RESEARCH REPORT

Eurofound

Anticipating and managing the impact of change

Fit for 55 climate package: Impact on EU employment by 2030

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Eurofound

European Foundation for the Improvement of Living and Working Conditions

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Executive summary

Introduction

One of the core strategic objectives of the EU is to ensure that Europe becomes the first climate-neutral continent, with net zero greenhouse gas emissions by 2050. Carbon neutrality is an ambitious objective that requires large investments sustained over time. In particular, it will require dramatic changes in the way we source and use energy. The impacts of the policies required to achieve the green transition will vary considerably among sectors, and will affect countries' income and employment levels and the composition of employment, creating employment in some sectors and destroying it in others. In July 2021, the Commission adopted a package of proposals to make the EU's climate, energy, land use, transport and taxation policies fit for reaching the 55% emission reduction target by 2030: 'Fit for 55'. In this report, we provide projections from a global macroeconomic model of how the Fit for 55 policy package may affect the territorial, sectoral and occupational structure of employment in the EU by 2030.

Policy context

In the EU's aim to become carbon-neutral by 2050, 2030 is a critical staging post. In 2021, EU policymakers adopted more ambitious intermediate decarbonisation objectives than before, and updated policies accordingly. The principal objective of the Fit for 55 policy package is to achieve a 55% reduction in greenhouse gas emissions compared with 1990 levels by 2030 (the prior target was a 40% reduction). The Fit for 55 package is a complex package of proposals that operates on many fronts; it extends the scope of the EU Emissions Trading System, revises upward targets for renewable energy use and energy efficiency, puts in place a carbon border adjustment mechanism and tightens emissions standards for cars and vehicles.

The package is also an evolving set of policy commitments. For example, in 2023 the Council of the European Union and the European Parliament have agreed provisionally to further strengthen the contribution of renewables to overall energy consumption by 2030 (to 42.5% from 40 indicated in 2021, up from 32% in 2018). Anticipating the impact of developing EU climate policy on the composition of employment in EU labour markets provides essential data to policymakers tasked with ensuring that the green transition is a just transition.

Key findings

- Most projections of employment impacts of decarbonisation policies in the EU show very modest net gains, rarely much more than 0.5% compared with the baseline.
- According to our estimates based on the GEM-E3-FIT macroeconomic model, the employment impacts of the main Fit for 55 policies are likely to be marginally positive at EU aggregate level in the main model specification. A net 204,000 jobs are projected to be created in the EU Member States as a result of the Fit for 55 package, in addition to the baseline employment growth of 6.7 million net new jobs between 2019 and 2030.
- The employment effects vary across regions and countries based on their reliance on carbon-intensive industries on the one hand and their capacity to take advantage of greening opportunities on the other. Negative employment effects are more likely in some central and eastern European countries (for example, Poland and Romania) and regions with relatively high shares of workers still working in extractive industries; positive employment effects are projected in southern European countries (in particular, Spain and Italy) and regions with natural endowments (wind and sun), developed energy efficiency infrastructure and capacity to manufacture renewable energy equipment.
- With jobs in both energy efficiency improvements and renewable energy capacity development, the sector likely to benefit most in terms of employment is construction. There will also be increased employment in market services as relative prices favour a shift in the structure of the economy towards 'cleaner' sectors, reinforcing the employment shift to the services sector.
- While employment overall is projected to improve towards 2030, the small boost to employment forecast for Fit for 55 tends to occur in medium-low and medium wage jobs that do not require tertiary qualifications.

Policy pointers

- Even though overall employment projections for 2030 arising from Fit for 55 are mildly positive, the absolute employment impacts of Fit for 55 policies are higher in the regions negatively affected – for example, in Polish and Romanian regions with a relatively high share of employment in mining and extractive sectors – while positive employment impacts are more dispersed across regions. This supports the rationale for region-focused funding of supportive measures, such as the territorial just transition plans.
- Projected employment impacts are sensitive to the details of policy implementation. Potentially greater gains in both output and employment may arise in a context of dedicated climate-related fiscal policies where carbon revenues are recycled in order to reduce labour taxes. Such revenues may also assist with the retraining necessary to facilitate employment reallocation to less carbon-intensive sectors and occupations.
- The source of finance for the large capital investment required by the green transition is also an important determinant of whether Fit for 55 policies will be employment-positive or -negative in practice. When funds are available without the need to crowd out existing investment plans, the macroeconomic implications are positive. However, when the financing of greening investments is not loan-based, both output and employment are projected to decline, albeit marginally.
- Policies aimed at lowering greenhouse gas emissions will have differential impacts on employment by sector and by occupation, increasing the demand for some jobs and decreasing it for others. They have to work hand in hand with education, training and employment policies in order to prepare workers with the required skills and competencies to contribute to the collective decarbonisation effort.

Introduction

The main goal of the European Green Deal is to turn Europe into the first climate-neutral continent, with net zero greenhouse gas (GHG) emissions by 2050. To this end, in September 2020 the European Commission proposed a new EU target to reduce net emissions by at least 55% compared with 1990 levels by 2030, and add it to the European Climate Law. European leaders endorsed the proposal. This was an advance on earlier climate commitments, which foresaw only a 40% reduction. In July 2021, the Commission adopted a package of proposals to make the EU's climate, energy, land use, transport and taxation policies fit for reaching the 55% emission reduction target by 2030: 'Fit for 55' (European Commission, 2021a).

The Fit for 55 package is a complex – and evolving – package of proposals that cover the EU Emissions Trading System (ETS) (extending its scope and target), the Effort Sharing Regulation, land use, land use change and forestry, targets for renewable energy sources and energy efficiency, alternative fuels infrastructure, carbon dioxide (CO_2) emission standards for cars, energy taxation, a carbon border adjustment mechanism and clean/green fuels in aviation and shipping.

In this report, we provide employment projections for 2030 for the EU and its countries and regions, based on a global macroeconomic model, with a view to describing the likely aggregate impacts of the Fit for 55 policy package on European employment. The GEM-E3-FIT model used for the projections has been specifically developed to integrate energy use parameters as well as broader economic and labour market parameters in its modelling of growth and employment projections. This makes it well adapted for the task of modelling potential employment impacts of implementing climate policy targets. Of course, like any macromodelling exercise it has its limitations. It is restricted in its capacity to deal with emerging geopolitical conditions which may affect decarbonisation in the EU, for example Chinese dominance in key materials (lithium, rare earths) or the US Inflation Reduction Act with its huge planned public investment in greening technologies. There are many factors that may impact regional economies as a result of climate change but which can only be partially captured, at best, in such models – for example, potential negative impacts on employment in tourism-related activities arising from increasingly frequent extreme weather events. But the more predictable impacts of the Fit for 55 policies are identified and captured in the model.

Carbon neutrality is an ambitious objective that requires large investments sustained over time. In particular, it will require dramatic changes to the way we source and use energy. The war in Ukraine is a stark reminder of this. The impacts of the policies required to achieve the green transition will vary considerably between sectors, and affect countries' income, employment levels and employment structures, creating employment in some sectors and destroying it in others. It will affect different regions, jobs and categories of workers in different ways (Eurofound, 2023a).

This report casts some light on these various impacts and is structured as follows. In Chapter 1, we provide a selective overview of other recent modelling exercises that look at the likely impacts of climate change policy on employment in the EU. In Chapter 2, we describe the GEM-E3-FIT macroeconomic model and explain how it was used to make employment projections for 2030 by region, sector and occupation in both a business-as-usual or reference (REF) scenario and a 'Fit for 55' scenario. We then summarise the employment projections with a specific focus on what additional effects Fit for 55 is likely to generate over and above prior climate policy commitments (notably under the Paris climate agreement). This second chapter is an extended summary version of a report completed by E3-Modelling for Eurofound in late 2022. In Chapter 3, these projections are used as inputs in a 'jobs approach' analysis designed to identify whether likely employment shifts arising from Fit for 55 will occur most in low-, medium- or high-paid jobs. A final chapter offers summary conclusions and policy pointers.

1 EU climate objectives

Policy context

In recent years, policy cooperation has intensified in order to meet the existential challenges posed by global warming and climate change. International and European institutions and individual countries have designed policies to adapt to or mitigate the impacts of climate change by steering a transition to a low-carbon economy. In December 2015, at the United Nations Climate Change Conference, 196 parties adopted the international treaty known as the Paris Agreement or the Paris Climate Accords. The treaty set the goal of limiting global warming to well below 2°C above pre-industrial levels and to work towards the more ambitious level of a +1.5°C limit. In order to achieve the objective, countries had to communicate their policy programmes aimed at lowering their GHG emissions, the most important contributor to global warming. The European Union, as a whole, committed to reducing CO_2 emissions to 40% below 1990 levels by 2030. Several climate policies were devised to meet the Paris targets.

In December 2019, the European Commission launched the European Green Deal, intended to be the heart of the EU's policymaking and action for the following years. The plan envisaged actions to be taken at both European and national levels with the aim of tackling climate change and transforming the European Union into a modern, resource-efficient and competitive economy based on the binding target of achieving carbon neutrality by 2050. The goal of making Europe the first climate-neutral continent in the world by 2050 is to be achieved through a combination of broad processes:

- promoting decarbonisation and a clean energy transition
- implementing an industrial strategy based on a clean and circular economy
- reducing or preventing the pollution of air, water and soil
- protecting nature and biodiversity
- promoting the construction and renovation of buildings with a view to greater energy efficiency
- accelerating the shift to sustainable and smart mobility
- developing a fair, healthy and environmentally friendly food system

The Just Transition Mechanism is provided to support the countries, regions and workers likely to be most affected by the carbon-neutral transition, so that the process can be considered fair and socially equitable.

The European Green Deal targets will require significant investments, and the EU's budget has a key role. At least 25% of the EU's long-term budget is to be dedicated to climate action.

The legislative process around the European Green Deal has continued to evolve. Both the European Parliament and the European Council endorsed the objective of achieving climate neutrality in the EU by 2050 (Eurofound, 2021). In the first quarter of 2020, financing and support actions were adopted through the European Green Deal Investment Plan (by 2030, mobilisation of at least €1 trillion between public and private investments) and the Just Transition Mechanism (with a fund of €150 billion to be mobilised between 2021 and 2027).

The Circular Economy Action Plan and the European Climate Law were proposed, in line with the European Green Deal policy areas. The Circular Economy Action Plan aims to reduce the EU's consumption footprint and increase the material reuse rate through legislation on sustainable product policy encouraging industry to reuse, repair and recycle. The European Climate Law is a regulation to achieve climate neutrality by 2050, which entered into force in July 2021 and is legally binding on the European Union.

In September 2020, the European Commission adopted the 2030 Climate Target Plan, raising the aspirations of the Paris Agreement by committing to reduce EU GHG emissions by at least 55% by 2030, compared with 1990 levels. After the outbreak of COVID-19, the EU institutions called for the European Green Deal to be included in the economic recovery programme. One-third of the €1.8 trillion investments from the NextGenerationEU recovery plan, and from the EU's seven-year budget (multiannual financial framework), both adopted at the end of 2020, should go to finance the European Green Deal. Overall, the transition towards climate neutrality was presented as being 'a unique opportunity to reduce systemic inequality' (European Commission, 2021a).

