PACTA
Paris Agreement Capital Transition Assessment

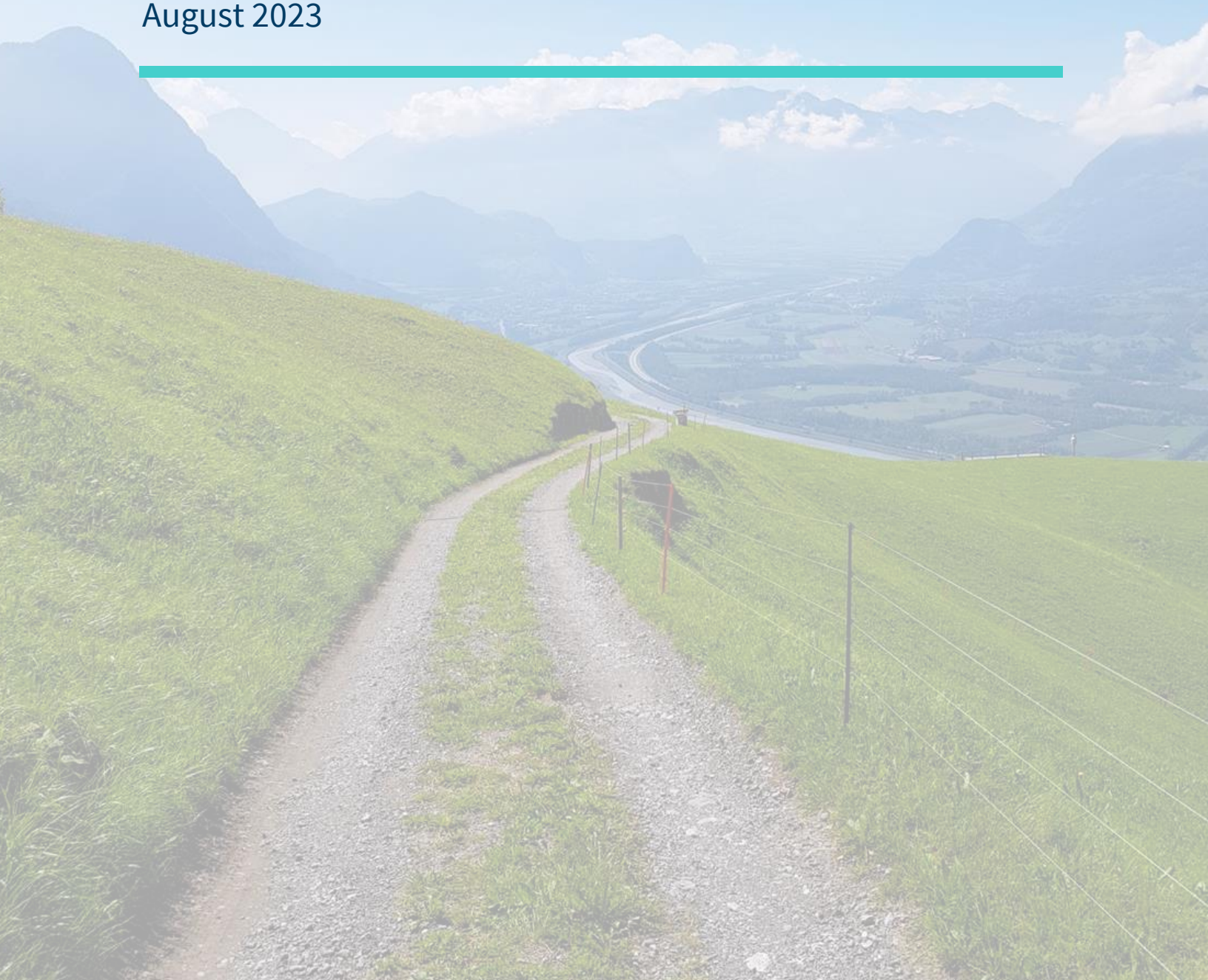
REGIERUNG
DES FÜRSTENTUMS LIECHTENSTEIN

PACTA Coordinated Project Liechtenstein 2022

HALFWAY THROUGH THE MARATHON

Measuring progress on the alignment of Liechtenstein's financial institutions with climate goals

August 2023



Authors

Catarina Braga, Monika Furdyna, and Antoine Lalechere

Contributing Authors (in alphabetical order)

Alex Axthelm, Nicholas Dodd, George Harris, Nayra Herrera, Jackson Hoffart, Jacob Kastl, Faria Khandaker, Sarah LaMonaca, Sarah Mendelsohn, Daisy Pacheco, and CJ Yetman

Contact

pactacop@rmi.org

About PACTA

Building off a vast climate-related financial database, the PACTA tool aggregates global forward-looking asset-based company data (such as the production plans of a manufacturing plant over the next five years), up to the parent company level. The tool then produces a customized, confidential output report, which allows investors to assess the overall alignment of their portfolios with various climate scenarios and with the Paris Agreement. This report is part of the PACTA Coordinated Projects (PACTA COP): our dedicated program in which we work together with individuals or groups of governments and supervisors to help them apply PACTA to the portfolios of their regulated entities.

Funders

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CONTENTS

Summary for policymakers

- By signing the Paris Agreement on climate change the Parliament of the Principality of Liechtenstein has committed itself to reduce its emissions by 40% by 2030 compared to 1990 (LGBl. 2017 No. 286). Liechtenstein has been acting on climate change and sustainable development on several fronts: as a result of a report submitted to the UN the government implement 3 key projects to tackle the Sustainable Development Goals (Education Strategy 2025, Energy Strategy 2030, Mobility Concept 2030).
- In this context, financial institutions in Liechtenstein are also subject to EU regulation on sustainability-related disclosure covering financial products' manufacture, distribution, and advice. The local Financial Market Authority also supervises the incorporation of sustainability risks and factors into the business strategies of the financial market. Nonetheless, concrete regulation and enforcement of the inclusion of climate topics on the strategic level are still incipient in the country.
- This report aims to measure progress over the alignment metrics report of PACTA Liechtenstein 2020. Just like the previous exercise, in the 2022 test, all Liechtenstein financial institutions have been invited, through the associations, to voluntarily carry out a climate test on their portfolios. 15 financial institutions participated in the 2022 PACTA Liechtenstein test and submitted more than USD 131,7 bn in assets under management – two times more than the assets submitted to the test in 2020.
- When analyzing the overall figures of submitted portfolios, the sectors covered by PACTA (oil & gas, coal mining, power, automotive, aviation, steel, and cement) make up about 7% of the value of all the participating financial institutions' assets in listed equities and corporate bonds. **The general share of listed equities and corporate bonds in the PACTA sector is significantly lower than the figures submitted in the 2020 Liechtenstein** test when shares ranged between 10-30%.
- Looking at the exposure of financial portfolios to each sector, we also see a general **absolute decrease in the share of total portfolios allocated to oil & gas, coal mining, power, automotive, aviation, steel, and cement** when compared to 2020. This is good news when considering the restricted financial flows going to companies producing high-carbon technologies. In fossil fuels, for example, financial institutions' exposure decreased to around 1.5% of Equity portfolios and 2.5% of Bonds portfolios with virtually no exposure to coal mining. The exposure to this sector is lower than the global market for all corporate bonds portfolios and mostly lower in the case of equity. The overall exposure to power and automotive sectors also decreased (from 2-6% and 1-6% in 2020 to 2% and 0.5%-1%, respectively).
- **In relative terms, the exposure to low-carbon technologies as a share of total investments in a sector (power or automotive, where low-carbon technologies are available) increased since the 2020 test**. In the power sector, renewables and hydro make about 50% of total investments in the sector (versus 40% in 2020), and in listed equities portfolios, the share allocated in electric vehicle production increased to 20% (versus less than 10% in 2020).
- **However, exposure is not indicative of the alignment**. Even though the exposure to high-carbon technologies decreased while the relative share of investments in low-carbon technologies increased, the alignment indicators show that the forward-looking **production pathways planned by invested companies are not yet aligned with the Net Zero scenario in almost all sectors and technologies**.
- **The overall decline in the exposure of climate-relevant sectors combined with a general misalignment of financed productions demonstrate that the financial institutions in Liechtenstein are still running the marathon to include climate strategies in their investment decisions, but concrete next steps are needed**. The decrease in exposure to high-carbon technologies is welcomed.
- In conclusion, it is suggested that financial institutions and policymakers give a step forward and **invest in capacity-building and the further development of credible climate strategy for investment decisions**.

1. Introduction

By signing the Paris Agreement on climate change the Parliament of the Principality of Liechtenstein committed itself to reducing its emissions by 40% (replacing the previous commitment made in 1990 for a 20% reduction) by 2030 (LGBl. 2017 No. 286). Liechtenstein has been responding to climate change and sustainable development on several fronts. As a result of a report submitted to the UN, the government implemented 3 key projects to tackle the Sustainable Development Goals: Education Strategy 2025, Energy Strategy 2030, and Mobility Concept 2030. Moreover, Liechtenstein also supports the Green Climate Fund (GCF) and together with the business associations of the Liechtenstein financial center and the University of Liechtenstein, established the Life Climate Foundation, which provides ongoing information and draws attention to the importance of sustainability with various events and awards.

The PACTA Liechtenstein 2022 Analysis builds upon the PACTA 2020 Analysis in the country and several other sustainable finance initiatives in Liechtenstein. The PACTA 2020 Analysis was one of the first country assessments in Liechtenstein[i] and it analyzed managed assets for climate compatibility. Liechtenstein's financial intermediaries (banks, asset managers, pension schemes, insurers, etc.) also had the opportunity to have their financial investments assessed free of charge, giving them tools to assess transition risks, set targets, and take action on climate-friendly investment strategies that promote impact in the real economy.

The test performed in 2020 showed that financial institutions in Liechtenstein were considerably exposed in sectors with high-carbon technologies – especially pension funds and insurance companies, indicating inconsistency between the fiduciary duty of pension funds and the need for phase-out of fossil fuels assets. The study also found that current investments made by participating organizations are not aligned with either the Beyond 2°C scenario or the Sustainable Development scenario in coal and oil production, coal power capacity, and internal combustion light/heavy-duty vehicles production.

In the 2022 test, once again all Liechtenstein pension funds, insurance companies, banks, and asset managers have been invited, through the associations, to voluntarily carry out a climate test on their portfolios. It consists of a quantitative module as well as a qualitative survey. The quantitative modules analyze the exposure of participating institutions' listed equity and corporate bonds investments to climate-relevant sectors and the alignment with global climate scenarios. A qualitative survey captures further climate-relevant activities of financial institutions across all their business activities.

15 financial institutions participated in the 2022 PACTA Liechtenstein test and submitted more than USD 131,7 bn in assets under management – two times more than the assets submitted to the test in 2020. In this round of the test, representatives from three peer groups participated: 7 insurance companies, 4 banks, 3 asset managers, and 1 financial institution classified as other. In order to keep the participants anonymous, the peer groups were not disaggregated and only the aggregated results for all participants will be disclosed. On average, 50% of total submitted portfolios are invested in listed equities and corporate bonds, which are the asset classes analyzed by PACTA.

The sectors covered by PACTA make up about 7% of the value of all the participating financial institutions' assets in listed equities and corporate bonds, and within the total investment in PACTA sectors, oil & gas extraction, power generation, and car manufacturing account for around three-quarters of the overall allocation in the sectors analyzed in this study.

The main PACTA results for listed equities and corporate bonds show that the participants in the Liechtenstein 2022 test reduced their exposure to high-carbon technologies (i.e., oil & gas) while increasing exposure to low-

[i] See PACTA 2020 Liechtenstein report

carbon technologies. The exposure to fossil fuels reduced drastically when compared to 2020 results – from 5% of the total portfolio in 2020 to 1.5% in 2022. At the same time, all groups increased their exposure to renewables and electric vehicles in both their listed equities and corporate bonds portfolios. This result is similar to the trend found in the 2022 test in Switzerland, and in that context, when comparing PACTA results with the climate strategies applied in the county there was some evidence that the decrease in exposure to fossil fuel is due to exclusion policies – which have a limited capacity to reduce emissions in the real economy as fossil fuel production plants are not being shut as result from exclusion policies, but just moving from one portfolio to another. The same evidence is not possible to test in Liechtenstein, due to the low response rate to the qualitative survey.

In terms of forward-looking Net Zero alignments of the production plans of the companies in the portfolios, Liechtenstein financial institutions are still mostly misaligned in both high-carbon technologies and low-carbon technologies. In oil production, for example, the Net Zero scenario requires the production to drop around 20% in the next 5 years, but portfolios of financial institutions in Liechtenstein are set to increase production by 10%. Moreover, participants of the test perform worse than the market benchmark in terms of alignment in oil and gas. Similarly, financial institutions in Liechtenstein are also misaligned in renewables power generation, meaning the build-out rate of renewables by investee companies is too slow. Here too, they perform worse than the market benchmark – which is also misaligned itself. On the positive side in the alignment context, investments in coal power capacity are already aligned with a Net Zero pathway and perform mostly better than the benchmark.

20% of Liechtenstein's economy relies on the financial sector and has direct links to the Swiss financial market, which makes the alignment of financial flows consistent with a pathway toward low greenhouse gas emissions crucial in order not only to comply with the Paris Agreement but also to manage transition risks. While it is good news that exposure to high-carbon technologies declined, alignment indicators deteriorated when comparing results from the 2020 test. The current results suggest that financial institutions in Liechtenstein keep running the marathon of tackling climate change, but the pace should increase; efforts in lowering exposure in high emission technologies are welcome, but it is time to move forward and think about aligning financial flows and reducing emissions in the real economy.

This report aims to contribute to the debate over aligning financial flows with Paris Agreement commitments among policymakers in Liechtenstein and is structured into 4 sections. After the current introduction, Section 2 briefly describes the participation and coverage of the study. Section 3 brings the full analysis of corporate bonds and listed equities. The section is organized by sector and contains charts on the exposure of the portfolio to the given sector, technology mix allocation of the portfolio, regional exposure of physical assets, and forward-looking alignment results. Section 4 presents the conclusions of this study.

2. Participation and coverage of the analysis

15 financial institutions participated in the 2022 PACTA Liechtenstein test. The participants include 7 insurance companies, 4 banks, 3 asset managers, and 1 institution classified as other. In order to keep the participants anonymous, the peer groups are not disaggregated in this report, and only the aggregate result for all participants is included. Therefore, any comparison between the 2020 Liechtenstein test and the current test, including the ones made in this report, is solely illustrative and should consider the composition of peer groups. In total, USD 131.7 billion in holdings were submitted and analyzed in the climate scenario analysis. A total of USD 38.7 bn in listed equities and USD 28.1 bn in corporate bonds could be analyzed using the PACTA methodology. The total amount analyzed in this report is more than double that submitted in the first round of the PACTA Liechtenstein test in 2020 (USD 56 bn) while the number of participants remained virtually the same (14 participants in 2020).

The share of total portfolios submitted allocated to listed equities and corporate bonds is approximately 50%, as shown in Figure 1 (29,4% in listed equities, and 21,3% in corporate bonds). The other portion of the portfolios is allocated to assets not analyzed by PACTA, such as sovereign bonds, derivatives, commodities, etc.

