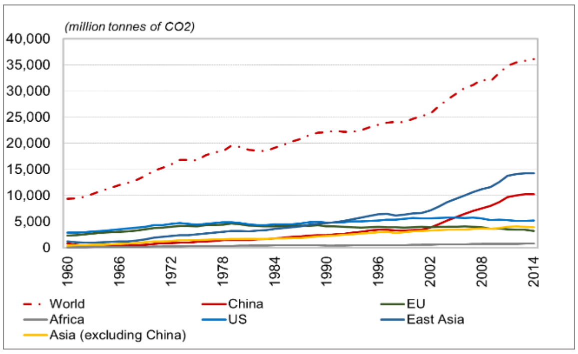
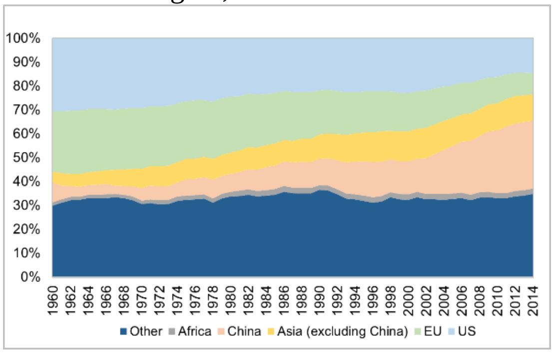


Figure 2.2: Breakdown of CO_2 emissions by region, 1960 to 2014

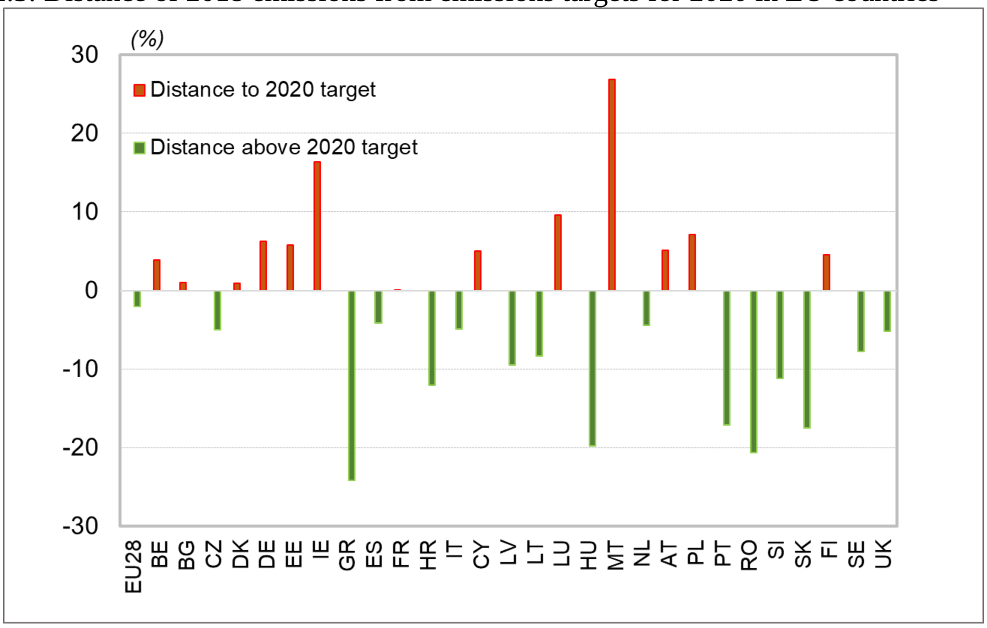


Source: World Bank (2020)

The EU's global emissions share is smaller compared to other regions. This indicates that the EU's efforts have a relatively smaller impact on slowing the rise in emissions and reversing climate change trends. The EU's impact on physical risks is therefore minor. It should be noted that transition risks will still be significant, as the EU is the leading region in terms of environmental policies and the transition to a green economy (e.g. through the EGD). This will also increase transition risks in Slovenia, due to i) the direct impact of Slovenia's environmental targets, and ii) the indirect impact of economic growth in other regions, for example Germany, which has also set more ambitious emissions targets because of its larger contribution to total EU emissions.

The failure of countries to meet their targets, particularly the countries with more ambitious environmental targets, will lead to increased transition risks, due to sudden transition policies intended to meet environmental targets. The figure below illustrates the current distance from the 2020 environmental targets according to the latest data (2018). It is evident that certain countries are already hitting their targets (including Slovenia), while the figures from the last years of the horizon will be crucial for some larger economies (including Germany and Austria as key trading partners of Slovenia). The potential failure to meet the emissions targets for 2020 is likely to lead to sudden policy changes over the next decade, with countries committed to even more ambitious targets for 2030. These would then have to be modified in order to achieve carbon neutrality by 2050.

Figure 2.3: Distance of 2018 emissions from emissions targets for 2020 in EU countries



Note: The emissions targets are set for sectors participating in the EU ETS and do not cover all sectors.
Source: Eurostat (2020)

After declining in 2014, emissions in Slovenia have been somewhat increasing at the annual level during recent years. It is important that the current levels of emissions and the projected trajectory of emissions in Slovenia are sufficient to meet the 2020 and 2030 targets.[3] The targets encompass limiting the increase in emissions by 2020 relative to 2005 to 4%, with an emissions reduction of 15% by 2030 (current level: a reduction of 7%).

Defining the scope of the impact of climate risks and the vulnerability of individual segments is key for analysing climate risks. While physical risks will impact all entities, transition risks will generally be concentrated in the sectors that contribute most to total emissions. The breakdown of emissions in Slovenia[4] shows that these are concentrated in manufacturing, construction, electricity and transport. The aforementioned four sectors accounted for 62.8% of total emissions in 2018.

Figure 2.4: Breakdown of emissions in Slovenia, 2008 and 2018

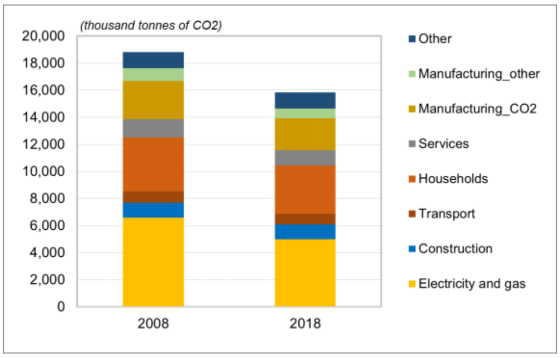
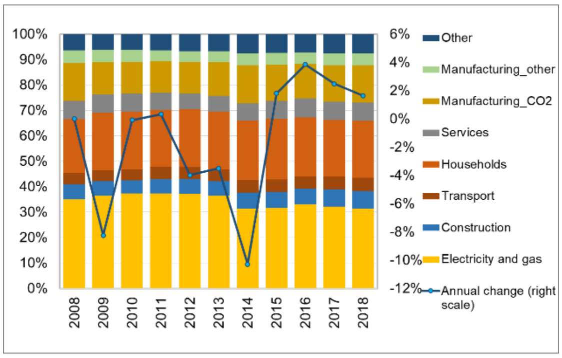


Figure 2.5: Breakdown of emissions in Slovenia and annual growth rate, 2008 to 2018



Source: Eurostat (2020)

Although there is a discernible declining trend in emissions (compared with the pre-crisis levels), the sectoral concentration is generally inelastic. The contribution to total emissions by the household sector, which is generally smaller than the contribution by the NFCs sector, should be noted. The comparison is relevant in determining the relative burden of the energy transition.

2.3 Definition of climate sensitivity

Climate sensitivity can be defined broadly or narrowly, according to the emissions covered.

Broad definition of climate sensitivity: According to the broad definition, the climate-sensitive sectors encompass the whole manufacturing, electricity, construction, transport and the households segment (85% of total emissions).

Narrow definition of climate sensitivity: According to the narrow definition, the climate-sensitive sectors are subsectors of manufacturing and transport, namely sectors C16 to C18, C22 to C25 and H49,[5] due to the size of their contribution to total emissions in the sector and climate relevance, as well as the total electricity, construction and households segment (80% of total emissions).

[3] As stipulated at EU level by Decision No 406/2009/EC and the Burden Sharing Regulation (Regulation 2018/842), while the targets set by Slovenia's NECP are higher.
[4] Described in detail in Appendix 5.
[5] Activities C16 to C18 encompass the entire wood and paper industry, C22 to C25 encompass the manufacture of rubber, metals, plastic and non-metallic mineral products, while H49 encompasses land transport. The definition is explained in greater detail in Appendix 5.

In addition to the definition of climate sensitivity, it is also important to note the amplification factors of climate risks and thus climate sensitivity. These include:
- ***the economic growth model:*** affects the timeline and intensity of the transition due to the role of natural capital in economic growth, i.e. the trade-off between emissions and growth;
- ***the structure of the economy:*** affects the timeline and intensity of the transition due to the share of value-added accounted for by energy-intensive firms;
- ***environmental policies:*** have an effect via the timeline and intensity of the transition.

It should be noted that in the event of favourable developments in individual factors, these become mitigating rather than amplification factors during the energy transition.

2.3.1 Economic growth model

The economic growth model is a climate risk amplification factor as economic growth depends on the consumption of natural capital and energy. The basic equation for economic growth includes physical capital (K) and human capital (L) with an additional technology factor (total factor productivity or TFP). Energy products are a type of natural capital and are a significant factor in achieving economic growth, given the energy consumption in production processes. This is the essence of the trade-off between economic growth and environmental protection, which is a crucial factor in the energy transition pathway. Namely, countries can delay the energy transition until reaching a sufficient level of economic development, which reduces transition risks during the delayed transition. The intensity and timeline of the transition have an impact on physical risks, which can further increase transition risks if climate action is taken too late.

The literature refers to the decoupling of economic growth from emissions, which stands for achieving economic growth without increasing emissions. This could ameliorate the problem of choice between economic growth and emissions and could lead to a faster energy transition. The two figures below illustrate changes in GDP and emissions in Slovenia and in the EU. The first figure shows the process of decoupling growth from emissions in both regions. The second figure shows similar trends in energy consumption and emissions, with emissions declining as energy consumption falls. Economic growth and a decline in energy consumption recorded in the same period indicate increased energy efficiency (greater output per unit of energy).

Figure 2.6: Changes in GDP and emissions in Slovenia and the EU27, 1995 to 2017

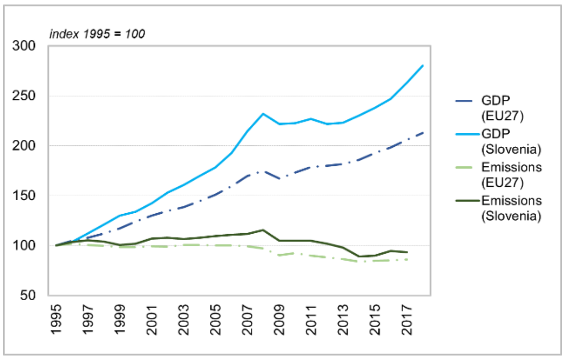
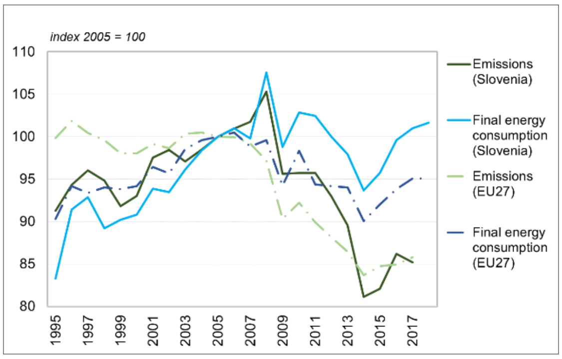


Figure 2.7: Changes in emissions and energy consumption in Slovenia and the EU27, 1995 to 2017



Source: Eurostat (2020)

2.3.2 Structure of the economy

The structure of the economy can act as an amplification factor for the energy transition if climate-sensitive sectors account for a large proportion of value-added. The energy intensity of individual sectors is also an important indicator. The energy transition will be particularly challenging for highly energy intensive sectors, as it is more difficult to decouple growth in value-added from energy consumption in energy-intensive sectors.

Figure 2.8: Breakdown of value-added in Slovenia, 1995 to 2018

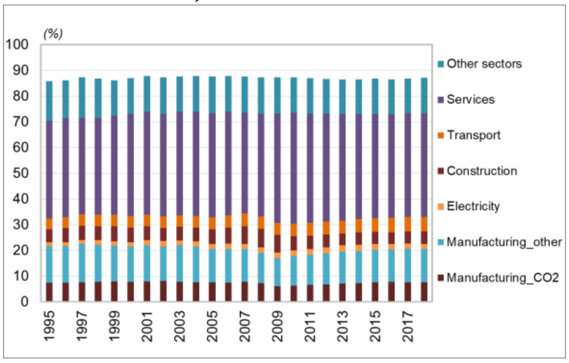
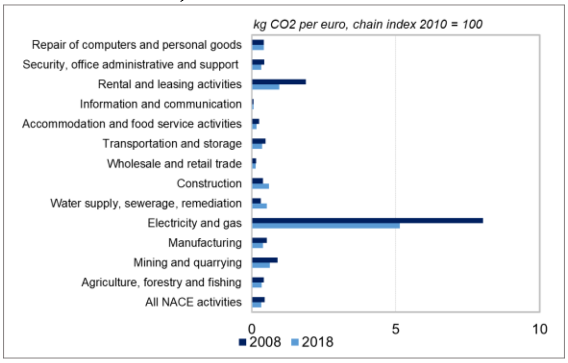


Figure 2.9: Energy intensity in Slovenia by sector, 2008 and 2018



Sources: SORS, Eurostat (2020)

Slovenia's economy is moderately energy-intensive according to the breakdown of value-added. Climate-sensitive sectors accounted for 17.4% of value-added in 2018 according to the narrow definition, and 33.1% according to the broad definition. Electricity is the most energy-intensive sector, though it only accounts for a small proportion of value-added (1.9% in 2018).

The energy intensity of the electricity sector has declined sharply after the last crisis. This could be encouraging in terms of the timeline of the energy transition, as it reflects the possibility of changes without high costs in terms of value-added in the economy. It should be noted that further improvements in energy intensity might be hindered by bottlenecks and technological limitations. Further improvements in energy intensity without high costs in terms of value-added declines are also possible in the transport sector. Both sectors have the potential for niche banking services on the pathway to a green economy.

2.3.3 Environmental policy

Fiscal environmental policies are based on internalising the externalities from pollution through carbon or pollution pricing. They include energy taxes such as taxes on fuels (excise duties) and carbon tax, and carbon pricing in the emissions trading system. Both policies are used in Slovenia and in the EU, as energy taxes are set at the national level, while emissions trading is regulated at the EU level through emission allowances. The two figures below illustrate the changes in the cumulative coverage of emissions within the existing carbon price initiatives at the global level and the share of emissions covered by individual initiatives and their carbon price.

Figure 2.10: Cumulative coverage of global emissions by tax initiatives in 2020

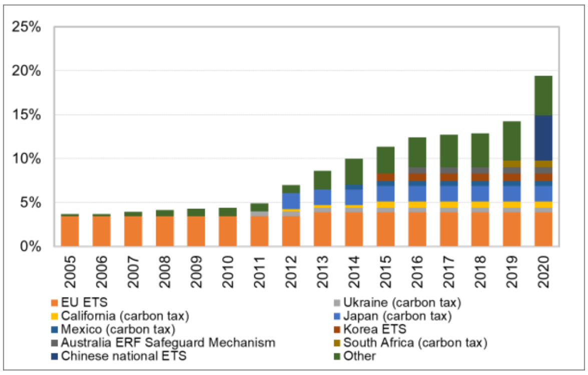
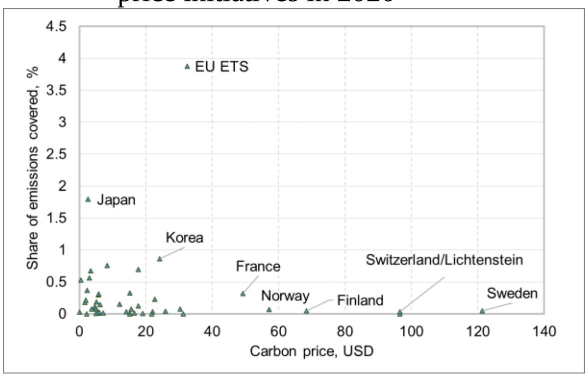


Figure 2.11: Coverage of emissions (in %) and carbon price under various carbon price initiatives in 2020



Source: World Bank (2020)

The figures show that the current initiatives are insufficient to have a greater impact on greenhouse gas emissions, as they generally cover less than 20% of global emissions (projected for 2020). Prices also fluctuate sharply from year to year and are higher in a small number of wealthy countries, which is indicative of the low level of internalisation of externalities, and consequently insufficient preventive action in reducing physical risks.

Carbon prices in the EU ETS, which includes Slovenian firms as well, are increasing. [6] The EU ETS features free allocation of a share of emission allowances. The amount of free allowances is reduced sharply each year, which will increase the burden for sectors covered within the EU ETS. Carbon prices are also increasing due to a smaller quantity of total emissions at the EU level. There was a sharp rise in prices over the last two years, when the carbon price rose five-fold compared to its initial value. Transition risks will be exacerbated by an increase in the EU's ambitious environmental targets overall.

Figure 2.12: Total and allocated emissions under the EU ETS (left scale) and carbon price (right scale) in the EU

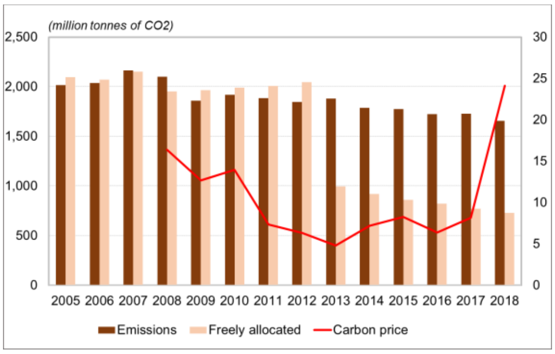
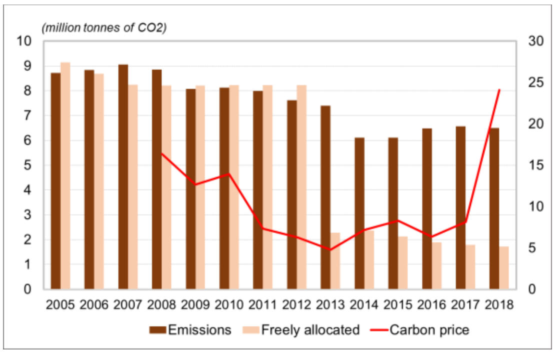


Figure 2.13: Total and allocated emissions under the EU ETS for Slovenia (left scale) and carbon price (right scale) in the EU



Sources: EU ETS registry, Bloomberg, ICE (2020)

Other fiscal policies that introduce a price for pollution are energy and environmental taxes. These encompass taxes on the consumption of resources, energy (excise duties), and pollution or transport (authorisations/licences). Energy taxes account for the largest share of revenues from environmental taxes. In general these taxes do not exceed 5% of GDP, given the smaller tax base. Although tax revenues from this source are generally smaller compared to other tax revenues, this could change in the event of a wider tax reform.

