Macroeconomic impacts of increased decarbonisation and green industrial policies in the European Union

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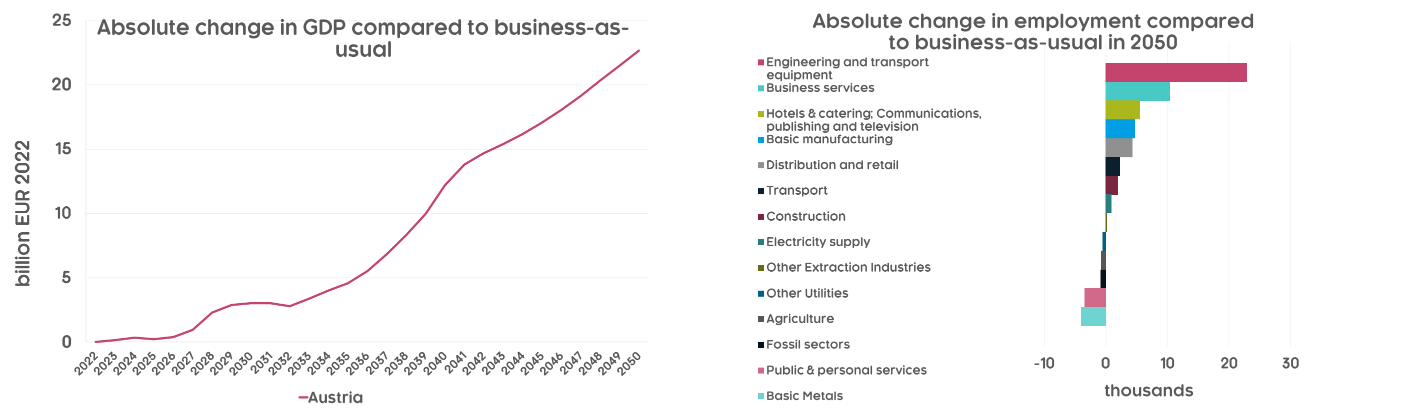
Executive Summary

The report discusses the macroeconomic impacts of increased decarbonisation and green industrial policies in the European Union, with a focus on Austria. The study uses a scenario analysis-based impact assessment to show the effects of additional decarbonisation and green industrial policies imposed within the EU, compared to a business-as-usual scenario.

The results indicate that both Austria and the EU are expected to achieve a 2-3.3% higher GDP level over the years between 2040-2050 compared to the business-as-usual, if the modelled additional policies are implemented. The economic stimulus is mainly driven by three major factors: subsidies, investments, and support of domestic production. The implementation of these policies will result in a productivity increase, with a higher level of employment over the long-term, relative to the business-as-usual case.

The growth in green industries is driven by the investment and support of domestic production, which affects various supply chains, impacting multiple economic sectors. The results show that fossil fuel sectors are declining considerably while emerging green industries show strong growth potential in both Austria and the whole EU.

Figure 1 Total output and employment by scenario, relative difference from baseline in Austria



Source(s): Based on modelling by Cambridge Econometrics.

+3.3% Higher GDP in the green industrial policy scenario in 2050 in Austria

-51 $MtCO_2$ Reductions in CO_2 emissions in 2050, because of green industrial policies in Austria

-7 % Reduction in total final energy demand in 2050 in Austria

+44 000 Higher employment in the green industrial policy scenario in 2050 in Austria

The modelling results provide strong evidence that the combination of decarbonization and green industrial policies have a positive overall impact on the economy of Austria and the European Union, both in terms of GDP and employment. The decarbonization policies have the benefit of reduced emissions and higher energy efficiency, while the green industrial policies provide support for investments in domestic production of low-carbon solutions. When emission targets are paired with appropriate green industrial policies, the decline in output in fossil fuel sectors is more than compensated with increased output in other sectors. In this way, the transition to a low-carbon economy is consistent with an overall economic development, with lower energy import dependence and an improved global competitiveness.

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Glossary

Term	Description
Output	Total level of production within a sector. The measure is equivalent to the turnover of a company. Production may occur to meet the demands of other companies ('intermediate demand'), for households or government to consume, or as part of investment.
Gross Value Added (GVA)	The production itself requires inputs from other sectors as well as inputs from labour and may be subject to taxes. Anything left is the operating surplus that is taken as profit. Gross Value Added (GVA) is the sum of the labour inputs, profit, and production taxes.
Gross Domestic Product (GDP)	Gross Domestic Product (GDP) is GVA plus taxes and subsidies on consumption besides the production taxes that are already included in the calculation of GVA.
Investment assumptions	Exogenous assumptions for investment that are driven by the scenario assumptions. Specific levels of investments are assumed in the relevant sectors when modelling policies assumed in a certain scenario.
Investment demand	Investment demand is calculated within the model and may differ from the scenario investment assumptions. It is measured as Gross Fixed Capital Formation and is determined through econometric equations estimated on time-series data.
Final Energy Demand	Final Energy Demand is the sum of the consumption in the end-use sectors and for non-energy use. Energy used for transformation processes and for own use of the energy producing industries is excluded. Final consumption reflects for the most part deliveries to consumers.
Primary Energy Demand	Primary energy demand refers to the direct use at the source, or supply to users without transformation, of crude energy, that is, energy that has not been subjected to any conversion of transformation process (oil, coal, natural gas, hydro, solar, nuclear, etc.).

1 Scenario design

The main goal of the study is to show the macroeconomic effects of additional decarbonisation and green industrial policies imposed within the European Union (EU), with special attention to its effect in Austria. For this purpose, a scenario analysis-based impact assessment is carried out. First a baseline scenario is set up, which represents the economic outlook in the case when only the policies that have already been implemented or enacted took place. As a second step, another scenario is defined which explicitly incorporates specific policies of interest besides the policies that are already included in the baseline. This scenario represents an ambitious decarbonisation and industrial policy package.

Once both scenarios have been defined, they are applied within Cambridge Econometrics' global macroeconomic integrated assessment model E3ME. The results of the modelling reveal the changes that can be anticipated in the scenario compared to the baseline, highlighting the effects of green industrial and decarbonisation policies. By comparing the results in these two scenarios, a detailed assessment of the anticipated effect of the additional policies is presented, including the impact on GDP, sectoral output and employment, as well as on energy use and fuel mix.

1.1 Business-as-usual scenario

The baseline represents a business-as-usual trajectory in which policies that have been implemented or enacted in the past continue to have an effect in the future, but no additional policies are introduced, even those which would be needed to meet the recently stated new ambitions and targets. As this is the business-as-usual scenario, the scenario is calibrated to historical data and future growth rates implied by external projections from various sources. This scenario is calibrated to the results from the Stated Policies Scenario of the International Energy Agency.[1] In order to capture the narrative of the specific sectors currently, in E3ME we included some additional policy assumptions in our baseline. Table 1 summarises the additional policies that we assumed for this scenario which were not included in the IEA datatables.[2]

[1] IEA STEPS: The Stated Policies Scenario (STEPS) by the International Energy Agency (IEA) is designed to capture the prevailing direction of energy system progression, based on the review of the current policy landscape without aiming to achieve a particular outcome. Tables B6 to B10 in the annex of IEA WEO 2022: World Energy Outlook 2022 (link) include the full list of policies considered by the IEA in their modelling.

[2] In E3ME, calibration is a scaling process, where some indicators will be exactly matched, while other indicators will be determined by the econometric equations. The first stage in matching E3ME's projections to a published forecast is to process these figures into E3ME's format. This means that the various dimensions of the model must be matched, including geographical and sectoral coverage, National Accounts entries. Once the data from the external forecast are processed, E3ME is solved endogenously, providing the calibrated projections. The calibration process does not directly affect the conclusions from the model results. See section 8.1 in the E3ME manual for more details.

Table 1: Policy assumptions in the business-as-usual scenario

Domain	Policy	Description
Energy/Transport	Biofuel blending mandate for transport sectors, other than road transport	From 2020 onwards, blending mandates in those countries that already implemented continue to grow up to 14-30%.
Emissions	Carbon price	Those countries with existing carbon market continue to grow in line with official projections (incl. PRIMES and IEA STEPS forecasts).
Economy	Revenue recycling	To balance government balance sheets, all policy costs and revenues are combined and redistributed. If revenues from green taxes are higher/lower than subsidies, taxes will be lowered/increased. The effects are distributed over value-added tax, employer's social security contribution rate, and income tax.
Power Generation	Nuclear phase out	Based on current announcements: Germany and Belgium phase out nuclear energy from 2020 onwards.