On 14 July 2021, the European Commission presented the 'Fit for 55' strategy. If the European Green Deal represents a general action plan to fight climate change, the Fit for 55 package prepares the path operationally to meet its target: climate neutrality by 2050. As reported in the European Commission press release, 'the European Commission adopted a package of proposals to make the EU's climate, energy, land use, transport and taxation policies fit for reducing net GHG emissions by at least 55% by 2030' (European Commission, 2021b).

The package strengthens eight existing pieces of legislation and presents five new initiatives, across a range of policy areas and economic sectors: climate, energy and fuels, transport, buildings, land use and forestry.

The Russian invasion of Ukraine in February 2022 instigated a further strengthening of EU climate policy. After COVID-19-era disruptions began to ease in late 2021, gas and energy prices were already beginning to rise as economic activity began to return to pre-crisis levels. A fresh increase in energy costs resulted from the EU's overdependence on Russian energy supply and the imposition of sanctions against Russia. Overall, the EU relied on imports for 90% of its gas consumption and – as of February 2022 – Russia provided around 45% of these imports. Russia also accounted for around 25% of oil imports and 45% of coal imports.

In May 2022, the European Commission (2022) proposed REPowerEU, a plan to phase out the EU's dependence on Russian fossil fuels (in the first instance, by reducing Russian gas imports by two-thirds in 2022). The plan also provided for large additional investments in renewable energies, increased energy efficiency and infrastructure, and the diversification of Europe's energy supply. Reducing the dependence on gas and fossil fuels by boosting renewable energy sources will contribute to the desired green transition while loosening or breaking European dependence on Russian hydrocarbons.

REPowerEU includes a proposal to increase the Renewable Energy Directive's target for EU energy from renewable sources to 45% by 2030, up from 40% in the Fit for 55 package. Member States will have to modify their recovery and resilience plans to add a dedicated REPowerEU chapter. Additional investments of €210 billion are estimated to be needed between now and 2027 to phase out Russian fossil fuel imports. In October 2022, the European Council agreed its position on the REPowerEU plan and its objectives, and proposed a new combination of funding sources: the Innovation Fund (75%) and frontloading ETS allowances (25%), to avoid disrupting the functioning of the ETS.

Projected impact of the Paris Agreement

Since the 2015 Paris Agreement, researchers using different approaches have been trying to assess policies consistent with the transition to a low-carbon economy and forecast their impact on employment and income, in Europe and in the rest of the world. Green and decarbonisation policies can affect economic sectors and labour markets in different ways and, according to the Organisation for Economic Co-operation and Development (OECD, 2018a), through several channels.

Changes in production modes: When adapting to green growth regulation, companies will use fewer polluting inputs and pollution-intensive processes. Sectors will change their labour demands, creating or destroying jobs.

Changes in demand patterns: Green policies lower the prices of clean goods relative to polluting products and this affects the demand for polluting and non-polluting goods, demand for the latter increasing as they become cheaper. This changes overall demand patterns and induces shifts in production across sectors. The extent to which workers are able to shift between sectors influences the overall effect on employment.

Changes in aggregate income and macroeconomic conditions: The implementation of green policies can influence overall economic activity and lead to changes in government fiscal policies (and thus, for example, changes in tax revenues).

Changes in trade and competitiveness: Producing pollution-intensive goods in a country with green policies can make the goods relatively more expensive than similar goods produced in countries without such regulations. Such concerns are relevant to internationally traded goods.

When evaluating the employment impacts of climate policy, it is important to consider the time horizon. In the short term, direct employment effects include job creation in 'green' sectors, which produce goods and services reducing environmental pressure, while job destruction is expected in sectors with large carbon or environmental footprints ('brown' sectors). In the medium term, jobs are created and lost along the value chains of affected industries: changes in employment will be induced by changes in relative prices causing a shift in the structure of the economy towards cleaner production sectors, mostly the relatively labour-intensive services sectors. In the long term, employment changes will result from structural adaptations, such as organisational and technological innovations accompanied by intersectoral structural change (Fankhauser et al, 2008; OECD, 2017).

According to the ILO (2018), the transition to a low-carbon economy will inevitably cause job losses in several sectors as carbon- and resource-intensive industries are scaled down or adapted, but these will be counterbalanced by new job opportunities. Measures taken in the production and use of energy will lead to the destruction of around six million jobs globally, but the shift towards renewable energy sources, greater energy efficiency and other practices will lead to the creation of around 24 million jobs by 2030, namely a net increase of approximately 18 million jobs around the world.

In 2019, the Future of Manufacturing in Europe project – an EU initiative proposed by the European Parliament and delegated to Eurofound by the European Commission – projected that a transition towards a

low-carbon economy, as defined by policies consistent with meeting the 2°C limit on global warming under the Paris Agreement, would have positive results for the EU by 2030: a 1.1% growth in gross domestic product (GDP) and a 0.5% growth in employment, in comparison with a business-as-usual baseline forecast (Eurofound, 2019). Research was carried out using the energy–environment–economy macro-econometric (E3ME) model, a global model designed to address major economic and environmental policy challenges, developed by Cambridge Econometrics. According to the projections, almost all the EU Member States would benefit from additional investment in energy efficiency and renewable energies, and from lower dependence on fossil fuels. The benefits would accrue in both GDP and employment. However, the impacts would probably differ substantially across countries, sectors and occupations. Countries already advanced in renewable energies and energy efficiency would see small positive impacts on employment (and GDP), while countries where coal production has a significant role, such as Poland, would experience negative employment effects because of the job losses related to decarbonisation.

Regarding sectors, again job losses were expected to concentrate to a large extent in the mining sector, but they would also feature in the utilities sector, because investment in energy efficiency reduces the demand for gas (Alexandri et al, 2021). Employment would increase in the construction sector, where jobs would be created in energy efficiency initiatives and in the building of renewable power facilities. Regarding occupations, the net change in employment for the energy scenario would be very similar to the business-as-usual scenario, but the sectoral shift for the EU in the production of investment goods would translate into employment increases for workers in building and related trades and in metal and machinery. Overall, much of the employment created by meeting the Paris Agreement targets is expected to be more at the bottom and the middle of the wage distribution, among non-tertiary-educated workers, rather than in the high-wage tail of the occupational distribution. This would result in a less polarised structural change in the employment distribution than the baseline scenario.

Using scenarios based on a multiregional input–output database and considering a 2°C scenario for the decarbonisation of the world economy and a 6°C business-as-usual scenario developed by the International Energy Agency (IEA, 2015), Montt et al (2018) found that the implementation of policies in line with the Paris Agreement's 2°C target would have a positive and relatively small effect on employment in Europe by 2030. The shift from fossil fuel-based energy towards energy efficiency and renewables would lead to 0.29% more employment globally, and 0.35% more in Europe, than the business-as-usual scenario. Job creation would be driven by the construction and renewables sectors, but also by the manufacturing of electrical parts and by the mining of copper ores (a key component of renewable energy systems). Jobs would disappear in fossil fuel-related sectors such as coal mining, petroleum refining and distribution or retail.

Mercure et al (2018) found that policies that make it possible to achieve emission reductions consistent with at least a 66% probability of not exceeding 2°C of global warming would have a relatively small but positive effect on employment (about +0.2%) and GDP (about +0.4%) in Europe by 2030. To assess the impact, they used the simulation-based integrated assessment model E3ME-FTT-GENIE.[1]

Several other studies forecast negative effects on macroeconomic indicators, or even conflicting trends in GDP and employment.

By carrying out simulations with the PRIMES energy system model[2] and the GEM-E3 model,[3] Fragkos et al (2017) found that policies consistent with a decarbonisation scenario will bring small losses in terms of European GDP (-0.4%) by 2030, but overall (very marginally) positive employment effects (+0.03% by 2030); employment will benefit from carbon tax revenues because they are recycled to lower social security contribution payments by employers, making labour relatively less costly. Using a similar approach, Vrontisi et al (2020) found that by 2030 there would be a small reduction in the EU GDP (-0.15% compared with the reference scenario), mainly related to losses from the sectors of manufacturing goods and services not counterbalanced by gains elsewhere.

Forecast impact of European Green Deal policies

The European Green Deal is the keystone of EU policy for the coming years. It now integrates the Fit for 55 policies, which go further and faster in terms of decarbonisation than the commitments in the Paris Agreement, setting the target of reducing net GHG emissions by at least 55% (instead of 40%) by 2030 compared with 1990 levels, as a staging post to reach carbon neutrality in 2050. Several studies have been carried out on the impact that implementing these upgraded climate change commitments will have on GDP, and on levels of employment across countries, sectors and occupations.

1 For more information on the E3ME-FTT-GENIE integrated assessment simulation model, see https://emi-ime.ca/inventory-model/e3me-ftt-genie/

2 The PRIMES energy system model projects the energy demand, supply, prices, trade and emissions for European countries and assesses policy impacts.

3 For more information on the GEM-E3 model, see https://joint-research-centre.ec.europa.eu/gem-e3/gem-e3-model_en

European Commission impact assessment study

The European Commission (2020) has published an impact assessment study on the accelerated 2030 climate targets. The baseline macroeconomic projections are based on the autumn 2019 forecast (before the COVID-19 crisis) of the Directorate-General (DG) for Economic and Financial Affairs, and three different economic models (with different labour market assumptions) are used to estimate the impact at EU level:

- JRC-GEM-E3[4], a computable general equilibrium model, a version of which is used in the modelling in the next chapter of this report
- Cambridge Econometrics' E3ME, a macroeconometric model
- DG Economic and Financial Affairs' E-QUEST, a neo-Keynesian dynamic stochastic general equilibrium model that has been enriched with a representation of the energy system

The business-as-usual scenario is the one that would achieve the 2030 targets that then existed (in September 2020) for GHG emissions, renewable energy shares and energy efficiency. The policy options aimed at achieving the target of reducing GHG emissions by 55% by 2030 are broad and interdependent, and involve complicated interactions. They were combined and translated into different policy scenarios so that a quantitative assessment could be performed.

- REG is based on regulatory measures. It assumes ambitious increases in energy efficiency, renewables and transport policies, but keeps the ETS scope unchanged so carbon pricing is not expanded.
- CPRICE is based on carbon pricing. It assumes the strengthening and further expansion of carbon pricing, through ETS or other carbon pricing instruments, and its application to the land transport and buildings sectors. It assumes moderate intensification of transport policies while not intensifying energy efficiency or renewables policies.
- MIX is a combination of REG and CPRICE. It expands carbon pricing to the road transport and buildings sectors, and moderately increases the ambition of energy efficiency, renewables and transport policies, but to a lesser extent than in REG and with lower carbon prices.
- ALLBNK is the most ambitious scenario. Based on MIX, it further intensifies fuel mandates for the aviation and maritime sectors.

MIX was used as the central scenario for the macroeconomic forecast at EU level. The impact assessment takes into consideration two levels of climate ambition, one where only the EU achieves the raised 2030 targets ('fragmented action') and one where the rest of the world also steps up ambitions to limit global warming to 1.5°C ('global action').
The results depend on the extent of the use of carbon pricing, on how governments use carbon revenues, on labour market imperfections and on the behaviour of energy-intensive industries in the ETS when confronted with auctioning or free allocation.