Figure 2.14: Breakdown of environmental tax revenues by segment (left scale) and share of environmental tax revenues in GDP in Slovenia (right scale)

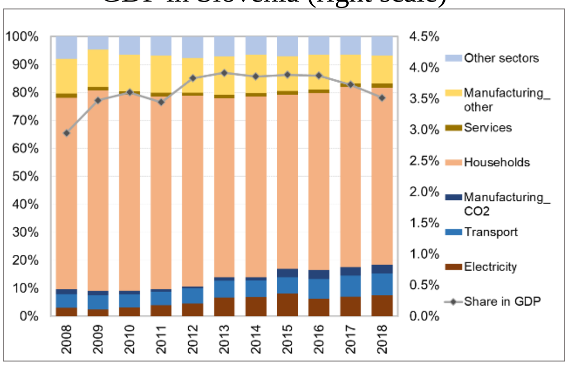
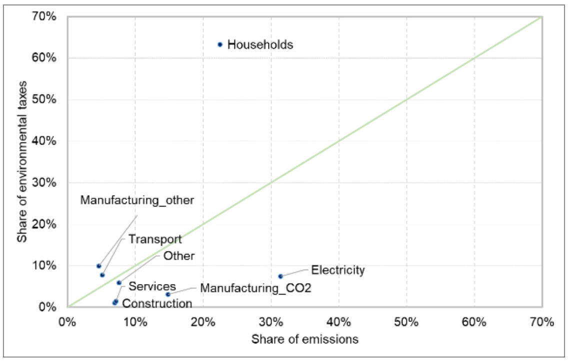


Figure 2.15: Share of emissions and share of environmental tax revenues in Slovenia by segment, 2018



Source: Eurostat (2020)

[6] Under the assumption that the current decline in carbon prices is temporary and is a result of the economic lockdowns caused by Covid-19, the price of an emission allowance reached EUR 19.6 at the end of April, down from EUR 28.3 in July 2019.

The burden of environmental taxes is unevenly distributed in terms of the contribution to emissions and the relative tax burden defined as the stakeholder's share of tax revenues. The burden generally falls most heavily on households, which account for more than 50% of revenues. The tax burden of other sectors is lower than their contribution to emissions. There have been no major changes in the relative tax burden over the years. More comprehensive analysis requires insights into environmentally harmful subsidies, which can increase imbalances. Reforming taxes and harmful subsidies therefore represents a potential source of elevated transition risks in the (near) future.

2.3.4 Assessment of amplification / mitigating factors for climate sensitivity

A review of the determinants which might have amplifying or mitigating effects on climate sensitivity suggests they are mostly amplification factors. The economic growth model is a mitigating factor in general, while the second factor has amplifying and mitigating effects. The third is an amplification factor.

The first factor, the economic growth model, is generally a mitigating factor in light of the decoupling of economic growth from emissions and the meeting of environmental (emissions) targets. The decarbonisation of the economy will be mitigated by the successful decoupling of economic growth from energy consumption / emissions. At the same time Slovenia is on a good pathway to meeting its emissions targets, as the targets for 2020 have already been met, while the current trajectory will allow meeting the 2030 environmental targets. It should be noted that more ambitious targets would require additional action, albeit not necessarily with an adverse impact on GDP growth.[7] The first factor is therefore a mitigating factor in general.

The structure of the economy acts as an amplification factor for climate sensitivity due to the shares of climate-sensitive sectors (manufacturing in particular). The most energy-intensive sectors (electricity) account for a relatively small share of value-added. Therefore, technological progress and adequate fiscal support measures could enable improvements in energy intensity and emissions without major costs in terms of value-added declines. However, the share of other climate-sensitive sectors in value-added remains moderate to high, primarily due to manufacturing. Increasing the share of services will mitigate the potential adverse effects.

Environmental policies are also an amplification factor, due to imbalances in the tax burden of energy/environmental taxes, the failure to reform environmentally harmful subsidies, and the volatility of carbon prices. There is great room for improvement in the distribution of the tax burden in green fiscal policy. The inherent volatility and increase in prices of emission allowances and the reduction in the number of freely allocated allowances serves to increase climate (transition) risks. Due to policy inertia and the need for greater coordination, such risks are currently assessed as low to moderate. The moderate assessment comes primarily from the risk stemming from emissions trading schemes, while tax reform and changes are a relatively static category. The main EU-wide initiatives, such as the green growth initiative, could accelerate the risks from changes in environmental policies.

A review of physical and transition risks follows in continuation.

[7] The emissions targets and current state are described in Appendix 2.

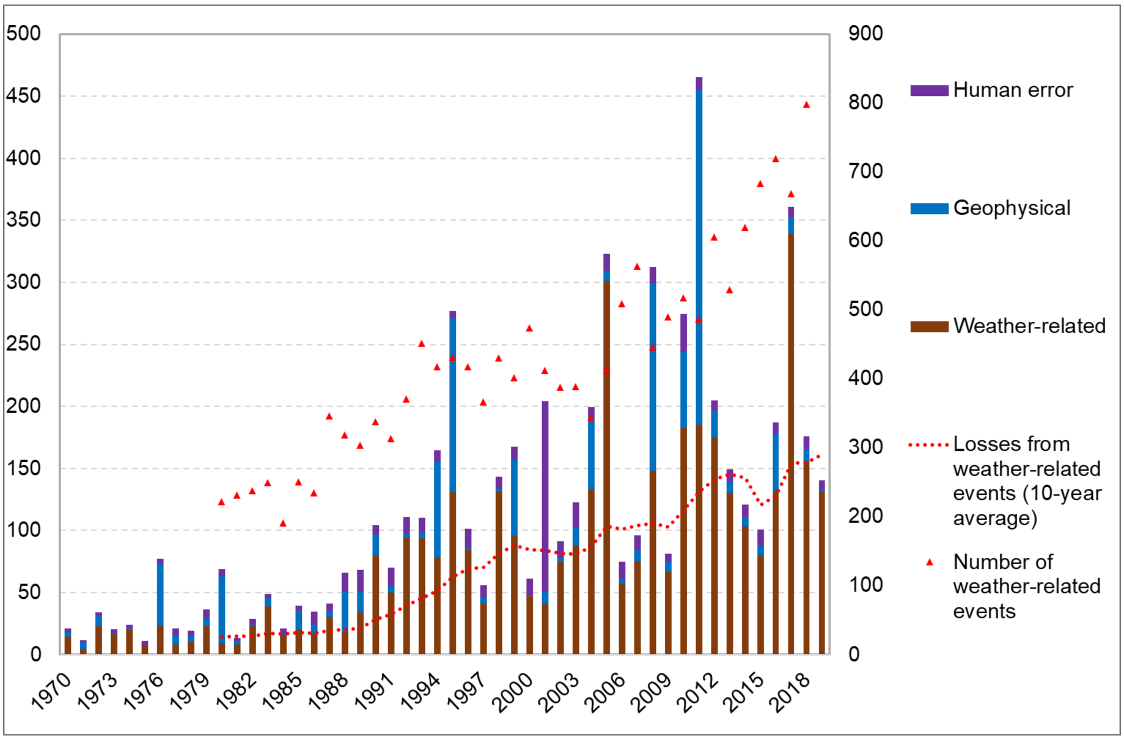
3. Physical risks

The financial burden of natural disasters is projected to fall most heavily on the government and insurers. Namely, weather-related loss events are events of low frequency and high magnitude, which are not fully covered by insurers. Among financial institutions the financial burden falls hardest on insurers due to weather-related claims, although physical risks have an impact on all stakeholders. Insurers also have the most systematic insight into physical risks, due to the collection of premia and claims. The section on physical risks therefore contains a review of the total and insured costs of natural disasters as an approximation of the fiscal burden and the financial burden to insurers due to climate risks.

3.1 Physical risks at global level

Physical risks arise due to an increase in the number of loss events (weather-related disasters) and material losses from weather-related disasters. The number of loss events and natural disasters, particularly weather-related disasters, is continually rising at the global level. Natural disasters are mainly weather-related disasters, while other events generally occur with lower frequency. The frequency of weather-related loss events has almost doubled over the past two decades, from 430 in 1998 to 798 in 2018. It should be noted that the analysis does not discuss the issue of causality, but rather the trends in physical risks. The exact role of climate change in exacerbating catastrophes and extreme weather-related events is subject to further discussion.[8]

Figure 3.1: Estimated catastrophe losses (USD billion, left scale) across categories and number of weather-related events (right scale), 1970 to 2019



Source: MunichRe (2020)

Losses from weather-related natural disasters increase with the rise in the number of events. The estimated losses from weather-related natural disasters amounted to USD 131 billion in 2019, and have been rising continually over the last decade. Losses from weather-related natural disasters

[8] The issue of causality is addressed in attribution studies, which assign the relative importance to individual factors (see Otto, 2019; Otto et al., 2020).

(ten-year average) amounted to USD 88 billion in 1999, compared with USD 161 billion in 2019, which is a two-fold increase during a relatively short period of two decades. The developments in the number of events and estimated losses[9] indicate a continuous increase in physical risks. Losses are increasing in absolute terms, though they remain smaller than 0.5% of global GDP in relative terms. This is indicative of lower climate risks at the global level due to simultaneous growth in global GDP, although it does not reveal the differences in vulnerability between countries and regions.

Figure 3.2: Global insured catastrophe losses (USD billion) across categories

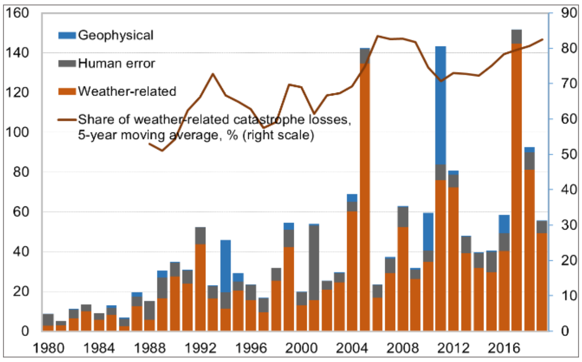
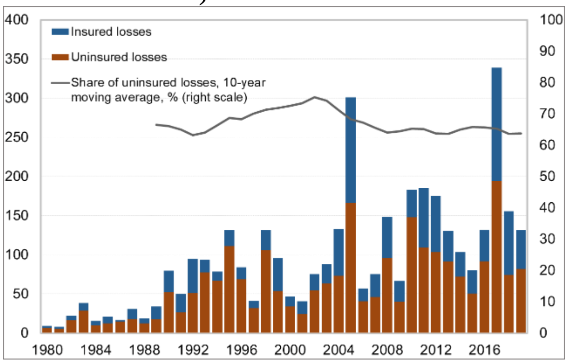


Figure 3.3: Global insured and uninsured losses from weather-related events (USD billion)



Source: MunichRe (2020)

Another important aspect of physical risks is the distribution of the burden, which is expected to fall most heavily on insurers compared with other financial institutions. The rise in the number of events and increased losses mean that climate risks are becoming increasingly material for insurers. The share of losses due to weather-related events in total insured catastrophes is generally above 50% and is rising continuously. The share of losses due to weather-related events in total insured losses (five-year moving average) stood at 82.9% in 2019, compared with 75.3% in 2005.

The majority of weather-related losses are uninsured, which exacerbates climate risks. While total losses from weather-related natural disasters amounted to USD 131 billion in 2019, insured losses amounted to USD 49 billion. The share of uninsured weather-related losses (ten-year moving average) is generally above 60% and amounted to 64% in 2019. This is indicative of pronounced physical risks that are generally underestimated, as the majority of losses related to weather-related natural disasters remain uninsured. These are physical risks that will burden either the government or households, due to the insurance protection gap.

The review suggests that physical risks are increasingly relevant, due to the increase in the number of events and the resulting rise in losses from weather-related natural disasters. At the same time the risks are profoundly understated, as more than half of the losses from weather-related disasters are uninsured. Given the data gaps for insured and uninsured losses, we draw attention to the potential risks stemming from the insurance protection gap in Slovenia. A review of the data on insured losses in Slovenia follows in continuation.

3.2 Physical risks in Slovenia (Slovenian insurers)

Premiums and claims for fires, natural disasters and other weather-related events have risen over the past two decades. There was an increase in both nominal non-inflation-adjusted premiums and claims, which are twice their initial values from 2002. The increase in premia related to fires and natural disasters excluding other weather-related events is more uneven and pronounced. The

[9] All losses are expressed in 2016 prices.

increase in premiums and claims is partly due to inflation, although both inflation-adjusted premiums and claims increased by 51% and 58% respectively. Premiums for weather-related loss events have exceeded claims in almost every year, except 2008. Coverage of claims by premiums is thus generally over 100%, with the exception of 2008, and averaged 179% in the period between 2008 and 2018. This indicates solid coverage for physical risks across insurers. Physical risks in Slovenia are relatively stable when taking economic growth into account. The shares of premiums and claims in GDP stood at 0.54% and 0.27% respectively in 2002, compared with 0.58% and 0.3% in 2018.

Figure 3.4: Premiums and claims for weather-related loss events in Slovenia, 2002 to 2018

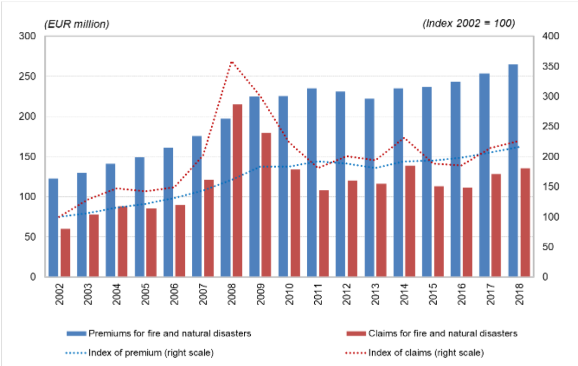
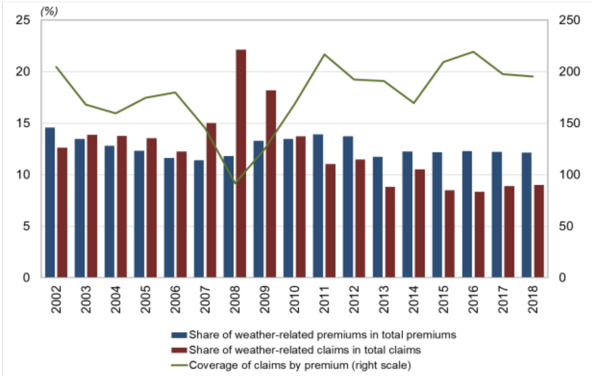


Figure 3.5: Share of weather-related premiums and claims in total premiums and claims (left scale) and coverage of claims by premiums (right scale) in Slovenia, 2002 to 2018



Note: The figures show premiums and claims for fires, natural disasters and other weather-related loss events.

Source: SORS (2020)

Claims related to physical risks have increased, but the share of claims from weather-related loss events is generally less than 15% of total claims at the systemic level, when accounting for all weather-related loss events, or less than 10%, when accounting for fires and natural disasters only. The share of claims from weather-related loss events accounted for 22% and 18% of total claims in 2008 and 2009. The share of claims from weather-related loss events is set to increase as the frequency of such events rises. This is also evident from the increased claims for weather-related events. The risks are manageable at present. First, the share of claims from weather-related loss events in total claims remains stable, which indicates a relatively constant number of events or smaller losses from a large number of loss events. Second, premiums for weather-related loss events are increasing at the same or quicker pace than claims, which suggests that climate risks for insurers are manageable. Third, the shares of premiums and claims in GDP have remained stable over the last two decades.

The insurance protection gap is a significant factor in physical risks. EEA figures show that the share of insured weather-related losses averaged 12% between 1980 and 2017 in Slovenia, compared with the overall EU-27 figure of 23%. Slovenia also ranks in the top half of countries in terms of absolute losses and in the bottom half in terms of losses relative to population or country size. This is indicative of a certain vulnerability to physical risks, although more detailed annual data would be needed for more reliable findings. Notably, Slovenia is highly assessed in the global list of adaptation to climate risks, specifically regarding vulnerability to climate risks, which ranked Slovenia at the 19th and 22nd place in 2017.[10] The index shows an improvement over the last decade, which indicates an increase in the resilience to physical risks.

[10] Based on the findings of the Notre Dame Global Adaptation Initiative, which accounts for vulnerability and readiness for dealing with climate risks (https://gain.nd.edu/our-work/country-index/rankings/).

Several key findings can be drawn from the above.

First, the number of weather-related events has risen sharply at the global level in recent decades, which also increases the losses from weather-related events. There is an increasing trend in weather-related losses in Slovenia. Given the lower frequency of events, this suggests a continuous increase over the long term (at least one decade).

Second, global losses from weather-related events are mostly uninsured, which exacerbates physical risks going forward, particularly for households and governments, and by extension banks. The share of uninsured weather-related losses generally exceeds 60%, which will represent a major burden for other segments. We draw attention to the risk of similar patterns in the insurance protection gap in Slovenia.

Third, physical risks in Slovenia are manageable for insurers, and are currently low due to an increase in premiums and claims, with a stable share of premium and claims in GDP, and a stable share of total weather-related claims in total claims. Premiums and claims have been rising in recent decades, though the share of weather-related claims in total claims is generally stable and does not exceed 15%, with the exception of certain years when weather-related claims amounted to a fifth of total claims. This indicates that physical risks are manageable for insurers. The share of premiums and claims in GDP has also been stable during recent decades, which is indicative of manageable physical risks for insurers. Uninsured weather-related losses remain a potentially major source of physical risks.