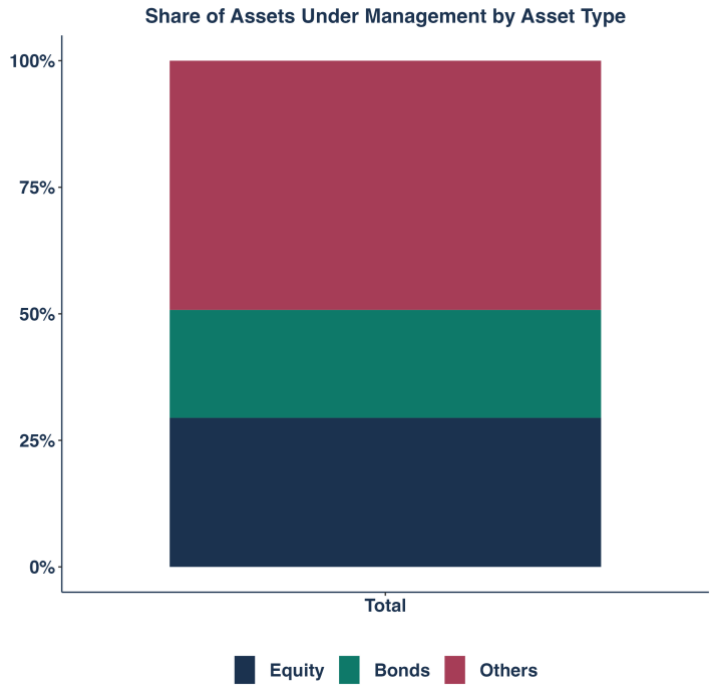


Figure 1: Breakdown of the assets under management analyzed by asset class category

The sectors covered by PACTA make up about 7% of the value of all the participating financial institutions' assets in listed equities and corporate bonds. The general share of listed equities and corporate bonds in the PACTA sector is significantly lower than the figures submitted in the 2020 Liechtenstein test. In 2020, for pension funds and insurance, the exposure to PACTA sectors ranged between 20-30% of the total value allocated in each asset class, while the exposure of banks and asset managers ranged between 10-20%.

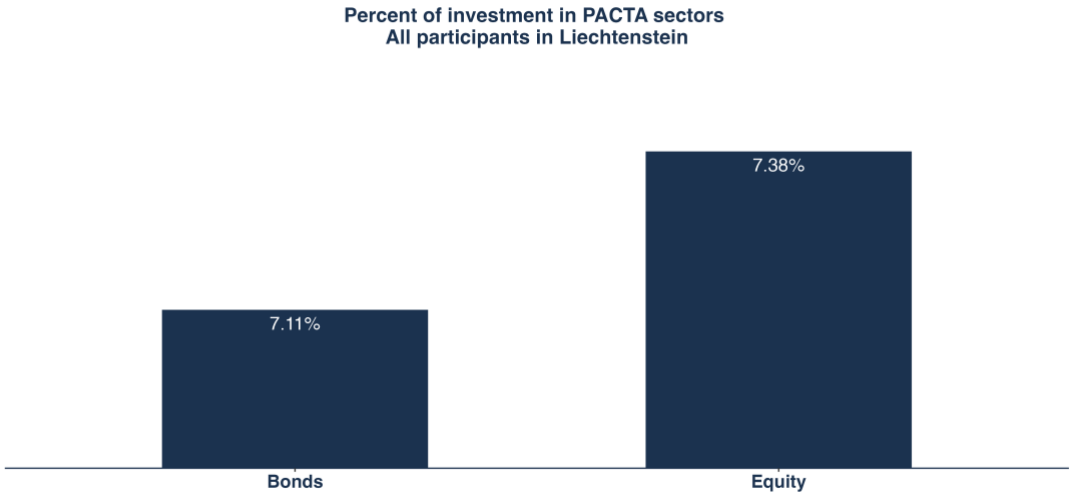


Figure 2: Proportion of assets under management in PACTA sectors

Within the total investment in PACTA sectors, oil & gas extraction, power generation, and car manufacturing account for around three-quarters of the overall allocation in the 7 sectors for both listed equities and corporate bonds investments. Interestingly, participants' exposure to fossil fuels decreased while increasing exposure to the power sector in the listed equities portfolios compared to the figures presented in the 2020 results. In the previous test, the share of fossil fuels in relation to the overall PACTA Sectors for both peer groups, Banks & Asset Managers and Pension Funds & Insurance, was around 40%, while in the 2022 round of the PACTA test, the share of fossil fuels does not reach 25% of the total investments allocated in PACTA sectors for all participants. The decreases in investment in the fossil fuels sector in relation to the total portfolio allocated in climate-relevant sectors may be the result of two different actions, i) a joint effort to exclude such technologies from portfolios, or ii) only parts of portfolios were submitted to the analysis – not its totalities - generating a selection bias in the results. The same trend of reduction in fossil fuels was identified in the 2022 round of the PACTA test in Switzerland.

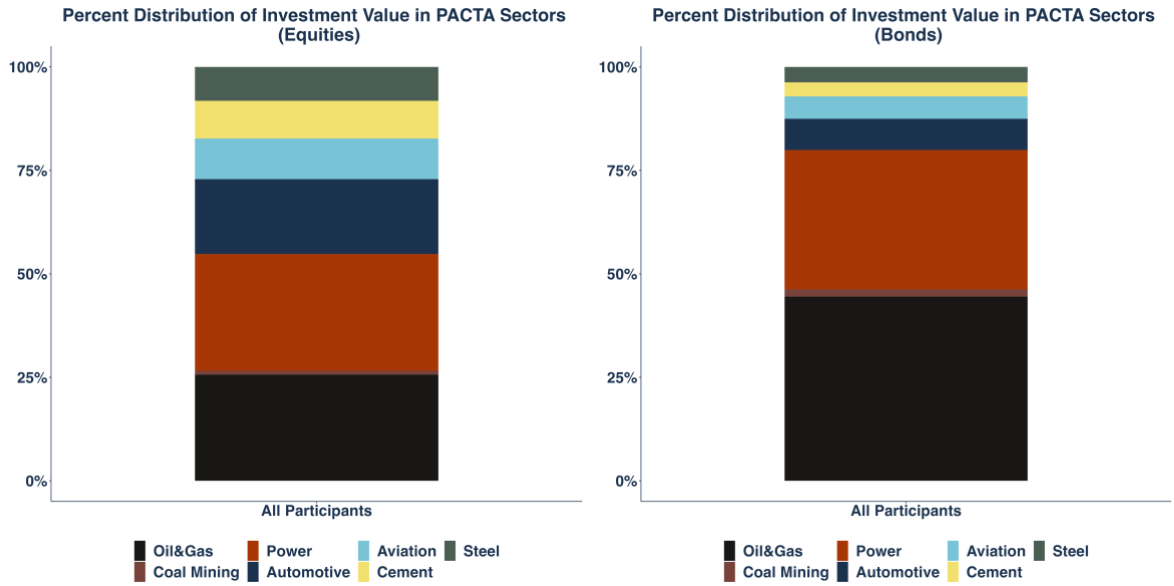


Figure 3: Distribution of the value in listed equity and corporate bonds investments across PACTA sectors

3. Exposure and alignment metrics

The Paris Agreement Capital Transition Assessment (PACTA) methodology was launched in 2018. It is a methodology for the climate change scenario alignment assessment of investor and bank lending portfolios. It enables the alignment of equities, bonds, and lending with decarbonization pathways, using 5-year forward-looking production plans of companies in climate-critical sectors to measure their alignment based on the technological change anticipated in decarbonization scenarios. Since 2018 over 3500 financial institutions have uploaded portfolios to the online investor tool.

PACTA is designed to support actionable alignment measurement. To achieve this, measurement is made based on the forward-looking production plans of companies, built up from granular data at the asset level on their production facilities. This data is used to measure the alignment of their production – for example, their power stations, oil wells, and car production plant – and the scale and rate of technological change and investment anticipated by climate scenarios.

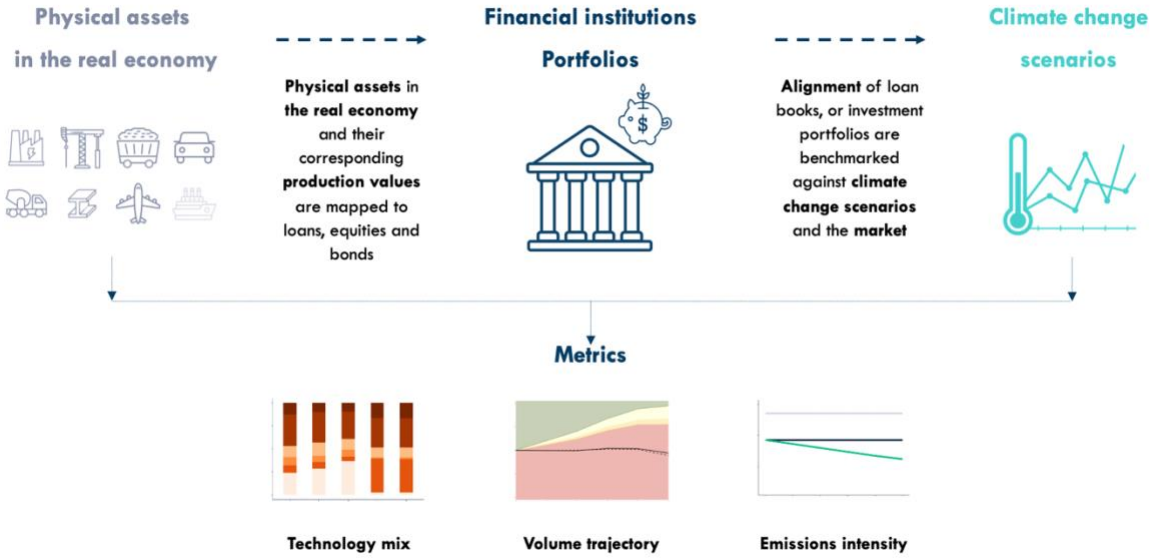


Figure 4: Overview of the PACTA methodology

As illustrated in the image above, the PACTA Methodology consists of several components. The quantitative part compares what needs to happen in sectoral decarbonization pathways determined through climate scenarios, with financial actors' exposures to companies in climate-relevant sectors. To do so, PACTA provides a five-year forward-looking, bottom-up analysis. It analyzes investment and production plans of companies, based on physical Asset-Based Company Level Data (ABCD), and consolidates that information to identify the transition profile of the companies and their related financial instruments. That way, PACTA can aggregate the production data to the portfolio level and compare that information to the production plans projected in different climate scenarios. The (mis-) alignment between the portfolio and these scenarios allows users to infer the potential exposure to transition risks and opportunities.

The current study will explore 3 main metrics that aim to answer different questions:

- **Exposure metric**. What is the current exposure of the portfolio to the economic activities that are most affected by the transition to a low-carbon economy?

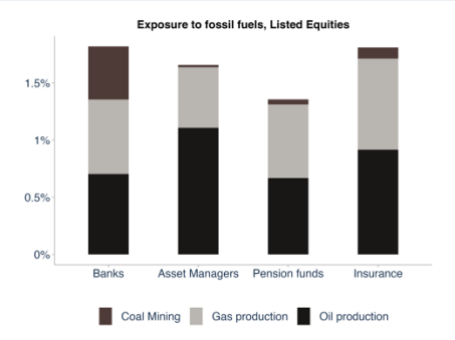
- **Future Technology mix metric**. How will the exposure of the portfolio change in the next five years, and how does it compare to a portfolio that is aligned with the Paris Agreement?
- **Production Volume Trajectory / Emission Intensity metric**. How aligned are the investment and production plans of companies in the portfolio with different climate scenarios and the Paris Agreement

Variations of these metrics will be available in this report.

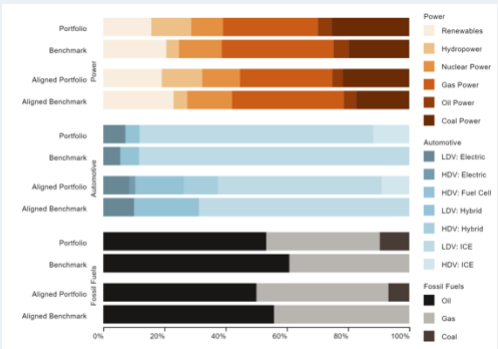
Box 1: How to read and interpret the main PACTA metrics?

The PACTA analysis measures alignment using three different metrics: Exposure shown as the Technology Share Mix, and alignment with either the Production Volume Trajectory or the Emission Intensities. The technology mix and the volume trajectory are used for the power, fossil fuels, and automotive sectors, for which there exist clearly defined technology decarbonization pathways. For example, in the power sector, there are technologies to transition to, i.e., coal-fired power generation can shift to renewable energies. For other sectors, where technology decarbonization pathways are not so well defined, such as steel, cement, and aviation, PACTA uses an emission intensity metric to compare it to scenario benchmarks.

The Exposure metric shows the estimated share of the portfolio that is currently exposed to companies with assets in the fossil fuels, power, aviation, cement, steel, and road transport sector. It is calculated by first taking the weight of the portfolio that is exposed to companies in each of these sectors and then calculating the technology breakdown of assets owned by these companies. The portfolio's current technology exposure is compared to the market portfolio, which is calculated based on the exposure of the global universe of assets in the relevant asset class to the sectors, as well as to the peers participating in the tests. Based on this metric, financial institutions, and supervisors can have more clarity on what extent the portfolios are exposed to transition risk and climate compatibility issues based on the allocation to the different sectors and technologies.

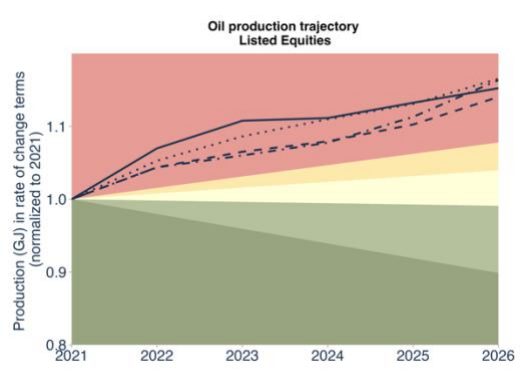


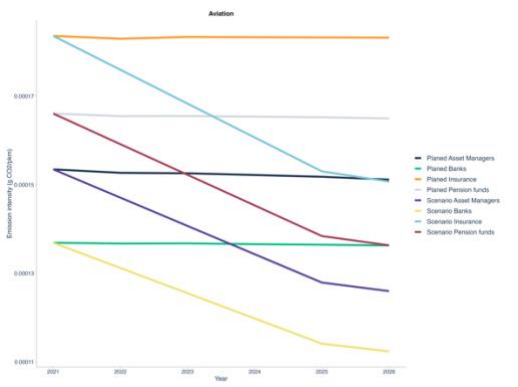
The Future Technology Mix metric illustrates the portfolio's expected technology mix in the power, automotive, oil and gas, and coal mining sectors in five years. It is calculated by taking the portfolio's current exposure to each technology and then applying the trajectory of the exposure over time based on revealed investment and production plans. It represents the next 5-year production values shown in the Production Volume Trajectory charts. The metric is compared to peers, the market, and a technology mix aligned with Paris Agreement goals (e.g.: Net zero scenario by IEA). Supervisors and financial institutions can manage the concentration risks and have portfolio diversification considerations.



The Production Volume Trajectory metric traces the portfolio's exposure to selected climate-relevant technologies relative to various IEA and JRC transition scenarios. The trajectory of the global listed equity or corporate bond market is shown for the different peer groups in this report. The metric is forward-looking and compares the portfolio's expected production trajectories in different technologies to scenario-aligned trajectories over the next five years. The portfolio's expected trajectory is based on the underlying companies' investment plans for the next five years, while the market's trajectory is the combination of the current investment plans of all companies in the respective asset class for the same period.

The first visualization type (left-hand chart) is the trajectories chart. These charts trace the listed equity and corporate bond portfolio's exposure to a given sector production (lines) in comparison to the IEA and JRC scenarios (background colors). We also make available the alignment of emission intensities by sector compared to the IEA's Net zero scenario (right-hand chart). The chart uses the current emissions intensity of companies within the portfolio as a starting point and shows how this is expected to develop over the next five years based on the plans of the company and what would be expected under the scenario.





In this section, we discuss the results obtained from the analysis of portfolio data voluntarily submitted by financial institutions in Liechtenstein. The section analyzes the exposures of portfolios to different climate-relevant sectors and presents the forward-looking production trajectory of portfolio holdings in the aforementioned sectors compared primarily to the sectoral decarbonization pathways designed by the International Energy Agency (IEA) and the Joint Research Centre (JRC). Descriptions of the scenarios that these pathways are taken from can be found in Annex II.

It is important to highlight that the alignment (i.e. the forward-looking assessment) for listed equities and corporate bonds are analyzed using different portfolio attribution methods and therefore a direct comparison between the results of the portfolios in the two asset classes should be carried out carefully. The portfolio attribution of production linked to listed equities is made using the ownership approach, which attributes the production results based on the shares owned by investors in the companies. The attribution of production linked to corporate bonds is made using the portfolio weight approach, which attributes the company's production to the portfolio based on the size of the investment into the companies relative to the investments into other companies in the same sector. Readers are invited to check Annex I where a detailed explanation of both approaches is exposed.