1.2 Industrial green policy and decarbonisation scenario

This scenario assumes an increased ambition for emission reduction, energy efficiency and domestic industrial production of low-carbon solutions. However, it is less ambitious than reaching a net-zero target by 2050 would require. The scenario includes additional assumptions relative to the baseline for green industrial and decarbonisation policies, which represent a higher level of effort to develop low-carbon industries within the EU. The decarbonisation policies are selected to target the main sectors which are the major CO2 emitters, while the industrial policies are included to support those industries which are most affected by the transition to a low carbon economy. Key assumptions that have been modelled in the decarbonisation and green industrial policies scenario:

- Coal phase-out from 2023 and natural gas phase-out from 2030 in the EU.
- Renewable energy sources (RES) subsidies and Feed-in-tariffs (FiT) are introduced.
- Kickstart for CCS technologies.
- The proposal increases the EU-level greenhouse gas emissions reduction target from 29% to 40%, compared with 2005 and updates the national targets accordingly in ESR (Effort Sharing Regulation) sectors: road transport, agriculture, buildings, small industries, and waste. Below are the policies in place for reducing emission in transport.

- Phase-out of sales of new internal combustion engine (ICE) passenger cars after 2025[3].
- Extend the sectoral coverage of carbon pricing to include road transport.
- Introduce taxes to promote emission reduction in aviation and maritime transport (to mimic impacts of a carbon price).
- Doubling the current deployment rate of individual heat pumps, resulting in cumulative 10 million units over the next 5 years.
- Regulations to phase out fossil-based heating.
- Extend sectoral coverage of carbon pricing to include buildings.
- Energy efficiency savings are assumed, together with investment into energy efficiency.
- Targeted import content for selected sectors, based on the EU's Net-Zero Industry Act[4] (NZIA).
- Investment to build EU-based industries.
- Financing arrangements for investment (private or public).
- Carbon border tax adjustments for competing imports.

Several green industries, such as solar photovoltaic panels, wind energy, heat pumps, electric vehicles, etc. and the related sectors from their supply chain are impacted by targeted import content. Similarly, besides the import targets, investments are defined for sectors that are key for green innovation. The targets are set according to NZIA, which aims to meet at least 40% of needs within the EU for key technologies by 2030. According to the Staff Working Document[5] by the European Commission "Investment needs assessment and funding availabilities to strengthen EU's Net-Zero technology manufacturing capacity", the minimum investment needed to expand clean technology manufacturing capacities over the 2023-2030 period is approximately around 92 billion euros.

This total is shared across all relevant low carbon industries (listed in Table 2 below) and distributed linearly over the modelling period. This amount is based on the assumption that the technology specific manufacturing shares from NZIA are met. Furthermore, the Critical Raw Materials Act[6] (CRMA) provides further information

[3] Sales of new normal ICEs are banned from 2025 and advanced ICEs after 2030 (Advanced ICE are more efficient newer ICE variants).

[4] Net-Zero Industry Act, available here.

[5] Staff Working Document of the European Commission, available here.

[6] Critical Raw Materials Act (CRMA) of the European Union, available here.

on investment in refining and processing capacities for critical materials including the following sectors: the refining and recycling of battery raw materials, rare earths extraction and other critical raw materials. Following this evidence, the investment split is as follows:

Table 2: Green Industrial Policy scenario investment assumptions across the EU

Technology	Investment for the period 2023-2030	CAPEX subsidy	OPEX subsidy
Solar photovoltaic	7.6 Bn EUR	30%	30%
Electrolysers	1.3 Bn EUR	40%	25%
Onshore wind and offshore renewables	6.1 Bn EUR	20%	8%
Batteries	68.2 Bn EUR	25%	35%
Carbon capture and storage	3.5 Bn EUR	20%	-
Heat pumps	5.6 Bn EUR	20%	18%
Material extraction, refining and processing	11.16 Bn EUR (20.88 Bn EUR by 2040) for batteries + 3.4 Bn EUR for rare earth materials + 3.1 Bn EUR for others	35% (based on range of 32-41% from American Battery Materials Initiative)	-

Table 2 includes investment assumptions in the scenario directly related to the NZIA and CRMA. For the period after 2030 until 2050, the assumed investment levels remain the same as in 2030. This investment is partly funded through government and private financing. The share of the investment to be government funded is, following the Staff Working Document estimates in the range of 17-20%, with sector-specific subsidy rates specified above. These subsidy rates are assumed to be in place until 2035 when they will be linearly reduced so that they are reduced to zero by 2050.

Additional capital expenditures (CAPEX) represent a direct boost to GDP and output in the affected sectors, and a cost to industries or governments. Operational expenditures (OPEX), on the other hand, will be reflected in increased output values and production costs for the affected sectors and increased costs to governments where they are assumed to provide subsidies.

The financing of the investment is key for the necessary transformation. There are various options for this effort like public or private debt, taxes, cross financing through ETS revenues, reducing fossil subsidies or a mix of instruments. The assumption for the modelling is increased debt or reduced profits for the private sector. The investment done by the government is covered through a combination of ETS revenues and other tax-raising mechanisms to maintain in all scenarios budget neutrality relative to the baseline.

Carbon Border Adjustment Mechanism (CBAM)

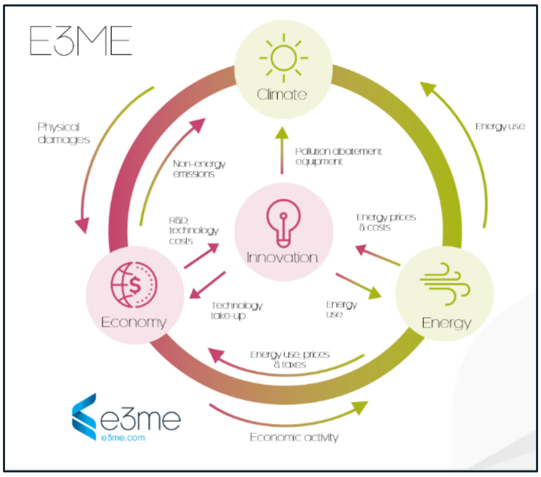
The carbon border adjustment mechanism (CBAM), as proposed by the European Commission (EC) as part of its Fit-for-55 agenda, is a tool that is primarily aiming to limit carbon leakage. The goal of the CBAM is to ensure the competitiveness of European industry, which faces higher environmental regulations than third party countries, while limiting carbon-leakage stemming either from offshore production or the import of goods from countries with inadequate environmental regulations.

Finally, the CBAM will be modelled as an additional cost to imports of the above sectors' output from other countries into the EU. The cost will be derived according to the difference in carbon pricing and carbon intensity of these sectors between the EU and the rest of the world (as a whole, to be calculated as weighted averages of all non-EU regions in E3ME). This is expected to have the economic effect of incentivising domestic production.

2 Macroeconomic modelling

E3ME is a computer-based model of the world's economic and energy systems and the environment. It was originally developed through the European Commission's research framework programmes and is now widely used in Europe and beyond for policy assessment, for forecasting and for research purposes. E3ME is often used to assess the impacts of climate mitigation policy on the economy and the labour market. The basic model structure links the economy to the energy system to ensure consistency across each area. Possible policies to assess include: 1) Carbon and energy taxes, 2) Emission trading systems, 3) Environmental tax reforms, 4) Energy efficiency programmes, 5) Subsidies for particular technologies in the power, transport and residential sectors, 6) Phase-outs of particular fuels and other direct regulation, 7) Resource efficiency programmes.

Economic activity undertaken by persons, households, firms and other groups in society has effects on other groups (possibly after a time lag), and the effects may persist into future generations. But there are many actors and the effects, both beneficial and damaging, accumulate in economic and physical stocks. The effects are transmitted through the environment, through the economy and the price and money system (via the markets for labour and commodities), and through global transport and information networks. The markets transmit effects in three main ways: through the level of activity creating demand for inputs of materials, fuels and labour; through wages and prices affecting incomes; and through incomes leading in turn to further demands for goods and services. These interdependencies suggest that an E3 model should be comprehensive and include many linkages between different parts of the economic and energy systems.