4. Transition risks

Transition risks refer to the risks inherent in changes to environmental policies, technologies and preferences. They are characterized by a higher frequency compared to physical risks, as they are a constant determinant of performance. The impact of this factor will increase with the ambition of environmental targets, as they are further tightened, with a subsequent rise in operating costs for climate-sensitive sectors. Transition risks will also have an impact on households, given their relative tax burden, and the potential pass through of transition costs into higher prices.

This section presents transition risk assessments focusing on banks. An assessment of the climate sensitivity and carbon footprint of the banking portfolio is presented. Climate sensitivity accounts for the size of exposures to climate-sensitive sectors and their creditworthiness through a review of non-performing exposures and the potential impact on their profitability. An assessment of carbon footprint and carbon intensity is also presented.

4.1 Climate sensitivity

The assessment of climate sensitivity is based primarily on an assessment of the size of exposures to climate-sensitive sectors. This encompasses all climate-sensitive sectors from the broad definition of climate sensitivity, namely manufacturing, transport, construction and electricity, together with households. The share of exposures accounted for by these sectors ranged from 36% to 44% in March 2020, depending on the definition of climate sensitivity. Households accounted for 26% of total exposure, while the climate-sensitive sectors accounted for 17.7%, or 10.2% when using the narrow definition. The structure of the non-financial corporations (hereinafter: NFCs) portfolio indicates that exposures to the most climate-sensitive sectors (narrow definition) generally account for less than 50% of total exposures at the bank level.

Figure 4.1: Breakdown of banking system balance sheet by climate-sensitive sector as of 31 March 2020

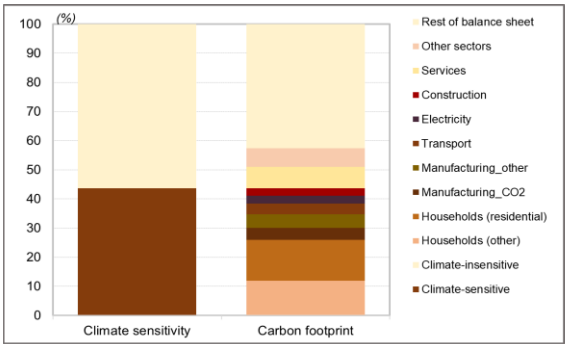
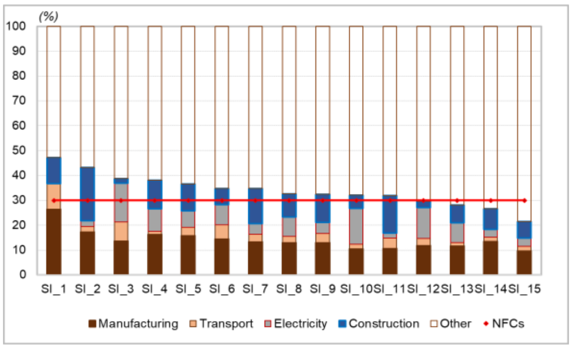


Figure 4.2: Breakdown of NFCs portfolio by climate-sensitive sector and share of the NFC portfolio in the total balance sheet as of 31 March 2020



Note (left): Carbon footprint shows segments based on the share of emissions by individual segments and differs from the carbon footprint of banks shown below.

Note (right): Climate-sensitive sectors are those according to the narrow definition, as described in Section 2.

Source: Bank of Slovenia (2020)

Climate risks are currently assessed as low to moderate based on the assessment of the climate sensitivity of the balance sheet and NFCs portfolio. It should be noted that the assessment of the climate sensitivity of the NFCs portfolio increases sharply when using the broader definition of climate sensitivity.

A more comprehensive discussion requires insights into the dynamics of climate risks through time, which shows that the shares have remained relatively constant. Exposures to climate-sensitive sectors accounted for 36.2% of balance sheet exposures according to the narrow definition, and 44% according to the broad definition in March 2020, compared with 33.8% and 41.9% in March 2017 respectively. The share of balance sheet exposure accounted for by the most climate-sensitive sectors (NFCs) stood at 10.2% in March 2020, compared with 9.4% in March 2017. The change in the share amounts to 3 percentage points over three years and the share is also stable through time. Exposures to climate-sensitive sectors increased by EUR 2.4 billion in absolute terms between March 2017 and March 2020 (an increase of 14%). The increase was driven primarily by growth in household exposures.

Figure 4.3: Breakdown of total exposures by climate-sensitive sector, October 2016 to March 2020

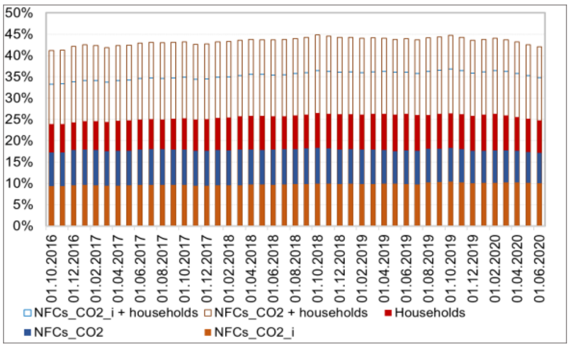
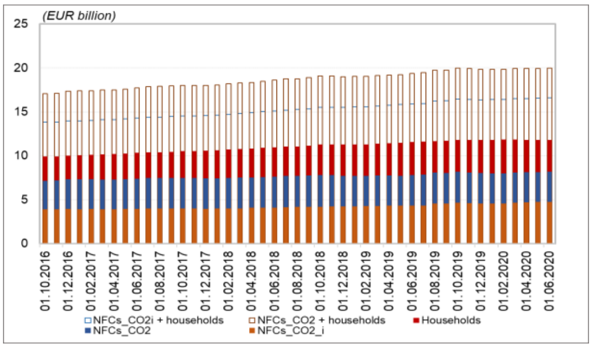


Figure 4.4: Total exposures by climate-sensitive sector (EUR billion), October 2016 to March 2020



Note: NFD_CO2 + households refers to the broad definition of climate sensitivity, while NFD_CO2_i refers to only subsectors within manufacturing, transport, construction and electricity (the definitions are explained in detail in Section 2).

Source: Bank of Slovenia (2020)

Climate-sensitive sectors accounted for 32.6% of the NFCs portfolio according to the narrow definition, or 56.4% according to the broad definition. Manufacturing accounted for approximately half of the aforementioned exposures (13.1% of the total according to the narrow definition, and 28% according to the broad definition). The electricity sector's share was 8.4% in March 2020, with a similar share of the construction sector of 8.1%. A certain inertia in climate-sensitive sectors is also evident in the NFCs portfolio through time. The most climate-sensitive sectors accounted for 30.1% of the NFCs portfolio according to the narrow definition, or 55.9% according to the broad definition in March 2017, compared to 32.6% and 56.4% respectively in March 2020. The difference in the figures according to the narrow definition comes from increases of EUR 163 million in transport and EUR 325 million in electricity (1 to 2 percentage points in each sector).

The changes in exposure are more dynamic at an annual level. Exposures to climate-sensitive sectors (broad definition) have been increasing at a moderate average rate of 4.8% over the last two years. A base effect means the growth in exposures is somewhat higher under the narrow than under the broad definition of climate sensitivity.

Figure 4.5: Annual growth in exposure to climate-sensitive sectors (broad definition) and contributions to annual growth, October 2017 to March 2020

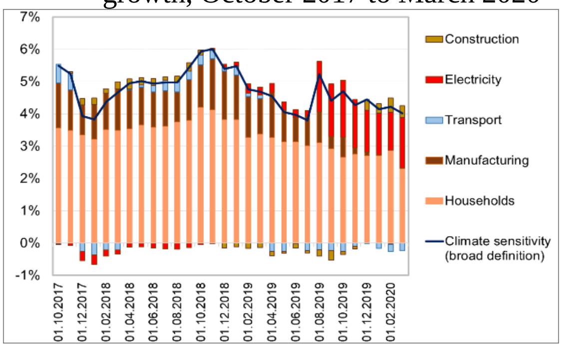
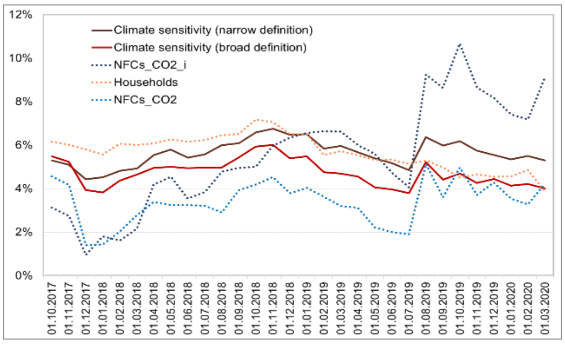


Figure 4.6: Annual growth in exposure to climate-sensitive sectors (narrow and broad definitions), October 2017 to March 2020



Note: NFCs_CO2 refers to all of the manufacturing, electricity, construction and transport sectors (broad definition), while NFD_CO2_i refers to only the most climate-sensitive sectors as defined in Section 2.

Source: Bank of Slovenia (2020)

The increases in climate sensitivity mostly reflect an increase in household borrowing, with small contributions from the climate-sensitive sectors in the NFCs portfolio. The increase in the latter is largely due to an increase in lending to manufacturing and a pronounced increase in exposures to the electricity sector over the last six months. This is also reflected in higher annual growth of exposures to the most climate-sensitive sectors in the NFCs portfolio (CO2_i) towards the end of 2019.

Figure 4.7: Balance sheet structure by climate-sensitive sectors (narrow definition), October 2016 to March 2020

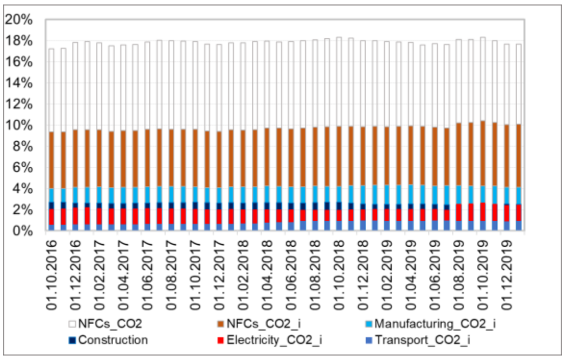
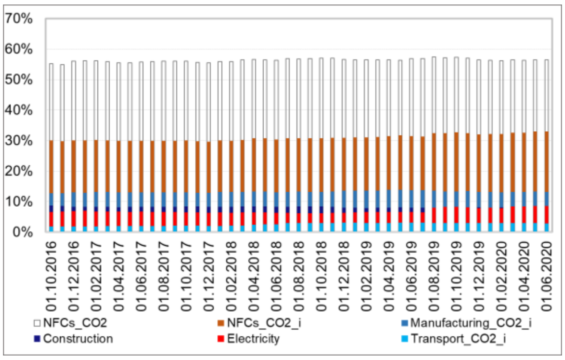


Figure 4.8: Breakdown of NFCs portfolio by climate-sensitive sector (narrow definition), October 2016 to March 2020



Note: NFCs_CO2 refers to all of manufacturing, electricity, construction and transport (broad definition), while NFCs_CO2_i refers to only the most climate-sensitive sectors as defined in Section 2.

Source: Bank of Slovenia (2020)

The exposure classifications suggest that climate risks are low to moderate, depending on the definition. The dynamics and breakdown of the growth in exposures in the NFCs portfolio are additional factors which support the assessment of climate risks. Annual growth in climate-sensitive exposures to NFCs averaged 3.5% over the last two years. The annual increase in exposure was largely driven by an increase in exposure to the most climate-sensitive sectors. This is evident from the contributions to annual growth in exposures to climate-sensitive sectors in the NFCs portfolio, which are generally larger for the sectors from the narrow definition of climate sensitivity compared to the contributions by other climate-sensitive sectors in the broad definition.

Figure 4.9: Annual growth and contributions to annual growth in exposure to climate-sensitive sectors in the NFCs portfolio, October 2017 to March 2020

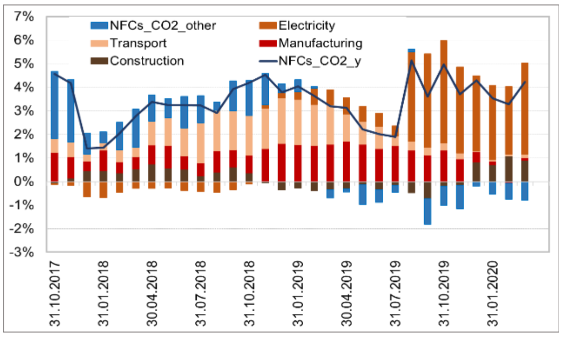
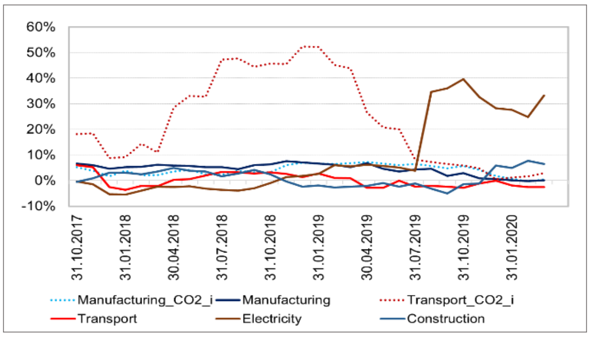


Figure 4.10: Annual growth in exposures to climate-sensitive sectors (narrow and broad definitions), October 2017 to March 2020



Note (left): The contributions by manufacturing, transport, electricity and construction relate to the contributions by the most climate-sensitive subsectors under the narrow definition of climate sensitivity. The contributions by NFCs_CO2_other refer to exposures to the other climate-sensitive sectors in the NFCs portfolio.

Note (right): The annual growth in exposures to manufacturing, electricity, construction and transport capture all exposures to individual climate-sensitive sectors (broad definition), while CO2_i denotes annual growth in exposure to the most climate-sensitive sectors within these sectors (narrow definition).

Source: Bank of Slovenia (2020)

A significant increase in growth can be observed in some periods, which is attributable to a one-off increases in exposures, for example the increase in exposures to the electricity sector in August 2019, or the increase in exposures to transport in 2018. Credit growth is more stable across the other sectors, e.g. manufacturing, regardless of the definition of climate sensitivity. The pronounced surges in growth indicate elevated climate risks because of potential delays in decarbonisation, as they may involve exposure concentration across large entities. Another important aspect of climate sensitivity is the concentration of emissions at the sectoral or the firm level, as they are often concentrated in a small number of firms.

Figure 4.11: Climate-sensitive sectors' shares of balance sheet exposure as of 31 March 2020 and shares of total emissions in 2018

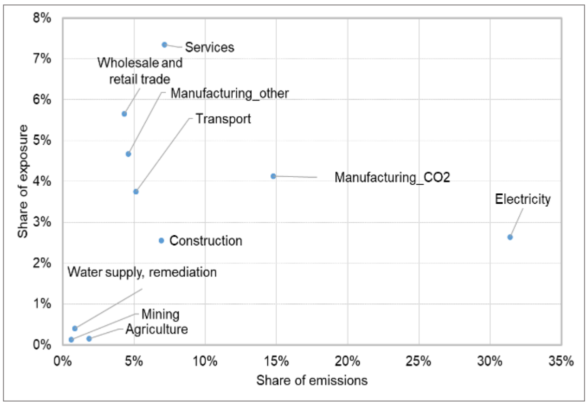
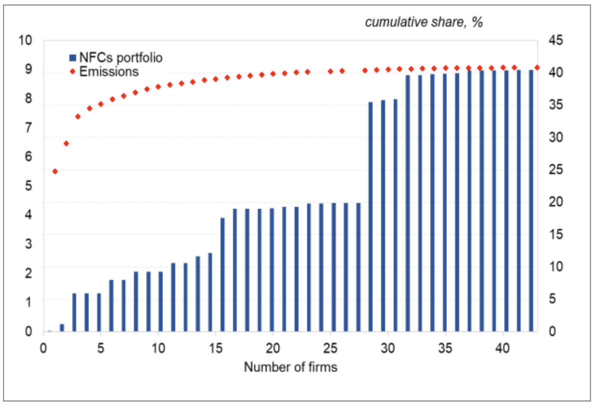


Figure 4.12: Shares of total exposures to NFCs as of 31 March 2020 (left scale) and shares of total emissions in 2018 (right scale) of EU ETS firms



Note (right): The shares of exposure to firms included in the EU ETS are arranged according to their relative contribution to total emissions.

Sources: left figure: Bank of Slovenia, Eurostat (2020); right figure: ARSO (2018), Bank of Slovenia (2020)

The charts suggest that portfolio concentration is moderate, as balance sheet exposures to the most polluting sectors are generally concentrated in manufacturing. The share of exposures of the most climate-sensitive manufacturing sectors in the balance sheet stood at 4.1% in March 2020, compared with the share of exposures of the most climate-sensitive sectors of 10.24%.

The concentration of climate risks is even higher when using firm level emission data. The chart above shows that emissions are concentrated in a small number of firms, where the cumulative share of emissions rises sharply at the lower end of the number of firms (the x axis). Thus, the ten largest polluters included in the ETS accounted for 38% of total emissions in 2018. This is indicative of a high concentration of climate risks.