Achieving the 55% GHG reductions in 2030, the worst-case scenario under the fragmented action scenario, results in a loss of about 0.4% of GDP by 2030, according to JRC-GEM-E3 projections. In this case, carbon revenues are used as lump sum redistributions to households, and there is free allocation of allowances in ETS sectors. Under the global action scenario, the model forecasts an even larger negative impact on real GDP (-0.7%) related to loss of output outside the EU.

The best-case scenario implies an increase in GDP of around 0.5% by 2030, according to the E3ME model, with both fragmented and global action. In this case, carbon revenues are used to reduce value added tax (VAT) rates, and allowances are auctioned in the ETS. The increase in GDP is related to higher demand triggered by higher investment needs and to the increase in consumption driven by the use of carbon revenues to reduce VAT.

The E-QUEST model forecasts an increase in GDP of around 0.1% by 2030, if carbon revenues are used to support investment in green technologies, but a decrease (-0.3%) if revenues are used as lump sum transfers to households.

As noted, the overall impact on aggregate GDP by 2030 will be relatively limited, but levels of employment will be affected: 'green' jobs will be created and some 'brown' jobs will disappear.

According to the JRC-GEM-E3 model, the fragmented action scenario resulting in a 55% reduction in GHG with the lump sum redistribution of carbon revenue would result in a decrease in employment of 0.26% by 2030 (around 494,000 jobs). However, if carbon revenues are used to reduce labour taxation, this translates into an increase in employment of 0.06% (about 110,000 jobs). According to the model, if carbon revenues are used to reduce VAT and support investment in energy efficiency, there is an increase in employment of up to 0.20%. In the best-case scenario, the E-QUEST model forecasts an increase in employment of 0.45% by 2030 (around

4 The European Commission's CGE Model for Economy – Energy – Environment.

884,000 new jobs) if carbon revenues are used to reduce labour taxation for lower-skilled segments of the labour force.

Joint Research Centre's foresight study

Building on the Commission's economic modelling results, an analysis of the realignment of employment between different economic sectors was carried out by the Joint Research Centre (Asikainen et al, 2021). If GHG emissions are reduced by 55% in 2030, employment in the coal, oil, and gas sectors could decrease in the range of -20.7% to -22% compared with the business-as-usual scenario. These are by some margin the sectors where negative employment impacts are most likely to be experienced. Employment will shift from fossil fuel-intensive, high GHG-emitting economic activities to growing 'green' sectors. The electrification of the economy and the switch to renewable sources will probably lead to an increase in the number of jobs in the electrical goods sector (estimates in the range of -0.1% to +3.8%); employment in energy-intensive sectors is expected to grow in the range of -0.3% to +2.4%; in the construction sector, the number of jobs will increase in the range of -0.1% to +0.6% compared with the baseline. Shifts in the sectoral composition of employment will affect regions differentially. Regions depending on coal mining may not have a diversified economy and may lack sectors that could absorb displaced labour. Employment in these regions would be negatively affected. Job creation related to advances in the renewable energy sector will be more regionally dispersed.

Cambridge Econometrics' study

Using its E3ME macroeconomic model, in another study that explored the impact of climate policies in line with the achievement of 55% net GHG reductions by 2023, Cambridge Econometrics (2021) evaluated the economic implications of two alternative policy pathways to deliver decarbonisation consistent with the targets in the transport and buildings sectors.

The business-as-usual scenario is constructed as broadly consistent with the national energy and climate plans, the framework for Member States to outline their climate and energy goals, policies and measures from 2021 to 2030. The scenario also adds short-term impacts of the COVID-19 pandemic, revised ETS prices to reflect the same assumptions as in the European Commission's 55% impact assessment (European Commission, 2020), reductions in wind and solar power costs and more up-to-date data on the uptake of electric vehicles.
In the first policy scenario, subsidies, regulations and investments are introduced into the transport and buildings sectors to contribute to the agreed 55% economy-wide emission reduction target by 2030, without the introduction of an ETS or carbon price ('policies scenario'). In the second policy scenario, the ETS is extended to the road transport and building sectors in 2025 ('ETS scenario'). Whether and how carbon revenues are recycled is relevant in determining outcomes.

The main ETS scenario without recycling yields negative GDP outcomes in the EU by 2030 (-0.7% compared with the baseline scenario), but when revenues are recycled the higher cost of emitting CO_2 is compensated for and by 2030 GDP is expected to increase by around 1%. However, the best-case scenario is the policies scenario: in that case, GDP at EU level could increase by 2% by 2030 (Cambridge Econometrics, 2021).

Total impact on employment reflects these GDP outcomes. In the main ETS scenario without recycling carbon revenues, employment is expected to fall by 0.7% by 2030, while when revenues are recycled it is expected to increase by around 1%. In the best-case scenario – the policies scenario – employment could be around 2% higher than the baseline.

Cedefop's skills forecast scenario

A broader macro perspective on the impact of policies consistent with the European Green Deal, and in particular with the Fit for 55 package, on employment across the EU countries has been developed by Cedefop (2021). Its aim is to explore the jobs and skills implications of the green transition. The study uses Cedefop's skills forecast framework to build a scenario that looks at the sectoral and occupational shifts at EU level that would probably occur if the target of 55% GHG reduction by 2030 were achieved.

Cedefop's European Green Deal skills forecast scenario provides insight into impacts of the European Green Deal from a vocational education and training and skills perspective and looks at employment consequences of the most important policies the European Green Deal encompasses. It uses the E3ME macroeconometric model. The scenario gathers information from several Commission communications on the sectors most targeted by the European Green Deal and from carbon emission reduction and sustainable economy policies (until October 2020), and then the outcomes are compared with the 2020 pre-pandemic Cedefop skills forecast (baseline scenario). The assumptions include increased energy efficiency and the investment required to achieve it, the extension of the ETS to the road transport sector, policies for less carbon-intensive technology, impacts of future price increases of polluting energy sources (through taxation) on road transport and buildings, increased recycling rates in the electronics and vehicles sectors, and other measures.

In the course of achieving the 55% GHG reductions through implementing climate policies, in 2030 employment in the EU is expected to increase by 1.2% compared with the baseline scenario (around 2.5 million additional jobs). Employment impacts are expected to vary across sectors.

The sectors (at Nomenclature of Economic Activities (NACE) Rev. 2.0 two-digit level) expected to see a substantial loss of employment compared with the baseline are mining and quarrying (-11%), coke and refined petroleum (-11.5%), and gas, steam and air conditioning (-20%). These account for 286,000 jobs lost. Water supply and waste management are expected to benefit from circular economy policies and will see the greatest increase in employment by 2030, +63.2% compared with the baseline. Employment in the electricity sector will increase by 17.2%, the construction sector will benefit from higher energy efficiency investment and employment will increase by 3.6% by 2030 compared with the baseline. Employment in the car manufacturing sector will increase by 1%, while in other manufacturing sectors climate change policies will not significantly affect future employment levels. This suggests that many shifts in employment and skills related to the green transition may occur within manufacturing sectors through job-to-job mobility and up- or reskilling.

The impact of the green transition on occupations was not predicted by the model but has been calculated using the occupational shares within each sector obtained from the skills forecast baseline scenario for 2020 to 2030. The assumption here is that the occupational distribution of employment in sectors would not change over time. At the International Standard Classification of Occupations (ISCO-08) two-digit occupational level, decarbonisation will entail employment increases in most broad occupational categories. Compared with the baseline, the European Green Deal scenario forecasts employment increases for building and related trades workers (+3.1%), refuse workers and other elementary workers (+7.4%), science and engineering associate professionals (+3%), science and engineering professionals (+2.4%), administrative and commercial managers (+2.1%), drivers and mobile plant operators (+2.1%), and chief executives, senior officials and legislators (+1.7%). A relevant finding is that employment gains will be somewhat more pronounced for some of the medium- and low-skilled (-paid) occupations for which employment growth has tended to be relatively weaker in the recent past (Eurofound and JRC, 2021). This will result in more balanced employment growth across occupations and offset tendencies towards employment polarisation.

Key takeaways on the impact of the EU policy framework

This chapter summarises the development of the EU policy framework aiming to combat climate change, from the Paris Agreement of 2015 to the Fit for 55 package of 2021 and subsequent modifications. Green transition policies will inevitably affect the structure of the economy and have an impact on GDP and on levels of employment across countries, sectors and occupations. While forecasts of these impacts do not come to a clear consensus, we can draw the following summary conclusions.

- Overall, the estimated employment impacts are likely to be relatively marginal, often less than 1% deviations from baseline or business-as-usual predictions.
- Most of the analyses reviewed indicate modest positive employment outcomes, suggesting that the investment required to meet climate commitments will yield some small employment dividend over the decade to 2030. This will be because employment gains in greening sectors outpace losses in carbon-intensive or extractive brown sectors.
- Carbon-intensive and extractive brown sectors tend to account for a high share of GHG emissions but a relatively low share of overall employment. The contraction of employment in these sectors will nonetheless be proportionately more severe in many cases, accounting for one in five or more of existing employees. Public policy support will be most called upon in these sectors, and the countries and regions most reliant on them, to ensure a just transition.

2 Employment projections based on the Fit for 55 policy package

In this chapter, employment projections based on the GEM-E3-FIT global macroeconomic model are provided by sector (at NACE Rev. 2.0 two-digit level), by occupation (at ISCO-08 two-digit level) and by EU Member State (at Nomenclature of Territorial Units for Statistics (NUTS) 2 regional level) for 2030, principally under the following two scenarios.

The reference scenario (REF): The reference or baseline scenario includes the implications of energy and climate policies that were already legislated before Fit for 55 and in force at EU and Member State levels. The implications of the war in Ukraine, captured by the 2022 summer forecasts of the International Monetary Fund's *World economic outlook: Update July 2022* and DG Economic and Financial Affairs, have been considered as well.

FIT55 scenario (FIT55): This scenario is consistent with the goal of meeting the 55% GHG emission reduction target of the Fit for 55 package. On top of these, the FIT55 scenario includes a list of energy- and climate-related measures and policies.

A full list of measures included in each scenario is given in the section 'Scenario design'.

Comparing the two scenarios reveals the impact of core policies included in the Fit for 55 package on the pace (for example, whether the policies accelerate or decelerate GDP growth rates) and pattern of economic growth (for example, which economic activities benefit and which do not), on employment and on the demand for labour in specific occupations. The analysis rests on a dynamic projection to 2030 of the sectors and occupations that make up the current EU employment structure.

The GEM-E3-FIT macroeconomic model has certain distinctive features that make it well suited to perform this analysis. It is a computable general equilibrium model that is:

- global (covering 46 countries or broader regions)
- multisectoral (67 economic activities)
- calibrated to a wide range of datasets, including the Global Trade Analysis Project, Eurostat and International Energy Agency [IEA] datasets, which identify each EU Member State separately
- incorporating energy use and emission-related parameters in its modelling as well as the standard macroeconomic and labour market parameters

Methodology

To calculate the impact on employment under FIT55, the steps below were followed.

First, a detailed database for 2019 was assembled. This is the most recent year that well reflects the structure of the economy and employment without any bias introduced by the COVID-19 pandemic. The dataset comprises NACE Rev. 2.0 two-digit, ISCO-08 occupation and NUTS 2 employment data for each EU Member State. The method for compiling the dataset is described below in the subsection 'Reconciliation of base year data'.