The close integration of the economy, energy systems and the environment, with two-way linkages between the economy and energy system is one of the core strengths of the model. Furthermore, additional features are needed to ensure the required linkages; A detailed sectoral disaggregation in the model's classifications, allowing for the analysis of similarly detailed scenarios. Its global coverage, while still allowing for analysis at the national level for large economies (70 regions total). The econometric approach, which provides a strong empirical basis for the model and means it is not reliant on some of the restrictive assumptions common to CGE models. The econometric specification of the model, making it suitable for short and medium-term assessment, as well as longer-term trends.

3 Economic results

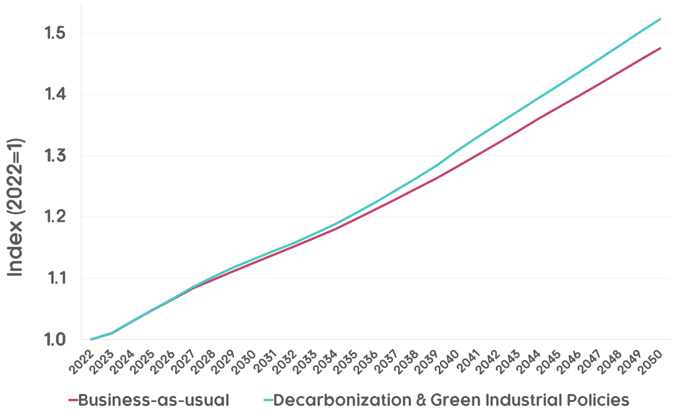
This chapter presents macroeconomic indicators, with each indicator describing different aspects of the anticipated effects of the scenario analysis, highlighting what the main driving factors of the changes are. The charts below illustrate different processes that occur in response to the policy inputs that are presented in the scenario design chapter. All reported monetary values are in real 2022 EUR terms.

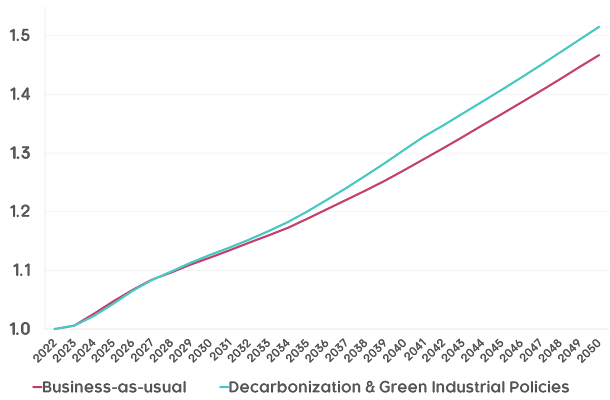
3.1 Economic development

The GDP growth potential of a country or region is a common indicator of its overall economic development. Figure 2 displays the expected changes in GDP for the two scenarios of the analysis: the business-as-usual (baseline) and the green industrial and decarbonization policies scenario. These growth trends show a normalized version of GDP, where the 2022 levels are set to 1. Hence, the GDP-growth trends seen here reflect the potential for economic development considering all relevant factors, including the underlying baseline macroeconomic outlook, which are part of both scenarios. The isolated effect of the additional policies specified in the scenario design are reflected by the difference between the business-as-usual and the green industrial and decarbonization policies scenario.

Austria and EU are projected to achieve 1.3-1.5% yearly growth in real terms over the course of the analysis, which results in an approximately 52% higher total GDP in 2050 than in 2022 (Figure 2). As the chart shows, the economy is expected to grow in both the business-as-usual and decarbonisation and green industrialization scenarios, indicating a general expectation of economic growth in the future. The primary objective of the decarbonisation policies in the scenario is to achieve a lower level of carbon dioxide and other greenhouse gas emissions, while the green industrial policies serve as supportive measures to complement the decarbonisation with economically beneficial, domestic industrial measures. An example of a decarbonisation policy would be a carbon tax, or a subsidy for low-carbon technology rollout, or a ban of the selected fossil-based technologies, or energy efficiency measures. Green industrial policies consist of measures to support the buildout of domestic production of equipment, raw materials or low-carbon technologies which are needed to reach the decarbonisation goals. The aim is to maintain or improve the economic competitiveness along with the decarbonisation efforts. The results suggest that the transitioning to a low-carbon economy can offer potential economic advantages, aligned with long-term economic growth through enhanced efficiency and productivity.

Figure 2: GDP growth projection across scenarios in Austria (left) and EU (right) - (2022=1)





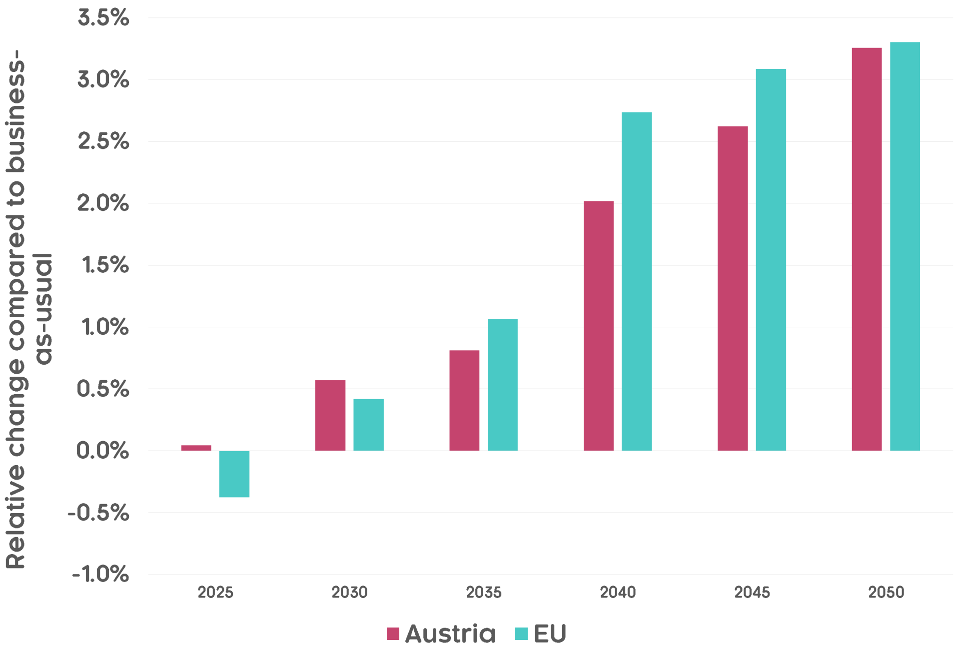
The goal of the current scenario analysis is to quantify the macroeconomic impact of the policies implemented in the decarbonisation and green industrial policy scenario. The scenario results presented below include the overall impact on the GDP, sectoral output, employment, as well as changes in the energy demand, the rollout-out of power generation capacities, and the adoption of passenger vehicles by type of propulsion technology. The impacts of the implemented policies are revealed by considering the differences between the business-as-usual and the decarbonisation and green industrial policies scenarios. Figure 3 highlights the relative changes of the scenario compared to the baseline for Austria and the EU. The results indicate that both regions are expected to achieve a 2-3.3% higher GDP on the long run when additional policies are implemented relative to the baseline.

This amounts to approximately an additional 3 billion EUR (real 2022) in 2030 in Austria compared to the business-as-usual scenario, which increases annually. By 2040, the additional GDP in the green industrial policies and decarbonisation scenario reaches 12 billion EUR (real 2022), which finally gets close to 23 billion in 2050.

The economic stimulus is mainly driven by three major factors: subsidies, public and private investments, and support of domestic production. Subsidies and investments work hand-in-hand, and they serve the essential purpose of strengthening the manufacturing capacity of the EU. Subsidies lead to price reductions in the related sectors, which allow for a greater level of output. Finally, the support of domestic production will limit the imports of certain goods and services to meet targets set forth across the EU on domestic production capabilities. The increased domestic production is expected to boost GDP-growth, just as sector specific investments also contribute to the overall economic output. The mechanisms introduced above explain how the additional industrial policy scenario benefits GDP-growth, compared to the baseline scenario which assumes that those additional policies do not take place.

Note that GDP first decreases in the EU in 2025 as shown on Figure 3, which later starts to grow at a faster pace than in the business-as-usual. This is explained by disposable income effects in the short run. Since public investments are assumed to be financed through taxation, households have a lower income over the short-term, which reduces aggregate consumption. However, in the long-run increased productivity and output due to the implemented policies can balance the negative short-term impact and leads to higher economic growth over the long-term.