The assessment of climate risks reduces significantly when using firm level emission data. The share of exposures to the top ten polluters in the non-financial corporations portfolio, which accounted for 38% of total emissions in 2018, stood at 2% in March 2020. The share of exposures increases to 9% when accounting for all EU ETS firms. This is indicative of significantly lower climate risks, also in relation to changes in the price of emission allowances. It should be noted that climate risks can be exacerbated depending on the profitability of other firms and actual changes in prices, which have been highly volatile in recent years. It is therefore reasonable to assess climate risks as moderate.[11]

Changes in the international environment are an additional factor in the moderate assessment of climate risks. A comparison of exposures shows that the shares of exposure to climate-sensitive sectors (broad definition) are larger in Slovenia than in the euro area overall. This suggests that

[11] Detailed analysis of the banking system's sensitivity to changes in carbon prices is presented in the September 2020 issue of the Financial Stability Review.

changes related to the energy transition could be smoother in the euro area overall, due to relatively smaller exposures. The dynamics in annual lending growth to the NFCs sector in Slovenia and in the euro area leads to similar findings. The sensitivity of the euro area's aggregate balance sheet does not change substantially when accounting for exposure to market risk from securities holdings from climate-sensitive sectors.[12]

Figure 4.13: Shares of exposures to climate-sensitive NFCs in Slovenia and in the euro area, 31 December 2016 and 31 December 2019

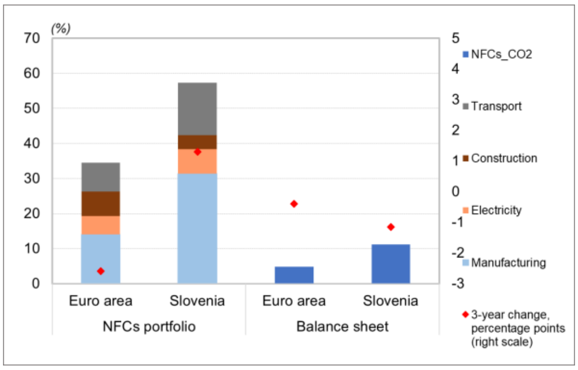
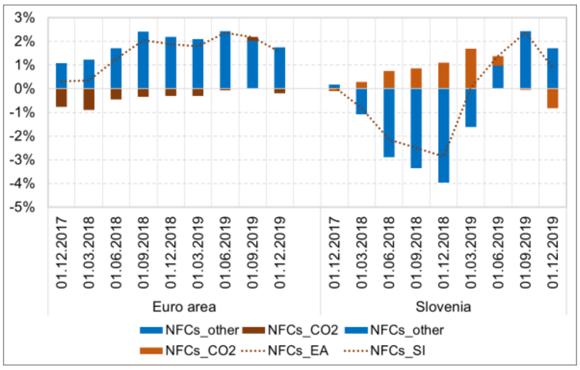


Figure 4.14: Contribution to annual growth in lending to NFCs by climate sensitive sector in Slovenia and in the euro area, December 2017 to December 2019



Note 1: The figures illustrate changes in gross lending and not total exposures.
Note 2: NFCs_CO2 refers to credit exposure to climate-sensitive sectors in the NFCs portfolio under the broad definition.
Sources: ECB (SDW), Bank of Slovenia (2020)

Growth in lending to NFCs in Slovenia is more reliant on climate-sensitive sectors. This could exacerbate the issue of exposure lock-in, or the existence of sectoral lending niches or longer maturities of existing energy-intensive exposures. This is also evident from the structure of corporate financing, which is characterized by a relatively higher share of bank financing in climate-sensitive sectors (particularly in manufacturing, with a lower share of bank financing in the electricity sector). A quicker transition could further increase transition risks in climate-sensitive sectors due to the symbiosis between banks and climate-sensitive sectors.

Figure 4.15: Share of emissions and share of bank financing by sector, 2018

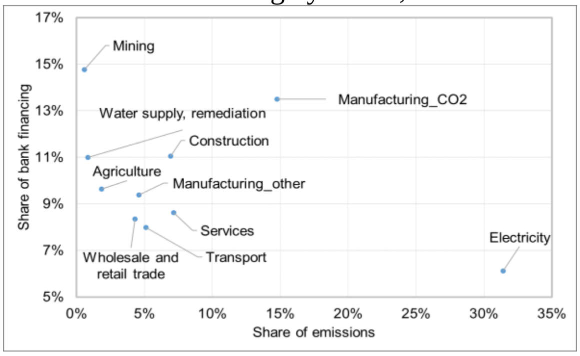
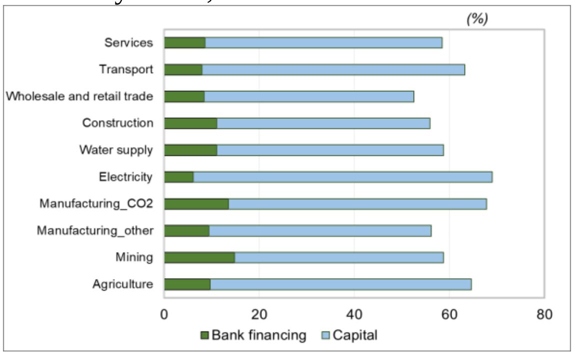


Figure 4.16: Breakdown of corporate financing by sector, 2018



Note (right): The shares of bank financing include exposures to banks in Slovenia only.
Sources: Eurostat (2020), AJPES (2019), Bank of Slovenia (2020)

[12] Based on the values given in the ESRB report *Positively green: Climate change risks and financial stability*, ESRB (2020).

There are three key findings to be drawn from the above.

First, climate-sensitive sectors account for a moderate to high share of the NFCs portfolio and a low to moderate share of the banking system's balance sheet, which suggests that climate risks are low to moderate. The share of the banking system's balance sheet accounted for by exposures to climate-sensitive sectors and segments (manufacturing, transport, electricity, construction and households) is low to moderate. This depends on the definition of climate sensitivity, i.e. the inclusion of households and aggregate sectors in the NFCs portfolio, or the sectors that pollute the most only. Households generally account for the largest share of exposure. Exposures to climate-sensitive sectors in the NFCs portfolio are moderate to high, regardless of the climate sensitivity definition. When using the broad definition of climate sensitivity, exposures to climate-sensitive sectors account for more than half of the NFCs portfolio, half of which comprises exposures to the most climate-sensitive sectors.

Second, banks' climate sensitivity is generally stable through time, based on the exposures to climate-sensitive sectors. The stable share of exposures to these sectors and the moderate growth rate, which are generally driven by the most climate-sensitive sectors, have various implications for banks' climate risks. On one hand, the relatively stable share through time indicates manageable climate risks for banks. On the other hand, climate sensitivity can have the opposite effect in driving the decarbonisation of the portfolio in case of sudden fire sales of the high-emissions segment of the portfolio. This might occur for example as a result of a sudden rise in carbon taxes or a sudden credit crunch caused by the downgrading of customers with high emissions, which would increase credit risks for banks. Namely, the relatively constant share could hinder the decarbonisation of bank portfolios due to maintaining long-standing business relations and sectoral niche lending. The growth of the balance sheet, which is driven by exposures to the most climate-sensitive sectors, adds to this effect. Conversely, the relatively stable share could enable decarbonisation since it is easier to set and monitor balance sheet targets (e.g. target shares for certain climate-sensitive sectors).

Third, the concentration of climate risks is moderate to high, due to the concentration of emissions in certain sectors and at certain firms. Climate risks are lower when using firm level emissions data, as the largest polluters account for a small share of exposures in the NFCs portfolio. Factors in the international environment (e.g. carbon prices) indicate a moderate assessment of climate risks. Using ETS emissions data, the share of exposures to climate-sensitive sectors in the NFCs portfolio is significantly lower compared to the assessment of climate sensitive exposures (five to ten fold). Climate risks are lower according to this assessment, although a comprehensive analysis requires further insights into corporate profitability. The volatility of carbon prices and the comparison with the euro area, which indicates relatively higher risk concentration overall in Slovenia, are additional factors which indicate moderate climate risks.

4.2 Creditworthiness

The shares of climate-sensitive sectors are stable through time and reflect the low to moderate climate risks based on the exposure classification. Another particularly important factor in the assessment of climate risks is the creditworthiness of climate-sensitive sectors, which could deteriorate due to changes in environmental policy and consumer preferences. This is assessed based on the NPEs in the balance sheet and the NFCs portfolio and corporate profitability.

4.2.1 Developments in NPEs

The developments in NPEs suggest a moderate assessment of climate risks as well. NPEs in the most climate-sensitive sectors account for around one-third of total NPEs in the NFCs portfolio. The share of NPEs of climate-sensitive sectors ranged from 0.3% and 0.5% of the total balance sheet in March 2020, compared to the overall share of NPEs of the NFC portfolio in the total balance sheet of 1.3%. NPEs in climate-sensitive sectors have declined sharply over the last three years, in line with the general improvement in the banking system's balance sheet. Similar findings arise from the structure of the NFCs portfolio, where the share of NPEs of climate-sensitive sectors ranged from 1% to 1.4%, compared to an overall NPE share of 4.3% in the NFCs portfolio in March 2020, compared to 4.5% and 6.4% and an overall 16% in March 2017.

Figure 4.17: NPE shares of climate-sensitive sectors in the total balance sheet, October 2016 to March 2020

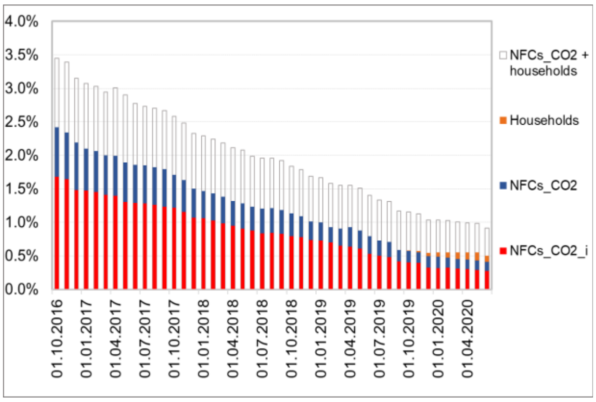
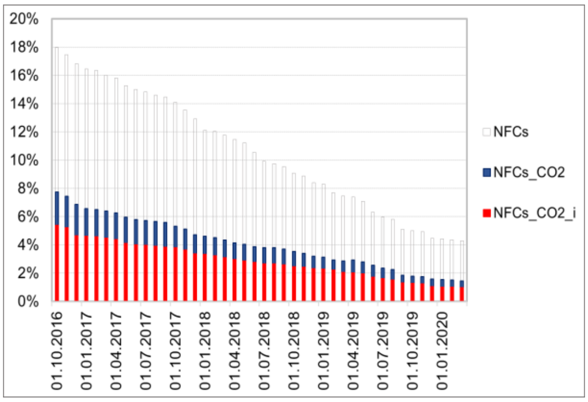


Figure 4.18: NPE shares of climate-sensitive sectors in the NFCs portfolio, October 2016 to March 2020



Note: NFCs_CO2 refers to all of manufacturing, electricity, construction and transport (broad definition) sectors, while NFCs_CO2_i refers to only the most climate-sensitive sectors within these sectors (narrow definition).

Source: Bank of Slovenia (2020)

Manufacturing and construction are the most sensitive sectors in terms of the exposure classification of NPEs per sector. The NPE shares in the most climate sensitive manufacturing subsectors ranged from 0.3% to 0.7% of the NFCs portfolio, while the NPE share of the construction sector stood at 0.6% in March 2020. The two sectors accounted for the majority of the total climate-sensitive NPEs, which amounted to 1% and 1.4% in the NFC portfolio in March 2020. The NPE shares of these sectors are declining through time and are a result of crisis legacy (e.g. in construction) rather than increased climate risks. Transition risks might further increase NPE shares in these sectors, given their greater sensitivity to the state of the economy. The NPE shares in the other sectors (transport, electricity) are practically negligible.

There are three key findings to be drawn from the above with regard to creditworthiness.

First, the share of climate-sensitive sector NPEs is moderate and can rise up to a third of the total NPEs of NFCs, if using the broad definition of climate sensitivity. The estimates of climate-sensitive NPEs are somewhat lower under the narrow definition, which includes only the most energy-intensive subsectors.

Second, NPEs are concentrated in manufacturing and construction, with minimal NPE shares of transport and electricity, which is a reflection of inertia and small and stable changes in climate risks, particularly transition risks. In other words elevated climate risks would reflect across all segments, except in the event of a more rapid adaptation in other sectors due to the relative ease of restructuring existing business model practices towards green models.

Third, the shares of climate-sensitive sector NPEs follow a similar trajectory of NPEs in other sectors. This is particularly important, as it reflects the currently stable climate risks. The previous two findings reflect the fact that changes in NPEs are driven by other factors, and not by climate (transition) risks. Climate risks might further increase NPE shares in an adverse economic environment.

It should be noted that the definition and the subsequent assessment of climate sensitivity are based on aggregates. More detailed assessments would require establishing a green credit register, which would enable further distinction of climate sensitivity. For example, the current assessments of the climate sensitivity of households are biased (on the upside), as they include all exposures to households, which are subject to a lower impact from climate risks (lower NPE shares). Similarly, there is no distinction between exposures related to renewable energy and other energy sources for electricity generation in the electricity sector.

4.2.2 Profitability

Profitability is measured by the ROA and ROE indicators, i.e. the return on assets and return on equity, where earnings are defined as EBITDA, i.e. earnings before interest, tax, depreciation and amortisation. Profitability in climate-sensitive sectors is systematically higher than in other sectors, as measured by both indicators.

Figure 4.19: ROA by sector, 2018

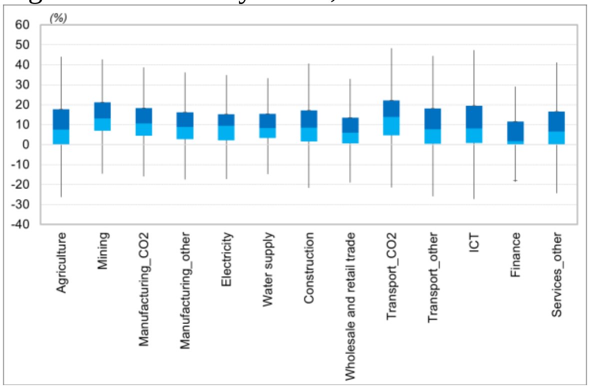
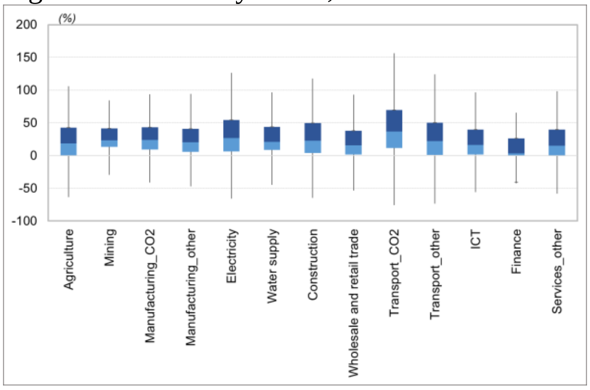


Figure 4.20: ROE by sector, 2018



Sources: AJPES (2019), Bank of Slovenia (2020)

The distribution of firms across sectors shows that the median of the performance indicators in climate-sensitive sectors are at least comparable to those for services. The average profitability indicators are generally higher for climate-sensitive sectors and the annual changes at the sectoral level do not reflect concentrated changes in climate-sensitive sectors. The largest annual changes can be observed in the electricity and construction sectors, with a slight decline in the profitability in the manufacturing and transport sectors in 2018. The changes do not reflect increased climate risks or resilience to a full extent, as the figures show the latest available data from 2018.

Figure 4.21: ROA in 2018 and annual change between 2017 and 2018 by sector

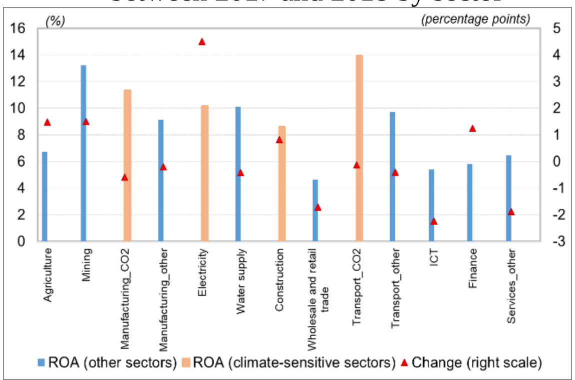
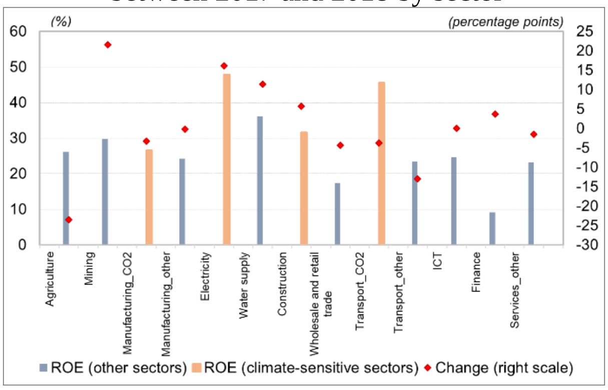


Figure 4.22: ROE in 2018 and annual change between 2017 and 2018 by sector



Sources: AJPES (2019), Bank of Slovenia (2020)

The changes through time show systematic differences in profitability between climate-sensitive and other sectors. There was a systematic gap between ROE in climate-sensitive and other sectors between 2015 and 2018. Average ROE stood at 32.7% in climate-sensitive sectors and 19.5% in other sectors in 2015, compared with 33.5% and 21.5% respectively in 2018. The changes in ROE in other sectors were driven by an increase in earnings per unit of capital in services. A large increase of 12.4 percentage points can be observed in the information and communication sector between 2015 and 2018. In climate-sensitive sectors, average ROE in the construction sector increased from 23% to 32%, while average ROE in the electricity sector declined from 128.2% in 2015 to 48% in 2018. The indicators stagnated or declined in some of the most climate-sensitive sectors in manufacturing and transport.