All results are compared to a listed equity and a corporate bond benchmark. For listed equities, the benchmark used was the ETF from the iShares MSCI World index which is composed of developed market equities. For corporate bonds, the benchmark used was the iShares Global Corp Bond UCITS ETF which tracks the performance of an index composed of investment-grade corporate bonds from issuers in emerging and developed markets.

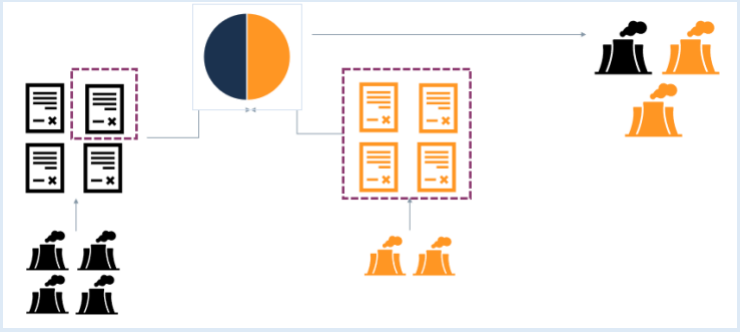
The timestamp of this report is 31st of December 2021, therefore all data represented in the analysis below reflects a static figure of results of 31st of December 2021. All charts represented in time horizons with a start date of "2021" should be interpreted as the end of the year 2021 instead of the full year 2021.

Box 2: Ownership Weight vs. Portfolio Weight Approach

The Ownership Weight Approach (OA) is based on what the investor owns. It is only available for equity as the equity holder has a proportion of the company that is delimited by the number of shares they own. As the owner of a proportion of the company, they have control over that same proportion in companies' decision-making.

As an example, let us assume there are two companies that compose a portfolio, each one of them issuing four shares, and the portfolio is the owner of one share of the blue company and four shares of the yellow company (see illustration below).

Under the ownership approach, 25% of the production of the assets owned by the blue company (1 power station) and 100% of the assets owned by the yellow company (2 power stations) will be attributed to the portfolio. This approach is used mainly in production volume trajectory metrics due to its characteristics of attributing production to the portfolio. Also in this sense of attributing direct responsibility to companies' production of different technologies, this approach allows the allocation of production of companies beyond its main activity sector.



The Portfolio Weight Approach (PA), on the other hand, allocates the production of the physical assets of the companies based on the proportion that the company represents in the portfolio. Although bondholders have relevant bargaining power with the issuer, investors do not have decision-making rights, which is why the Ownership Weight Approach would not be suitable.

The result of the previous example under the Portfolio Weight Approach would be as follows: If the same portfolio is composed of two companies that are equally weighted, the Portfolio Weight Approach would attribute half of the production of the assets owned by the blue company and half of the production owned by the yellow company to the portfolio. Thus, two power stations from the blue company, and one power station from the yellow company.

As mentioned previously, in the individual interactive reports, users can choose the allocation methodology used in each of their charts, however, for this report, the portfolio approach was used for bonds and the ownership approach for equity. This metric is mainly used in exposure metrics and accounts only for production in the main activity of the company invested.

3.1. Fossil Fuels

The potential consequences for the economy posed by physical and transition risks associated with climate change are sufficiently material reasons for financial institutions and governments to shift financial flows away from fossil fuels. Nonetheless, the current energy crisis following the invasion of Ukraine by Russia and the inflation spike around the globe place even more urgency on a transition to a more resilient, low-carbon economy – and subsequently less dependency on fossil fuels. The potential long-term effect of the current high fossil fuel prices on clean energy transitions is still to be studied and is modeled by only a few scenario developers, such as the IEA. On one hand, the high fossil fuel prices might, at least in the short term, push governments and industries to produce and stockpile more fossil fuel energy – as is evidenced by the repowering of mothballed coal power generation plant in Germany – or to subsidize such technologies due to the rise in energy bills. On the other hand, there are early signs that the energy crisis might also incentivize policymakers to invest in clean-energy infrastructure at a faster pace, fossil fuel-producing companies to take action such as to reduce methane leaks or gas flaring, and consumers to improve energy efficiency or moderate consumption.

Financial institutions in Liechtenstein decreased their exposure to fossil fuels to around 1.5% of Equity portfolios and 2.5% of Bonds portfolios when compared to the previous 2020 exercise (3-4% for listed equity and 5-7% for bonds of exposure to fossil fuels). The exposure to the sector is lower than the global market for all corporate bonds portfolios and mostly lower in the case of equity.

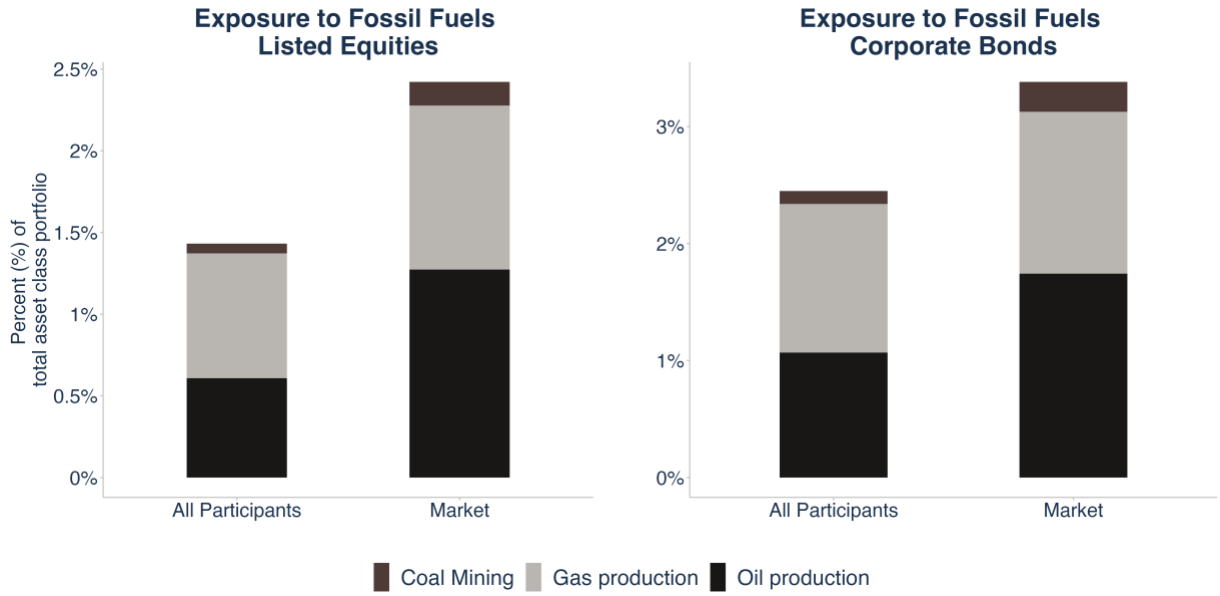


Figure 5: Share of aggregated portfolio value (exposure) invested in companies active in fossil fuel industries

Looking at the plans of investee companies for the next 5 years, we can see portfolios of participant financial institutions in Liechtenstein are misaligned with the IEA scenarios. In most asset classes and technologies, an increase in production is planned while the Net Zero Emissions by 2050 (NZE) scenario requires a (sometimes steep) decrease in production. Compared to the previous 2020 exercise in Liechtenstein participants seem to even decrease their ambition. All participants listed equities portfolio production plans are expected to increase production of oil by almost 30% by the end of 2026 while the scenarios prescribe an increase in production of at most 5% and a decrease in the case of the NZE scenario. In the case of bonds portfolios, a decrease in production plans is observed, towards the end of the period analyzed, but not enough to reach a net-zero scenario.

Gas-producing investee companies in Liechtenstein financial institutions' portfolios are also misaligned with a planned increase of 20% in production in the next 5 years – the increase is also higher than the benchmark production plan. It is important to highlight that for gas, most decarbonization scenarios still allow generous leeway in the next five years as a so-called bridge technology. In coal mining, the results are mixed. In listed equities, the alignment slightly adjusted since the 2020 test, and it is now aligned with an Implied Temperature Rate between 1.65°C and 2.1°C which is lower than the benchmark trajectory for the next 5 years. In corporate bonds portfolios, on the other hand, the production of coal mining is expected to increase 25% in the next 5 years. This result is similar to the one observed in Switzerland and might be a reflection of the coal price spike due to the energy crisis in Europe. Nonetheless, the trajectory of the production is misaligned with Paris Agreement for coal mining and Liechtenstein portfolios are currently financing coal production in line with a more than 2.7°C temperature increase by 2100.

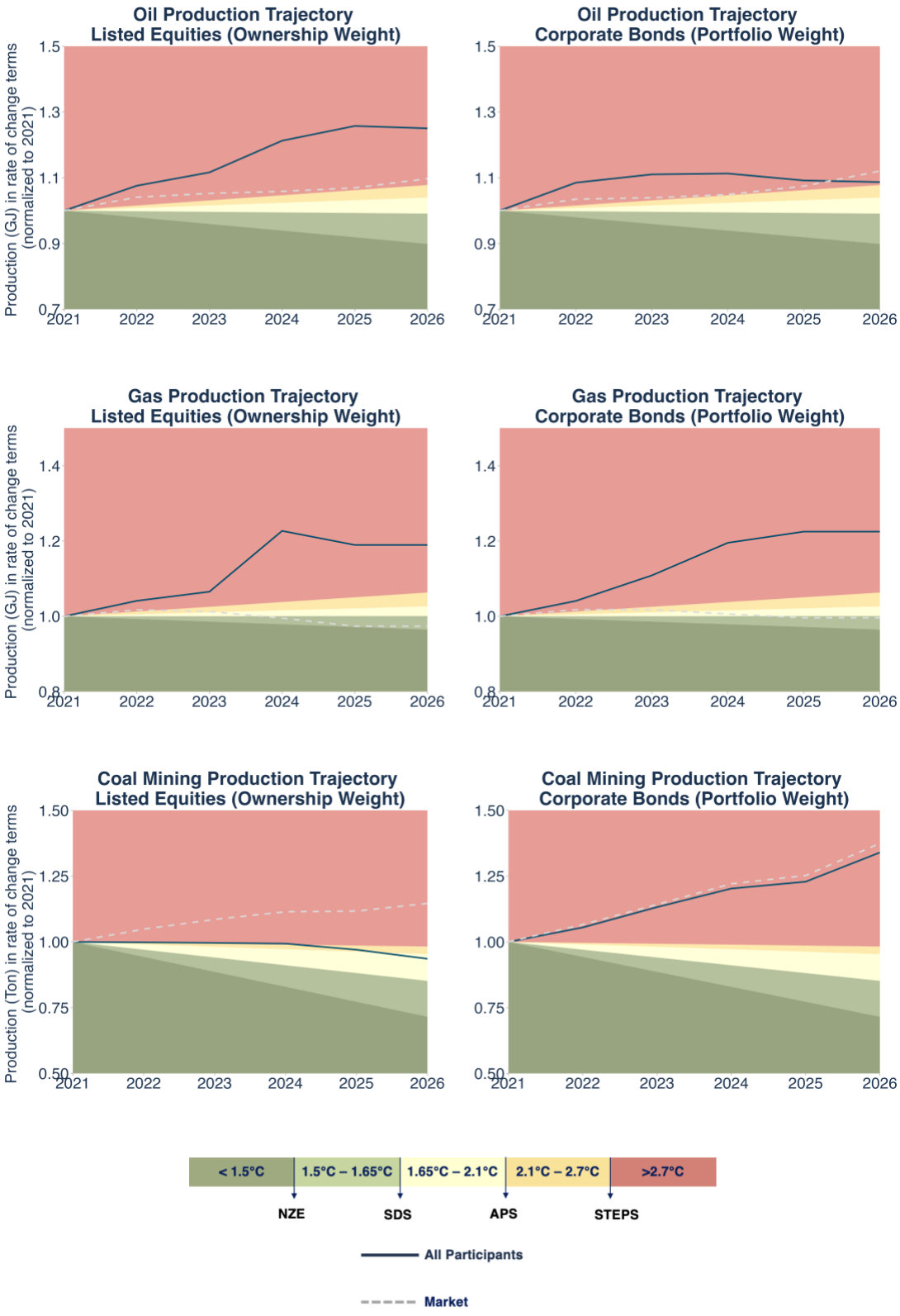


Figure 6: Alignment of oil, gas, and coal mining production plans with global decarbonization scenarios

3.2. Power

There is increasing evidence that a transformation is happening in the real economy, with power production and consumption having experienced dramatic changes in the past 5 years. Beyond the Covid-19 pandemic and the current energy crisis that has influenced consumer behavior, the build-up of the capacity of renewable sources of energy such as wind and solar PV increased at their fastest rate following a rapid cost decrease that has made them more bankable than fossil fuel production in most regions. As electricity and the electrification of transport and heavy industries such as steel production becomes a central piece of the energy transition, financial flows are required to build out new capacity and invest in the required technology transitions.

Despite the opportunities in the sector transition to low carbon alternatives, both bonds and equity portfolios of Liechtenstein financial institutions are less exposed (both asset classes have around 2% exposure for all participant institutions) to the power sector than benchmark markets. The exposure is also lower than the previous exercise when the exposure ranged between 2%-6% of portfolios. In terms of the technology mix, portfolios of Liechtenstein financial institutions are set to be less exposed to renewable power by 2026 than the prescription to achieve the Net Zero scenario. In equity portfolios, renewables are set to achieve 40% of the total value in the sector, while the scenario expects 55%. In corporate bonds portfolios, the difference is even bigger: renewables are set to achieve 10% of the total value in the sector by 2026, while the scenario expects 40%. At the same time, the share of gas and coal technologies are much higher by 2026 than the Net Zero scenario.