Figure 3: GDP relative changes compared to baseline - Austria and EU

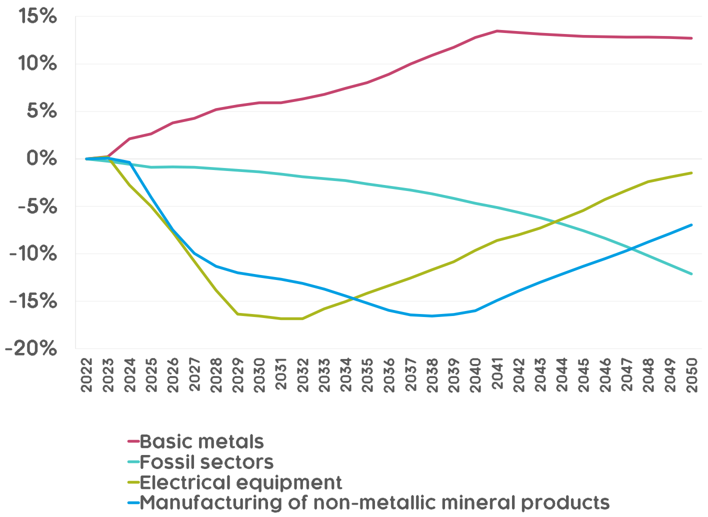


3.2 Competitive advantage through green industrialization

A further important factor in evaluating the impact of the green industrial policies and decarbonization on the economic growth of Austria and the EU is to examine how these regions' international competitiveness is affected. This can be done by looking at how the regions' import requirements change, which indicates their international dependence for certain products.

Across the whole economy, there is a decrease in fossil fuel imports (coal, oil and gas) sectors, which is a direct result of the decarbonisation policies. Coal imports decrease by approximately 5% in 2050, while oil and gas decrease by more than 10%, strongly indicating a lower reliance on fossil fuels. Imports in the basic metals sector, and some other aggregated sectors increase because a higher volume of imported materials are needed to support a higher economic output and investments driven by the green industrialization. Figure 4 shows the relative changes in sectoral imports in Austria between 2023 and 2050, highlighting the sub-sectors that are directly impacted by the green industrial policies assumed in the scenario design.

Figure 4: Relative change in sectoral imports - Austria



Note that the manufacturing of non-metallic mineral products and the electrical equipment sectors decrease significantly compared to the business-as-usual scenario, by about 15% in 2030, as a higher share of the production in these sectors takes place domestically. Over the long-term, however, imports will gradually increase driven by a strong increase in the overall demand, but still remain below levels seen in the business-as-usual scenario. As domestic demand for critical raw materials and minerals rises, the import of basic metals also goes up[7].

[7] To find out more about the topic, please get in touch with Cambridge Econometrics about its earlier research: '*Investment cost and mineral demand in global decarbonisation scenarios*'.

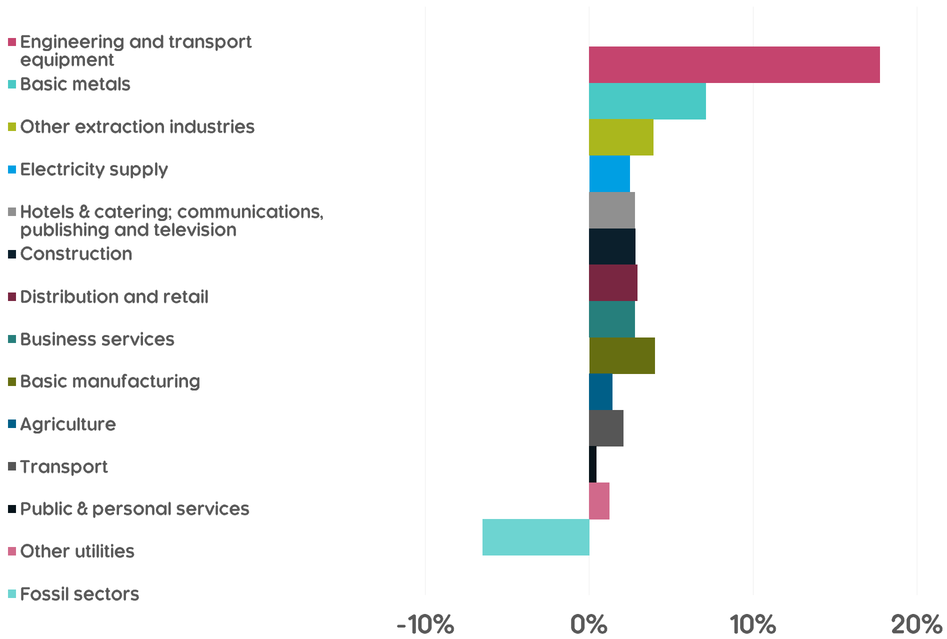
3.3 Sectoral output

Sectoral output growth measures the value of goods and services that a specific sector of the economy produces over a period. Sectoral analysis can reveal the impact of economic growth by showing which sectors are leading growth and which sectors are falling behind. This can help policymakers to find areas that need assistance and investment to boost overall economic growth.

Growth in green industries is driven by the investment and support of domestic production which affect various supply chains impacting multiple economic sectors. Investment initially targets specific sectors and subsequently spreads to other sectors through direct and indirect effects. Direct effects refer to the initial investment, as well as the multiplicator effects that arise from intermediate demand between economic sectors. Indirect effects include the changes in household's disposable income which affect their consumption which is a key component of overall GDP.

Figure 5 compares economic sectors by showing how the sectoral output differs between the business-as-usual scenario and the industrial policy scenario, covering all economic activities. The findings are in line with the ex-ante anticipated impacts of the scenario design, namely that fossil fuel sectors are declining drastically while emerging green industries show strong growth potential in both Austria and the EU.

Figure 5: Relative change in sectoral output in Austria in 2050

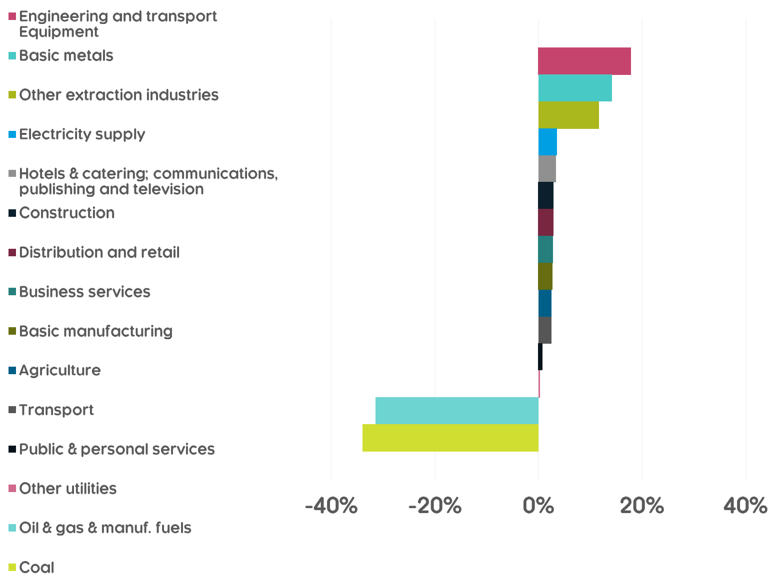


The electrical equipment sector, which is part of engineering and transport equipment sector, is a key sector in the supply chain of green industries, having the highest potential for growth. It includes the production of household electric appliances and industrial tools used in the production of several low-carbon solutions. The sector achieves a 30% increase in output compared to baseline by 2030 and maintains this higher level until

2050. Other sectors benefiting from these policies are machinery, equipment, basic metals, other mining, and non-metal mineral products, which all play a key role in the spread of electricity-based technologies such as electric vehicles, solar PVs, wind farms, heat pumps, electrolysers etc.

On the other hand, declining sectors include the ones related to fossil fuel extraction and transformation. which are being limited or partially phased out as a result of the decarbonisation policies. Coal, oil and gas and manufactured fuels are the most heavily impacted, which all experience a steady decrease compared to the baseline. The relative decline is15-20% in the period between 2030 and 2035, and 30-35% after 2045 in the EU.

Figure 6: Relative change in sectoral output in the EU in 2050



A similar outcome is found in the output of the power sector. The power generation which relies on fossil fuels as an energy source will decline, being replaced by renewable energy capacities. Renewable in power generation account for a much larger share of the electricity mix in 2050 compared to 2025, as shown on Figure 7. Note that among renewable energy sources, solar and wind power are expected to capture most of the expected growth in electricity supply from 2030 onwards in the decarbonization and green industrial policy scenario, in both Austria and in the EU.