Figure 4.23: ROA in climate-sensitive and other sectors, 2012 to 2018

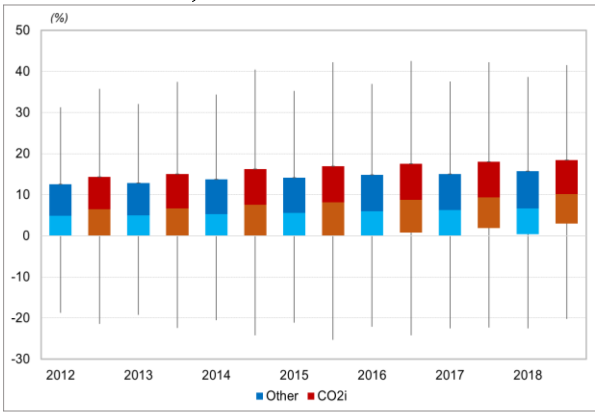
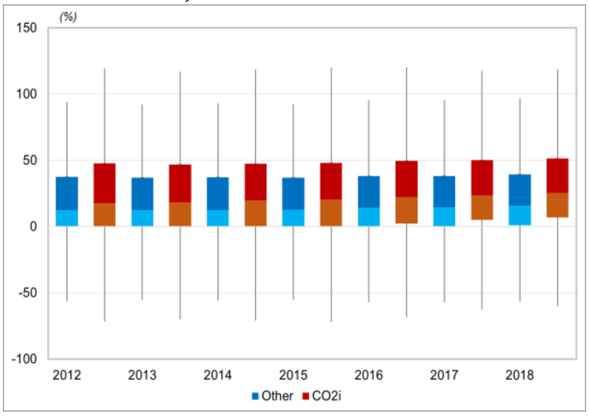


Figure 4.24: ROE in climate-sensitive and other sectors, 2012 to 2018



Sources: AJPES (2019), Bank of Slovenia (2020)

ROA improved slightly in climate-sensitive sectors overall, but deteriorated in other sectors in the period between 2014 and 2018. ROA increased from 9.7% in 2015 to 10.4% in 2018 in climate-sensitive sectors, with an increase in ROA in construction, while the indicators remained unchanged in other sectors. ROA in services declined by 1 percentage point on average between 2015 and 2018. In general there was a discernible widening of the gap between ROA in climate-sensitive and other sectors, which stood at 10.4% and 6.1% in 2018 respectively. This is indicative of low and manageable climate risks during the recent period, as the energy transition is still in the phase of planning and implementation.

Several findings can be drawn from the profitability indicators, which are in line with the findings from the NPEs review.

First, climate-sensitive sectors (manufacturing, construction, transport and electricity) were systematically more profitable than other sectors between 2012 and 2018. This applies to both profitability indicators (ROA and ROE), although the gap in ROA was somewhat wider. ROE in climate-sensitive sectors generally exceeded profitability in other sectors. ROA improved in climate-sensitive sectors and average ROA was higher compared to other sectors.

Second, the changes through time show a gap in profitability between climate-sensitive and other sectors, which might decrease in the future in the event of an intensive transition to a low-carbon economy. Profitability in general indicates manageable climate risks for firms with high emissions. The gap in profitability indicators has been stable for both indicators over the last three years, with an increase in ROA. The gap could narrow over the medium term amid a faster energy transition and a rise in profitability in other sectors, for example services. A higher ROA suggests that currently climate risks do not present challenges to business performance. The changes in a one-year period are generally smaller and are not concentrated in climate-sensitive sectors. The solid profitability of climate-sensitive sectors reflects stable climate risks at present, and will indicate elevated climate risks relatively promptly in the future.

The insights from the profitability indicators support the low assessment of climate risks. These risks have been relatively stable over the analysed period, as evident from the solid profitability in climate-sensitive sectors. Climate-sensitive sectors have a higher profitability compared to other sectors, which indicates manageable and low climate risks in the recent period. Structural changes in the economy could affect profitability significantly, depending on the pace of the transition.

Elevated climate (transition) risks due to changes in environmental policy such as higher environmental taxes or changes in consumer preferences will reflect in a narrowing of the gap or in a sharp decline in profitability in climate-sensitive sectors, with a subsequent rise in their NPE share. Physical risks, which are characterized by a lower frequency, will act as an amplification factor for climate sensitivity through a deterioration in creditworthiness.

4.3 Decarbonisation of the credit portfolio

The current exposure classification based on climate sensitivity and their dynamics through time provide some insight, albeit not comprehensive, into climate risks and bank behaviour. To a certain extent, climate sensitivity reflects climate risks, given the fundamental relation between economic and financial indicators and emissions. Namely, climate sensitivity has been defined by determining the sectors and segments in Slovenia that pollute the most. One advantage of climate sensitivity is the quick evaluation of climate risks with regard to the size of the balance sheet / portfolio, but its main disadvantage is the static definition of climate sensitivity. Once defined, the subset of climate sensitive sectors can change in theory, though the nature of industrial processes predicates that the set of most polluting sectors is generally consistent through time. Furthermore, the definition of climate sensitivity does not reflect the different degrees of climate sensitivity across individual segments, for example as a result of their share in total emissions. This means that metrics of climate sensitivity defined in terms of the size of exposures or NPEs do not reflect the size or change of emissions in individual sectors.

Climate risk vulnerability and relevance indices or carbon footprint and carbon intensity metrics of the portfolio could be calculated for a more comprehensive assessment of climate risks and bank behaviour. These can improve upon certain deficiencies in climate sensitivity, in particular the insufficient relation between emissions and financial indicators and consequently the lack of dynamics in the indicator of climate risks. It should be noted that the aforementioned metrics of climate sensitivity are still informative about the magnitude of climate risks. Metrics that account for changes in exposure shares by accounting for changes in emissions provide more detailed insight into the dynamics of climate risks. Carbon footprint and intensity metrics provide additional insights into the decarbonisation process by accounting for the basic function of banks, i.e. lending.

4.3.1 Vulnerability index (VI) and relevance index (RI) for climate risks

Additional metrics that introduce dynamics through time and account for individual sectors' contributions to emissions are based on changes in the weighted share of exposures to a particular sector through time, either within its own portfolio or total systemic exposures. The weight reflects the individual sector's contribution to total emissions. The exposure shares weighted by contributions to emissions enable bridging the data gap issues in constructing climate metrics. For example, vulnerability and relevance indices can be calculated to assess climate risks for individual institutions (Monasterolo et al., 2017). The vulnerability index accounts for the share of exposures to climate-sensitive sectors in the bank's own portfolio, while the relevance index accounts for the share of exposures to climate-sensitive sectors in total systemic exposures (the market share of the individual bank). Both indices account for the individual sector's contribution to total emissions when weighting the exposure shares.

The vulnerability index is based on the individual sector's share of the institution's portfolio ($\boldsymbol{w_k}$). The index reflects the sector's overall weighted share of the portfolio, where the weight reflects the sector's contribution to total emissions (S_k):

$$VI_j = \sum_k w_k * S_k$$

A sector's contribution to total emissions (S_k) is defined as the share of the sector's emissions in total emissions:

$$S_k = \frac{Emissions_k}{Emissions}$$

The relevance index is based on the institution's share in the total systemic exposures to certain sectors (w_{jk}). This reflects the individual institution's market share, compared to the vulnerability index, which reflects the vulnerability to climate risks based on its own balance sheet structure:

$$RI_j = \sum_k w_{jk} * S_k$$

The climate risk relevance index of Slovenian banks shows a large market share at systemic institutions (weighted by contributions to emissions), which generally account for 75% of the total NFCs portfolio. This indicates the systemic importance of O-SIIs with regards to climate risks as well. The vulnerability indices are generally lower and do not suggest extremely high concentrations in the credit portfolios of individual banks. The vulnerability indices show that exposure shares weighted by contributions to emissions do not exceed 10% of the credit portfolio at the bank level.[13] A comparison of the two indices shows that the relevance index is higher than the vulnerability index at some banks, with the opposite pattern at the other banks. The gap is generally smaller in the latter case, which indicates lower climate risks. The changes during a three-year horizon display some dynamics, with changes of up to 3 percentage points in the shares according to VI and RI.

Figure 4.25: Climate risk vulnerability indices of Slovenian banks and systemic average, March 2017 and March 2020

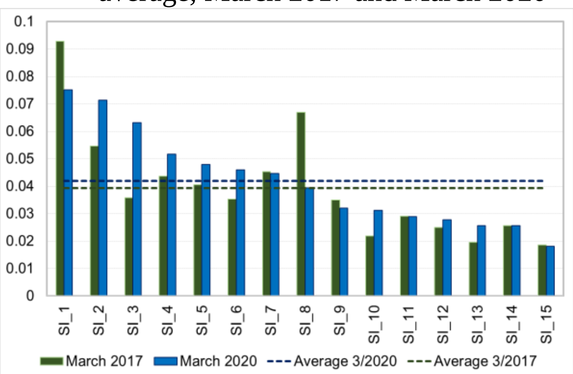
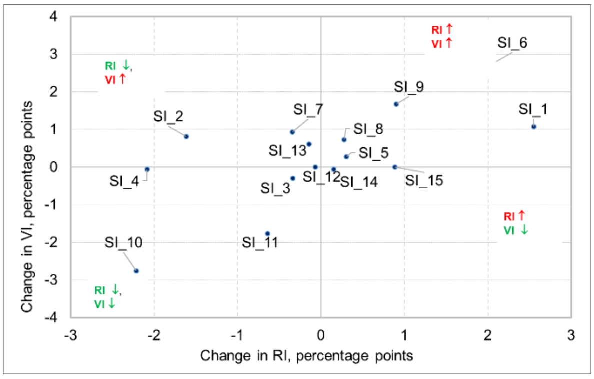


Figure 4.26: Changes in the climate risk vulnerability and relevance indices between March 2017 and March 2020



Note: The bank labels of SI_1 to SI_15 do not correspond across the figures and do not refer to the same financial institutions.

Sources: Bank of Slovenia, Eurostat (2020)

The changes through time also reveal sizeable differences between banks in terms of the increase in climate risk vulnerability and relevance. The quadrant plot generally places banks in the quadrants with a deterioration or improvement in both indices, which is partly a result of the methodology, since an increase in bank exposures also increases its share of systemic exposures.

[13] It should be noted that the vulnerability index at bank level cannot be more than 1, due to the weighting by emissions. Accounting for the sector with the largest share of total emissions, namely electricity, the maximum weighted share in a bank's portfolio would be 0.31 in the case of 100% (maximum) exposure to the electricity sector. The relevance indices sum to 1 at the systemic level, since the calculation is based on market shares.

4.3.2 Definition of carbon footprint and carbon intensity

Metrics of carbon footprint and carbon intensity could provide additional insight into the decarbonisation process. The carbon footprint builds on the climate risk relevance index accounting for the absolute emissions and not the sectoral share in total emissions. The carbon footprint shows the emissions financed by individual banks through their NFCs portfolios, while the carbon intensity metric expresses carbon footprint relative to the bank's lending activity. An increase in carbon footprint and carbon intensity indicates increased climate risks, while a decline in carbon footprint and carbon intensity indicates reduced climate risks and a decarbonisation process.

a) Carbon footprint

Carbon footprint is measured based on the calculation presented in Appendix 6, by assigning emissions to each sector relative to the share of financing per activity (w_{jk}). Carbon footprint is thus based on two factors: the bank's exposure to a specific sector and the sectoral emissions. The emissions for bank *j* are determined as the sum of the bank's assigned emissions across all *k* sectors:

$$CO2_j = Emissions_j = \sum_k w_{j,k} * Emissions_k$$

Sectoral emissions are assigned based on the share of exposure of bank *j* to a specific sector *k* at the systemic level, i.e. the share of sector *k* financed by bank *j*, or the share $w_{j,k}$, where:

$$w_{j,k} = \frac{Exposure_{j,k}}{Exposure_k}$$

It follows from the above that the carbon footprint can increase if the bank increases its exposure to a specific polluting sector, which increases $w_{j,k}$, or if it retains the same exposure to a sector that is polluting more, which increases $Emissions_k$.

It also follows that the carbon footprint will be highest for the largest banks because of the size of exposures. This means that it is not sensible to compare the carbon footprint across banks in absolute terms. The carbon footprint can be compared across banks in relative terms, in terms of comparing changes in the footprint and portfolio decarbonisation through time.

Comparing the carbon footprint through time will reflect the decarbonisation process of the banking portfolio, where the change in the carbon footprint reflects a change in both factors explained above. Emissions can be fixed to a base point to exclude the effect of emissions on the carbon footprint. Comparing the carbon footprint based on emissions fixed to a base point will thus reflect changes in exposures only and not the changes in emissions. Two calculations are further presented, one with a current and fixed carbon footprint. The current carbon footprint is calculated using emissions with a one-year lag, as an approximation of the emissions data available to the bank at the decision point (i.e. in 2018, the emissions data for 2017), while for fixed emissions the emission data are fixed to 2016.

b) Carbon intensity

The calculation above reflects the carbon footprint at the bank level, with a positive effect of the size of the bank on the carbon footprint. The carbon intensity of the portfolio provides further insights, as it is a more comprehensive metric of the carbon footprint and the decarbonisation process. A higher carbon footprint is the result of a larger credit portfolio, which increases climate risks for larger banks. However, the credit portfolio also has an economic function of allocating resources for productive purposes, which is why it is sensible to express the carbon footprint relative to unit exposures.

This provides additional insight into the decarbonisation process, as the changes through time will reflect in the carbon footprint, i.e. emissions and exposures, and lending in general. The carbon footprint may increase at a particular bank in absolute terms, which indicates no decarbonisation and increased climate risks. An increase in the carbon footprint and simultaneous growth in the credit portfolio leads to a decline in the carbon intensity of the credit portfolio. This would indicate partial decarbonisation of the bank portfolio. Climate risks would therefore be assessed as lower.

Carbon intensity is defined as carbon footprint relative to the size of the credit portfolio. It is expressed as tonnes of CO_2 per EUR 1,000:

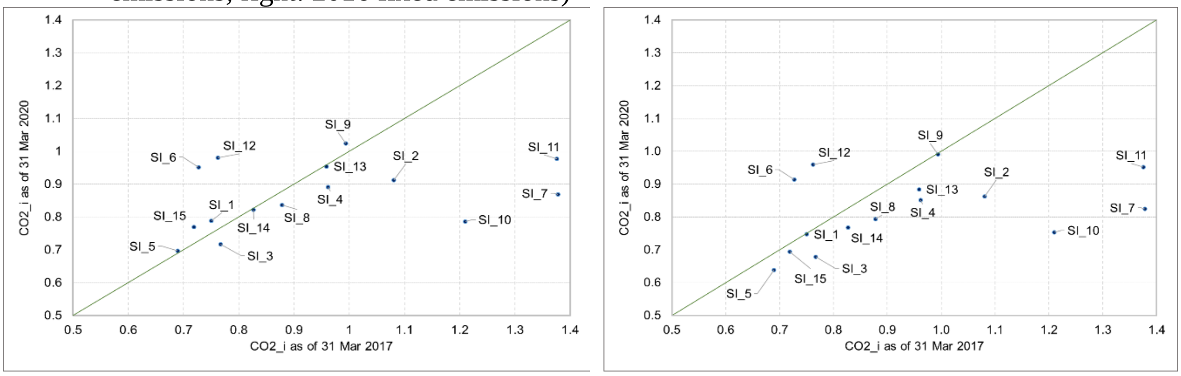
$$CO2\_i_j = \frac{CO2_j}{NFCs\_exposure_j}$$

4.3.3 Carbon footprint and carbon intensity of Slovenian banks

The carbon footprint is calculated based on the exposures to all sectors, while the change through time at the bank level will reflect an increase in exposures to (polluting) sectors and/or an increase in the emissions by sectors. Since the carbon footprint can increase as a result of an increase in sectoral emissions, rather than increased sectoral lending, the carbon footprint is also calculated based on fixed emissions (from 2016). The results show that there is an increase in the carbon footprint through time across several banks, regardless of whether emissions are fixed at initial levels. Decarbonisation can be observed at seven of the 15 banks, according to the calculation based on the current carbon footprint. Fixing emissions at the base year reduces the carbon footprint across all banks and improves the assessment of decarbonisation.

The panels below show the carbon intensity metric which relates the carbon footprint per unit of exposures (tonnes of CO_2 per EUR 1,000). A bank positioned above the diagonal line had a higher carbon intensity in March 2020 than in March 2017. Decarbonisation of the credit portfolio between 2017 and 2020 (the three-year horizon) can be observed for the banks below the diagonal line, which shows as a greater distance from the line of equal carbon intensity for banks with portfolio decarbonisation. Fixing emissions has a significant impact on the assessment of banks' decarbonisation using the carbon intensity metric. Namely, using fixed emissions the carbon intensity metric indicates decarbonisation at 13 of the 15 banks, compared to approximately half (seven out of 15) according to the calculation based on the carbon footprint metric.

Figure 4.27: Carbon intensity of Slovenian banks in March 2017 and March 2020 (left: current emissions; right: 2016 fixed emissions)



Note: In the calculation based on current emissions, the data publication lag of emissions data means that emissions are taken into account with a one-year lag. Current emissions for 2017 would actually be emissions in 2016, as this is the best approximation available for the banks' emissions at that time. Because the latest emissions data available is from 2018, the current emissions for 2019 and 2020 are from 2018.

Sources: Eurostat, Bank of Slovenia (2020)

The indicators reflect various insights regarding the decarbonisation process, depending on the carbon metric, i.e. carbon footprint or intensity. The results should thus be interpreted carefully.

The carbon intensity metric shows better results in terms of decarbonisation and cross-bank comparisons, compared to those suggested by the carbon footprint metric. It should also be noted that a decline in carbon intensity can arise as a result of a reduction in the carbon footprint, or a reduction in the credit portfolio. While the first is beneficial to society and reflects decarbonisation in its true sense, the second reflects declines in lending rather than simultaneous credit growth and environmental benefits. This reflects the trade-off between (portfolio) growth and emissions at the bank level. The latter can be observed for example for a bank with a contraction in the credit portfolio and as a result significantly improved environmental indicators.

4.3.4 Decarbonisation of the NFCs portfolio between March 2017 and March 2020

Analysing the decarbonisation process therefore requires multiple dimensions. The following figures show decarbonisation through time, as depicted by the changes in the carbon footprint and carbon intensity between March 2017 and March 2020.

Bank classification

Banks can be classified into four quadrants based on the changes in their carbon footprint and carbon intensity.

I) **The first quadrant contains banks with an increase in carbon footprint and carbon intensity (CO2 ↑, CO2_i ↑).** Under the assumption of credit growth, this means that the increase in the balance sheet is insufficient to outweigh the effect of the increase in the carbon footprint, which increases the carbon footprint per unit of exposure as a result. In this case, carbon intensity would also increase as a result of a contraction in the balance sheet.

II) **The second quadrant contains banks with a decrease in carbon footprint and an increase in carbon intensity (CO2 ↓, CO2_i ↑).** This would be the result of a contraction in the credit portfolio that outweighs the effect of the reduction in the carbon footprint (and the subsequent improvement in carbon intensity). There are no such banks in Slovenia at present.

III) **The third quadrant contains banks with a decrease in carbon footprint and carbon intensity (CO2 ↓, CO2_i ↓).** These are the banks that are achieving improvements in both environmental indicators. This is also the best quadrant of classification under the assumption of credit growth, as in this case the decrease in carbon intensity is the result of a decrease in carbon footprint instead of a contraction in the balance sheet. Namely, this would also result in a lower carbon footprint and carbon intensity.