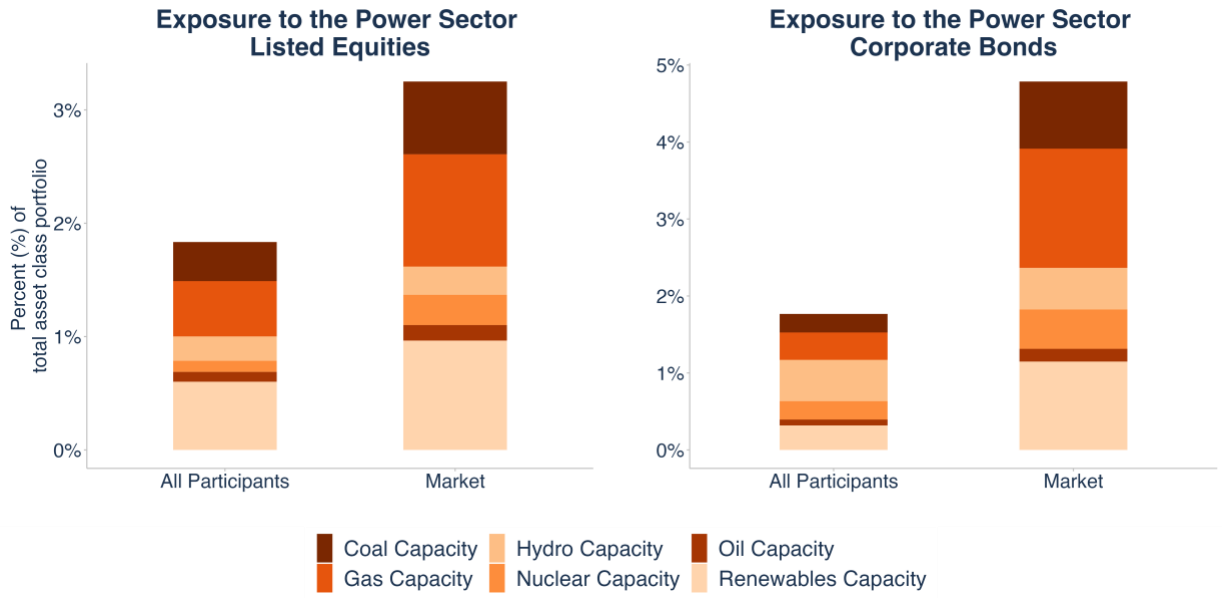


Figure 7: Share of aggregated portfolio value (exposure) invested in companies active in the power industry

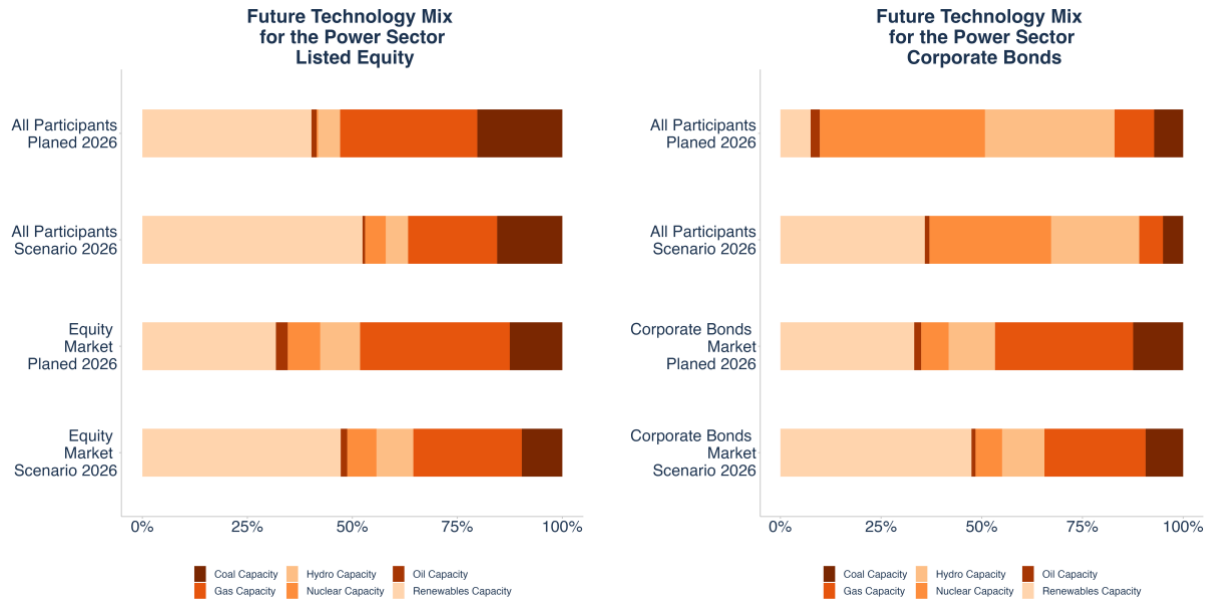


Figure 8: Technology mix as a percentage of allocated exposure to the power sector

In terms of production volume trajectory, Liechtenstein financial institutions' portfolios are mostly not aligned with even the least ambitious scenarios for low and high-carbon technologies. The exception is coal power companies which mostly meet the climate goals for nearly the entire period analyzed. In oil power capacity, a significant decrease in production is required by the IEA NZE scenario, while all production plans of companies in institutions' portfolios are stable for the next 5 years. Also, a significant increase in production plans can be observed for all gas power capacity companies in Liechtenstein's portfolios (between 10% and 20% increase) while the scenario advises only a mild increase over the next 5 years.

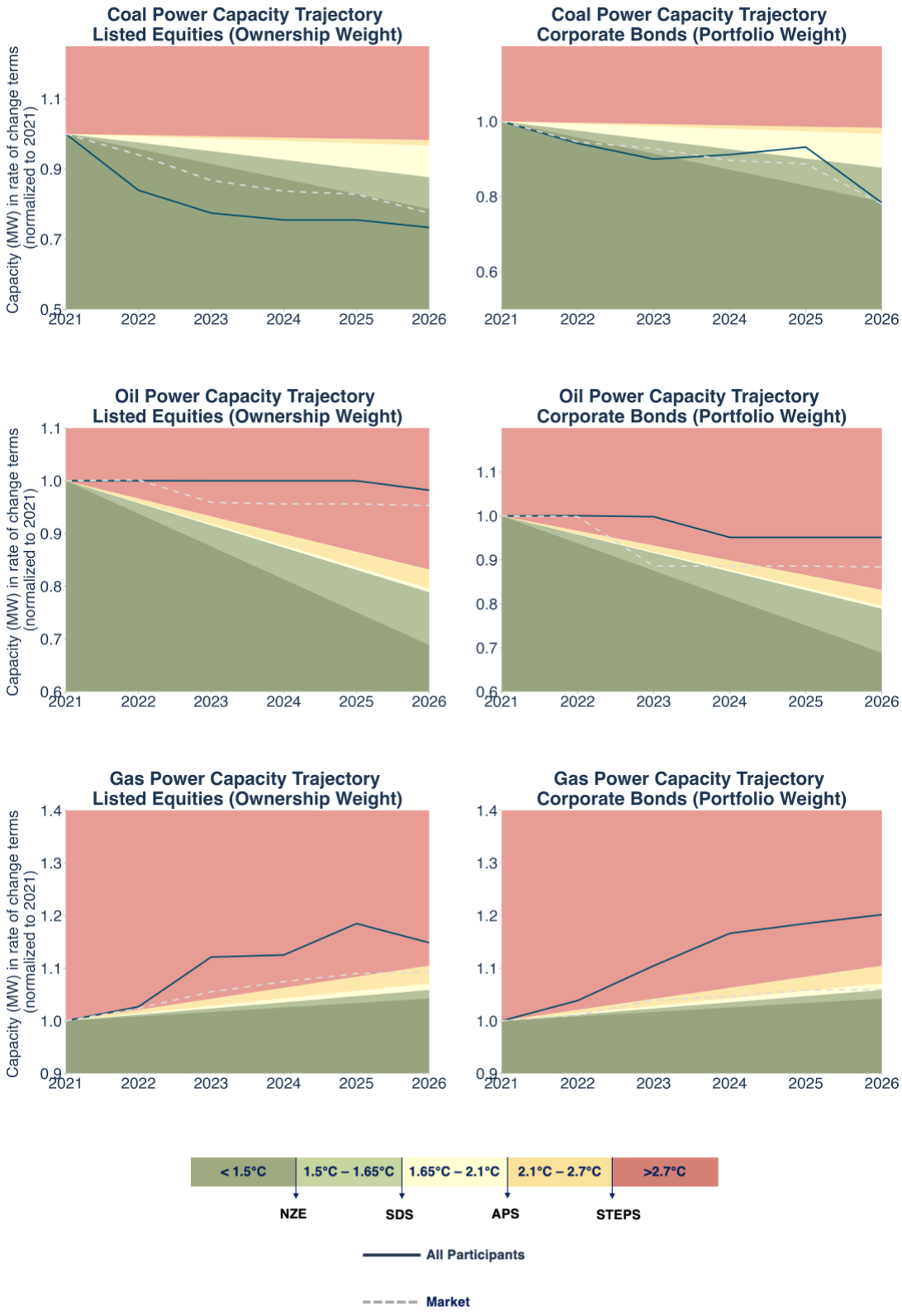


Figure 9: Alignment of coal, gas, and coal power capacity plans with global decarbonization scenarios

In renewables, the production plans for building out the production in this technology are not ambitious enough compared to the IEA Net Zero scenario. In hydropower, bond portfolios are set to build out a small capacity in the next 5 years (less than 5%), which is enough to meet the net zero scenarios, but equity portfolio allocation is set to remain constant and misaligned in the entire period.

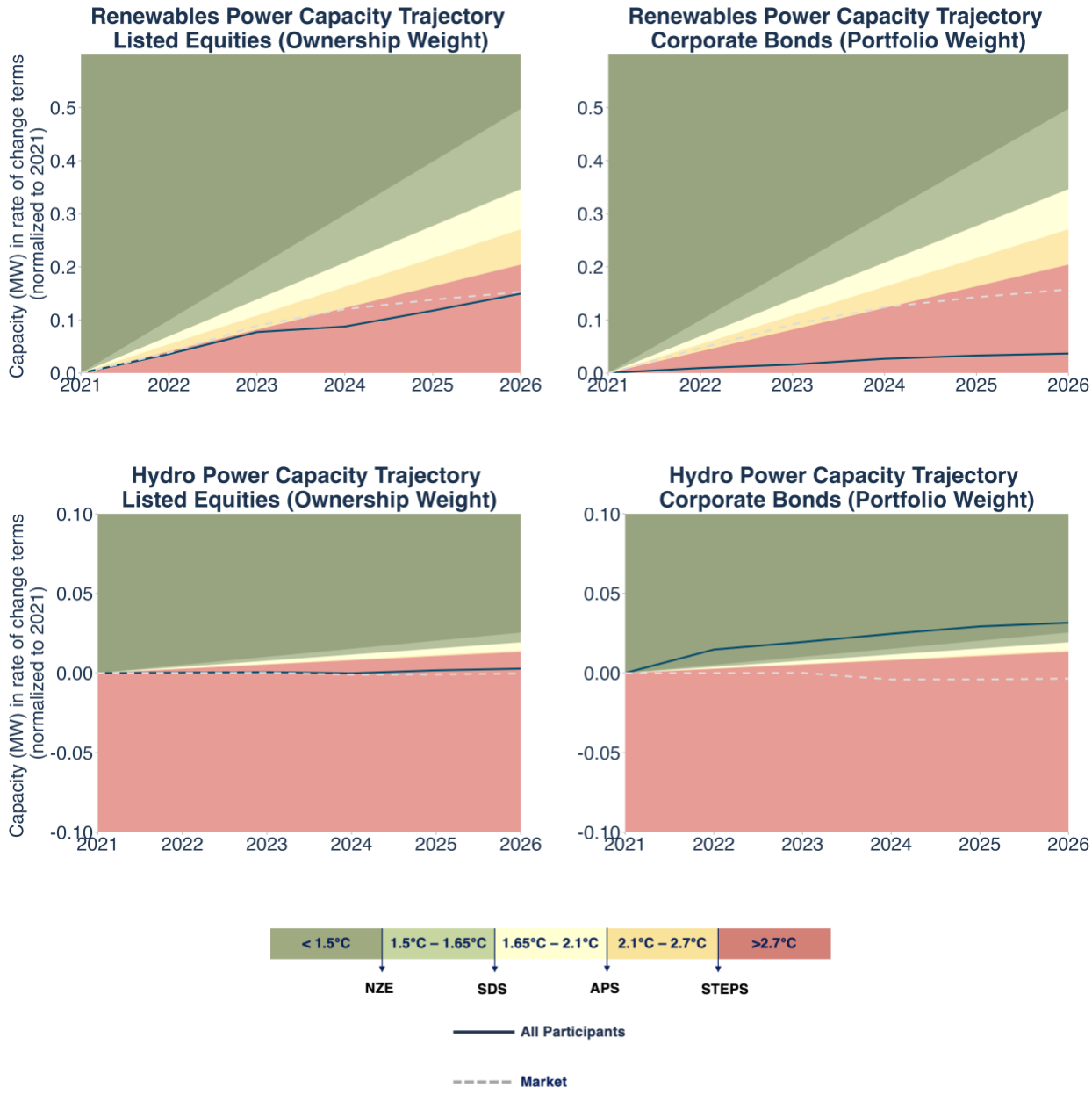


Figure 10: Alignment of renewables and hydropower capacity plans with global decarbonization scenarios

3.3. Automotive

The automotive sector is one of the sectors facing a fast-paced change when it comes to transition driven by regulatory commitments to reduce vehicle emissions and in some markets such as in the EU to set a date for the phase-out of Internal Combustion Engine (ICE) vehicles. According to scenarios, broader sustainability drivers also

include modal shifts, shared mobility services, autonomous driving, and connected vehicles. In particular, consumer behavior has been observed to have changed after the COVID-19 pandemic, with scenario developers such as the JRC factoring into their modeling the influence of remote working on travel patterns and the emerging preference of consumers for cleaner electric or hybrid vehicles.

In this sense, the switch from light-duty vehicles based on internal combustion engines to electric or plug-in hybrid vehicles can be seen as one of the major opportunities for a green economic transition. All major Below 2°C scenarios anticipate that the demand for ICE cars will fade and eventually cease as sales of battery-electric vehicles increase from 5% of new-car sales today to almost 100 percent by 2050. or earlier, as the ICE vehicle stock is gradually replaced. An important change to note in this Climate Test is in the classification of mild hybrid vehicles in IEA and JRC scenarios, which are now included within the ICE category. The hybrid category now consists exclusively of plug-in hybrid technology.

Nonetheless, it is important to note that the overall life cycle emissions of electric and plug-in hybrid vehicles are important to consider. Two factors contribute significantly to the total life cycle emissions of plug-in hybrid and electric cars: the manufacturing of their batteries and the power grid mix where these vehicles operate. Overall, electric and plug-in hybrid vehicles tend to have lower average full-lifecycle CO_2-eq emissions than internal combustion engines, but this is dependent on the decarbonization of the electricity sector as a necessary condition for zero emissions road mobility.

Just as in the case of power, Liechtenstein institutions are not substantially exposed to the automotive sector (around 2% of total exposure for Equity and 0.5% for bonds), and most of the exposure is allocated to ICE vehicle production. The exposure to this sector had a major decrease on average compared to the previous exercise (2-6% exposure). This is not necessarily positive since without exposure to the sector institutions do not have the power to shift the financial flows from high- to low-carbon technologies, in this case from ICE to electric cars. Especially in the case of bonds, we can see that the exposure within the sector is mostly toward ICE. This is in line with the global corporate bonds market. In the case of equity, the market is substantially invested in electric cars already (more than 50%) while the Liechtenstein financial institutions are still mostly invested in the high-carbon ICE technology.

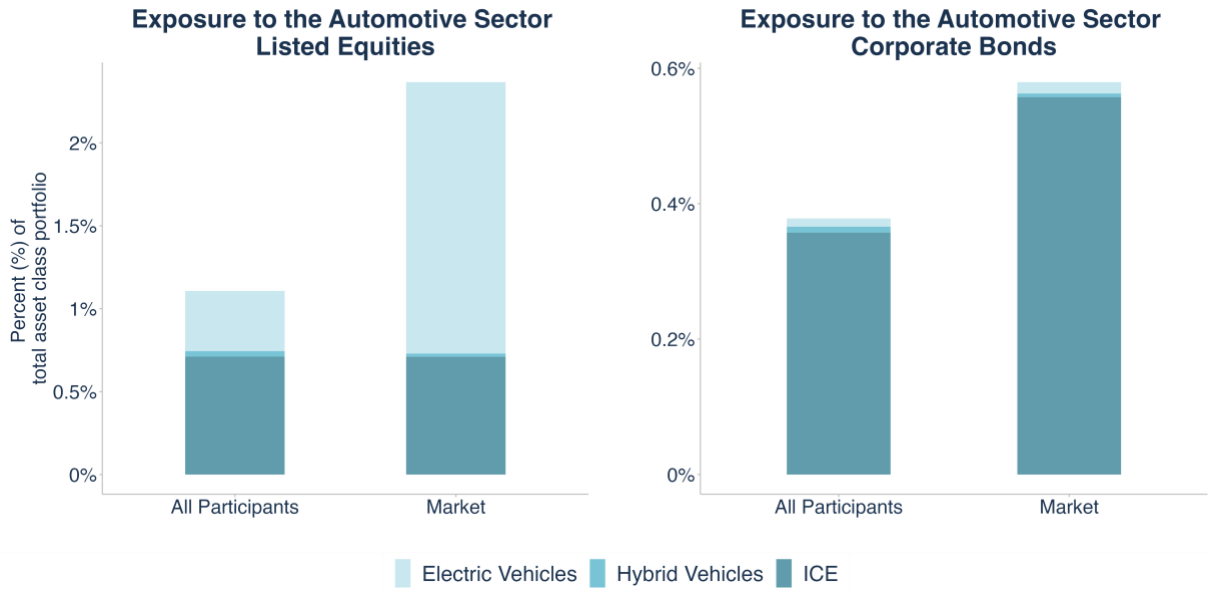


Figure 11: Share of aggregated equity portfolio value (exposure) invested in companies active in automotive industry

The future production plans of most investee companies show mixed results. Compared to the previous exercise, a decrease in ambition is observed within the ICE technology, and portfolios of financial institutions in Liechtenstein are misaligned with all scenarios. An increase between 5% - 10% is expected by invested companies in ICE production in the next 5 years. The plans are also to increase the production of electric cars at a rate that is aligned with the Nationally Determined Contributions and Long-term Strategies (NDC-LTS) scenario. However, in the case of equities, the build-out rate is still well below the market benchmark (40% production increase by 2026).