The GEM-E3-FIT model was then used to quantify a reference projection to 2030 under the assumptions of continuing trade openness and sustainable growth. The model was then used to quantify a scenario consistent with the Fit for 55 package and two alternative policy scenario variations, one adjusting the mode of financing necessary for greening investments and the other adjusting the recycling of emissions trading revenues.

Finally, the GEM-E3-FIT results were extrapolated (where necessary) to the full regional, occupational and sectoral dimension required for the analysis in the next chapter of the report.

The subsection below provides the key features of the model used and the key assumptions and indirect methods adopted to complete the base year dataset.

Reconciliation of base year data

A unified and complete dataset linking employment by NACE Rev. 2.0 two-digit, ISCO-08 two-digit and NUTS 2 regional detail is not readily and publicly available. The compilation of the unified dataset starts from the European Union Labour Force Survey (EU-LFS) statistics for employment (lfsa_eisn2) and proceeds with the disaggregation of the data into 88 sectors (NACE Rev. 2.0 two-digit) and 10 occupations (ISCO-08). The data used for this study are presented in Table 1.

Table 1: Datasets used in the analysis

Database	Dataset (step(s) in which it is used)	Sector (NACE Rev. 2.0)	Occupation category (ISCO-08)	Regional coverage
EU-LFS	lfsa_eisn2 (a and c)	21	10	National
EU-LFS	lfsa_egan22d (a)	88	–	National
National accounts	nama_10_a64_e (b)	64	–	National
Structural Business Statistics	sbs_na_sca_r2 (b)	65	–	National
Structural Business Statistics	sbs_r_nuts06_r2 (d)	68	–	NUTS 2
Regional accounts	nama_10r_3empers (d)	11	–	NUTS 2
EU-LFS/Eurofound	(e)	21	40	NUTS 2

Source: *Fragkiadakis et al (2022)*

EU-LFS data were used as the main source of the employment statistics, with national accounts used to fill the gaps where data were missing. The main differences between them are as follows.

- National accounts calculate mainly the employment irrespective of the place of residence (domestic concept) while EU-LFS data cover resident households (national concept).
- EU-LFS data exclude persons under 15 years of age, while national accounts do not make this distinction.
- National accounts integrate information from many sources (including EU-LFS). The information is combined to provide a consistent estimate. Thus, the results will often differ between the national and EU-LFS data for the same measured quantity.

The following steps were taken.

a. Data were harmonised to match the total national employment figures available in the EU-LFS data [lfsa_eisn2]. The EU-LFS data were used to derive the total employment by Member States and sector (21 sectors, NACE Rev. 2.0). The employment by detailed economic activity dataset [lfsa_egan22d] was used to further disaggregate the sectors to NACE Rev. 2.0 two-digit level.

b. Several data were missing for some sectors and countries. For the sectors where data were not available, the following approach was adopted.

   I. In cases where only one subsector was missing, the difference of all other subsectors from the aggregate sector was used.

   II. When many subsectors were missing, the structure from the corresponding sectors of national accounts [nama_10_a64_e] was used; when these were not available, the EU average allocation of employment over the subsectors was used. If information on the production of these subsectors was available from Structural Business Statistics (sbs_na_sca_r2), then the employment intensity (employment divided by production) of the EU was used to derive the employment by sector. The normalisation was done in the corresponding aggregate sectors after the gaps were filled.

c. To further distinguish employment by occupation, the shares from the EU-LFS [lfsa_eisn2] were used. When data were available only for aggregate sectors, then uniform subsector shares from the corresponding aggregate sector were used. In this way. a complete dataset for employment was created with 88 sectors (NACE Rev. 2.0 two-digit level), 10 occupations (ISCO-08) and 27 Member States.

d. National data were further disaggregated into regional (NUTS 2) data for 88 sectors using the data from step c, the Structural Business Statistics [sbs_r_nuts06_r2] and regional accounts. For the data to be consistent with the sectoral NACE Rev. 2.0 accounts data and the regional data [nama_10r_3empers], a RAS procedure by sector and country was followed. The structure for the sectors included in the classification B–E, F, G–J, L–N was assumed from the national accounts dataset [sbs_r_nuts06_r2], and for the rest of the sectors the same structure of the national data was used, based on the aggregate number of employed people in the national accounts dataset [nama_10r_3empers].

e. National occupational structure data by region, occupation and sector provided by Eurofound based on an ad hoc data extraction request to Eurostat were utilised as weights to step d to decompose employment in NUTS 2, NACE Rev. 2.0 (two-digit level) and ISCO-08 (two-digit level).

The unemployment rate by occupation in GEM-E3-FIT was estimated in order to define the occupation-specific wages, taking account of the supply of and demand for each occupation. It was calculated as follows:

a. collate labour force, employment rate and working age data from EU-LFS statistics [ifsa_pganws]

b. calculate the unemployment rate based on labour force and employment rate

c. estimate the unemployment rate by occupation by using the unemployment rate by education level from the EU-LFS [lfsa_urgaed] and by mapping education level to occupations

GEM-E3-FIT model

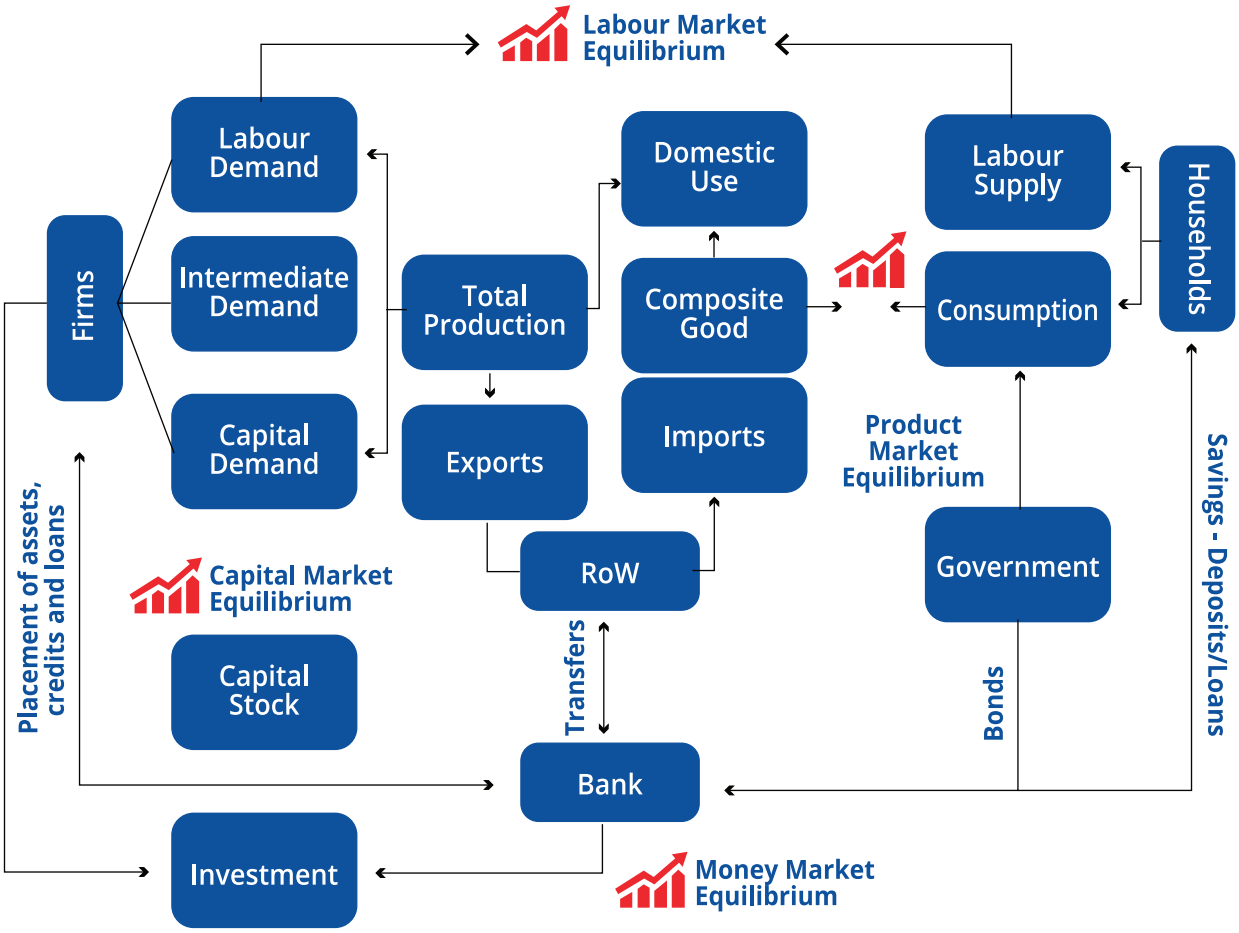
GEM-E3-FIT is a large-scale multisectoral computable general equilibrium model that governments and public institutions have been using extensively since the 1990s to assess the socioeconomic implications of policies, mainly in the fields of energy and the environment. The model is founded on microeconomic theory, which allows it to study in a consistent framework the interlinkages between economic sectors and to determine the key driving factors behind policy impacts (see Figure 1).

Over the years, GEM-E3-FIT has evolved from a standard, textbook computable general equilibrium model (where all resources are assumed to be fully used) to a modelling system that represents the complex economic system in a more realistic way. Key innovations of the model are the explicit representation of the financial sector, the semi-endogenous dynamics of technical progress induced by research and development, knowledge spillovers, the representation of multiple households (460 household types distinguished by income group), unemployment in the labour market and endogenous formation of labour skills.

The model features bilateral trade flows, where the origin and destination countries are defined. It places special emphasis on the representation of the energy system featuring specialised bottom-up modules of power generation, buildings and transport sectors. The model adopts a sequential dynamic mechanism (that is, it proceeds period by period) in which agents assume that the prices and the demand they face today will last. The model delivers projections of the economic and energy systems until 2100 in increasing time steps: annually from 2015 to 2030 and then in five-year periods until 2100.

The choice of agents among different consumption goods or production factors is shaped by substitution elasticities, which are econometrically estimated.

Figure 1: Schematic representation of GEM-E3-FIT model



Note: *RoW refers to the rest of the world*
Source: *Fragkiadakis et al (2022)*

The most important projections that GEM-E3-FIT delivers are (Fragkiadakis et al, 2022):

1. full input–output tables for each country/region identified in the model
2. dynamic projections in constant values and deflators of national accounts by country
3. employment by economic activity and by occupation and unemployment rates
4. capital, interest rates and investment by country and sector
5. private and public consumption
6. bilateral trade flows, consumption matrices by product and investment matrix by ownership branch
7. GHG emissions by country, sector and fuel
8. detailed energy system projections (energy demand by sector and fuel, power generation mix, deployment of transport technologies and energy efficiency improvements)

Scenario design

The scenario framework in the modelling exercise for this report consists of a reference scenario (REF), one central policy scenario (FIT55) and two variants of the policy scenario (FIT55_Crowd and FIT55_SocSec). The REF scenario is consistent with the EU Reference Scenario 2020 (European Commission, DG Climate Action, DG Energy and DG Mobility and Transport, 2021) – the cut-off date for climate and energy policies considered is 2019 – but with updated macroeconomic projections to account for the initial impacts of the war in Ukraine (European Commission, DG Economic and Financial Affairs, 2022). The central policy scenario, FIT55, considers the core policies of the Fit for 55 package. In addition, the two variants of this scenario assess the impacts of (i) different methods of recycling ETS carbon revenues and (ii) different schemes for financing Fit for 55 investment requirements (see Table 2).