Figure 7: Electricity Generation by technology (%) in Austria

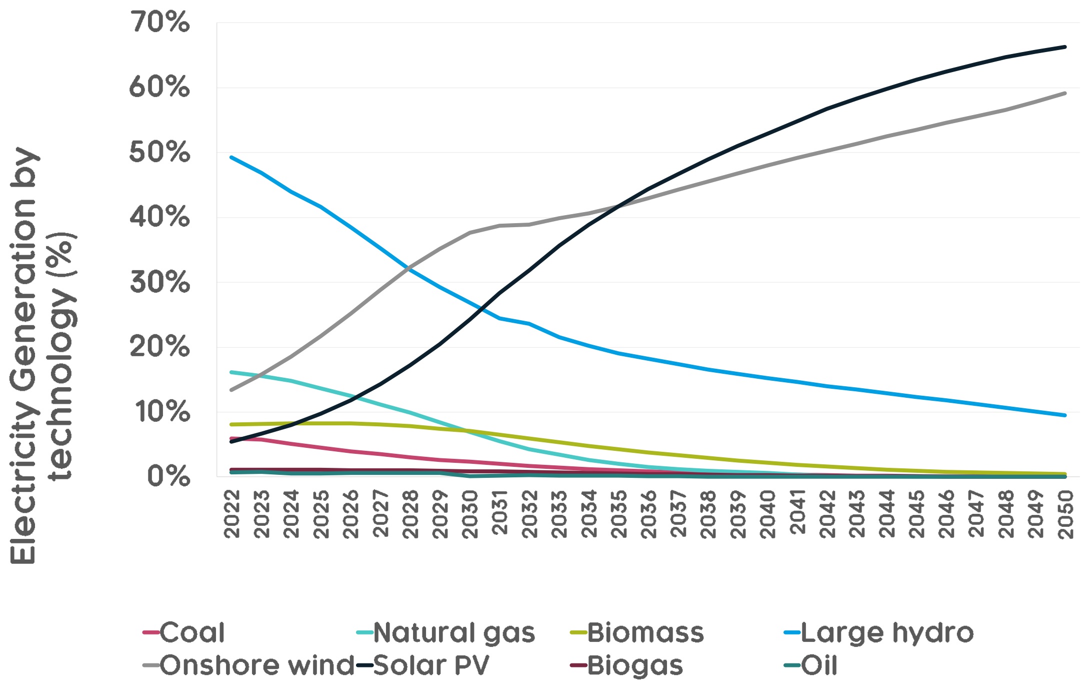


Table 3 shows the absolute changes in sectoral output for Austria in 2030 and 2050 compared to the business-as-usual scenario. The table reveals that most sectors experience a positive change, with engineering and transport equipment leading the way with a 30 billion EUR (real 2022) increase in 2050. Other sectors that benefit from the green transition include basic manufacturing (~6 billion EUR, real 2022), business services (~9 billion EUR, real 2022) and distribution and retail (~4.5 billion EUR, real 2022). On the other hand, some sectors are impacted negatively, especially those related to fossil fuels. In absolute terms, the oil and gas sector produces approximately 800 million EUR (real 2022) less in 2050, compared to the business-as-usual case.

Table 3: Absolute sectoral output changes compared to business-as-usual in Austria

Sector	2030	2050
	billion EUR (real 2022)	
Engineering and transport equipment	*9.51*	*29.51*
Business services	*-0.73*	*9.14*
Basic manufacturing	*2.27*	*6.11*
Distribution and retail	*-0.66*	*4.42*
Construction	*1.87*	*3.15*
Hotels & catering, communications, publishing, television	*0.29*	*2.66*

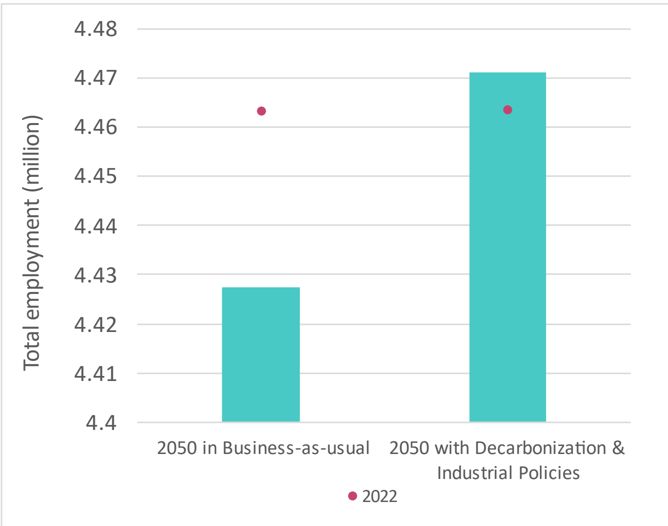
Basic metals	*0.98*	*1.85*
Transport	*0.22*	*1.40*
Electricity supply	*-0.42*	*0.80*
Public & personal services	*-0.86*	*0.75*
Other utilities	*-0.26*	*0.30*
Agriculture	*-0.05*	*0.23*
Other extraction industries	*0.08*	*0.11*
Coal	*0*	*0*
Oil & gas	*-0.12*	*-0.80*

3.4 Employment

Changes in sectoral employment shed light on the wider socio-economic impacts besides economic output. There are two major mechanisms that affect employment impacts which feed back into the overall economic performance of a country. First, there might be changes in a sector's productivity due to automation and other innovations. This results in fewer people being able to produce the same (or higher) level of output. Second, changes in employment affect the disposable income of households which feeds back into the economy through aggregate consumption. Furthermore, disposable income of household is also affected by taxation, which is assumed to be the main source of financing for the public investments related to the green industrial policies.

Figure 8 shows the overall employment impact of the green industrial and decarbonization policies. The blue bars on the chart show the total employment in 2050 in the business-as-usual and green industrial policies scenarios, and the dots show the total employment levels of Austria in 2022. In the business-as-usual scenario a decline is seen in the total employment level of approximately 35 thousand employees, which is explained by the overall declining trend in employment that is anticipated both in Austria and the EU. On the other hand, in the green industrial and decarbonization policies scenario, an additional 10 thousand workers can be expected to be employed in 2050, compared to the 2022 employment levels. For a further assessment of employment impacts, a sectoral analysis is needed to highlight which sectors benefit from job creation.

Figure 8: Employment in Austria (thousands)



Sectoral employment impacts (Figures 9 & 10) of a scenario often correlate strongly with changes in output, since a large divergence between the two variables would indicate a substantial change in productivity as well, which needs to be interpreted with caution. Within the EU and Austria, the green industry sectoral employment increases and the fossil sectoral employment decreases. The largest growth takes place in the electric equipment sector, but the change in employment is much lower in percentage terms than the change in output. In Austria, employment is expected to increase by 30-40% by 2050, while output is expected to rise by 40-50%, indicating a strong boost in productivity.