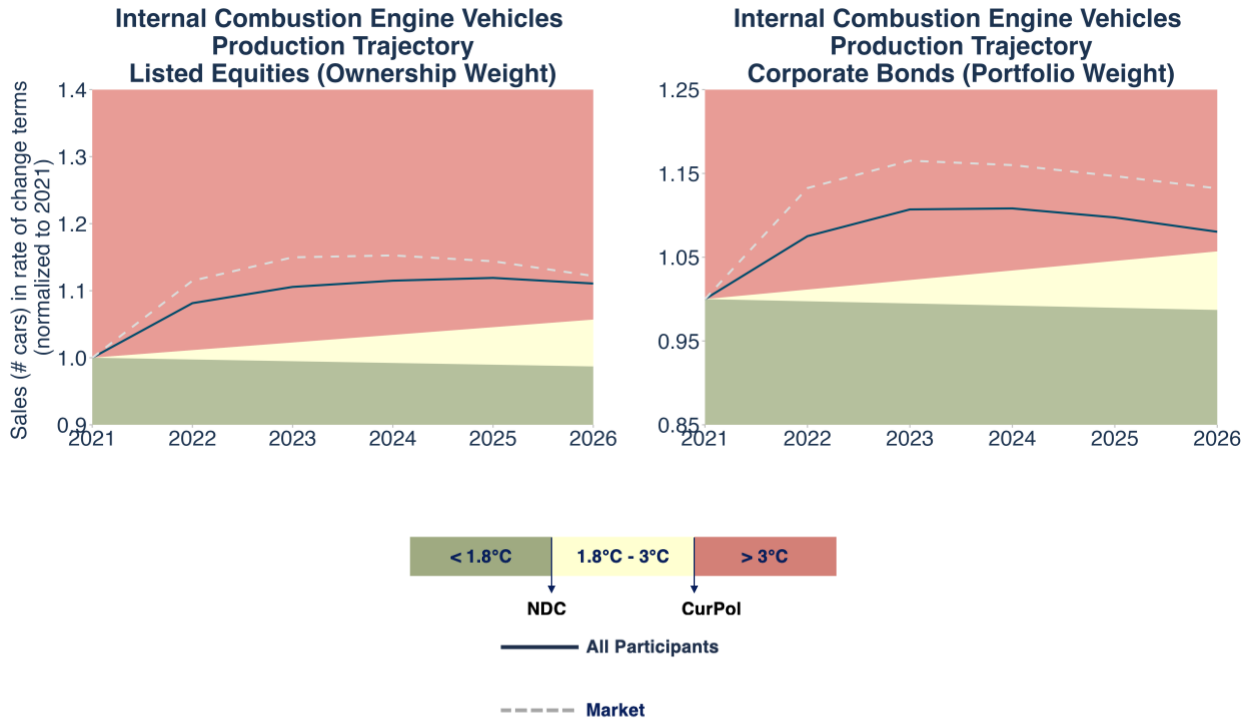


Figure 12: Alignment of Internal Combustion Engine vehicles production with global decarbonization scenario

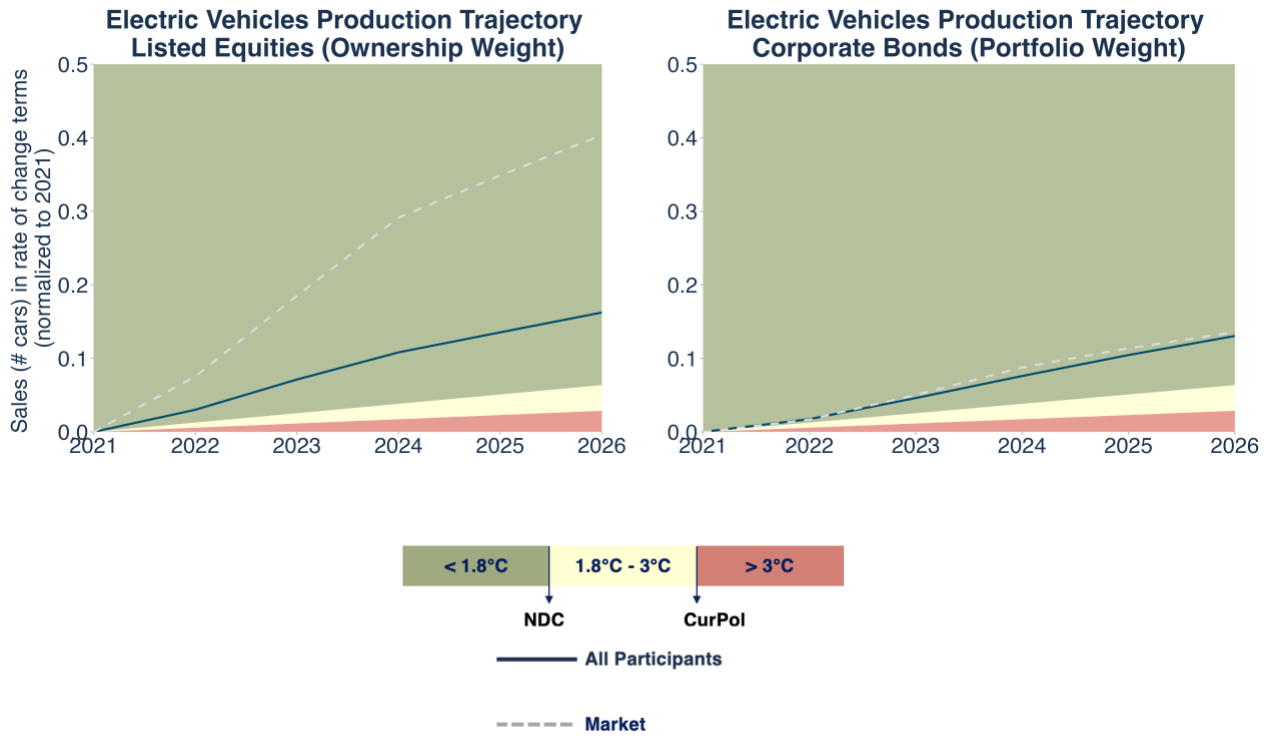


Figure 13: Alignment of Electric vehicle production with global decarbonization scenario

3.4. Aviation

The aviation sector is a hard-to-abate sectors – in other words, it is a sector in which the transition is not likely to be as straightforward due to technological, regulatory, and economic constraints. Whilst scenarios point to the need to commercialize a combination of new propulsion technologies and more sustainable fuels, it will likely not be before 2030 that both can be widely implemented. For example, initiatives like the ZEROe from Airbus are set to produce hydrogen propulsion commercial aircraft, but not until 2035. Prior to 2030, airline operators will have very little margin to reduce emissions in their operations. According to scenario assumptions, best practices may include small improvements in their operations, including utilization rates, and the retirement of old aircrafts combined with the acquisition of newer and more fuel-efficient aircrafts. As a result, financial institutions willing to green their portfolios in this sector should consider, in the near term, the extent to which airlines are focusing on operational efficiency improvements and the composition of aircraft fleets. Given the long lead times for investing in new aircraft and the long-lead times for innovation in the sector, it is also important that investee companies are already engaged in the development and trial of new low or zero-carbon fuels and technologies, so as to ensure that they are commercialized in time to maintain the pace of sectoral decarbonization. Moreover, joining sectoral-focused initiatives like the Climate-Aligned Finance Working Group for the aviation sector convened by RMI can help financial institutions understand the sector better and how to engage with airlines and other stakeholders in order to reduce emissions of the companies they are investing in.

Exposure to the Aviation sector is small both in the base of bonds and equity portfolios (less than 0.5% of the total portfolio) and didn't experience changes compared to the previous exercise in Liechtenstein. In the case of bonds, all peer groups are invested in totals that are less than the global market, however, insurers and banks are more heavily invested in passenger flights than in the global bonds market.

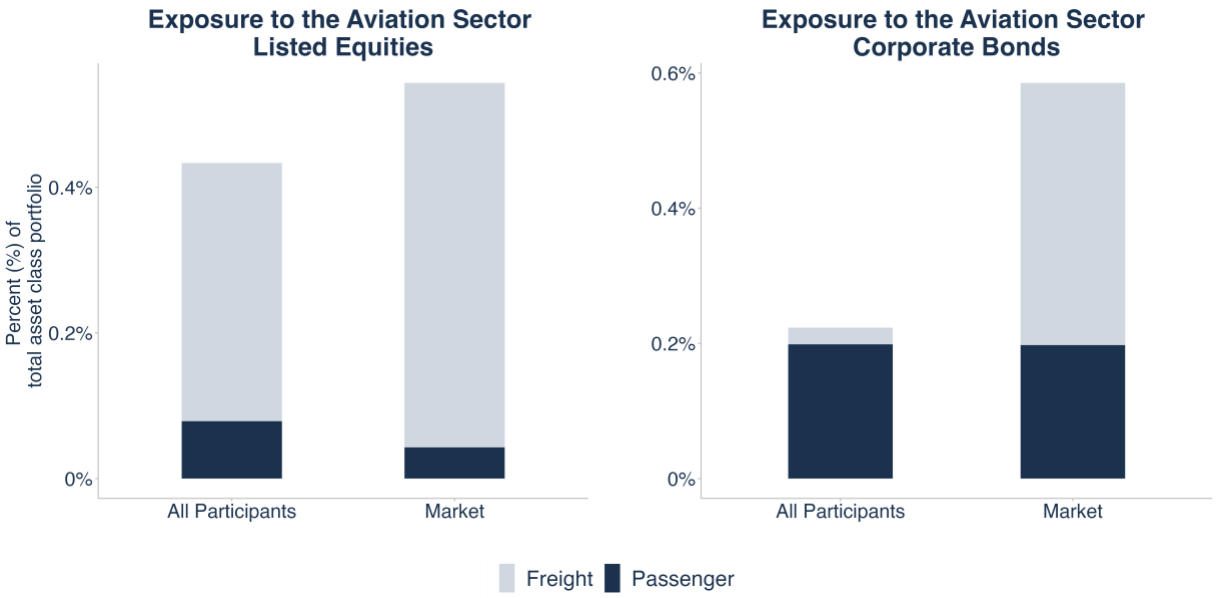


Figure 14: Share of aggregated equity portfolio value (exposure) invested in companies active in aviation industry

Looking at the planned emission intensities of passenger flights we can see that the plans of invested companies are not aligned with the scenario trajectory, both in the case of equities and bonds. The scenario requires a substantial decrease (about 10-15%) of the emission per passenger over the next five years while the plans of the investees are to maintain constant emission intensities.

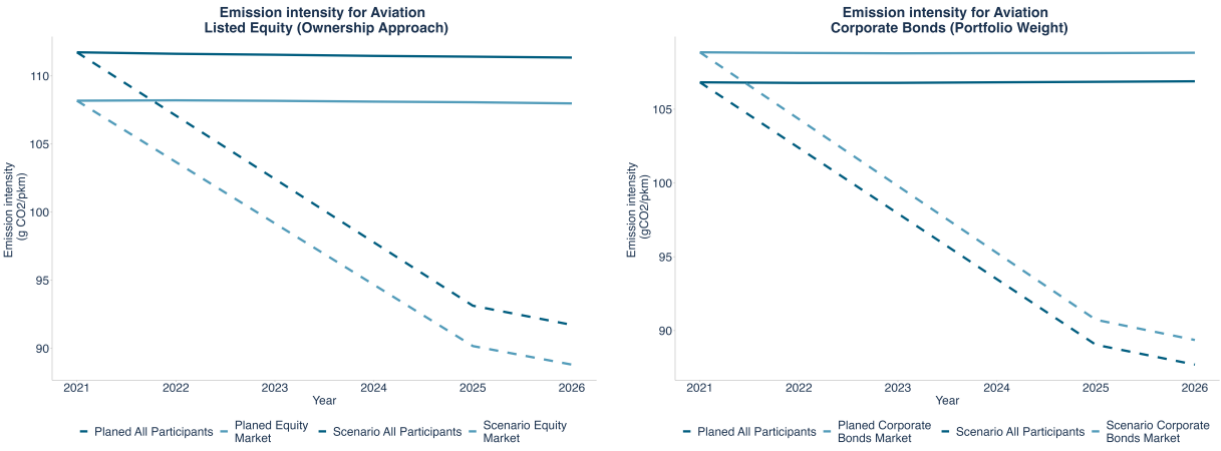


Figure 15: Current fleet emission intensity vs reduction required under GECO 1.5C scenario for the aviation sector

3.5. Steel

The steel sector accounts for roughly 4% of global CO_2 emissions and is, at the same time, an emissions-intensive and hard-to-abate sector. With the demand for steel under business-as-usual scenarios projected to grow by 30% by 2050, the financial sector has a key role to play, with lending in particular being one of the largest sources of capital for the steel sector. According to the World Energy Outlook 2021, the iron and steel sectors are one of the

largest contributors to the ambition gap between the Announced Policies Scenario (APS) and the Net Zero Scenario (NZE). The Net Zero Scenario includes an assumption of lower steel demand due to improvements in the steel-intensive industries, an increase in the steel recycling rate, and more resource-efficient use of steel in end-uses such as construction.

Regarding the technologies available in the sector, Electric Arc Furnace (EAFs) is key to decarbonizing the steel sector as it draws upon secondary scrap steel and is considerably less energy-intensive than primary production from iron ore and than pig iron. The industry is currently dominated by Blast Furnace (BF) and Basic Oxygen Furnace (BOF) technology, which relies on the use of coal as an energy source and reducing agent. The emissions intensity of EAF plants is to a great extent reliant on electricity grid decarbonization.

Nonetheless, the exposure of the Liechtenstein financial institutions to the steel industry is rather low, between 0.1% and 0.3% of total exposure. It's a slight decrease compared to the previous exercise. Most of the current exposure is in the Basic Oxygen Furnace (BOF) technology.

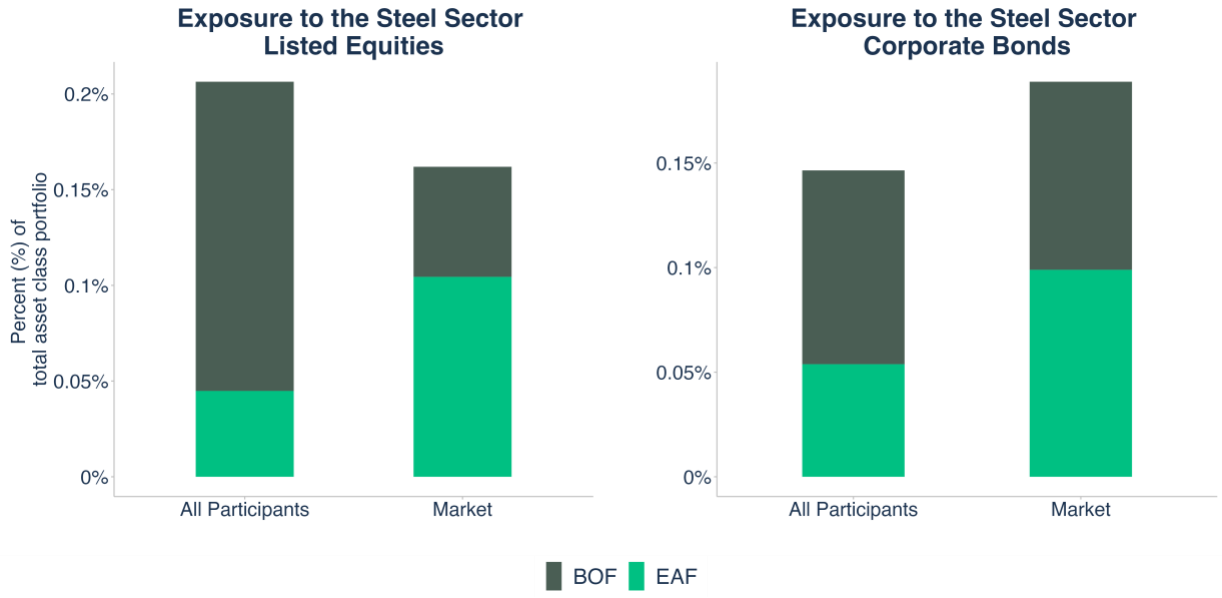


Figure 16: Share of aggregated portfolio value (exposure) invested in companies active in steel industry

Looking at the emission intensity plans for the sector, we can see that the emission plans of investee companies are not aligned with the emission decreases required by the scenario – which means emission per ton of steel is around 20% lower than the current levels. Nonetheless, forward-looking CO2 emissions and production data are more limited for the steel sector. Changes in the future emissions intensities of steel-producing companies are only currently partly forward-looking as well as being influenced by changes in asset ownership. As such, the insights that can be obtained from these graphs below are mostly on an absolute basis in relation to how far ahead (or behind) the companies in the Liechtenstein portfolios are relative to the scenario at the present moment or, taking into account the long investment cycles for the sector, the investment required to achieve 2026 targets and beyond.