Accordingly, all policy scenarios include the same core policies but make different assumptions regarding:

- the financing of the core Fit for 55 policies, either through loans or by crowding out investments from other sectors
- the recycling of the ETS revenues into the economy, either through a reduction in VAT or social security contributions

Each option has different effects. For example, reducing VAT drives up the final demand for both domestically produced and imported goods and does not offer any competitive advantage to domestic industries, while reducing social security contributions paid by employers reduces the labour costs of local industries, which, in turn, boosts their competitiveness compared with that of foreign competitors.

Table 2 provides a brief overview of the scenario framework and the main scenario assumptions, including the respective levels of EU and non-EU climate policy ambition (as per countries' nationally determined contributions[5]), the shares of auctioned ETS allowances that result in carbon revenues to be recycled back to the economy, the method of financing the additional-to-REF climate-related investments and the recycling of ETS revenues.

Table 2: Scenario framework

Scenario	EU climate action	Non-EU climate action	Allocation of Emissions Trading System allowances in 2030	Financing of additional climate-related investments	Recycling of Emissions Trading System revenues
REF	Energy and emission projections consistent with the EU Reference Scenario 2020, leading to 40% GHG reductions in 2030 relative to 1990	Nationally determined contribution as of 2020	Auctioning in power supply, 57% of aviation, domestic and intra-EU maritime	Not applicable	VAT
FIT55	Climate action consistent with the Fit for 55 policy package, leading to 55% GHG reductions in 2030 relative to 1990	Nationally determined contribution as of 2020	Auctioning in power supply, 57% aviation, domestic and intra-EU maritime; 50% extra-EU maritime; 50% industry, buildings and road transport	Loan-based financing	VAT
FIT55_Crowd	Climate action consistent with the Fit for 55 policy package, leading to 55% GHG reductions in 2030 relative to 1990	Nationally determined contribution as of 2020	Auctioning in power supply, 57% aviation, domestic and intra-EU maritime; 50% extra-EU maritime; 50% industry, buildings and road transport	Own financing leading to crowding out	VAT
FIT55_SocSec	Climate action consistent with the Fit for 55 policy package, leading to 55% GHG reductions in 2030 relative to 1990	Nationally determined contribution as of 2020	Auctioning in power supply, 57% aviation, domestic and intra-EU maritime; 50% extra-EU maritime; 50% industry, buildings and road transport	Loan-based financing	50% VAT and 50% social security contributions

Source: *Fragkiadakis et al (2022)*

5 Nationally determined contributions are non-binding national plans that apply to both developed and developing countries. The plans highlight measures that mitigate the impact of climate change, including climate-related targets for GHG emission reductions.

The reference scenario

The REF scenario reflects the most recent EU economic projections, which consider the initial impact of the war in Ukraine on the economy and energy prices. The economic projections used in REF are based on DG Economic and Financial Affairs' summer 2022 forecast. For short-term GDP projections (up to 2025) in non-EU countries, world economic outlook 2020 (International Monetary Fund, 2020) data were used; for the long run, OECD long-term projections from 2018 (OECD, 2018b) were applied. The resulting EU Member State GDP projections are shown in the annex (Figure A1 and Table A1).

As with the macroeconomic projections, energy system projections correspond to those of the EU Reference Scenario 2020. That scenario was published as a follow-up to the EU Reference Scenario 2016, fully updating the statistical databases, models and techno-economic assumptions that were used in 2016 (European Commission, DG Energy, DG Climate Action and DG Mobility and Transport, 2016; European Commission, DG Climate Action, DG Energy and DG Mobility and Transport, 2021).

The GEM-E3-FIT REF scenario builds on the EU reference scenario and thus includes all legislated climate, energy and transport policies at EU and Member State levels until December 2019 (cut-off date). These include the directives and regulations of the Clean Energy for All Europeans package, the revised EU Emissions Trading System Directive, the Ecodesign Directive and Energy Labelling Regulation, the Energy Efficiency Directive, the Energy Performance of Buildings Directive, internal energy market policies (EU target model for electricity and gas markets), the waste regulation and EU fluorinated gas regulation, and key transport policies such as the CO_2 standards for vehicles, the Alternative Fuels Infrastructure Directive and the Clean Vehicles Directive. National policies considered in REF are those adopted as part of the national energy and climate plans and other national plans, as well as those planned to be adopted, involving coal phase-out and nuclear-related policies and long-term renovation strategies. Moreover, REF assumes the achievement of the national energy targets for 2030, mainly national energy efficiency and renewable energy source targets. For the non-EU countries, all scenarios assume the implementation of emission reductions that are consistent with the nationally determined contribution as of 2020.

The GEM-E3-FIT model has been calibrated to reflect the implications of all the above-mentioned policies on energy systems in each EU Member State. Table 3 presents an overview of the key set of policies that are part of REF. The cut-off date for the climate and energy policies considered is December 2019.

Table 3: Overview of policies in REF

Policy	Reference scenario	Note
EU GHG target	Economy-wide emission reduction by 40% by 2030 compared with 1990	The scenario design combines regulatory-based measures with economic measures such as carbon pricing to achieve the 40% GHG emission reduction target at EU and UK level.
Renewable energy	An EU-level target of at least 32% of renewable energy sources in the overall energy mix by 2030	Regulatory measures and carbon pricing act as drivers of renewable energy source use in the demand sectors, complementing bottom-up measures (for example, promotion of renewable energy source policies). Incentives for the uptake of renewable energy sources in heating and cooling – particularly heat pumps – in buildings and industry are in line with a binding renewable energy source heating and cooling target for 2030. This policy drives consumption of energy products and production of renewable energy source equipment. These sectoral changes affect employment.
Energy efficiency	An EU-level target for energy efficiency of 32.5% for final consumption	Regulatory measures and carbon pricing act as drivers of energy efficiency in the demand sectors, complementing bottom-up measures (for example, more efficient technologies and policies to increase renovation rates). This policy drives consumption of energy products, renovation and energy-efficiency equipment. These sectoral changes affect employment.
CO_2 emission standards for cars and vans	Rules on CO_2 emissions for cars and vans; EU-wide reduction targets	CO_2 standards for light-duty and heavy-duty vehicles will have an important bearing on the manufacture of internal combustion engine-based cars. Where electric vehicles and the batteries for electric vehicles are made will have positive employment effects in specific countries and regions.
National energy and climate plans and Effort Sharing Regulation	Individual (by Member State) targets on GHG emissions, renewable energy source and energy efficiency targets, transport mandates	These are detailed by sectoral final energy consumption and renewable energy source shares, deployment of alternative fuel vehicles and other characteristics.

Source: *Fragkiadakis et al (2022)*

At the time of finalising this report, there was no clear allocation of all ETS revenues. Parts of the revenues were earmarked for the Modernisation Fund and the Innovation Fund, as well as for NextGenerationEU, while there was a policy commitment to devote at least half of the ETS revenues to financing climate-related research and innovation, including via the Social Climate Fund. For the purposes of this analysis, we follow a stylised approach across all EU Member States and assume that ETS revenues are used to reduce VAT rates in the main reference scenario, and to reduce a combination of VAT rates and social security taxation in the REF variation that serves as a point of comparison for the FIT55_SocSec scenario variant.

Fit for 55 scenario and variants

In addition to the policy measures included in REF, the FIT for 55 scenario (FIT55) and its variants set of scenarios include policies that increase the GHG emission reduction targets, renewable energy source deployment targets and energy efficiency targets by 2030 (Table 4). In addition, FIT55 and its variants assume a dedicated climate measure, the Carbon Border Adjustment Mechanism, that aims to mitigate any loss in competitiveness of EU-based carbon-intensive industries that is associated with climate mitigation actions. The scenario design combines regulatory and economic measures such as carbon pricing to achieve the 55% GHG emission reduction target at EU level.

Table 4: List of policies in FIT55

Policy	Scenario	Note
EU GHG target	Economy-wide emissions reduce by 55% in 2030 compared with 1990.	Regulatory-based and economic measures are combined to achieve the 55% GHG target at EU level.
Extension of the ETS	The ETS includes maritime activities, buildings and road transport.	New sectors (buildings, transport) enter the ETS. A single endogenous carbon price applies to both old and new ETS market segments. A separate emissions trading system, for example for buildings and transport, is not considered in the modelling.
Renewable energy	The package includes a proposal for a review of the Renewable Energy Directive. The proposal is to increase the current EU-level target of at least 32% of renewable energy sources in the overall energy mix to at least 40% by 2030.	Regulatory measures and carbon pricing act as drivers of renewable energy source uptake in the demand sectors, complementing bottom-up measures. Incentives for the uptake of renewable energy source in heating and cooling – particularly heat pumps – in buildings and industry are in line with a binding renewable energy source heating and cooling target for 2030.
Energy efficiency	The current Energy Efficiency Directive is revised by increasing the current EU-level target for energy efficiency to 36% for final and 39% for primary energy consumption.	Regulatory measures and carbon pricing act as drivers of the uptake of energy efficiency in the demand sectors, complementing bottom-up measures (for example, more efficient technologies and policies to increase the renovation rates).
CO_2 emission standards for cars and vans	Rules on CO_2 emissions for cars and vans are updated and there are EU-wide reduction targets.	CO_2 standards for light-duty and heavy-duty vehicles are a driver of the introduction of alternative fuels in the vehicle fleet, implying an expansion of electric vehicle production.
Energy taxation	The Energy Taxation Directive is revised.	GEM-E3-FIT incorporates the revision of the Energy Taxation Directive after 2025 to include energy content taxation in accordance with the central objective of the directive.
Carbon border adjustment mechanism	The Carbon Border Adjustment Mechanism is a climate measure that should prevent the risk of carbon leakage and support the EU's increased ambition on climate mitigation, while ensuring compatibility with the rules of the World Trade Organization. It will be gradually put in place with the phase-out of free allowances allocated to carbon-intensive activities. It will equalise the price of carbon between domestic products and imports and ensure that the EU's climate objectives are not undermined by production relocating to countries with less ambitious policies.	The Carbon Border Adjustment Mechanism policy will be gradually introduced in 2026 to be fully in place in 2035. The current implementation assumes the Carbon Border Adjustment Mechanism is introduced for basic metals, chemicals and non-metallic minerals for all Scope I emissions. We consider only Carbon Border Adjustment Mechanism implementation that involves Scope I, notably, direct GHG emissions that occur from sources controlled or operated by the economic activities of the sector in question.

Note: *Subsequent to this modelling, operational details of the Carbon Border Adjustment Mechanism have been updated. The mechanism enters a transitional phase on 1 October 2023, with the permanent system entering into force in 2026 and phased in over the following decade up to 2035 in tandem with revisions to the EU-ETS (European Commission, 2023).*
Source: *Fragkiadakis et al (2022)*

The scenario assumes the integration of buildings and road transport sectors into the ETS ('new' ETS sectors). The unified market of allowances implies that a single carbon price will apply to both 'old' and 'new' ETS market segments. The pricing of carbon emissions acts as a driver of energy efficiency and renewable energy source uptake in demand sectors, complementing bottom-up measures, for example the promotion of renewables and more efficient technologies and policies to increase renovation rates. In the buildings and industry sectors, incentives are included for the uptake of renewable energy sources in heating and cooling – particularly heat pumps – in line with a binding renewable energy source heating and cooling target for 2030. Regarding energy taxation, FIT55 incorporates the revision of the Energy Taxation Directive after 2025 to include energy content taxation in accordance with the central objective of the directive (European Commission, 2021c). For the transport sector, the scenario includes CO_2 standards for light-duty and heavy-duty vehicles.