IV) **The fourth quadrant contains banks with an increase in carbon footprint and a decrease in carbon intensity (CO2 ↑, CO2_i ↓).** This means that the expansion of the credit portfolio is sufficient to outweigh the effect of the increase in the carbon footprint, which reduces carbon intensity.

Figure 4.28: Changes in carbon footprint and carbon intensity between March 2017 and March 2020 (current emissions)

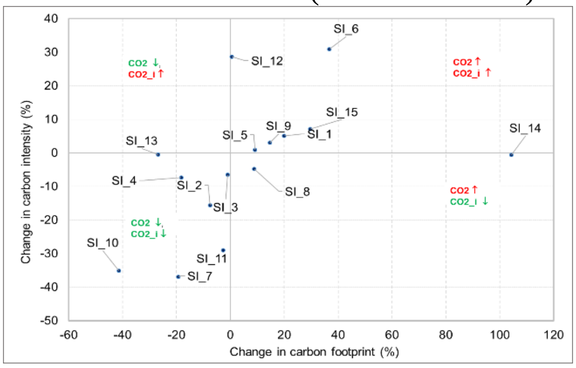
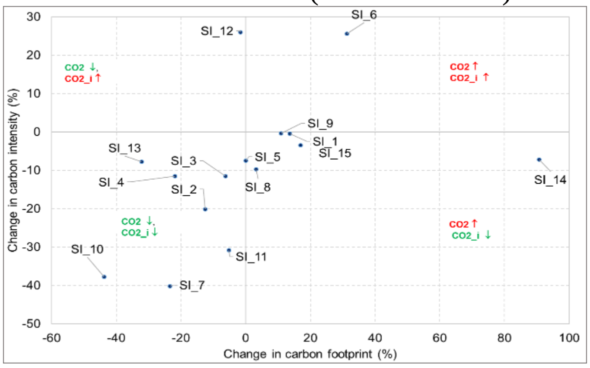


Figure 4.29: Changes in carbon footprint and carbon intensity between March 2017 and March 2020 (fixed emissions)



Sources: Eurostat, Bank of Slovenia (2020)

The classifications above present a mixed picture of the decarbonisation process in Slovenian banks, with most banks classified in the first and third quadrants, using the carbon footprint metric based on fixed emissions. These are the banks for which both environmental indicators either improved or deteriorated, which indicates that changes in carbon footprint are in general larger than changes in the credit portfolio (increases in the majority of cases). The increase in the credit portfolio could hypothetically outweigh the increase in the carbon footprint, thereby reducing carbon intensity. Several banks shift from the first to the fourth quadrant when calculating carbon footprint based on fixed emissions. An increase in carbon footprint and a decrease in carbon intensity are characteristic for this quadrant. In this case, the expansion of the credit portfolio outweighs the increase in the carbon footprint, which leads to a reduction in carbon intensity. The effect of the increase in lending is not sufficient to outweigh the effect of the increase in carbon footprint for two banks.

Decreases in carbon footprint and carbon intensity can be observed for the banks in the third quadrant, which indicates portfolio decarbonisation. It should be noted that in some cases the decarbonisation process is the result of a decline in lending, rather than lending to sectors that pollute less.

Systemic aspect of decarbonisation

The classifications above are also informative in terms of systemic decarbonisation, as they show changes across O-SIIs and other institutions. Overall, when accounting for the systemic aspect the largest changes can be observed for other institutions in aggregate.

Figure 4.30: Carbon footprint and changes in carbon footprint between March 2017 and March 2020 by type of institution

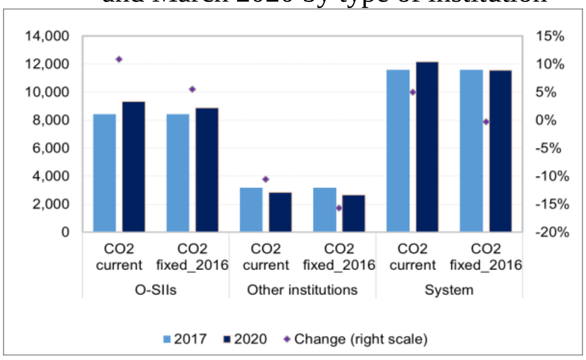
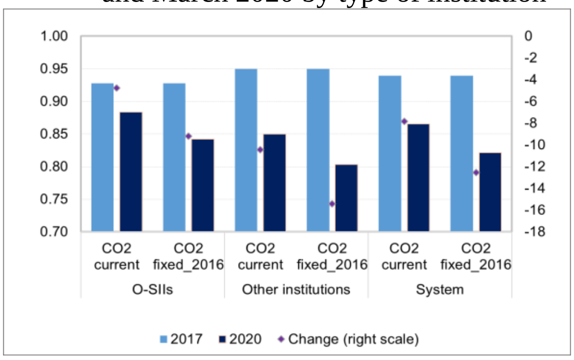


Figure 4.31: Carbon intensity and changes in carbon intensity between March 2017 and March 2020 by type of institution



Note: The definition of O-SIIs is fixed over time and is based on Bank of Slovenia's most recent assessment of the systemic importance of banks from December 2019.

Sources: Eurostat, Bank of Slovenia (2020)

A decrease in the carbon footprint can be identified for other institutions when comparing the carbon footprint of systemically important and other institutions in aggregate, regardless of whether the calculation is based on current or fixed emissions. The carbon footprint of systemically important institutions increased by 10.9% or 5.5% between March 2017 and March 2020, based on current or fixed emissions respectively. An increase in the carbon footprint of 5% or a decrease of 0.3% was observed at the systemic level, depending on the emissions basis.

The carbon intensity figures indicate decarbonisation as a result of growth in lending at O-SIIs. The carbon intensity of systemically important institutions averaged 0.88 tonnes of CO_2 per EUR 1,000 in March 2020, compared with 0.93 tonnes of CO_2 per EUR 1,000 in March 2017, which is a decline of 4.7%. The average carbon intensity of systemically important institutions declined by 9.14%, when using fixed emissions. An even greater improvement can be observed in other institutions' average carbon intensity, which decreased by 10.5% using current emissions, or by 15.4% using fixed emissions. The effect arises mostly from improvements at a smaller number of institutions with high carbon intensity. The improvement in carbon intensity at both types of institutions reflects in the decrease in average carbon intensity at the systemic level (based on fixed emissions) of 12.5%, from 0.94 tonnes of CO_2 per EUR 1,000 in March 2017 to 0.82 tonnes of CO_2 per EUR 1,000 in March 2020.

It should be noted that the carbon footprint of O-SIIs deteriorated during 2019 despite improvements in carbon intensity as a result of lending growth. The two figures below illustrate the changes in carbon footprint and average carbon intensity over time at the O-SIIs and other institutions. The figure shows that carbon intensity of the O-SIIs is improving, while the growth in carbon footprint remains positive. It is also increasing based on fixed emissions, which indicates that the growth in the carbon footprint is a result of lending to activities which pollute more. An improvement in both indicators could be observed at other institutions in the second half of 2019. The decrease in carbon intensity for both types of institutions reflects in the decrease in carbon intensity at the systemic level.

Figure 4.32: Annual growth in carbon footprint and average carbon intensity by type of institution (current emissions)

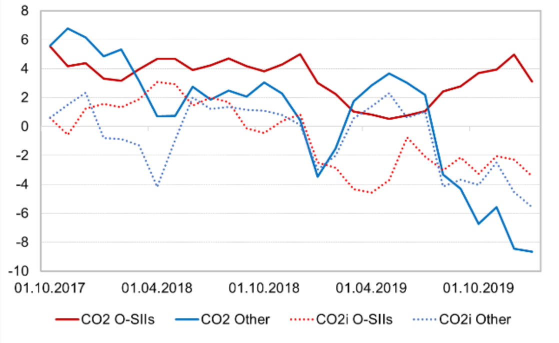
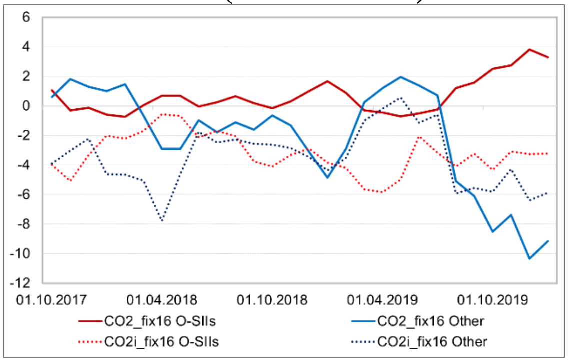


Figure 4.33: Annual growth in carbon footprint and average carbon intensity by type of institution (fixed emissions)



Note 1: O-SIIs are defined according to the most recent assessment of systemic importance of banks in Slovenia from December 2019.
Note 2: CO2i denotes carbon intensity, while CO2 denotes carbon footprint.
Sources: Eurostat, Bank of Slovenia (2020)

This shows the importance of addressing climate risks systemically, as the contributions by both types of institutions are materially significant in terms of the carbon footprint and carbon intensity, in terms of systemic improvement or deterioration. Systemically important institutions will contribute significantly to improvements in the carbon indicators given their recent positive contribution and the potential for economies of scale in boosting green lending. The high awareness of climate risks[14] across banks is encouraging, although tackling climate risks will depend on banks' active policies, which are currently in a preliminary phase. This will require an increase in the supply of green loans, human capital investment and the development of climate risk management tools.

There are several findings to be drawn from the above.

First, the carbon footprint of the system is increasing as a result of the overall growth in emissions, while carbon intensity is improving as a result of growth in lending between March 2017 and March 2020.

Decarbonisation can be observed at least partially across most banks, which reduces systemic risks. There was a simultaneous deterioration or improvement in both environmental indicators for most banks, based on current emissions. A decarbonisation process is evident for most banks, with an improvement in at least one environmental indicator of the credit portfolio, based on fixed emissions. Deterioration in environmental indicators can be observed across only two banks, regardless of the emissions basis or the environmental indicator.

From a systemic perspective, decarbonisation is more pronounced at the other (smaller) institutions than at the O-SIIs. Overall, there was a deterioration in the carbon footprint and an improvement in the carbon intensity for O-SIIs during 2019 (at the annual level). An improvement in carbon footprint and carbon intensity can be observed across the other (smaller) institutions over the three-year horizon. The latter was driven by improvements at a small number of banks. An additional improvement in carbon intensity can be observed at the O-SIIs in recent months due to increased lending, with a positive and increasing trend in the annual growth rate of the carbon footprint.

4.4 Next steps

The next steps depend on an increased granularity of reporting, so as to reflect the green dimension more accurately. This is particularly important in the case of households, where we include all exposures, although some loans might be green household loans. Similarly, some firms may have raised funds to green at least some of their business processes. This can be part of the core business process in the electricity sector, for example electricity generation from renewable energy sources. The current data granularity enables further integrating firm-level ETS emissions and loans.

Increasing granularity and firm level data consistency are feasible over the medium term and depend on the evolution of EU regulations. Further extensions in the climate sensitivity metrics are feasible. The evolution of EU regulations, for example within the green taxonomy framework, will enable increased granularity over the medium term. The climate sensitivity metrics might be expanded to cover additional parts of the system, for example based on the available environmental indicators across countries for assessing insurers' exposures. Banks' carbon intensity could be calculated on the basis of firm or sectoral carbon intensity (as the weighted carbon intensity of all firms based on the carbon intensity of the individual sector), as the current calculation relates the bank's carbon footprint relative to the size of its credit portfolio.

An assessment of the maturities across sectors would be particularly important from the perspective of financial stability. One feature of climate risks in the banking system is the issue of lock-in, which arises as a result of the maturities of existing loans, which are generally longer for major investment projects, for example in climate-sensitive sectors. This could increase climate

[14] Based on the findings from Bank of Slovenia's Survey of future challenges to the banking system conducted in October 2019.

risks significantly, as it prolongues the decarbonisation horizon. Analysing loan maturities will thus be an additional source of information on the horizon and magnitude of climate risks.

5. Conclusion

Climate risks are increasingly coming to the forefront, given the anticipated materiality of climate change and related loss events. The upcoming energy transitions in response to climate change are an additional source of risk. Physical and transition climate risks are systemically important. Physical risks impact financial institutions (insurers in particular) and households, due to the direct costs of the damages and the indirect costs of disruptions to trade. Transition risks impact a range of stakeholders. Households are affected due to changes in environmental policy, firms are affected due to market changes and environmental policy measures, while financial institutions are affected due to the impact on securities and creditworthiness. The main impact for banks in Slovenia is expected to arise from credit risk, as market risk is relatively lower.

Climate risks will depend on the climate sensitivity of individual sectors or segments, defined based on their share of emissions. Climate-sensitive sectors in Slovenia include households, manufacturing, transport, construction and the electricity sector. This report applies the narrow and broad definitions of climate sensitivity, depending on whether we account for only the most polluting subsectors or all sectors within manufacturing, electricity, construction and transport. Macrodeterminants could increase the climate sensitivity of the system due to the structure of value-added and imbalances in environmental policies.

Physical risks will be most significant for insurers and the government, due to the expected increase in insured losses and the high share of uninsured losses. The current data for Slovenia indicates low and manageable physical risks. This follows from the growth in premiums and claims, their stable shares in GDP and the coverage of claims by premiums. The share of weather-related claims in total claims is also low, which suggests a manageable level of losses. Additional risks can also arise from the insurance protection gap, i.e. in case of a large share of uninsured losses.

The current assessments indicate moderate transition risks in Slovenia, based on the definition of climate sensitivity. The moderate assessment of climate risks is due to the low to moderate share of exposures to climate-sensitive sectors in the balance sheet or the NFCs portfolio, their solid creditworthiness based on NPE shares and profitability ratios. The NPEs in climate sensitive sectors have a similar trajectory compared to other NPEs, with a systematic gap between the profitability of climate-sensitive and other sectors. The latter indicates manageable climate risks.

The risk assessment could be significantly reduced if using firm level emission data, despite a higher risk concentration. Factors in the international environment indicate a moderate assessment of climate risks. Climate risks are further reduced if using firm level emissions data, despite an increased concentration of risks due to emissions concentration in a small number of firms. Climate risks remain moderate because of the volatility in carbon prices and the potential changes in profitability, for example in the event of a faster green transition in the EU.

Another significant factor in transition risks will be the decarbonisation of the portfolio in terms of reducing the carbon footprint and carbon intensity of the portfolio. The report presents initial calculations of carbon footprint and carbon intensity, which show partial decarbonisation across banks in Slovenia between March 2017 and March 2020. There is an improvement in carbon intensity at the systemic level, driven by growth in lending. Carbon footprint is calculated by assigning emissions to banks according to their sectoral exposures, using current or fixed emissions. The latter excludes the effect on the carbon footprint from changes in emissions at the sectoral level. When using fixed emissions, the carbon footprint mostly improves across all banks. Growth in lending is contributing to the improvement in carbon intensity. At the systemic level, climate risks are more concentrated in the O-SIIs, while improvements in the carbon footprint and carbon intensity can be observed at the other institutions.

The current assessment of climate risks is low to moderate, based on developments in the physical and transition risks indicators. With regard to physical risks, premiums and claims have been increasing during recent decades, while the share of weather-related claims in total claims and GDP remain stable. Increased risks can also arise from the insurance protection gap, i.e. a large share of uninsured losses. The assessment of transition risks is moderate, due to a stable and moderate share of exposures to climate-sensitive sectors in the portfolio, solid creditworthiness based on the NPE shares and profitability indicators, and the partial process of decarbonisation. Several factors might increase climate risks, such as changes in Slovenia's environmental targets, the volatility of carbon prices, or more ambitious environmental policies for EU countries in general. The impact of the crisis is another factor that could increase climate risks sharply. The recovery from the crisis could increase climate risks significantly for climate-sensitive manufacturing and transport sectors, which were among the sectors hit hardest by the crisis. It should be noted that climate risks can also be an opportunity, in light of the green growth initiatives, within the European Green Deal and the green recovery strategy.

The next steps include increasing the granularity of reporting and expanding the metrics of climate sensitivity. The analysis of loan maturities will be particularly important from the perspective of financial stability, in light of the lock-in of bank loans. Increased data granularity will be important to assess the climate sensitivity of specific segments more accurately. Furthermore, the analysis of loan maturities will be particularly informative due to potentially longer maturities in climate-sensitive sectors (e.g. manufacturing).

6. Appendices

6.1 Climate scenarios and the trade-off problem

Sustainability is a concept with two main pillars, economic and environmental, and objectives that are frequently characterized by a problem of choice due to the energy consumption which is needed for economic growth. This is the trade-off issue, which can be alleviated in light of the coming climate crisis. Additional investment to mitigate the effects or reduce the risk of climate change can provide a stimulus to economic growth. This is the opportunity presented by climate change.

There are several scenarios that provide preliminary estimates of the need for additional investment to reduce global warming, e.g. to 2 degrees or below at the global level compared with the pre-industrial period. The figure illustrates estimates of the additional investment at the annual level in absolute terms and as a percentage of GDP. The figure shows that the additional investment will cost at least 0.5% of GDP in the initial year in each region. Additional investment of around 1% of GDP is required under the more ambitious scenarios, where the rise in global temperatures is limited to 1.5 degrees. This could be an additional source of economic growth, as secular growth is an issue in advanced economies. Another factor is the recession caused by the Covid-19 shock.