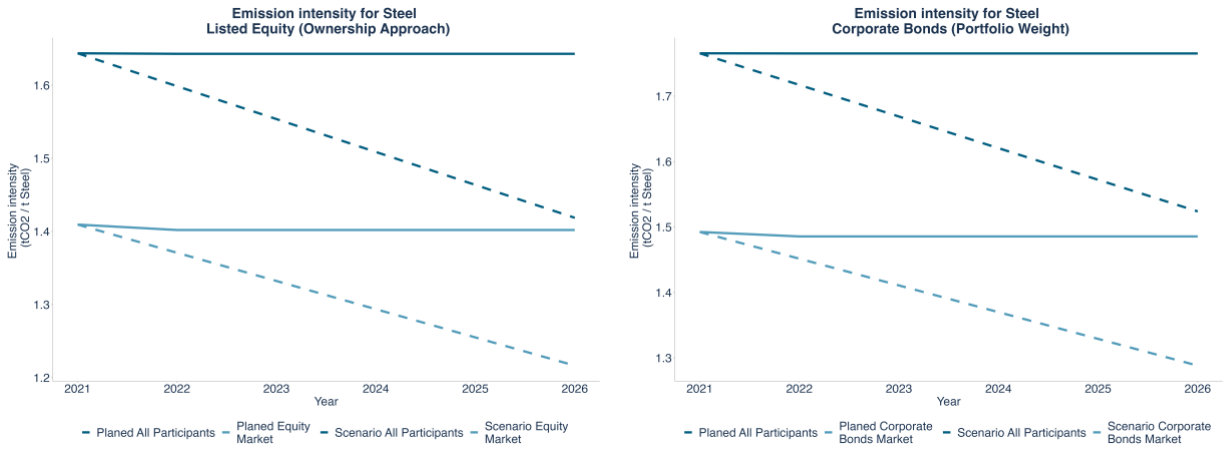


Figure 17: Current emission intensity vs reduction required under IEA NZE scenario for the steel sector in equity portfolios

3.6. Cement

Cement is the second-largest industrial CO2 emitter and the sector registers the highest emissions per revenue dollar (6.9kg CO2 /USD) among other hard-to-abate sectors, such as steel (1.4kg CO2 /USD). Like steel, demand is driven largely by the construction sector and infrastructure projects with, in the business-as-usual scenario, demand predicted to see a moderate increase through 2030 in response to global development. Scenarios indicate that a combination of more resource-efficient construction, the substitution of clinker with alternative materials, alternative kiln energy sources, and the use of carbon capture technologies will be required to decarbonize the sector. There is not one clear technology transition that can decarbonize the sector and several low-carbon solutions are yet not a commercial reality.

Liechtenstein institutions' portfolios hold little exposure to the cement industry at the moment of this analysis. The exposure is lower than 0.5% of total portfolios. There is a slight decrease in exposure compared to the previous exercise. Most of the exposure is towards companies using integrated facility technology.

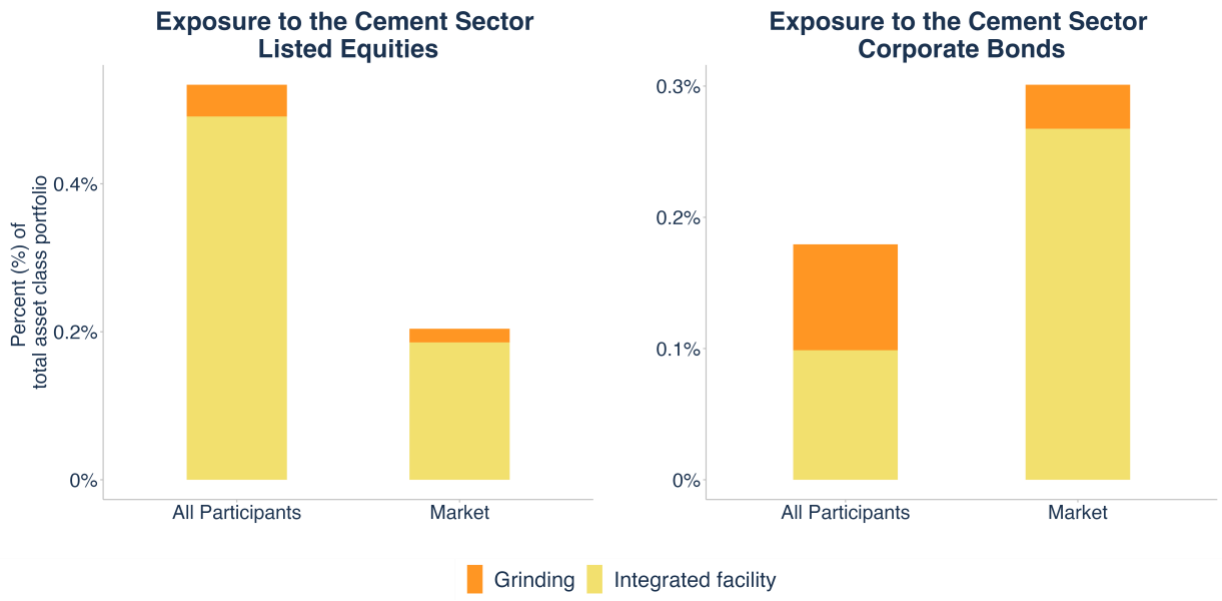


Figure 18: Share of aggregated portfolio value (exposure) invested in companies active in cement industry

Once again for this sector, while the scenarios require a reduction in emission intensity, the production plans of investee companies are not aligned with this requirement. The scenario requires about a 10% decrease in emission intensity by 2026 while no such plans are observed among companies that Liechtenstein investors are invested in.

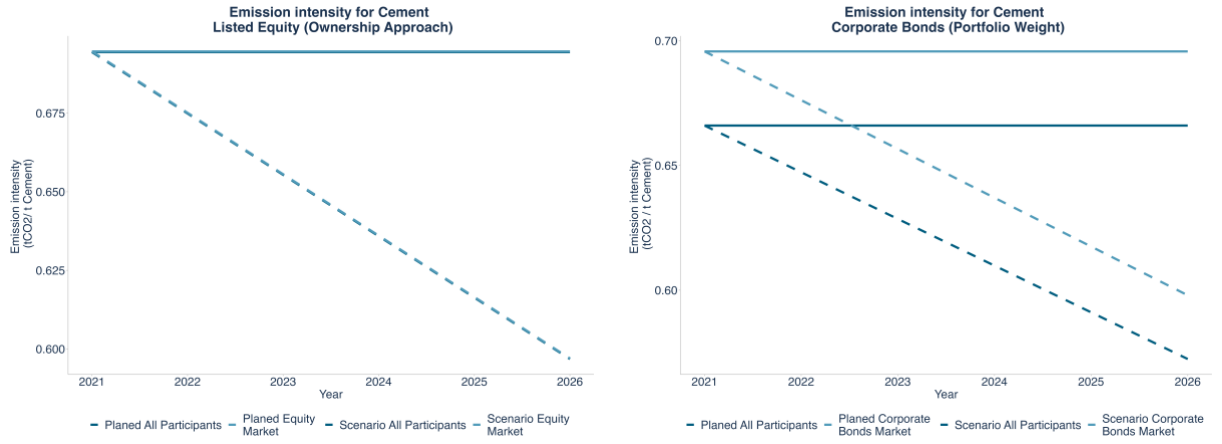


Figure 19: Current emission intensity vs reduction required under IEA NZE scenario for the cement sector in equity portfolios

4. Conclusion

The 2022 PACTA Climate Test in Liechtenstein is a voluntary initiative that analyzes the climate alignment and climate actions of the local financial sector. All pension funds, insurance companies, banks, and asset managers in the country were invited to participate voluntarily and free of charge in the test. The test consists of (i) a quantitative module that measures investments in listed equities and corporate bonds against global climate goals, and (ii) a qualitative survey that aims to capture more broadly the climate actions and strategies Liechtenstein financial institutions are undertaking. As an output, financial institutions received an interactive report with PACTA for each portfolio submitted, and the Ministry of Finance receives the present report analyzing the overall alignment of the financial sector. Unfortunately, due to the low response rate to the qualitative survey, the overall conclusion about climate actions and strategies in Liechtenstein could not be drawn in this report. Nonetheless, participants received an individual analysis in their interactive report comparing their answers to their peers.

15 financial institutions participated in the 2022 PACTA Liechtenstein test and submitted more than USD 131,7 bn in assets under management – double the size of the assets submitted to the test in 2020. In this round of the test, representatives from three peer groups participated test: 7 insurance companies, 4 banks, 3 asset managers, and 1 financial institution classified as other. Around 50% of the total asset submitted were allocated to listed equities and corporate bonds, and about 7% of the equities and bonds portfolios were allocated in PACTA sectors.

The overall exposure of financial institutions to oil & gas, coal mining, power, automotive, aviation, steel, and cement (climate-relevant sectors, or PACTA sectors) decreased considerably in the portfolios of Liechtenstein financial institutions when comparing numbers with the 2020 results. This is good news when considering the restricted financial flows going to companies producing high-carbon technologies. In fossil fuels, for example, financial institutions' exposure to the sector decreased to around 1.5% of Equity portfolios and 2.5% of Bonds portfolios with virtually no exposure to coal mining. The overall exposure to power and automotive sectors also decreased (from 2-6% and 1-6% in 2020 to 2% and 0.5%-1%, respectively), but the proportional share in high-carbon technologies within these sectors remained the same (40% of the total share in power and 80% of the total share in automotive allocated in high-carbon production).

In relative terms, the exposure to low-carbon technologies as a share of total investments in a sector increased since the 2020 test. In power, renewables and hydro make about 50% of total investments in the sector (versus 40% in 2020), and in listed equities portfolios, the share allocated in electric vehicle production increased to 20% (versus less than 10% in 2020). Nonetheless, because the overall exposure in the sectors decreased in absolute terms, the financial flows going to low-carbon technologies also decreased. It is important to note that a low share of investments in climate-relevant sectors doesn’t mean portfolios are greener or emissions reduced in the real economy. In order to increase the production of low-carbon technologies, financial flows need to be allocated in the strategic sectors and financial institutions should carry credible climate engagement strategies with companies to transition to low-carbon production.

However, exposure is not indicative of the alignment. Even though the exposure to high-carbon technologies decreased while the relative share of investments in low-carbon technologies increased, the alignment indicators show that the forward-looking production pathways planned by invested companies are misaligned with the Net Zero scenario in almost all sectors and technologies. In fossil fuels, an increase in production is planned while the Net Zero Emissions by 2050 (NZE) scenario requires a (sometimes steep) decrease in production. Compared to the previous 2020 exercise in Liechtenstein participants appear to even decrease their ambition. In power, production plans in oil, gas, and renewables capacities are also misaligned. The production of Internal combustion engine vehicles is also set to increase, although less than the market. On a more positive note, the production plans for coal power capacity are set to decrease by around 20% in the next 5 years and are aligned with the Net Zero

scenario. On this same note, the production of electric vehicles is set to increase and is aligned with the Nationally Determined Contributions scenario conditions.

The overall decline in the exposure of climate-relevant sectors combined with a general misalignment of financed productions demonstrate that the financial institutions in Liechtenstein need to work towards including credible climate strategies in their investment decisions. The decrease in exposure to high-carbon technologies is welcomed The climate performance of portfolios can only ever improve in two simple ways: through portfolio reallocation (divesting from polluting companies and investing in greener companies) or through the investee companies themselves becoming greener. While divestments and exclusion policies can achieve an impact on a company's share price and its ability to raise capital when applied in a coordinated way by multiple peers, such policies from the point of view of physical assets lead mostly to virtual changes, meaning, that the physical assets may have simply been moved to another actor in the financial system. is suggested that policymakers work with financial institutions to identify climate strategies applied by the local financial institutions and build capacity for effective climate actions.

In the authors' view Liechtenstein's financial sector still running the marathon to tackle climate change but the pace needs to increase Itwhen it comes to advancing in the alignment of financial portfolios, and with global warming of 1.5°C at serious risk, it is time to move away from reducing emissions only in portfolios to reduce emissions in the real economy. The financial sector is an important part of the country's economy and has direct links to the Swiss financial market, which makes the alignment of financial flows consistent with a pathway toward low greenhouse gas emissions crucial in order not only to comply with the Paris Agreement but also to manage transition risks. In this sense, for all financial flows to be aligned with the 2050 climate goals, ambitious climate targets, and concrete, climate-effective measures must be implemented by more financial institutions and more stringently while policymakers should not only measure and monitor main indicators but also guide the financial sector through more precise and strict policies and engagement.

Annex I: The PACTA Methodology

I. General considerations

The PACTA Methodology consists of several components. The quantitative part of it compares what needs to happen in sectoral decarbonization pathways determined through climate scenarios, with financial actors' exposures to companies in climate-relevant sectors. To do so, PACTA provides a five-year forward-looking, bottom-up analysis. It looks at the investment and production plans of companies, based on physical Asset-Based Company Level Data (ABCD), and consolidates that information to identify the transition profile of the companies and their related financial instruments. That way, PACTA can aggregate the production data to the portfolio level and compare that information to the production plans projected in different climate scenarios. The (mis-) alignment between the portfolio and these scenarios allows users to infer the potential exposure to transition risks and opportunities.

In total, the present study analysis consists of 4 components that aim to answer the following questions:

- Exposure Analysis. What is the current exposure of the portfolio to the economic activities that are most affected by the transition to a low-carbon economy?
- Future Exposure Analysis. How will the exposure of the portfolio change in the next five years, and how does it compare to a portfolio that is aligned with the Paris Agreement?
- Scenario Analysis. How aligned are the investment and production plans of companies in the portfolio with different climate scenarios and the Paris Agreement?
- Climate Action. How ambitious are the financial institution's climate strategies and how do they compare quantitative climate goal alignment indicators?

Further information on the methodology applied to answer those questions will be provided in the following sub-sections which will elaborate on the coverage, data inputs, allocation methods, PACTA metrics, and climate action analysis.

Coverage

Asset classes covered

The PACTA Methodology covers listed equity and corporate bond portfolios. The selection of asset classes covered by the methodology responds to the key role corporate issuers have in the transition to the low-carbon economy and the flexibility investors have to carry out different actions that allow mitigation of portfolio-level climate-related risks and risks in the real economy. PACTA further not only covers single titles but also funds. A fund look-through was applied automatically. However, to increase coverage, PACTA recommended users to do the look-through themselves if they were not satisfied with the coverage of the automated procedure.

Sectors covered

The PACTA methodology covers eight of the most carbon-intensive sectors in the economy (i.e., the sectors most exposed to transition risks) – oil, gas, coal, power, automotive, cement, aviation, and steel (the "PACTA sectors"). Together, they are responsible for around 70% of global CO_2 emissions. In each sector, PACTA focuses on the part of their value chain with the highest contribution in terms of CO_2 emissions. For example, in the oil and gas sector, the focus is on upstream activities related to production, while in the power sector, the focus is on power generation and related sources of energy. For more information regarding the segments of the value chain see the figure below.