Figure 9: Relative changes in employment in Austria in 2050

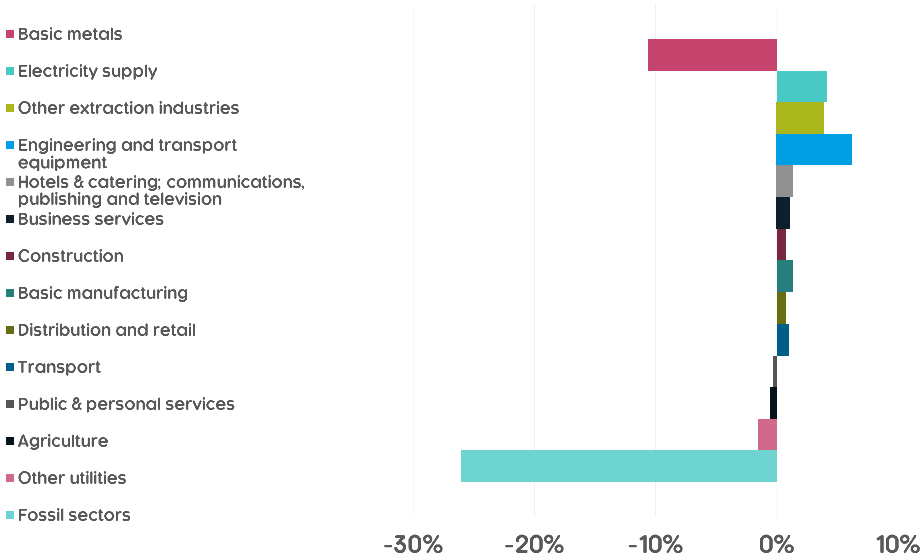
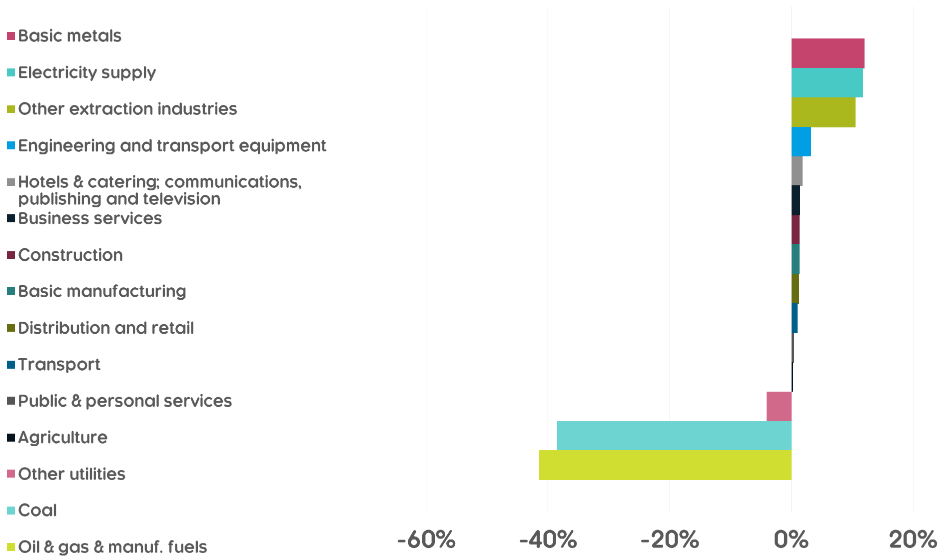


Figure 10: Relative changes in employment in the EU in 2050



3.5 Environment and energy savings

The primary goal of the enhanced green industrial policies is to strengthen the economy; however they also vastly contribute to reaching mitigation targets. Figures 11 illustrates the emission reduction potential of the applied decarbonization policies, relative to the scenario without any policy interventions (see the left side of the chart) in Austria and the EU.

By 2050, total annual CO_2 emissions fall below the 2022 emission levels by almost 30% in Austria, and more than 60% in the whole EU. Note, that this reduction is a more ambitious mitigation potential from what is assumed to take place within the business-as-usual scenario. The red line shows the baseline assumptions for CO_2 reductions in Austria and the EU which are already considerable, however the modelled decarbonization and green industrial policy scenario (blue line) implies an even more ambitious reduction in emissions.

Figure 11: CO_2 emissions in Austria and the EU

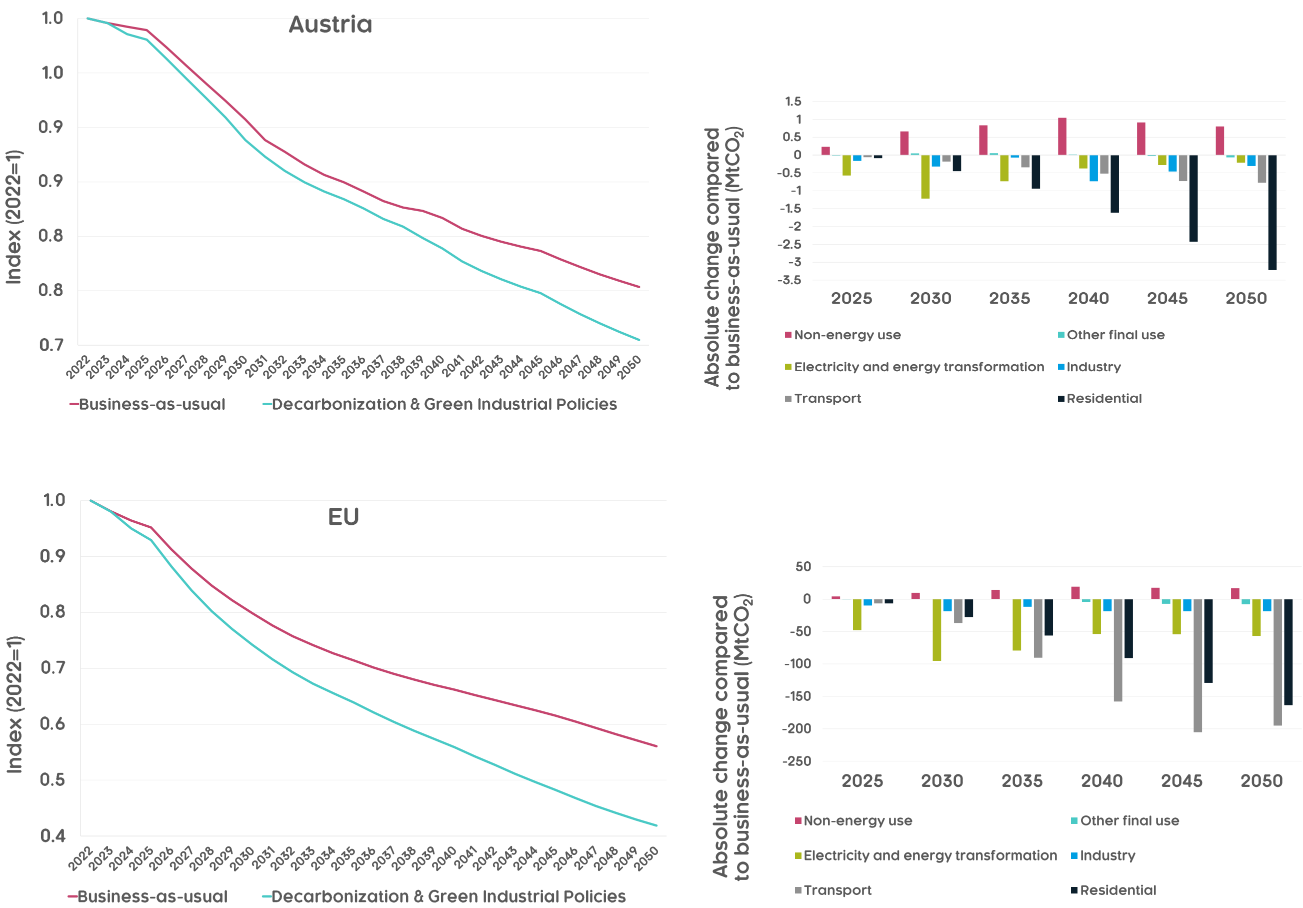
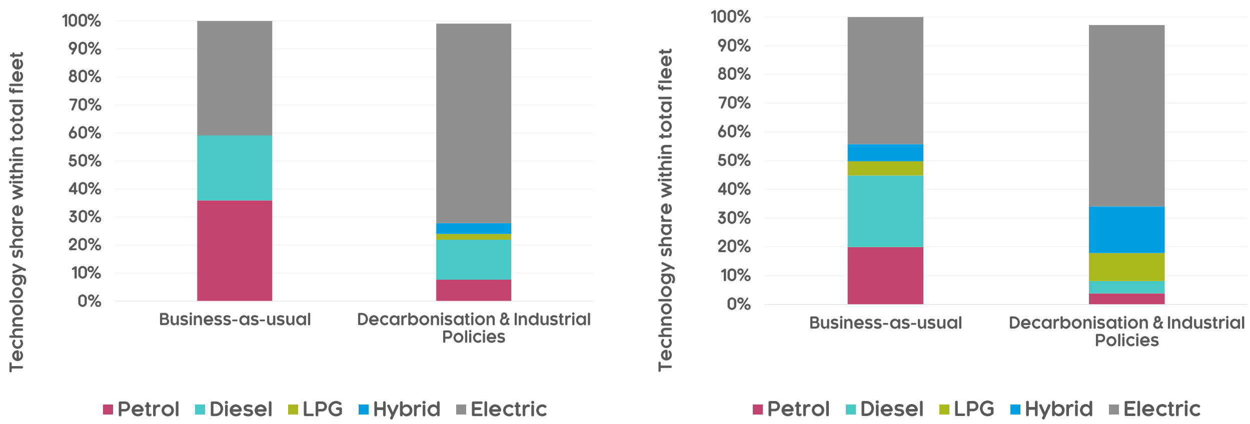


Figure 11 (right) shows how CO_2 emissions change in different sectors. The residential sector is a key target of many policies in the scenario design, such as the strategic support of solar panels and other electricity-based, green household solutions. These policies lead to considerable CO_2 reductions in both Austria and the EU. The transport and residential sectors offer the most opportunities for cutting emissions in the EU, while the residential sector is the main source of potential in Austria. The decarbonization policies in Austria have a positive effect on lowering CO_2 emissions from transport activities, but the same policies lead to more significant reductions in other parts of the EU. The slight increase in emissions in the non-energy use sector can be attributed to the process emissions of the implemented policies. This includes the implementation and realization of those policies, which result in a slight increase in CO_2 emissions. However, as seen on the chart showing the total CO_2 emissions, the aggregate impact of the policies has a strong mitigation potential.