Figure 6.1: Additional investment over the baseline scenario under various scenarios (absolute and % of GDP) at EU level and in the global economy

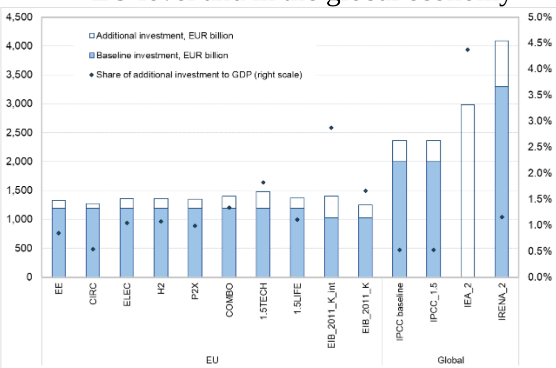
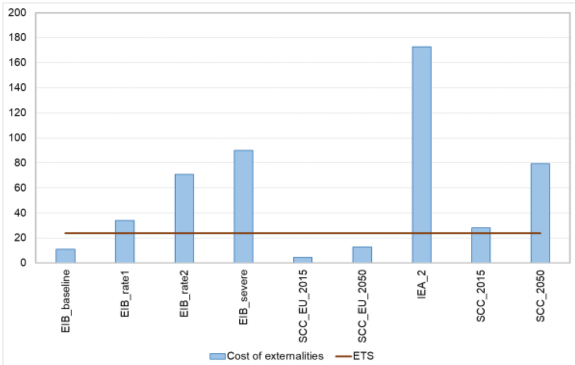


Figure 6.2: Cost of externalities and carbon price under various scenarios



Note: The scenarios for the EU encompass changes based on improvements in an individual factor in the green economy, for example focusing on electricity (ELEC), the circular economy (CIRC), carbon-neutral gases (H2, P2X) or increased energy efficiency (EE). The COMBO scenario represents an intermediate scenario that does not achieve carbon neutrality, but combines factors from the aforementioned elements, as it is unrealistic to expect the green transition to be based entirely on a single factor, while the 1.5TECH and 1.5LIFE scenarios achieve carbon neutrality through a technological breakthrough or changes of lifestyle among the public.

Note 2: The EIB scenarios from 2012 are based on a capital-intensive energy transition (the EIB_K_int scenario is extremely capital-intensive compared with the lower capital intensity of the EIB_2012_K scenario). The other scenarios include the IPCC scenarios with a target global temperature rise of 1.5 degrees, and the IEA and IRENA scenarios with a 66% probability of limiting the temperature rise to 2 degrees compared with the pre-industrial age.

Note 3: Estimates of externalities may differ depending on the year of publication and the purpose is to illustrate a range of estimates. The SCC estimates are based on the estimates by Nordhaus (2017), and represent the social cost of carbon, which rises at 3% annually from 2015 under the baseline scenario. The IEA estimates of carbon prices estimate the price required to limit the temperature rise to 2 degrees with a probability of 66%. The EIB estimates are based on the EIB estimates from 2012, using different discount rates to reflect preferences for the wellbeing of future generations. An increase in the latter also increases the social cost of carbon or pollution. The various discount rates also raise the estimate of SCC in Nordhaus (2017).

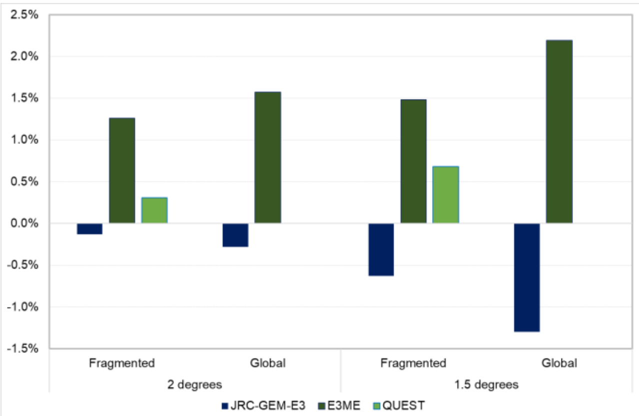
Sources: European Commission (2018), EIB (2012), IPCC, IEA, IRENA (2017), Nordhaus (2017)

In addition, climate investments are sensible also in terms of reducing or internalizing the externalities related to climate change. The externalities from pollution are difficult to estimate and are subject to model uncertainties. According to some preliminary estimates, they generally exceed the current carbon price under the EU ETS. This suggests that current carbon prices are insufficient to cover the social cost of carbon pollution, which increases climate risks due to excess pollution.

Another significant factor for raising economic growth through green investment is the policy timeline. Analysis by the European Commission finds that the impact on GDP generally reaches up to 2 p.p. over the long term in terms of deviation from the baseline scenario, and depends on the actions taken by other countries, environmental policy and model assumptions.

The impact on economic growth in the EU is positive for example under models with the assumption of an output gap or the economy operating below full employment (E3ME, Quest), and negative under models with a full employment assumption (JRC). The impact is also greater in the case of coordinated global action, regardless of the sign of the effect. Greening the EU economy reduces its competitiveness compared with other regions. This exacerbates the adverse impact in the case of models with a full employment assumption. However, action by other countries has a positive impact, considering the market size effect and the increase in investment in other regions. In the long term, the market size effect ensures a positive impact on economic growth in the models with an output gap assunption, even in the case of coordinated global action.

Figure 6.3: Impact on GDP in the EU (deviation from baseline scenario) under various green transition scenarios



Note 1: The fragmented scenario assumes a reduction of 80% in EU emissions and achieving carbon neutrality in the case of scenarios where the temperature rise is limited to 2 or 1.5 degrees. Other countries reduce their emissions in line with their national targets.

Note 2: The global scenario assumes reductions of 46% and 72% (in aggregate) by other countries under the scenario where the temperature rise is limited to 2 or 1.5 degrees.

Source: European Commission (2018)

Table 6.1: Deviation from baseline GDP in 2050 based on various environmental scenarios

Model/scenario	Assumption	2 degrees		1.5 degrees		Dominant effect	Difference under 2-degree scenario	Difference under 1.5-degree scenario
		Fragmented	Global	Fragmented	Global			
JRC-GEM-E3	full employment	-0.13%	-0.28%	-0.63%	-1.30%	competitiveness	-0.15%	-0.67%
E3ME	output gap	1.26%	1.57%	1.48%	2.19%	market size	0.31%	0.71%
QUEST	output gap	0.31%		0.68%				

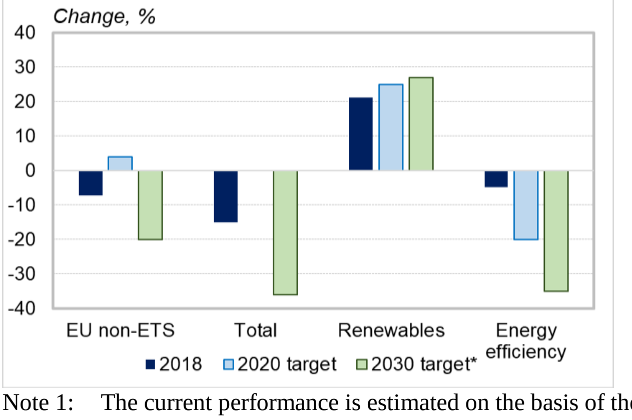
Source: European Commission (2018)

6.2 Emissions targets in Slovenia and the NECP

The current emissions targets are set by Decision 406/2009/EC and the Burden Sharing Regulation (Regulation 2018/842), which oblige Slovenia to reduce emissions from sectors outside the EU ETS (non-ETS sectors) by 15% by 2030, and to limit the increase to 4% by 2020, both relative to 2005.[15] Current targets are not set with regard to aggregate emissions. The current level of emissions allows meeting both targets, as the 2020 target was met, with a 7% reduction in non-ETS emissions in 2018 relative to 2005. The projected trajectory of emissions also meets the 2030 target, with a projected reduction of 15% in non-ETS emissions.[16] The targets across other environmental areas include a 25% share of renewable energy sources in total energy consumption and a 20% reduction in energy consumption within the energy efficiency target.

The national energy and climate plan (NECP) sets new targets for climate neutrality and envisages a reduction of at least 20% in non-ETS emissions by 2030, compared with the current target of a 15% reduction. At the same time, the NECP also introduces a total emissions target reduction of 36% by 2030 relative to 2005 (twice the currently projected reduction of 18%). In other areas, the target for renewable energy sources is increased from 25% in 2020 to 27% in 2030. The share of renewables in energy consumption is currently not meeting this target. Slovenia is also not meeting its energy efficiency targets, where the targets entail reductions of 20% by 2020 and 35% by 2030 relative to 2007 (the Primes scenario). Currently, Slovenia is meeting only its 2020 target reduction in non-ETS emissions, with a significant distance to the 2020 and 2030 targets set in other areas (renewables, energy efficiency).

Figure 6.4: Current performance and targets for 2020 and 2030 across environmental target areas (emissions, renewables, energy efficiency)



Note 1: The current performance is estimated on the basis of the latest available data for 2018.
Note 2: The targets for 2030 are derived from the targets set by the NECP and not from EU regulations.
Source: National Energy and Climate Plan (2020)

The total investment envisaged under the current NECP is EUR 28.3 billion for the period of 2021 to 2030, or EUR 22 billion excluding transport. To ensure sufficient investment, the NECP envisages existing fiscal incentives, in addition to EU funds and a private sector contribution to total investment. The total fiscal incentives required to meet the targets for renewables and energy efficiency (excluding transport, additional funding for research and innovation and the distribution network) amount to almost EUR 2.5 billion for 2021 to 2030, with up to EUR 3.1 billion available from budget incentives, which encompasses funding from the climate fund, incentives for renewables and energy efficiency (of which more than half from incentives for renewables).

[15] Decision 406/2009/EC.
[16] Based on emissions forecasts for Member States, reviewed by the European Environment Agency (https://ec.europa.eu/environment/eir/pdf/report_si_en.pdf).

Another source of funding is carbon taxation, which is projected to raise approximately EUR 1.4 billion in the period between 2021 and 2030. This is an additional source of financing that could double the existing fiscal incentives, in addition to the funds from the ETS allowances.

Overall, the fiscal incentives could raise up to EUR 4.5 billion (excluding funds from the EU ETS), or around 16% of the total investment required under the NECP. Without the funds from carbon taxes, these could account for up to approximately 11% of total investment. This implies that the required fiscal multiplier for the incentives is between 6 and 10, as the total amount of required investment can amount to ten times the existing fiscal incentives. Alternative sources of financing, private sector investment and EU funds will thus be of key importance in providing the required investment.

The sustainability of alternative sources of financing could be hindered by the downturn caused by the Covid-19 pandemic. From this perspective, it is crucial to identify priority investments, as the total funds envisaged in the NECP amount to approximately 60% of current GDP. The NECP scenario also envisages maintaining annual growth in private sector investment at over 4% between 2021 and 2030. Current conditions and the recession caused by the Covid-19 pandemic raise issues for the current ambitious investment plan. Increasing the scale of green investments would provide a higher fiscal multiplier than otherwise, for example through investment in infrastructure. Another factor is social acceptability, in light of the impact of the NECP scenario on social equality, which will reduce disposable income in the first quintile and increase disposable income in all other quintiles (NECP, 2020).

Figure 6.5: Projected fiscal incentives and annual investment under the NECP scenario and scenarios with existing measures, absolute (EUR billion) and as % GDP

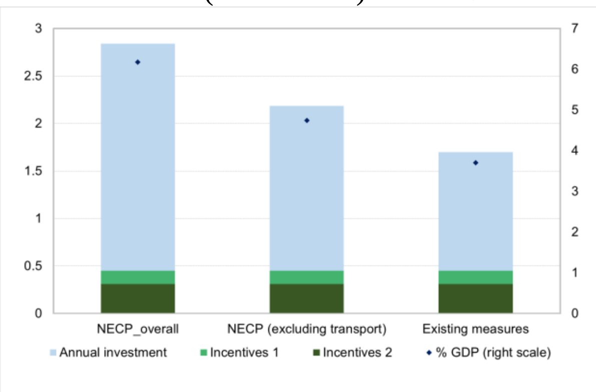
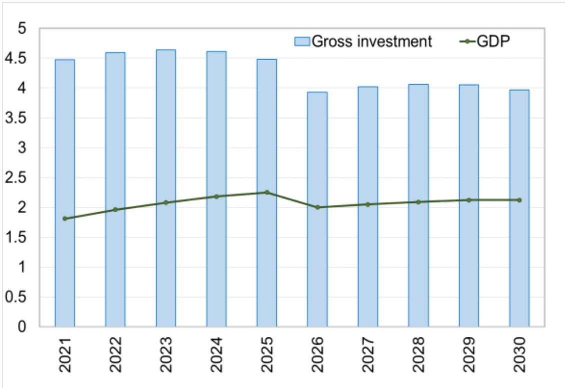


Figure 6.6: Projected annual growth in gross investment and GDP under the NECP scenario (%)



Note: Incentives 1 covers all incentives under the climate fund, contributions for renewables and energy efficiency, and carbon taxes, while Incentives 2 covers all incentives under the climate fund, contributions for renewables and energy efficiency, excluding carbon taxes.

Source: National Energy and Climate Plan (2020)

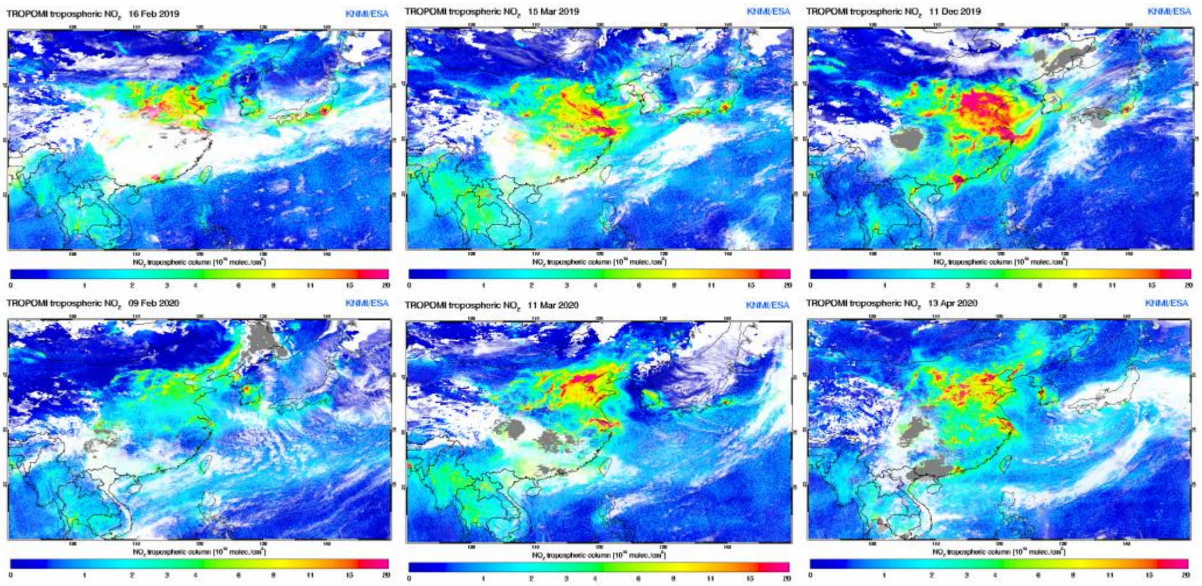
6.3 Impact of Covid-19 on emissions

The Covid-19 containment measures caused lockdowns in parts of the economy and consequently led to an improvement in air quality. Satellite images show a significant improvement in NO_2 emissions. The figures below illustrate emissions concentrations in Europe and south-east Asia before and after the introduction of containment measures. There are no major discernible changes in CO_2 concentrations so far, although some estimates suggest that CO_2 emissions may have declined by 5.5% to 5.7%.[17]

[17] CO_2 emissions estimated on the basis of developments in NO_2 emissions.

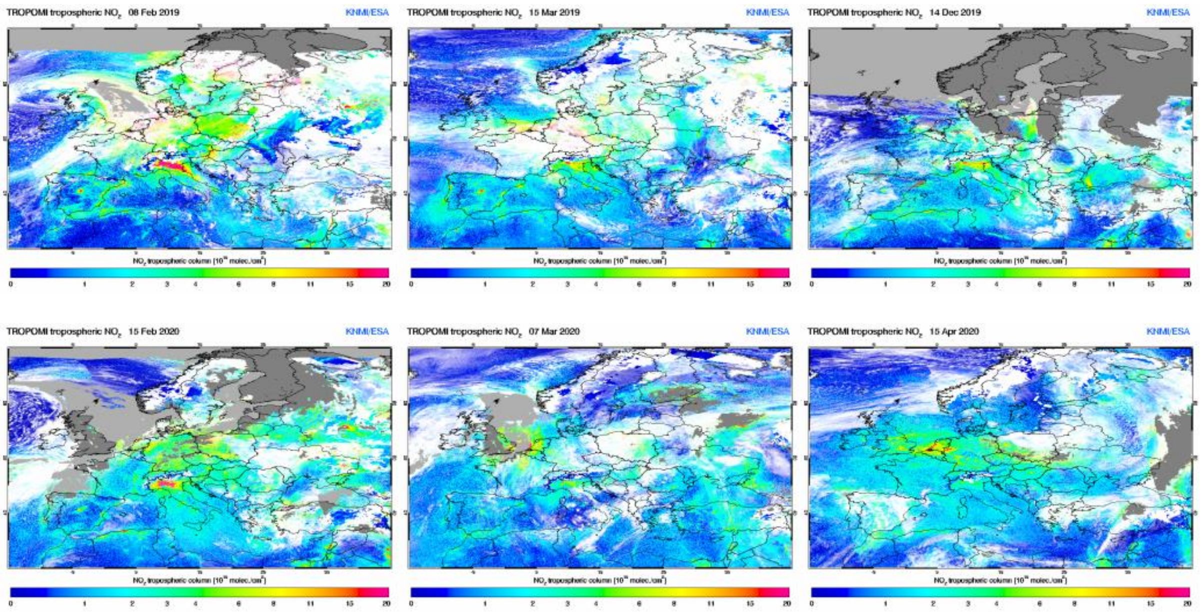
Although the containment measures will slow the trend of growth in CO_2 emissions, there will not be a significant impact on the evolution of the climate crisis without additional measures.[18] Namely, these are emissions with a longer lifecycle, which require longer-term action. Another effect of the pandemic on climate risks could arise from the exit pathway from the crisis and the economic recovery strategies. These offer a number of opportunities for climate action, for example maintaining or expanding the scope of the European Green Deal and the green recovery. A surge of green investment will increase climate risks in this case, particularly in climate-sensitive sectors.