Data inputs

Portfolio data

To run the portfolio assessment, participants provide an input file containing security information for each portfolio to be analyzed. It includes the following information:

- Investor and portfolio names
- One ISIN per listed instrument (funds are identified by their ISIN. Securities in each fund are included in the analysis)
- The market value of the financial assets held in the portfolio
- The currency code corresponding to the market value
- A timestamp of the portfolio

Financial data

Financial data is used to assign securities to its correspondent sector and link companies along the ownership tree (i.e. subsidiaries to parent companies). Financial data is also used to identify the composition of funds and allocate these assets to portfolios as indirect ownership – if the portfolio is exposed to funds. The financial data is sourced by FactSet.

Physical Asset-Based Company Data (ABCD)

For each sector covered in the analysis, PACTA sources data from the data provider Asset Impact (AI). In turn, AI sources its data from independent industry data providers that obtain data on individual assets in climate-relevant industries using a variety of research capabilities, including web scraping, desk research, and direct engagement with the industry. The asset-based company-level data covers more than 280,000 individual physical assets (e.g., individual power plants, oil fields etc.).

The figure below shows the coverage of asset-level data relative to estimated global production figures—the global benchmark—for the power, oil & gas, coal, and automotive sectors. The figure highlights the share of assets that have been mapped to financial data and are thus included in the analysis.

Scenario data

Measuring alignment requires scenarios that explain what needs to happen in a sector to decarbonize. While climate change scenarios do not predict the future, they provide essential information to understand climate change, and the pathways projected to reach certain goals. In the efforts to tackle climate change, it is critical to understand what can and should happen to mitigate climate change. It is important to note that climate scenarios are built under different assumptions, and therefore can propose different courses of action to achieve climate targets. The table below shows an overview of the scenarios used in this report and which sectors they cover. Further details on climate scenarios are provided in Annex II.

II. Allocation methods: Ownership versus portfolio weight approach

In the interactive report available for each portfolio, among the options for calculating and plotting the results, users can select between two methodologies - the Portfolio Weight Approach and the Ownership Weight Approach. These methodologies are used to attribute the physical assets of a company to the financial instrument

or portfolio. The Ownership Weight Approach is only available for equity, and the Portfolio Weight Approach is available for both bonds and equity. For this Meta report, it was decided to use the Ownership Weight Approach for listed equity and the Portfolio Weight Approach for corporate bonds.

As the explanations above show, even though both the Portfolio Weight Approach (PA) and the Ownership Weight Approach (OA) allocate physical assets to financial portfolios, they are based on different calculation methods. The OA approach allocates the "owned" physical assets of investors to their portfolio and thereby depicts production values from a real-world and macro perspective, while the PA allocates physical assets based on the weight of a company within the portfolio. I.e., the PA comes rather from a risk perspective of the individual institution.

These differences reflect that both approaches answer slightly different questions, based on the asset classes they are used for. While the ownership of listed equity allows attributing responsibility of physical assets to an investor and the investor has decision-making power based on their shares, the investment in corporate bonds does not allow the same level of engagement, which is why the PA rather reflects a risk-perspective on the exposure to the transition-related (mis-)alignment.

Please see an overview of the key differences between the two approaches below:

Ownership weight approach (for listed equity only)

- Answers the following question: How can the responsibility for the physical assets and total production be allocated to financial assets?
- Allocates production to your portfolio based on your real-world ownership.
- Does not include funds as funds are not directly owned and therefore investors cannot engage with invested companies in the same way as with directly owned financial assets.
-
- Allows monitoring of climate alignment of real production and is therefore especially useful from a macro and political perspective.
- Not applicable to corporate bonds in PACTA.

Portfolio weight approach (for listed equities and corporate bonds)

- Answers the following question: How exposed is your portfolio to different technologies?
- The portfolio weight approach is a representation of the investor's allocation choice and is inferred as a more risk-intuitive allocation rule
- Does not show "ownership" of technologies in the real world, but rather takes a risk-perspective focusing on the exposure to companies and technologies.
- Applicable to listed equity and corporate bonds.

III. PACTA metrics

The PACTA analysis measures alignment using three different metrics: Exposure shown as the Technology Share Mix, alignment with either the Production Volume Trajectory, or the Emission Intensities. The technology mix and the volume trajectory are used for the power, fossil fuels, and automotive sectors, for which there exist clearly defined technology decarbonization pathways. For example, in the power sector, there are technologies to transition to, i.e., coal-fired power generation can shift to renewable energies. For other sectors, where technology decarbonization pathways are not so well defined, such as steel, cement, and aviation, PACTA uses an emission intensity metric to compare it to scenario benchmarks. Each of these three metrics is explained below.

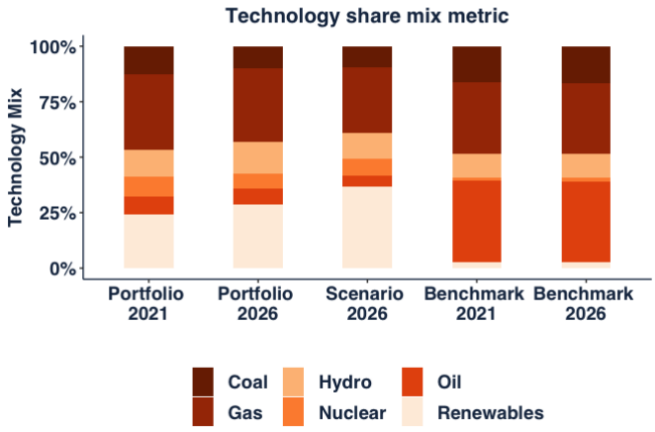
Exposure: Technology share mix

The technology share mix metric represents the weight of each technology in the sector as a percentage of investment therein. The portfolio's technology mix is compared to the scenario and a market benchmark (see Figure below as an example).

The technology share mix metric focuses on technology shifts within the power, fossil fuels, and automotive sectors, namely:

- the changes in the technological processes by which outputs are produced (e.g., shift from coal-fueled to renewable-fueled power capacity)
- changes in the nature of the output itself (e.g., shift from internal combustion engines to electric vehicles).

This metric measures the portfolio's relative exposure to the economic activities that are impacted by the transition to a low-carbon economy. It is a function of how diversified the investments' portfolios are across the companies they invest in and how diversified these companies' activities are across technologies or output types.



The figure above shows the high and low-carbon technology mix for the power sector in a sample portfolio:

- Portfolio 2021: reflects the current technology mix of the power sector in the analyzed portfolio.
- Portfolio 2026: reflects the future technology mix of the power sector in the analyzed portfolio.
- Scenario 2026: shows the projected technology mix of the portfolio in 2026 based on the SDS scenario.
- Benchmark 2021: reflects the current technology mix of the power sector based on the current production plans of companies comprised at a market index benchmark.
- Benchmark 2026: reflects the future technology mix of the power sector based on the capital plans for the next five years of companies at a market index benchmark.

PACTA assumes a static balance sheet. As such, the difference in the technology mix between Portfolio 2021 and Portfolio 2026 is solely a result of the production plans of the companies the investor is currently financing and not a result of any change in the portfolio composition.

Alignment: production volume trajectory and emission intensities

Production of Volume Trajectory

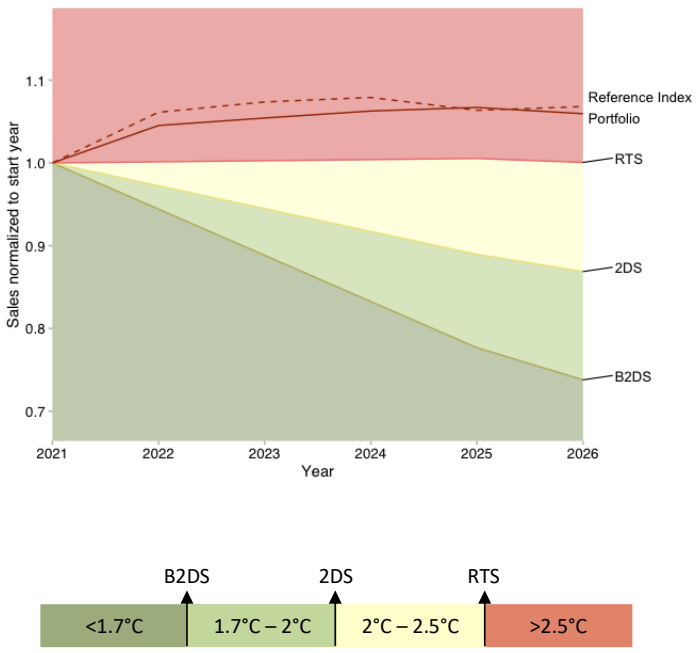
The production volume trajectory metric aims to measure the forward-looking alignment of a portfolio's projected production volumes, based on the five-year capital plans of companies, to the production volume ranges set as targets in different climate scenarios.

Changes in production volume result either from the transfer of production from one technology to another (e.g., internal combustion engines to electric vehicles) or from the sheer expansion or contraction in production coming from the technology/fuel (e.g., a company brings a new coal-fired power plant online). The Figure below shows an example of the production volume trajectory metric for internal combustion engine (ICE) vehicles.

Amount of ICE cars allocated to the investment portfolio. This is the "planned production profile" of the companies that

Amount of ICE cars produced by companies in a specific benchmark.

Coloured areas denote the production volume ranges that are compatible with different climate scenarios.



Misalignment with a <2° C scenario.

The Y-axis of the figure shows the normalized production, in this case sales planned for the next five years with the current capacity represented as 1. The chart shows that the portfolios' ICE vehicles' production trajectory falls within the red area and increases between 2021 and 2026. This means that the portfolio companies' production plans for ICE vehicles for the next five years are not compatible with the Beyond 2° Scenario (B2DS) and perform worse than the 2° Scenario (2DS) and the (Reference Technology Scenario (RTS), but similar to the selected benchmark (please note that these are just example scenarios – the scenarios change every year according to data availability).

Box I. Interpreting the technology share mix metric and the production volume trajectory metric altogether

The technology mix metric and the production volume trajectory metric both provide an indication of the alignment of portfolio companies with the Paris Agreement goals. However, they differ in that the technology mix metric is a measure of the relative amounts invested in different climate-relevant technologies within the portfolio, while the production volume trajectory measures whether the rate of change in the production amount is sufficient to meet the benchmark scenario that is in line with Paris Agreement goals. For example, it is possible that renewable power generation makes up a large portion of a credit portfolio relative to carbon-intensive power generation, resulting in a portfolio that is aligned with the Sustainable Development Scenario (Paris Agreement aligned) from a technology mix perspective. Yet the rate of increase of renewable power generation may be too small to meet the same scenario from a production volume trajectory perspective, because companies in the portfolio might not be planning an increase in their production plans in the next five years.

Emission Intensity

The emission intensity metric measures the average CO_2 intensity of the portfolio in the steel, cement, and aviation sectors. This emission intensity is given as CO_2/economic unit of output (for example, CO_2/per ton of steel produced). This is then compared to an emission intensity reference point set by a climate scenario.

While this is not the main metric of choice for the largest sectors tackled in this methodology, the emission intensity of the activities financed by the portfolio is nonetheless the first metric in sectors for which no clear technology pathways have been set out (namely, steel, cement, and aviation). Put differently, for these sectors, no zero-carbon alternative yet exists. As such, it is not possible to use the technology mix metric or the volume production volume trajectory metric to measure alignment. However, it is still imperative to steer capital in a way that aims to decrease carbon emissions in these sectors – hence the emission intensity metric is used.

Annex II: Scenarios – what are climate-related scenarios and decarbonization pathways?

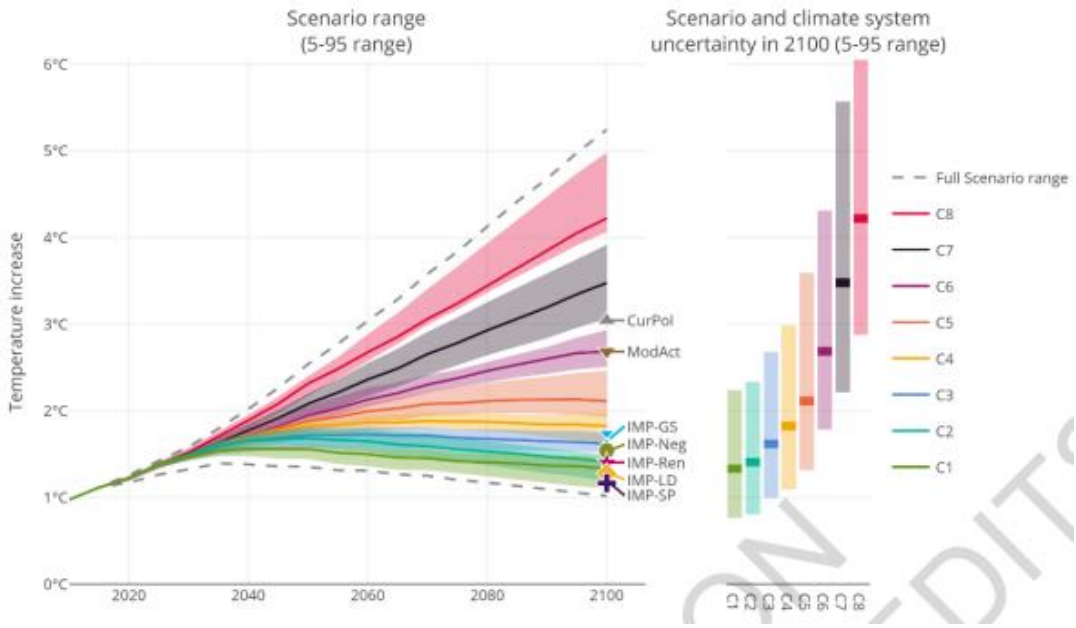
In the efforts to tackle climate change, it is critical to understand what can happen and what should happen in the future that, although uncertain, can be planned for with the aid of the foresight provided by scenarios. Climate-related scenarios have been defined as being:

"*A plausible description of how the future may develop based on a coherent and internally consistent set of assumptions about key driving forces (e.g., rate of technological change, prices) and relationships*" IPCC (2021)

Climate-related scenarios are therefore depictions of possible futures that incorporate scientific, technical, and socio-economic assumptions in order to describe a range of potential pathways to the future. They constitute a powerful tool that allows society to understand the consequences of not taking action today and, importantly going forward, the scale and pace of technological change and investment that is likely to be required in order to mitigate climate change.

I. Understanding scenarios and their sectoral pathways

A common reference point for understanding scenarios is the indicative pathways developed by United Nation's Intergovernmental Panel on Climate Change (IPCC), whose regular reviews and updates of the latest climate science form the basis for international policymaking. The IPCC maintains a global database of models and scenarios that it reviews in order to create a set of indicative pathways to different average global mean temperature rises in 2100, together with their associated probability and what they imply in terms of the techno-economic and social change required. Their latest and 6th review, published in October 2021 in advance of COP26, presented eight pathways for policymakers to consider at the global level (see figure below).



Whilst useful to understand the headline scale of change and investment required, the IPCC pathways are in general not granular enough to use at the sector level in PACTA. To measure alignment scenarios based on Integrated Assessment Models (IAM) are required. They tend to be built-up from much more granular information

on what needs to happen at the sectoral level in order to contribute to achieving an overall climate goal, such as limiting the global average mean temperature rise to 1.5°C.