Passenger road transportation has a huge impact on the reduction of CO_2 emissions both in Austria and the EU, which is achieved through the extensive diffusion of electric vehicles as seen in Figure 12. The chart shows changes in technology shares within the total fleet size of passenger cars. In the business-as-usual scenario only an insignificant portion of all vehicles are expected to be electric by 2030, and approximately 40% of them by 2050. On the other hand, in the decarbonization and green industrial policy scenario, new sales of ICE vehicles are assumed to be banned after 2025. While this does not result in a significant decrease of ICE vehicles by 2030, but it is expected that 71% of vehicles will be electric in Austria in 2050 and 63% in the EU. A similar trend is seen across the whole EU, with differences in the uptake of LPG and hybrid vehicles, as these technologies can spread at a slightly faster rate in the EU than in Austria alone.

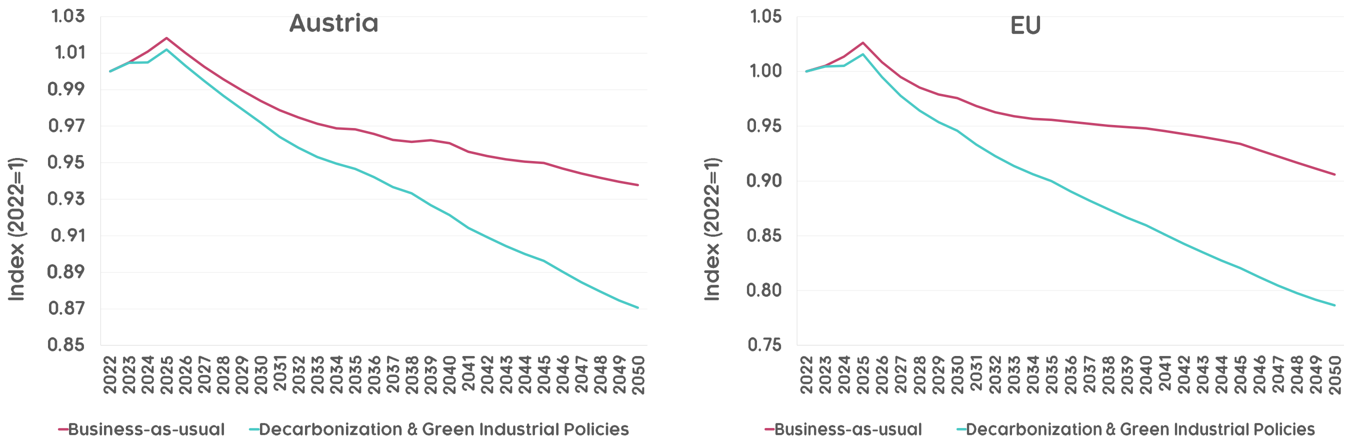
Figure 12: Passenger road transportation technology shares within the total fleet size of private vehicles in Austria (left) and EU (right) in 2050



The difference in the transportation technology shares translates into a significant variation in the final energy demand, as shown in Figure 13. The business-as-usual scenario results in a slightly decreasing trend for both Austria and the EU, reaching about 90-95% of current consumption levels by 2050. The green industrial and decarbonization policy scenario, however, leads to a substantial reduction of the final energy demand, especially after 2030, when the electric vehicles become more prevalent. By 2050, the final energy demand is reduced by 13% in Austria and by 21% in the EU compared to 2022. This indicates that the adoption of cleaner and more efficient transportation technologies can have a major impact on the energy consumption and the CO_2 emissions in the region.

Besides the adoption of more efficient technologies, the reduction in final energy demand is also influenced by the changes in the energy prices that consumers face, namely electricity and gas prices. In nominal terms prices increase in Austria between 2022 and 2050 by approximately 75-80%, reflecting the policy assumptions of the scenarios in the short-run and the market responses of the modelling analysis. However, this does not imply that the consumers are worse off in real terms, adjusted for inflation, as the real prices of electricity and gas decrease over time, which is mainly driven by the technological development of renewable energy sources that lower energy costs.

Figure 13: Total final energy demand in Austria and the EU



4 Conclusion

This report presents an analysis of the impacts of a decarbonization and green industrial policies scenario on the Austrian and European economy. The scenarios are derived from the EU's long-term vision for a climate neutral Europe by 2050, with varying levels of ambition and policy instruments. The analysis employs a macroeconomic model (the E3ME model of Cambridge Econometrics) to assess the effects of the scenarios on key indicators such as GDP, output, employment, power generation and energy demand.

The main results show that the scenario creates positive economic impacts for Austria and the EU in terms of economic growth, job creation, and decarbonization. The green industrial policies generate more investments, innovation, and lead to structural change which allows greater productivity in green growth sectors and therefore overall economic progress. Moreover, the scenario cuts greenhouse gas emissions by 60% in 2050 within the EU compared to the business-as-usual scenario. Finally, the scenario also improves the energy efficiency and energy security of Austria, because the modelled policies lower the final energy demand and the reliance on fossil fuel imports.

Green industrialization leads to the strategic development of sectors which are at the forefront of the transition and highlights the need for the creation of new skills across supply chains that align with a sustainable development future. This is particularly the case for electric engineering and related products, which is expected to grow by 20% compared to the business-as-usual scenario. This growth potential has direct and indirect effects on the whole economy, leading to an overall 3% relative GDP growth in 2050 compared to the business-as-usual. Moreover, the green industrialization policies are important for the entire European economy to remain competitive globally, as indicated by the reduced import dependence. Lastly, the higher growth potential also creates employment opportunities. The overall population and active workforce are predicted to decline in the coming decades across Europe in the business-as-usual scenario, but due to the green industrialization policies and the structural change they imply for the whole economy, it is possible to keep and even increase the current level of jobs.

The green policies also affect the fossil sectors, which see a drop in demand and output as a result of the policies implemented in the scenario. Coal, oil and gas production sectors shrink the most over the period of the analysis in both Austria and the EU. This suggests a reduction in their overall potential to create value and employ people, and therefore the fossil sectors will have to adjust their business model and shift their activities towards green products to stay competitive and viable in the low-carbon economy.

The main finding of the study in this report is that a policy package which includes decarbonisation measures along with green industrial policies, will lead to a sustainable development and economic growth, with lower emissions, higher employment, higher energy efficiency, and a lower reliance on fossil fuel imports. This is a path to follow in order to maintain Europe’s long-term competitiveness.