Figure 6.7: Images of NO_2 concentrations in south-east Asia, 2019 and 2020



Source: Temis (2020)

Figure 6.8: Images of NO_2 concentrations in Europe, 2019 and 2020



Source: Temis (2020)

[18] https://news.un.org/en/story/2020/04/1062332

6.4 Climate metrics

Table 6.2: Climate sensitivity metrics for banks and insurers

	Description of metric	*Unit/Indicator*	*Purpose*
1.	Exposures to climate-sensitive (e.g. high-carbon) segments in the (equity) portfolio, absolute or relative	EUR million or %	Size of exposures to climate-sensitive sectors that are sensitive to climate risks or opportunities
2.	Carbon intensity of the portfolio (based on reported data or estimates)	tonnes CO_2 per EUR million of revenues	Size of exposures to climate-sensitive sectors that are sensitive to climate risks or opportunities
3.	Sectoral exposures	% of total exposures	Concentration of exposures to high- and low-carbon sectors
4.	Regional exposures to credit risk and value of collateral in regions with high vulnerability to physical risks	EUR million	Concentration of exposures and collateral in countries and regions that are highly exposed to physical risks
5.	Amount of collateral related to climate risk mitigation activities	% of collateral	Amount of low-carbon collateral
6.	Financing for sustainable activities related to climate risk mitigation and adaptation, absolute and relative	EUR million and % of total exposures	Concentration of green investment and resilience to climate change
7.	Total investment in green bonds (e.g. based on the EU Green Bond Standard), absolute or relative	EUR million or % assets in green bonds	Implementation of a green transition strategy in investment decisions

Note: The metrics are taken from the European Commission's Guidelines on reporting climate-related information (2019) and encompass guidance for reporting by banks and insurers.

Table 6.3: Basis for climate sensitivity metrics

Corporations		
Metric	*Basis/description of indicator*	*Purpose and notes*
Greenhouse gas emissions	Tonnes of GHG emissions from firm's (in)direct operations	Scope 1: direct emissions from energy production and other industrial processes Scope 2: indirect emissions from energy purchased off-site Scope 3: indirect emissions throughout the production chain
Greenhouse gas intensity	Emissions relative to EUR million of revenues or EBITDA	Allows for comparisons at sector and firm level
Green/brown share	% of green or brown activities in firm's revenue	Depends on the classification of green or brown activities and the taxonomy in use
Exposure to physical risks	Physical risk score with regard to location, supply chain and market risk	Evaluation of overall long-term and short-term potential exposures to physical risks from climate change
Environmental score	Underlying E of the ESG score	
Government bonds		
Metric	*Basis/description of indicator*	*Purpose and notes*
Greenhouse gas emissions (absolute)	National GHG emissions, million tonnes	Production-based: GHG emissions from production within national territory Consumption-based: GHG emissions from national consumption Economic activity: emissions associated with national production and consumption, including imports
Greenhouse gas emissions (relative)	National GHG emissions, million tonnes	Relative to size of population or economy, emissions per capita or per unit GDP
Power generation mix	% breakdown of energy production	Overview of sources of power generation and comparison with global targets
Renewable energy	% of renewable energy in total energy consumption	Overview of sources of power generation and comparison with global targets
Physical risk	Provides insight into physical risk vulnerability based on several factors, e.g. sea level rise, storms, heat stress	Evaluation of overall long-term and short-term potential exposures to physical risks from climate change
Environmental score	Underlying E of the ESG score	

Source: NGFS (2019) A sustainable and responsible investment guide for central banks' portfolio management

6.5 Definition of climate sensitivity

Climate sensitivity can be defined on the basis of several environmentally relevant factors. CO_2 emissions are the main driver of climate change and are also the most important factor in climate sensitivity. The EU taxonomy for example sets out six environmental objectives: climate change mitigation, climate change adaptation, the sustainable use and protection of water and marine resources, the transition to a circular economy (waste management), pollution prevention and control, and the protection and restoration of biodiversity and ecosystems.

Battiston et al. (2017) define climate-policy-relevant sectors on the basis of three criteria: the contribution to emissions, the position of the sector in the emissions chain, and the relevance for environmental policy (e.g. because of high energy intensity). The definitions are applied in ECB climate analysis.

Climate sensitivity in this report is defined on the basis of two criteria, the contribution to emissions and the relevance with regard to climate risks, where the contribution to emissions is the core criterion. At the systemic level, the first criterion is a contribution to total emissions of at least 5%, or classification as a climate-relevant sector, which is defined as a sector with an increase in emissions by more than 20% over time. This could increase the share of systemic emissions by a maximum of 1 percentage point, in the case of an initial share that does not exceed 5%. According to this criterion, emissions are concentrated in four sectors: manufacturing, electricity, construction and transport. These are also significant in terms of climate risks, due to waste management, prevention of pollution or resource consumption.

A more detailed classification is possible in the manufacturing sector, where the subsectoral classification provides insights into the contributions of individual subsectors to the sector's emissions, which are generally concentrated in a small number of subsectors, or the sectoral relevance for a particular climate risk area. The defined subsectors need to account for at least 10% of sectoral emissions, thereby making a significant contribution to emissions by manufacturing. The reason for the higher threshold is to identify subsectors that contribute heavily to manufacturing emissions and thus to total emissions, where the contribution to total emissions will be smaller than the contribution to manufacturing emissions. The second criterion is the definition of the sector as a climate-relevant sector, which covers all climate-relevant sectors except those with a sharp reduction in emissions over time (of at least 20%). The reason for the less stringent criterion for the identification of climate-relevant manufacturing subsectors is the expectation of higher transition risks in manufacturing than in primary sectors, due to regulations for waste management and prevention of pollution in industrial processes, in addition to resource consumption.

Table 6.4: Climate sensitivity criteria by sector at the systemic level

Sector/Year	2018 share	Change 2018/2009	Contribution to emissions	Change over time	Climate relevance	Climate relevance and emissions	Indicator
Agriculture, forestry and fishing	1.8%	5.4%	0	0	1	0	0
Mining and quarrying	0.6%	-21.0%	0	0	1	0	0
Manufacturing	19.4%	1.8%	1	0	1	0	1
Electricity, gas, steam	31.4%	-21.1%	1	0	1	0	1
Water supply, sewerage, remediatio	0.9%	37.9%	0	1		0	0
Construction	6.9%	13.2%	1	0	1	0	1
Wholesale and retail trade	4.3%	17.2%	0	0		0	0
Transportation and storage	5.1%	8.8%	1	0	1	0	1
Accommodation and food service ac	0.9%	-25.2%	0	0		0	0
Information and communication	0.5%	6.1%	0	0		0	0
Financial and insurance activities	0.3%	-10.6%	0	0		0	0
Real estate activities	0.3%	-45.7%	0	0		0	0
Professional, scientific and technical	1.4%	-7.1%	0	0		0	0
Administrative and support service a	1.4%	31.9%	0	1		0	0
Public administration and defence	0.5%	93.0%	0	1		0	0
Education	0.5%	-35.4%	0	0		0	0
Human health and social work activi	0.6%	-29.2%	0	0		0	0
Arts, entertainment and recreation	0.3%	-29.1%	0	0		0	0
Other service activities	0.4%	-14.5%	0	0		0	0
Households	22.5%	-8.5%	1	0		0	0

Sources: Eurostat, Bank of Slovenia (2020)

Table 6.5: Climate sensitivity criteria by manufacturing subsector

Sector/Year	2018 share	Change 2018/2009	Contribution to emissions	Change over time	Climate relevance	Climate relevance and emissions	Indicator	Climate relevance
Manufacturing	n/a	1.8%			n/a		n/a	All dimensions of EU taxonomy
Manufacture of food products, beverages and tobacco products	5.9%	-4.1%	0	1		0	0	
Manufacture of textiles, clothing, leather and related products	1.3%	-19.4%	0	1		0	0	
Manufacture of wood, wood products and related products	2.0%	5.1%	0	1	1	1	1	Resource use
Manufacture of paper and paper products	10.5%	-21.9%	1	0	1	0	1	Resource use, pollution
Printing and reproduction of recorded media	0.8%	2.7%	0	1	1	1	1	Pollution, circular economy
Manufacture of coke and refined petroleum products	0.0%	-100.0%	0	0	1	0	0	Emissions at EU level
Manufacture of chemicals and chemical products	4.5%	-48.3%	0	0	1	0	0	Emissions at EU level
Manufacture of basic pharmaceutical products and pharmaceutical preparations	2.1%	30.0%	0	1		0	0	
Manufacture of rubber and plastics products	3.4%	21.2%	0	1	1	1	1	Circular economy
Manufacture of non-metallic mineral products	34.0%	0.1%	1	1	1	1	1	Pollution, climate change
Manufacture of basic metals	18.4%	54.6%	1	1	1	1	1	Pollution, climate change
Manufacture of fabricated metal products, except machinery and equipment	7.2%	10.9%	0	1	1	1	1	Pollution, climate change
Manufacture of computer, electronic and optical products	0.3%	7.2%	0	1		0	0	
Manufacture of electrical equipment	1.6%	23.4%	0	1		0	0	
Manufacture of other machinery and equipment	2.3%	18.7%	0	1		0	0	
Manufacture of motor vehicles, trailers and semi-trailers	1.4%	15.4%	0	1		0	0	
Manufacture of other transport equipment	0.1%	-36.6%	0	0		0	0	
Manufacture of furniture, other manufacturing activities	1.9%	3.4%	0	1		0	0	
Repair and installation of machinery and equipment	2.3%	22.8%	0	1		0	0	

Sources: Eurostat, Bank of Slovenia (2020)

6.6 Calculation of carbon footprint and carbon intensity

Emissions need to be assigned across individual exposures for the purpose of assessing the carbon footprint of a bank's credit portfolio and assessing decarbonisation or an increase in carbon intensity. Emissions data is not available at the firm level, which predicates the use of sectoral emissions, which are then assigned to banks proportionally. Emissions at the sectoral level are available from Eurostat starting from 2008. Since exposures to individual sectors are unevenly distributed across banks, emissions need to be reassigned whereby the bank that lends most to sector X (e.g. 30%) is also assigned 30% of the emissions from that sector. Assigning emissions is done on the basis of weights that reflect the share of bank X's exposures to sector K in the total exposures to sector K at the systemic level. The exposure shares of individual sectors and banks are calculated on the basis of exposure weights.

6.6.1 Calculation of emissions weights

Emissions are assigned to each transaction relative to the share of the transaction/exposure of the particular sector in the total systemic exposure to the sector.

Thus the weight of transaction *i* (at bank *j*) is defined as:

$$w_{i,k,j} = \frac{Exposure_{i,k}}{Exposure_k}$$

where the weights by transaction and bank for a particular sector must sum to 100% at the sectoral level in the system as a whole (which ensures that the calculated/assigned weights cover the entire exposure to sector *k* in the system):

$$\sum_j \sum_i w_{i,k,j} = 1$$

The weight for sector *k* at bank *j* is thus given by:

$$w_{j,k} = \frac{Exposure_{j,k}}{Exposure_k}$$

whereby the shares of all transactions in a particular sector at the individual bank must sum to the share of the bank's exposure to the particular sector in total exposures to the sector at the systemic level:

$$\sum_i w_{i,k,j} = w_{j,k}$$

or:

$$w_{jk} = \frac{Exposure_{j,k}}{Exposure_k} = \sum_i w_{i,k,j} = \sum_i \frac{Exposure_{i,k}}{Exposure_k}$$

6.6.2 Calculation of the carbon footprint on the basis of system emissions

Emissions per transaction in a particular sector are calculated as the product of the sector's emissions and the share of exposure to the sector (i.e. the share of total exposure in the system accounted for by the transaction $w_{i,k,j}$). At the bank level, the emissions for a particular sector are equal to the sum of the emissions by all transactions in the sector:

$$Emissions_{j,k} = \sum_i w_{i,k,j} * Emissions_k$$

Total emissions at the bank level are equal to the sum of the assigned emissions of all sectors that the bank finances:

$$Emissions_j = \sum_k \sum_i w_{i,k,j} * Emissions_k$$

At the systemic level the emissions for a particular sector are equal to the sum of the emissions assigned to exposures (transactions) in the sector across all banks:

$$Emissions_k = \sum_j \sum_i w_{i,k,j} * Emissions_k$$

6.6.3 Determining systemic emissions of CO_2 for the carbon footprint calculation

Several emissions series can be used for systemic emissions. In addition to current emissions, it is sensible to use series based on fixed emissions, which can provide more information on the actual decarbonisation of the portfolio. The carbon footprint can change either because a sector has reduced its emissions, or because a bank has reduced its financing and exposure to the sector. Fixing emissions to a base year provides partial insight into banks' behaviour. For example, the carbon footprint calculated on the basis of exposures in 2019 and emissions in 2016 will reflect the changes in carbon footprint from the reduced exposure to carbon-intensive industries since 2016 only (and not the changes in emissions in the sectors), as the potential effect of an increase in energy intensity is eliminated by fixing emissions.[19]

There are several options when it comes to emissions:

1. *current*: emissions from 2019 with weights from 2019 or 2018 according to data availability (emissions currently have a one-year lag because of data publication lags);
2. *fixed*: all emissions are fixed to a base point of 2016;
3. *weighted by share of bank financing.*

Furthermore, all of the above calculations can be repeated accounting for the share of bank financing in the particular sector. In other words, the above calculation assigns all emissions across banks and sectors. Since the share of bank financing differs between sectors and is generally lower, the carbon footprint calculated by assigning total emissions has an upward bias, as the bank's contributions to the sector's emissions are lower.

In this case, emissions in sector *k* are assigned to bank *j* as follows:

$$Emissions_{j,k} = \sum_i w_{i,k,j} * w_{bk} * \ Emissions_k$$

where w_{bk} is the share of bank financing in sector *k*, or:

[19] The calculations are subject to caveats in the event of rapid changes in carbon footprint at the sectoral level.

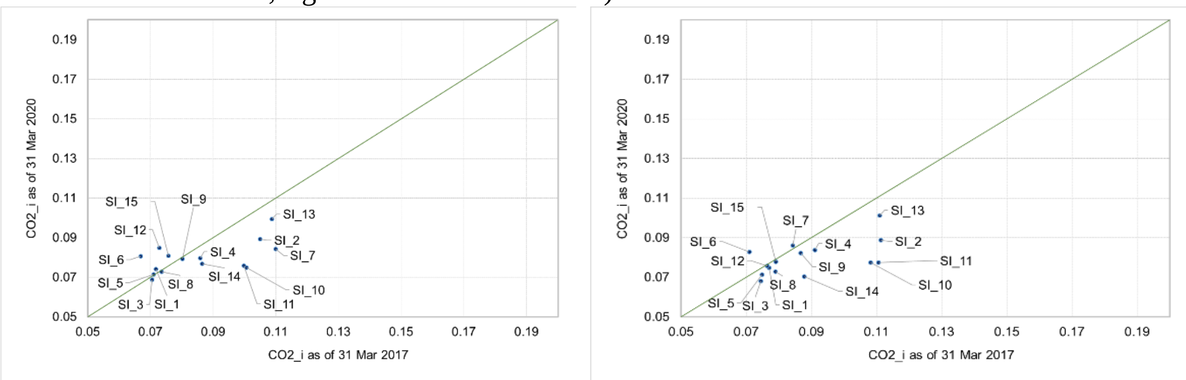
$$w_{bk} = \frac{Bank\_exposures_k}{Total\ financing_k}$$

However, banks are a significant factor in the financial framework for projects, therefore we apply the broader assessment by assigning total emissions. Such an approach complies with the guidelines on the reporting of climate risks.

6.7 Carbon footprint based on the share of bank financing

The carbon footprint and carbon intensity of individual banks are significantly reduced when calculating carbon footprint based on the share of bank financing. According to the classification of banks based on current emissions, the majority of banks are above the diagonal line of equal emissions in March 2017 and March 2020. The majority of banks shift below the diagonal line when basing the carbon footprint estimate on fixed emissions and accounting for the size of the credit portfolio, which is indicative of decarbonisation. The O-SIIs shift downwards when accounting for the size of the NFCs portfolio, similarly to the previous calculations based on total emissions.

Figure 6.9: Carbon intensity of Slovenian banks in March 2017 and March 2020 (left: current emissions; right: 2016 fixed emissions)



Sources: Eurostat, Bank of Slovenia (2020)

Figure 6.10: Changes in carbon footprint and carbon intensity between March 2017 and March 2020 (current emissions)

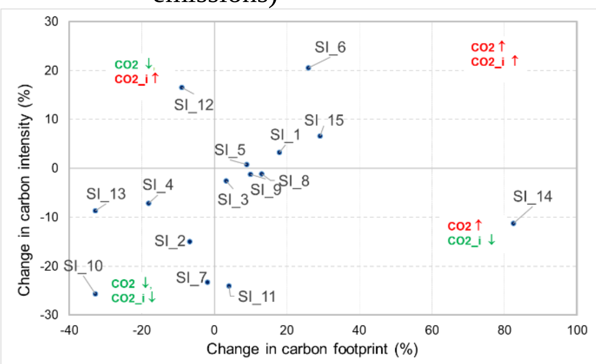
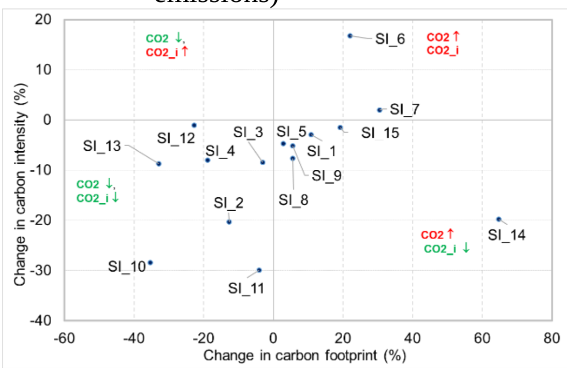


Figure 6.11: Changes in carbon footprint and carbon intensity between March 2017 and March 2020 (fixed emissions)



Sources: Eurostat, Bank of Slovenia (2020)

The three-year changes based on current emissions show a deterioration in carbon footprint for half of the banks over the period of three years, with a simultaneous deterioration (increase) in carbon intensity. Based on fixed emissions, the majority of banks move into the third or fourth quadrant, which is indicative of decarbonisation according to at least one environmental indicator.

Table 6.6: Number of banks which decarbonised their NFCs portfolios and % of decarbonisation between March 2017 and March 2020

Decarbonisation indicator	RI	VI	CO2	CO2_fix	CO2_i	CO2_fix_i
Number of banks with decarbonisation	8	6	7	8	8	13
of which O-SIIs	2	1	2	2	3	6
% of decarbonisation	-19.0%	-12.2%	-16.8%	-18.4%	-17.1%	-14.5%

Sources: AJPES (2019), Bank of Slovenia (2020)

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