Policies on alternative fuels infrastructure, sustainable aviation fuels, greener fuels in shipping and the Social Climate Fund are not covered by the analysis, since the GEM-E3-FIT model does not have the sectoral representation and the data required to explicitly cover these policies. However, the expected impact of such policies on total employment is likely to be limited. Tsiropoulos et al (2022), for example, estimate that investments in electric vehicle chargers range between €8.7 billion and €16.2 billion in 2021–2030 (less than €2 billion on average per year).

In FIT55, we assume an emissions trajectory as a uniform cap for both new and existing ETS sectors and implement an emissions target to derive endogenous carbon prices for the extended ETS, including current ETS sectors, buildings and road transport. All emissions under the 'new ETS' are covered by auctioning in 2030. The number of auctioned allowances multiplied by the endogenous carbon price equals the carbon revenues directed to the public budget. The further employment of renewable energy – especially beyond the power supply sector, which is covered and already fully auctioned by the ETS – is fostered by additional policies. For example, a minimum increase by 1.1 percentage points of the renewable energy source heating and cooling target at Member State level applies in line with the proposed Renewable Energy Directive revision; an overall 2030 transport target for all transport modes is expressed as a 13% drop in GHG intensity; a subtarget for advanced biofuels of 2.2% by 2030 across transport modes is in line with the proposed revision, along with a subtarget of 2.6% for renewable fuels of non-biological origin by 2030; and CO_2 standards for light-duty and heavy-duty vehicles drive renewable energy source uptake across transport. The CO_2 standards are reduced by 55% in cars and 50% in light-duty vehicles compared with 2021 CO_2 standards, consistent with the CO_2 standards proposal. In heavy-duty vehicles a 30% reduction from 2020 applies, consistent with the CO_2 performance standards for new heavy-duty vehicles. Energy efficiency targets are enabled by bottom-up measures such as savings related to the renovation of existing buildings and the uptake of more efficient appliances and technologies. In addition, the GEM-E3-FIT model incorporates the revision of the Energy Taxation Directive after 2025. The Carbon Border Adjustment Mechanism policy is gradually introduced with the phase-out of free allowances to industries subject to carbon leakage. Full implementation takes place in 2035 (see note to Table 4).

Scenario results

The projection of employment in 2030 is a complex task taking into account multiple factors, including the rate of growth in, and the structure of, GDP and sectoral production, changes in labour productivity, population trends and participation rates. In REF, these factors are considered in order to quantify the employment projections for 2030. In FIT55, the impact of the selected policies on GDP and sectoral production are the key drivers of the 2030 projections.

Reference scenario results

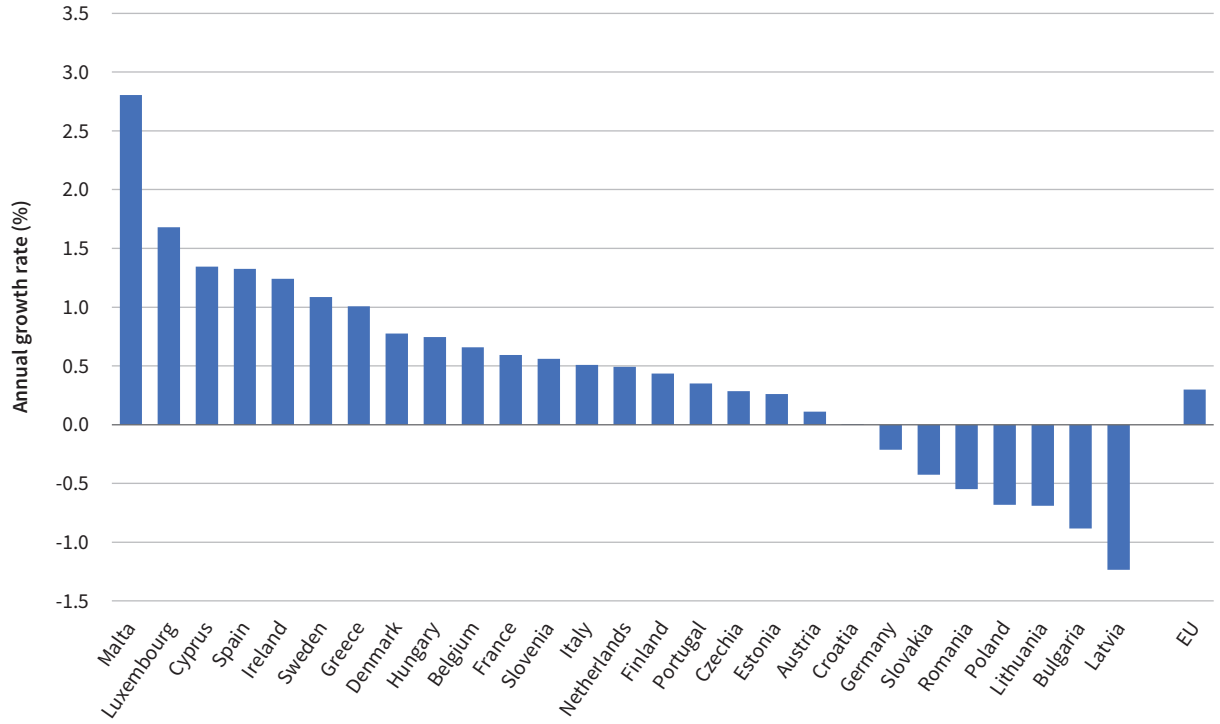
Under REF, in 2020–2030 the annual GDP growth rate of the EU economy is 1.76%, driven mainly by investment. By 2030, the EU population and labour force (aged 15+) rise by 0.05% and 0.35% per annum on average respectively compared with 2019 levels (Table 5). Due to an increase in unemployment rates, total employment increases at a slower pace (0.30%) than the labour force (0.35%) up to 2030. While the annual growth rate of employment in the EU is positive (Figure 2), in eight of the EU Member States employment is forecast to contract or remain the same.

Table 5: Projection of EU total employment in REF

	2019 (thousand people)	2030 (thousand people)	2019–2030 (% annual change)
Employment	199,903	206,600	0.30
Population	446,825	449,122	0.05
Labour force	214,271	222,624	0.35
Unemployment	14,367	16,024	1.00

Source: *Fragkiadakis et al (2022)*

Figure 2: Annual growth rate of total employment in REF, EU, 2019–2030



Source: *Fragkiadakis et al (2022)*

In line with recent trends, the REF scenario projects that service-oriented activities will continue to have the largest share in total employment and will grow their share further by 2030.[6] This will drive up the demand for professional, service and sales occupations in particular (see Table 7). The 'other industries' sector and transport/storage experience a slight decline while construction's share is forecast to increase marginally (Table 6).

Table 6: Share of employment in REF, by sector, EU (%)

Sector	2019	2030
Agriculture	4.3	3.9
Energy, mining and extraction	1.1	1.0
Energy-intensive industries	2.4	2.3
Other industries	13.9	13.2
Construction	6.8	7.1
Transport and storage	5.4	4.9
Market services	41.1	41.3
Non-market services	25.0	26.4

Source: *Fragkiadakis et al (2022)*

Table 7: Share of employment in REF, by occupation, EU (%)

Occupation	2019	2030
Managers	5.2	5.1
Professionals	19.3	19.7
Technicians and associate professionals	16.7	16.8
Clerical support workers	9.4	9.4
Service and sales workers	16.6	16.8
Skilled agricultural, forestry and fishery workers	3.6	3.1
Craft and related trades workers	11.9	11.9
Plant and machine operators and assemblers	7.8	7.2
Elementary occupations	8.9	9.2
Armed forces occupations	0.6	0.7
No response	0.1	0.1

Source: *Fragkiadakis et al (2022)*

6 Market services include services related to water and waste; trade; accommodation and food; information and communication; real estate; professional, scientific and technical; administration and support; arts and recreation; other services; activities of households as employers; and activities of extraterritorial organisations and bodies. Non-market services include services related to education; health and social work; and public administration and social security.

The outlook of occupations in the EU under REF remains similar between 2019 and 2030 (Table 7). The occupations with the largest share of employment in 2030 continue to be professionals, technicians and associate professionals, and service and sales workers. The occupations with the lowest shares are managers, skilled workers in agriculture, forestry and fisheries, and those in the armed forces.

Fit for 55 main scenario results

The policies considered in FIT55 mandate a restructuring of the energy system towards low-carbon production processes, higher energy efficiency and a greater share of renewable energy sources in energy consumption. The decarbonised energy system is expected to be capital intensive but with lower operating and maintenance expenditures. For example, purchasing household appliances with the top energy efficiency rating (AAA+) requires significantly higher upfront costs than lower-rated energy-intensive appliances but subsequently lower spending on electricity during operation, namely the opposite of current expenditure trends.

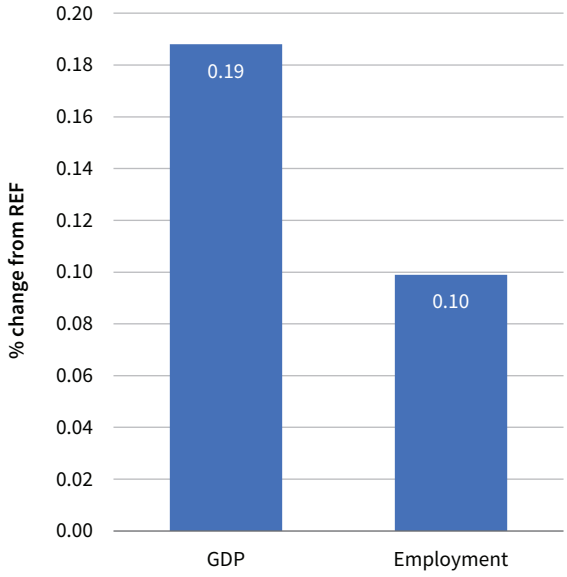
The restructuring of the energy system will make certain economic activities obsolete (for example, it will gradually phase out coal mines) while boosting others (for example, manufacturing of renewable energy source equipment and energy-efficient appliances, renovation of buildings).

The low-carbon transition will not affect all economic activities and occupations across the EU Member States in the same way. The increasing activity of emerging sectors that contribute to the restructuring of the energy system, such as the production of wind turbines, is expected to bring benefits to local economies, whereas countries that are net importers of low-carbon technologies and/or dependent on carbon-intensive activities are expected to face challenges. Similarly, it is expected that skilled engineers and technicians included in the construction of renewable energy source projects will replace coal miners. However, what will determine the net effect on employment and the economy is the labour intensity (for employment) and the value added (for economic growth) of fossil-based activities in comparison with low-/zero-carbon production and consumption processes.