5 Appendix

5.1 Total investment

Figure 14: Total investments in Austria

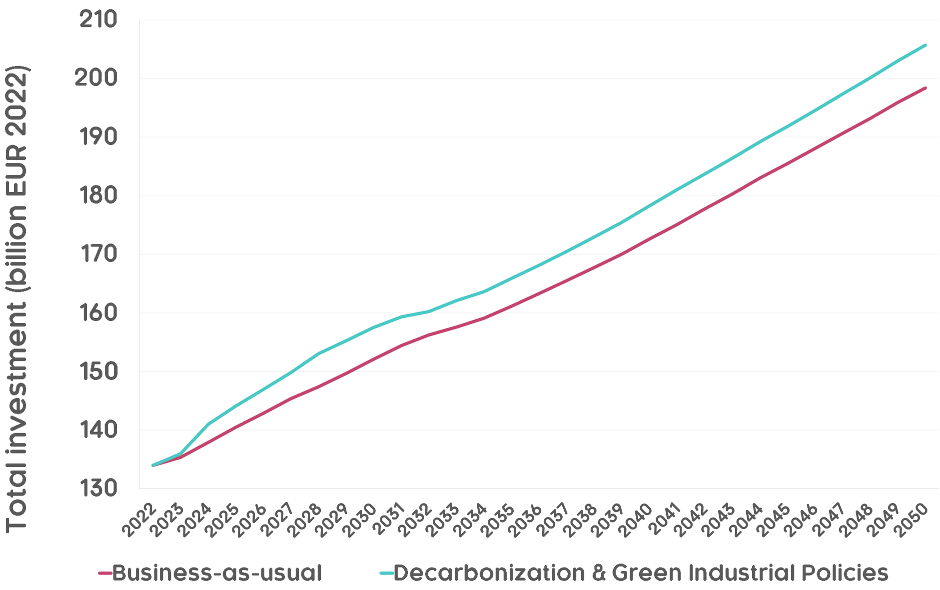
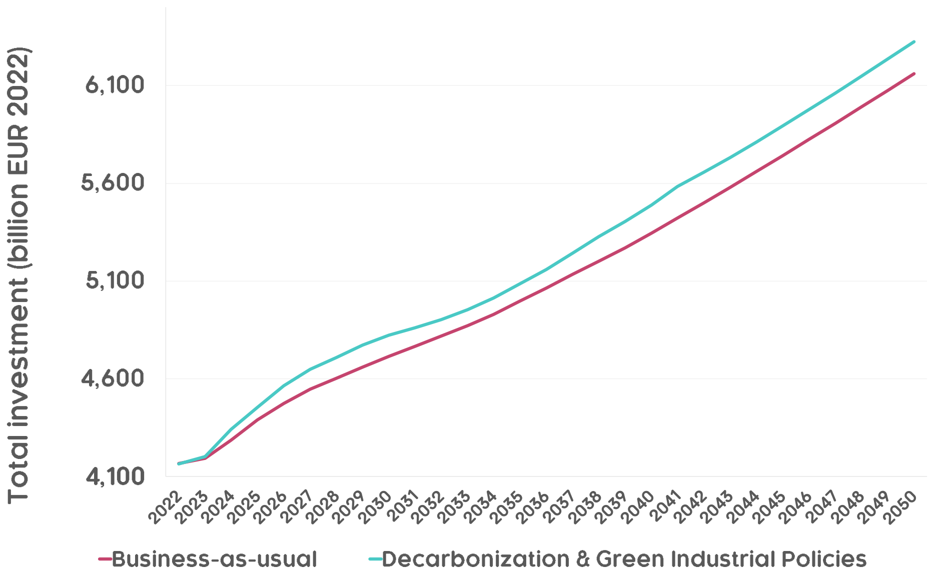


Figure 15: Total investments in the EU



5.2 Primary energy demand

Figure 16: Primary energy demand in Austria in the Decarbonization & Green Industrial Policy scenario

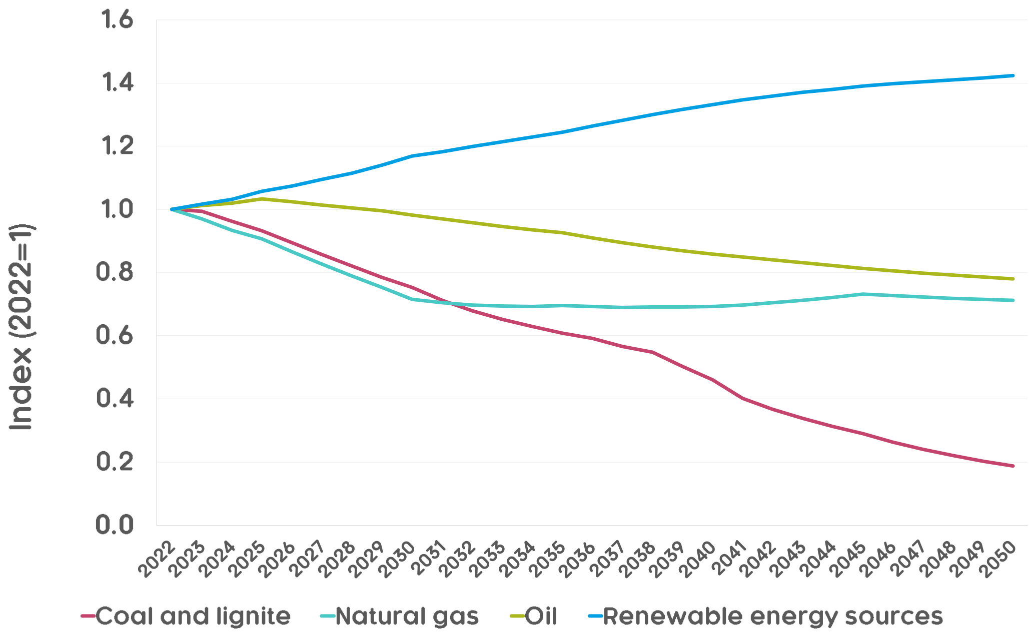
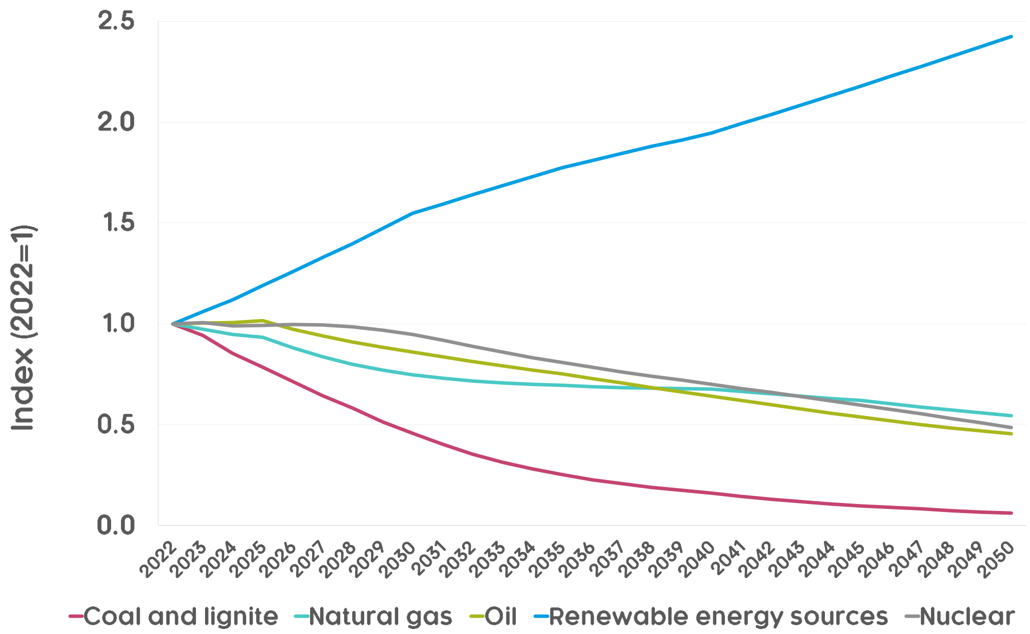


Figure 17: Primary energy demand in the EU in the Decarbonization & Green Industrial Policy scenario



5.4 Power generation

Figure 18: Power generation in Austria in the Decarbonization & Green Industrial Policy scenario

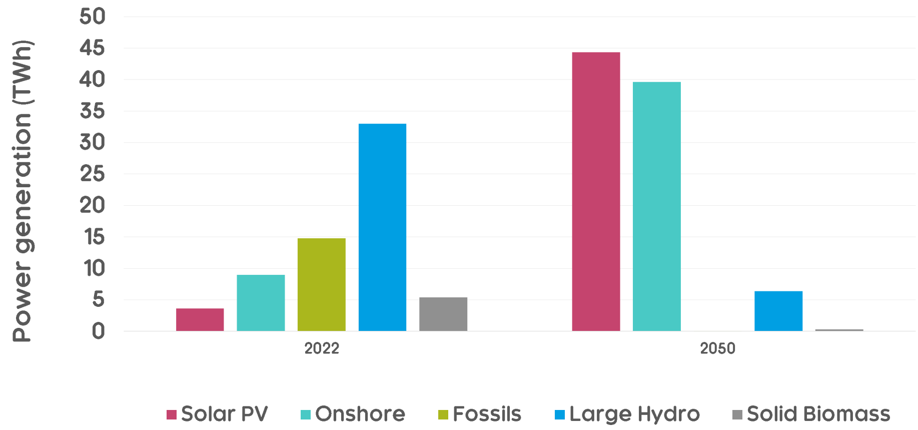


Figure 19: Power generation in the EU in the Decarbonization & Green Industrial Policy scenario