Scenarios with decarbonization pathways that can be used by PACTA have been developed by the International Energy Agency (IEA), the European Commission, and on behalf of other organizations such as United Nations Principles for Responsible Investment (PRI), the Network for Greening the Financial System (NGFS) and the Net Zero Asset Owners Alliance (NZAOA). The scenarios selected for use with PACTA generally have two main features that lend themselves to alignment measurement:

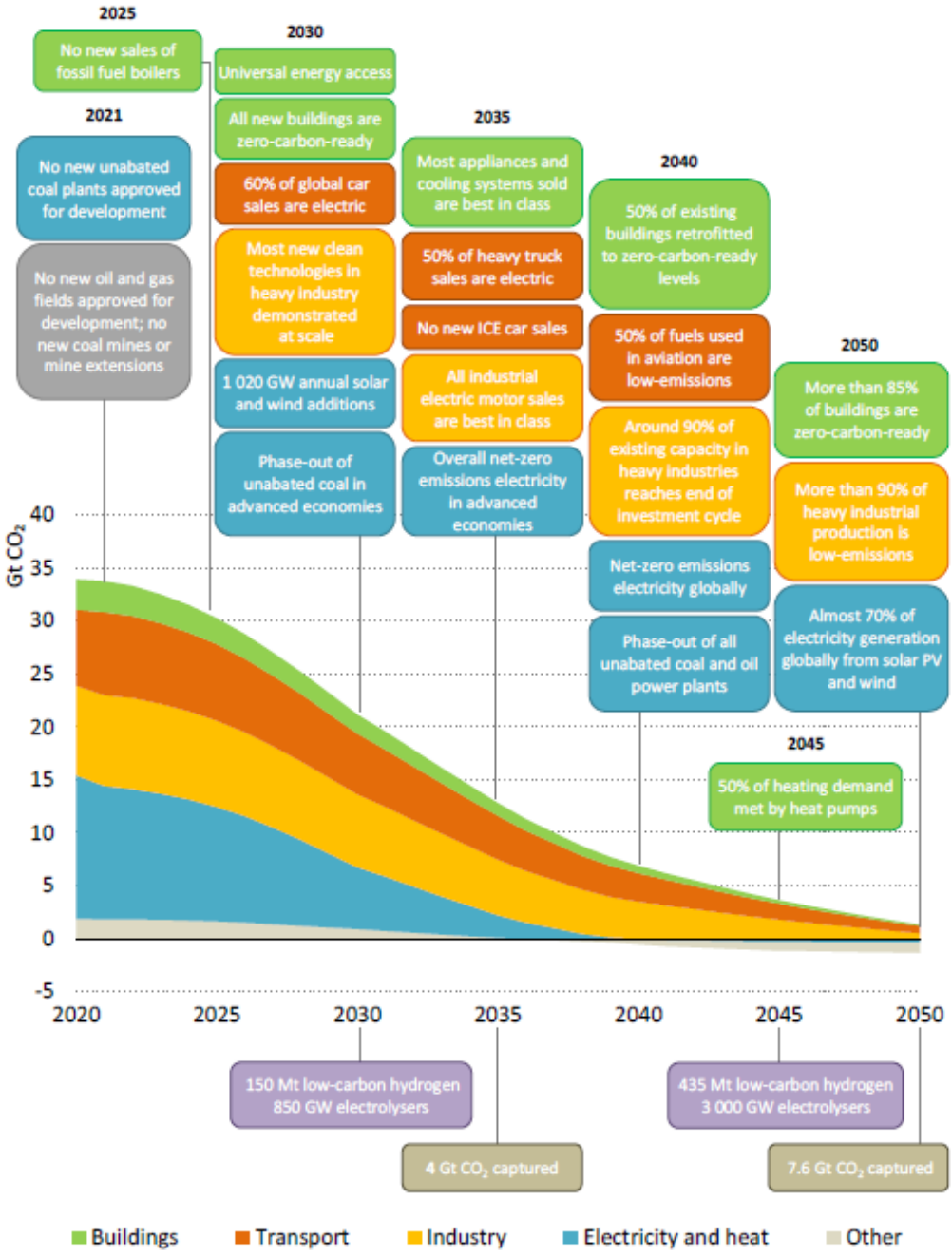
- A set of scenarios: They come as a set, reflecting different possible political, social, and economic futures as well as different climate outcomes. This is important because it allows internally consistent comparisons to be made between a baseline that represents what may happen if the transition occurs according to current policies that are modeled to be on track to limit global warming to 2.7°C and what will need to happen in order to accelerate the pace of change in order to limit global warming to below 2.0°C or, ideally, 1.5°C.
- Sector decarbonization pathways: They provide sectoral decarbonization pathways against which progress and in particular alignment can be measured. Decarbonization pathways have been defined as being: "A temporal evolution of a set of mitigation scenario features, such as greenhouse gas emissions and socio-economic development, towards a future state. Pathways can include narratives of potential futures and solution-oriented decision-making processes to achieve desirable societal goals." (IPCC 2021)

Pathways tell us how the different technologies will shift within a sector or how the emissions intensity will change as a result of implementing different measures over time.

These selected scenarios and their pathways are built up from a range of socio-economic and technical assumptions, as well as expert judgments. It is therefore important when using them to be aware of some of the main differences between them and the drivers for different climate outcomes. Some of the factors to bear in mind that can differ from the modeling of one scenario to the other can include:

- The speed at which decarbonization occurs;
- Availability and maturity of technologies, their scalability, and cost;
- Favoring or ruling out different technologies (e.g. reduced role for nuclear power, more prominent use of carbon capture technologies);
- Level of ambition for decarbonization, resulting in varying probabilities of limiting the global average global rise in temperature to <2°C;
- Levels of granularity (time, geography, etc.)

Based on the IEA´s Net Zero Energy by 2050 scenario, the figure below illustrates the types of assumptions and technological changes that may inform different sectoral pathways within a scenario (as indicated by the different colours) and on what timescale.



II. Limitations and assumptions of the scenarios used in the present study

As has already emphasized, scenarios and their sectoral pathways are depictions and models of possible futures, they are not forecasts of what will happen. When reading the PACTA results for meta, peer group, and individual financial institution portfolios, it is therefore important to understand the underlying limitations and assumptions behind the scenarios used as the basis for the analysis.

III. Probability of achieving the stated climate outcomes

Probability is a significant factor to bear in mind. In general, the climate outcome or target of stabilizing global warming at the °C target above pre-industrial levels by 2100 should be accompanied by a percentage probability. Thus, based on table 1 for the IEA WEO scenario set, aligning with a 2°C scenario may represent, for example, only a 50% chance and thus won´t necessarily lead to the limiting of global warming to 2°C and in fact, the probability of falling below 2°C falls to 33%.

Scenario	2030		2050		2100	
Confidence level:	50%	33% – 67%	50%	33% – 67%	50%	33% – 67%
Stated Policies	1.5	1.4 – 1.6	2.0	1.8 – 2.1	2.6	2.4 – 2.8
Announced Pledges	1.5	1.4 – 1.6	1.8	1.7 – 2.0	2.1	1.9 – 2.3
Sustainable Development	1.5	1.4 – 1.6	1.7	1.5 – 1.8	1.6	1.4 – 1.7
Net Zero Emissions by 2050	1.5	1.4 – 1.5	1.5	1.4 – 1.7	1.4	1.3 – 1.5

Note: Shows the maximum temperature rises with 33%, 50% and 67% confidence levels. Source: IEA analysis based on outputs of MAGICC 7.5.3.

The second table below compares the overall global warming goals and probabilities of four ambitious scenarios analyzed using PACTA. The use of a given scenario from within a set (e.g. from with WEO 2021 – NZE, SDS, NPS, CPS) does not constitute an assumption that this scenario is more likely to prevail than others, but the assumptions made about the market maturity of the different technologies in the pathways can provide an overall indication of the degree of uncertainty It is also important to note that the choice of IEA scenarios or other providers should not be interpreted as an endorsement of the underlying assumptions by RMI.

Scenario parameters	**IEA WEO 2021 SDS scenario**	**IEA Net Zero by 2050 scenario**	**ISF (NZAOA) Net Zero scenario**	**JRC GECO 1.5oC Unified scenario**
Average global temperature target in 2100	1.6°C	1.4°C	1.5°C	1.5°C
Probability of achieving warming goal by 2100	50%	50%	66%	50%

IV. The assumptions and judgments related to technological maturity

Most ambitious scenarios rely on assumptions about the implementation of technologies, some of which are still in the early stages of development and hence may not be available at the speed and scale that the scenario requires. For example, one criticism of the IEA 2°C and SDS scenarios is that it relies on a significant portion of BECCS (Bioenergy with Carbon Storage) up to 2050, which might not be technically feasible. The table below summarises the main assumptions and expert judgments about the technological maturity of solutions.

Scenario parameters	**IEA WEO 2021 SDS scenario**	**IEA Net Zero by 2050 scenario**	**ISF Net Zero scenario**	**JRC GECO 1.5°C Unified scenario**
Main identified sources of model uncertainty	Covid uncertainties, behavioral changes, CCUS for fossil fuels	Behavioral change, bioenergy, CCUS for fossil fuels	Behavioral change, large-scale	Carbon price and mitigation policies

			deployment of renewables	
Main assumptions on technology maturity	60-65% of required CO2 reductions are from technologies currently commercially deployed.	50-60% of required CO2 reductions are from technologies currently at demonstration or prototype stage.	Only considers theoretical technologies that have demonstrated proof of concept.	A technology learning-curve approach is applied.

V. The role of different technologies in each scenario

Underpinning the four selected scenarios are major technology shifts. In the past, IEA scenarios have been quite conservative and have underestimated both energy efficiency developments and renewable deployment rates. This is because technology learning rates and cost reductions turned out to be faster than predicted. This means that the scenarios might not be ambitious enough (compared to what is feasible) and that there is a need for more ambitious scenarios that lead to higher probabilities of limiting global warming to well below 2°C, one of the main goals of the Paris agreement. The table below compares and contrasts the role a number of key high and low-carbon technologies are earmarked to play in the selected scenarios – including energy demand, fossil fuel use, renewable energy, and carbon capture.

Scenario parameters	IEA WEO 2021 SDS scenario	IEA Net Zero by 2050 scenario	ISF Net Zero scenario	JRC GECO 1.5oC Unified scenario
Primary Energy demand reduction	17% less in 2030 compared to 2019	7% less in 2050 compared to 2020	8% less in 2050 compared to 2020	7% less in 2050 compared to 2020
Fossil fuel use and exploitation	Fossil fuel share in the primary energy mix falls around 70% by 2030	No new development or exploitation from 2020 onwards.	Emissions from fossil fuel must decline by more than half by 2030.	Fossil fuel share in the primary energy mix falls around 70% by 2050
The role of renewable energy	Renewable energy generation share increases from 30% in 2019 to 40% in 2030	Renewable energy generation is 60% of global power generation by 2030	Renewable energy generation share increases from 30% in 2019 to 40% in 2025	Renewable energy accounts for 78% of global power generation in 2050.
The role of nuclear energy	36% growth in nuclear capacity by 2040	76% growth in nuclear capacity by 2040	No new nuclear power stations	337% growth in nuclear capacity by 2040.
The role of carbon capture utilization and storage	2.9 Gt CO2 after 2050	7.6 Gt CO2 in 2050	No use of the technology	4.6 Gt CO2 in 2050
Use of nature-based solutions as offsets	80-240 Gt CO2 in 2050	No offsets assumed	152 Gt CO2 in 2050	Use of forest management to mitigate emissions.

VI. Summary descriptions of the scenarios used in is study

In this section, an overview of the main scenarios used to measure the climate-related alignment and exposure of the meta and peer group portfolios is provided. The scenarios summarized have been developed the IEA, the European Commission, and the Institute for Sustainable Futures. The individual scenarios within each set are described, allowing the reader to compare and contrast their rationale and basic assumptions.

International Energy Agency (IEA), WEO 2021 and ETP 2020

The IEA scenarios form part of two linked but separate energy models and publications, the World Energy Outlook (WEO) and Energy Technology Perspectives (ETP). Both are based on the IEA World Energy Model (WEM). The Net Zero 2050 scenario forms an extension of the WEO and has its own supporting documentation .

The WEO and ETP each provide sets of scenarios, providing depictions of potential future outcomes from current stated policies, orderly policy transitions in response to the Paris Agreement, as well as ambitious sustainable development and net zero transitions towards meeting specific climate goals. The IEA scenarios, therefore, allow for a scenario selection to be based on the overall strategic objectives for climate mitigation and the extent to which each scenario deviates from current climate change policies.

The WEO provides insight into the energy sector, with a focus on pathways for the fossil fuel and power generation sectors. The ETP covers the buildings, transport, and heavy industrial sectors. In PACTA, it is used for industry and transport, namely the steel, cement, and automotive sectors. It provides pathways with a time horizon from 2017 to 2070. In contrast, the WEO only extends until 2050. The WEO and ETP scenario set comprises:

- Stated Policies Scenario (STEPS): This scenario incorporates policies declared today. The goal of this is to assess what the world may look like in the future based on policies that have currently been announced. Energy demand rises by 1% per year until 2040. More than half of this growth in demand is met by solar photovoltaics (PV) while natural gas enabled by trade in liquefied natural gas (LNG) accounts for a third. Oil demand plateaus in 2030. Despite this, the global economic and population growth means that there is no peak in global emissions ahead of 2040 and hence globally shared sustainability goals (like those set out in the Paris Agreement) are missed. If all the targets are achieved as set out by this scenario there would be at least a 50% chance of limiting global temperature rise to 2.7°C by 2100.
- Sustainable Development Scenario (SDS): This scenario aims to meet stricter sustainable development goals. This requires rapid and widespread changes across all parts of the energy system. It is aligned with the goals set out in the Paris Agreement, with a 50% chance of limiting global temperature rise to below 1.65oC by the end of the century, as well as objectives related to universal energy access and cleaner air. These efforts are shared amongst multiple fuels and technologies.

In addition, the WEO in 2021 started to include an ambitious 1.5°C, ´net zero´ scenario:

- Net Zero Emissions by 2050 (NZE) This scenario extends the SDS scenario in order to target net zero emissions. The scenario responds to the increasing number of countries and companies that have made commitments to reach net zero emissions earlier combined with the aim of limiting the rise in global temperatures to 1.5oC by the end of the century (with a 50% probability). In particular, it explores the actions needed in the period to 2030 in order to be on track to achieve net zero emissions by 2050, including the need to end new fossil fuel exploitation from 2021 onwards and to avoid stranded assets across sectors. The original May 2021 documentation is provided below, as many of the scenario and sectoral pathway assumptions remain unchanged.

IEA, Energy Technology Perspectives (2020)

IEA, World Energy Outlook (2021)

IEA, Net Zero by 2050 (2021)

European Commission Joint Research Centre (JRC), GECO 2021

The Global Energy and Climate Outlook (GECO) scenario set has a basis in the energy-economic models that are used by the Joint Research Centre (JRC) to inform policy-making by the European Commission, combining the use of a global energy model (POLES) and a global economic model (GEM-E3). It provides pathways for all PACTA sectors, with the exception of cement. The time horizon extends to 2070. The 2021 edition of GECO comprises three main scenarios:

- Current Policy (CurPol) This scenario models at a macroeconomic level the effect of enacting current policies that have already been adopted up until 2019. If there are NDC targets at the national level but no policies, then these are not taken into account. Macroeconomic projections for GDP and population growth are combined with the modeled effects of policies on energy prices and technology development and deployment in order to then make projections for changes in energy systems and CO2 emissions. The effects of the Covid-19 pandemic on the energy system are factored into the modeling of growth and in particular in the transport sector. The global temperature outcome of the scenario is not specifically stated in the scenario literature, but the charts indicate greater than 3°C .
- Nationally Determined Contributions and Long-term Strategies (NDC-LTS) This scenario uses the Current Policy as its starting point and adds the potential effect of NDC policies in the short term and in the longer-term policy measures that may be implemented post-2030. This scenario results in a 50% chance of limiting global temperature rise to 1.8°C by 2100.
- 1.5°C Unified (Unif) This scenario represents an economically efficient pathway to achieving 1.5°C. The scenario assumes a low overshoot by 2050 (1.7°C) with global net zero GHG emissions reached before 2070. It assumes the application of a single global carbon price from 2021 onwards and that this functions as the main policy driver. It has limited reliance on carbon capture and storage technologies and does not consider financial transfers between countries to implement mitigation measures. If all the targets are achieved as set out by this scenario there would be at least a 50% chance of limiting global temperature rise to 1.5°C by 2100.

A second version of the 1.5°C scenario has also been developed, a ´differentiated´ scenario in which the carbon price is varied on a regional basis. This scenario is not currently available as part of the GECO 2021 scenario set prepared for use with PACTA.

JRC, Global Energy and Climate Outlook (2021)