A key feature underpinning the short- to medium-term transformation of the energy system is the need for additional investments in low-carbon power generation technologies, mainly solar photovoltaic and wind; the electrification of final demand; the emergence of new energy carriers such as hydrogen; the upgrading of grid infrastructure; and the energy retrofitting of buildings. Nevertheless, it should be noted that most fossil-based power generation production has already been phased out in REF, thus lowering the mitigation challenges to be met by carbon-intensive countries in FIT55. To this end, requirements for significant additional investment in power supply are linked to the higher electrification levels observed in FIT55. The default financing option for the investment is loans (national and foreign capital). An alternative financing option is the self-financing case where other investment projects are cancelled in order to provide the financial resources for the clean energy transition.

At EU level, FIT55 has a small but positive net impact on GDP (0.19% increase from REF levels) over 2019–2030. The impact on net employment is found to be marginally positive (0.10% increase compared with REF) (Figure 3). The positive macroeconomic effect of new investments in low-carbon technologies and processes, and lower imports of fossil fuels, is counterbalanced by lower economic activity in fossil-based/-related sectors but also by a short-term increase in production costs of carbon-intensive and export-oriented industries, which lead to lower sales within and outside the EU. As the EU increases its carbon pricing and reduces the provision of free allowances to those industries, their production costs increase more than in other competing countries.

Figure 3: Impact of FIT55 on EU GDP and employment, 2030



Source: *Fragkiadakis et al (2022)*

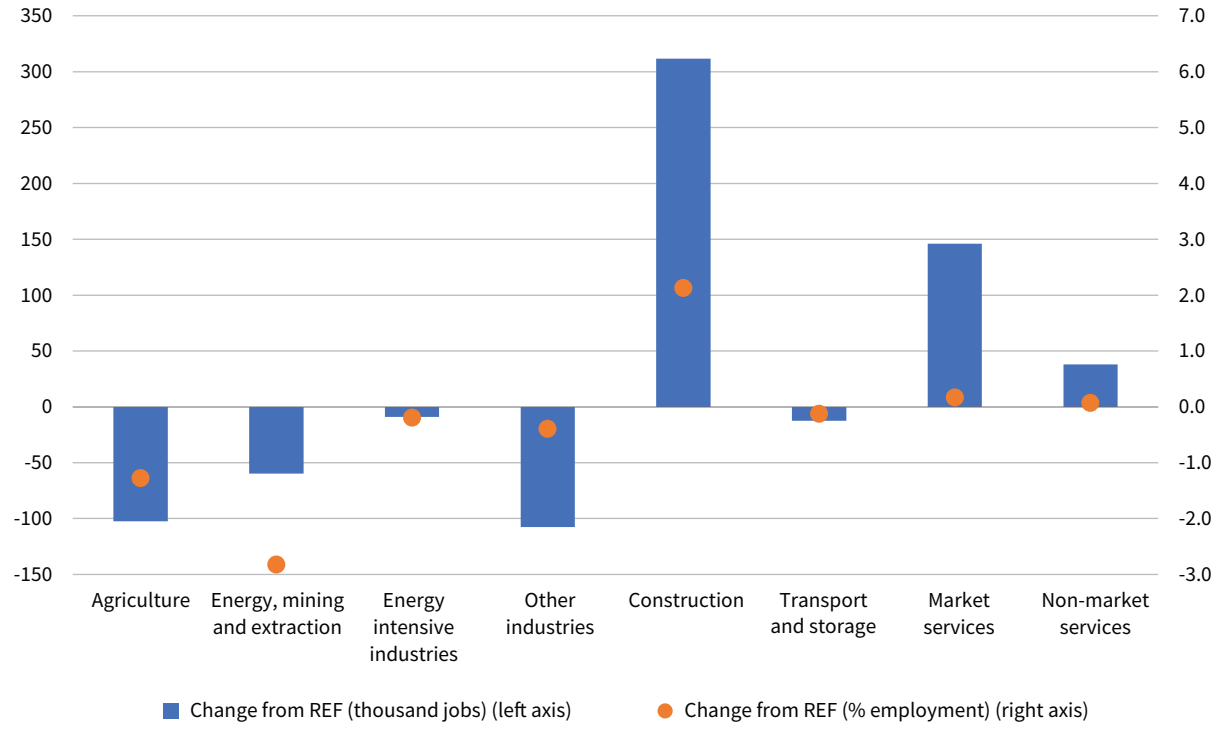
This entails losses in competitiveness, which lower exports compared with REF. The EU's domestic production of energy-intensive and other manufacturing goods becomes more expensive as a result of higher energy prices and the capital-intensive decarbonisation of the production processes, so exports fall. The introduction of the Carbon Border Adjustment Mechanism reduces the loss of competitiveness in the EU internal market by adding a carbon price at the border to balance the costs of EU imports, but

nevertheless cannot limit the expected export losses. However, the Carbon Border Adjustment Mechanism's introduction means that carbon pricing is implemented not only on domestic goods but also on the corresponding imported ones. Thus, the prices of composite goods increase, driving private consumption downwards, and limiting any potential gains from higher incomes associated with higher employment. Nevertheless, the transition has a net positive effect, as investment demand in emerging sectors – such as those involved in the production of efficient electric appliances, wind turbines and electric vehicles – and in construction increases compared with REF. Overall, however, the impacts are marginal given the already ambitious effort that the pre-existing climate policies of REF introduced.

From a sectoral perspective, the implementation of the FIT55 policies has a positive impact on construction and services, while all other aggregate sectors see a negative impact. However, it should be noted that the sectors producing low-carbon goods and technologies, such as energy-efficient electric appliances and wind turbines, register major employment growth. Figure 4 presents the impact of FIT55 policies on sectoral employment in eight aggregate sector categories in absolute terms compared with REF.

Construction is the sector that benefits the most from the implementation of the FIT55 policies, given that the energy-related investments are additional to REF ones and do not crowd out investments in other sectors. The additional investments required in power generation, grid extension and retrofitting of buildings amount to €103 billion (Table 8) and have a positive net impact on construction employment, namely 2.1% or 312,000 jobs additional to those projected under REF. This net impact encompasses not only the positive direct impact of additional investments but also the induced and income effects that these investments result in. Close to 40% of additional investment expenditure is directed into construction services, resulting in an implied labour intensity of seven jobs per €1 million invested. The labour intensity of wind and photovoltaic manufacturing is five and two jobs per €1 million respectively, and the driver of this is the local/EU content in the production process of these sectors. In an IEA (2022) study, the labour intensity in jobs per USD 1 million varies from one job in nuclear plants to seven jobs in solar photovoltaic at the installation phase (IEA, 2022). Labour intensity is equal to 0.8 jobs per €1 million in wind turbine manufacturing, 5.4 jobs per €1 million for photovoltaic manufacturing and 15 jobs per €1 million overall for the construction of energy efficient new buildings.

Figure 4: Impact of FIT55 on sectoral employment, 2030



Source: *Fragkiadakis et al (2022)*

Table 8: Sectoral demand for additional investments in FIT55 compared with REF (€ billion)

Sector	Construction	Wind turbine manufacturing	Photovoltaic manufacturing	Services	Other	Total
Renovation	27	–	–	6	6	39
Power plants	5	18	7	6	7	43
Grid network	10	–	–	3	7	21
Total	**43**	**18**	**7**	**15**	**20**	**103**

Source: *Fragkiadakis et al (2022)*

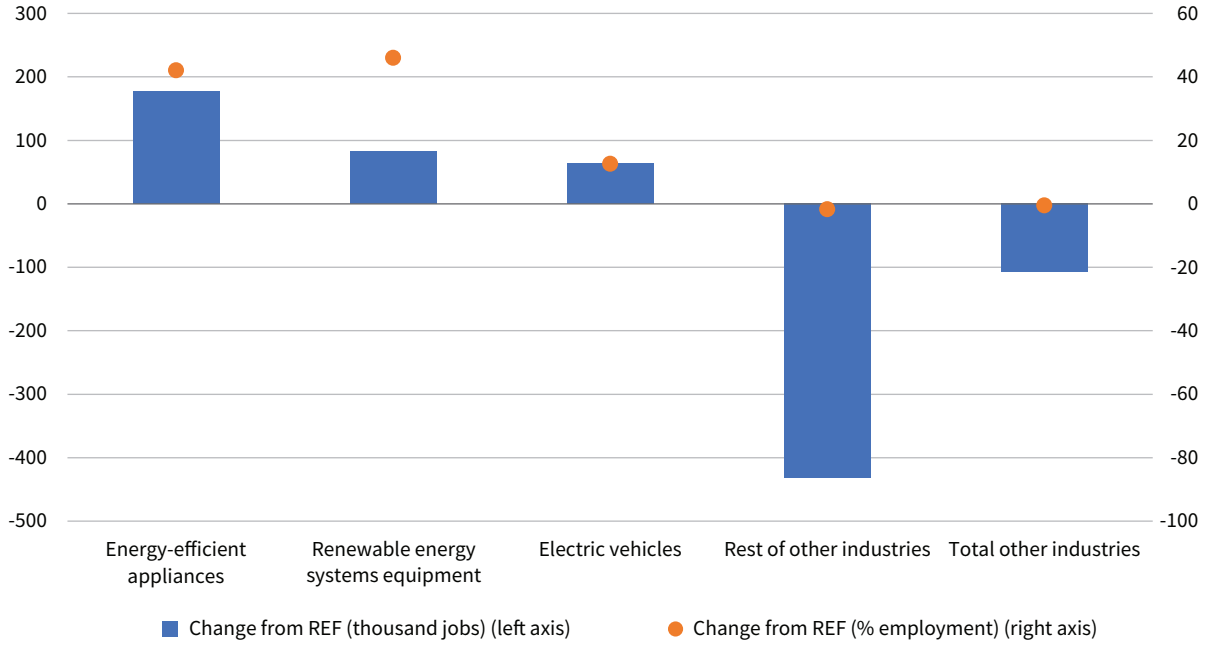
Employment in the services sector is primarily influenced by the demand generated by the additional investments as well as by the positive economy-wide induced effects. Market services see a rise of 0.2% or 146,000 jobs in 2030, and non-market services a rise of 0.1% or 38,000 jobs compared with the REF projections.

Employment in agriculture drops by 1.3% from REF levels in 2030. This is due to the hard-to-abate non-CO_2 emissions of the sector, which are subject to a carbon price with the expansion of the ETS sectoral coverage. The agriculture sector contributed 60% of total EU methane (CH_4) emissions and 80% of total EU nitrous oxide (N_2O) emissions in 2019. While mitigation options have been considered in FIT55 (for example, automation solutions and improvements in cropland and livestock management), these result in an increase in the cost of agricultural products, which in turn affects production and employment in a negative way. It is assumed that all costs associated with mitigation action pass through to the end-use price for consumers without any government intervention (subsidies). Possible countervailing gains in the sector through carbon farming – adopting agricultural practices that help remove carbon from the atmosphere by storing or sequestering it in plant or soil material – are not considered in the model.

Employment in the energy, mining and extraction sector decreases by 2.8%, or 60,000 jobs, compared with REF in 2030, which is the net outcome of fossil fuel phase-out and the increasing deployment of renewable energies and electricity. When looking at energy subsectors, the estimated net impact on employment in the electricity, gas, steam and air conditioning supply sector (D35) is positive, with 91,000 additional jobs compared with REF, attributed mainly to the operation of renewable energy source-based power generation technologies (photovoltaic and wind), the increased demand for electricity and the increased penetration of new hydrogen and e-fuel power sources. On the negative side, the estimated net impact on employment in the fossil-based energy, extraction and mining sectors (B and C19) is 151,000 fewer jobs than REF, associated with declining demand for and production of fossil fuels.

Employment in the energy-intensive industries (basic metals, chemicals, paper and pulp, non-metallic minerals) is negatively affected by higher costs, which bring about a loss of competitiveness and a subsequent drop in exports. However, owing to the Carbon Border Adjustment Mechanism policy, which is included in FIT55, this negative effect is limited and does not result in higher EU imports of these goods. The Carbon Border Adjustment Mechanism protects the competitiveness of EU energy-intensive industries by raising the price of products imported from non-EU countries in a way that is proportionate to their carbon intensity and to carbon prices in the EU ETS. At net level, the aggregate energy-intensive industry sector registers 9,000 fewer jobs, or a 0.2% decrease, in 2030. Other industries are also affected negatively by rising costs of capital and energy. In addition, industries, mainly the downstream sectors that use in their production process (as intermediate inputs) the products that are protected through the Carbon Border Adjustment Mechanism policy, face additional costs compared with non-EU competitors (as the prices of the products protected by the Carbon Border Adjustment Mechanism increase in the EU because of either carbon taxes or the Carbon Border Adjustment Mechanism tax on imported non-EU products). An additional key driver of job losses in the aggregate other industries sector is the loss of jobs in the manufacture of vehicles, owing to transport policies that raise the costs of private transport and thus create a shift towards public and shared transportation. The rest of the other industries sector, however, also includes the production of low-carbon technologies, which are expected to record a large increase in employment, especially the domestic production of wind turbines and energy-efficient domestic appliances. Figure 5 shows the breakdown of the other industries' results in key clean energy manufacturing sectors. The overall net effect of the other industries sector is reflected in the number of jobs, which shrinks by 108,000, or 0.4%, compared with REF.

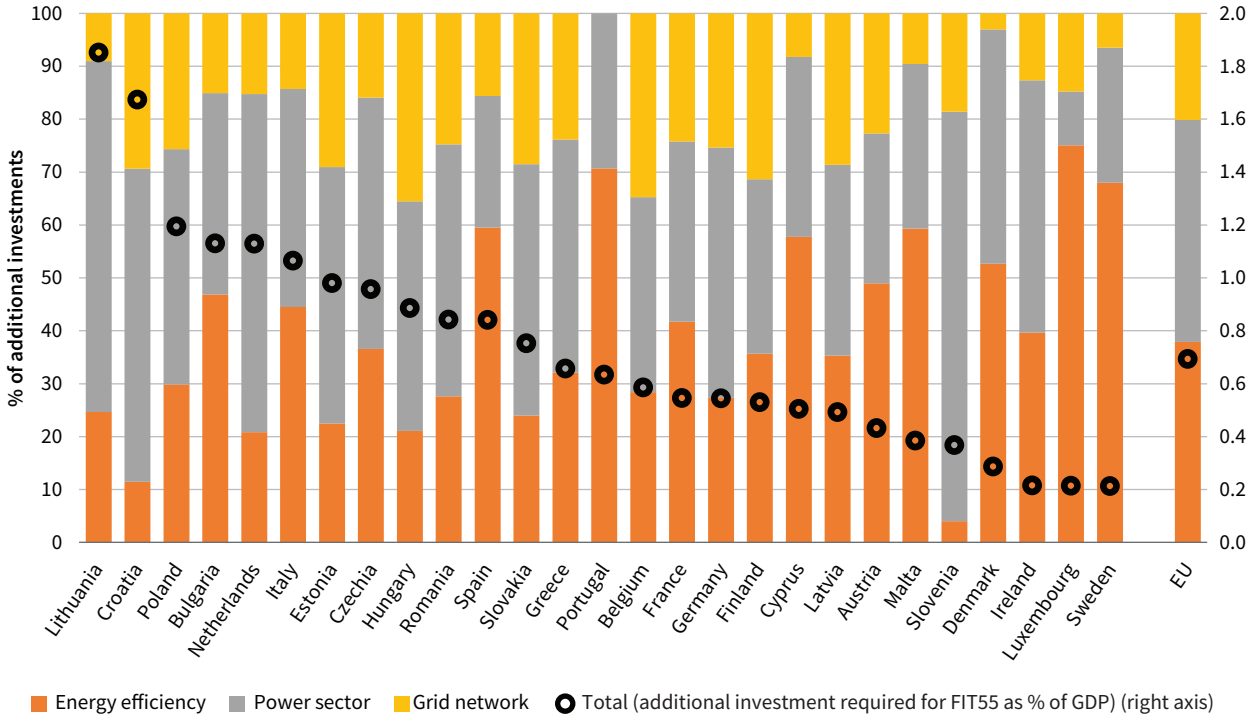
Figure 5: Impact of FIT55 on key clean energy manufacturing sectors, 2030



Source: *Fragkiadakis et al (2022)*

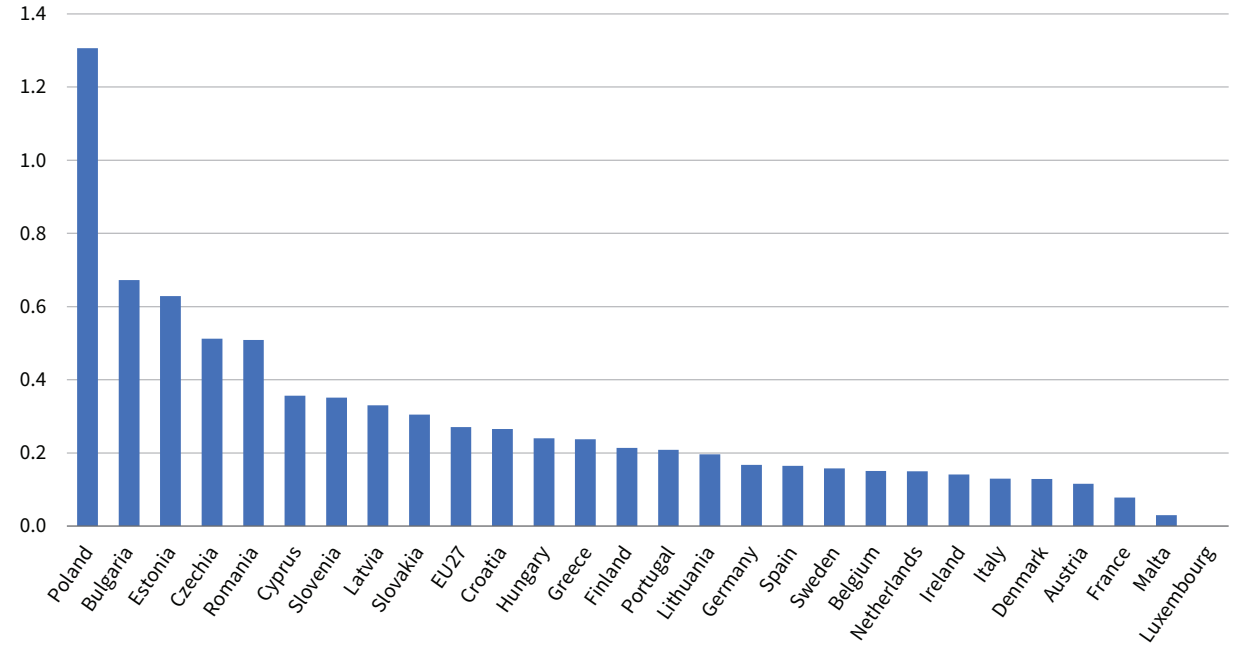
At national level, the net impact on employment (see Figure 9) is determined by (i) whether the countries are producers of the equipment, materials and services required for the clean energy transition, (ii) the demand-driven growth effect of the investments, namely, the relative size of the new climate-related investments linked to FIT55 as a share of GDP (Figure 6), (iii) the extent to which countries produce fossil fuels (Figure 7) and (iv) the GHG intensity of fossil fuel production (Figure 8). The first indicator contributes positively to the economy, with varying labour intensity depending on the type of additional investments. For example, investment expenditure on building renovation generates more jobs than investments in the grid network, while the greater the additional investment requirements as a share of GDP, the higher the employment benefits (on the assumption that investments are financed by idle capital and not by crowding out other types of investments). On the other hand, the last two indicators define the carbon dependency of the economy; thus, the higher the decarbonisation effort compared with REF, the more jobs are lost during the transition. We note again that already in REF the decarbonisation of the energy system has taken place in many Member States, thus lessening the challenges of implementing the policies that FIT55 assumes.

Figure 6: Additional investments in FIT55 versus REF



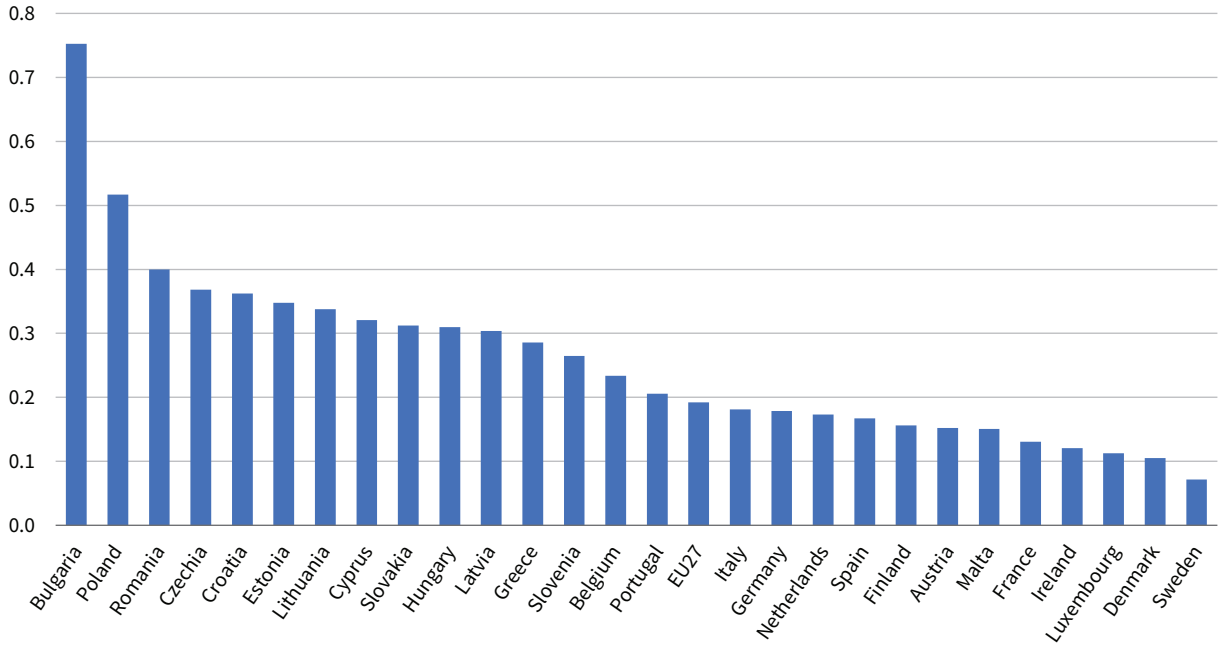
Source: *Fragkiadakis et al (2022)*

Figure 7: Share of mining, quarrying and manufacture of coke and refined petroleum products in total employment in REF, 2030 (%)



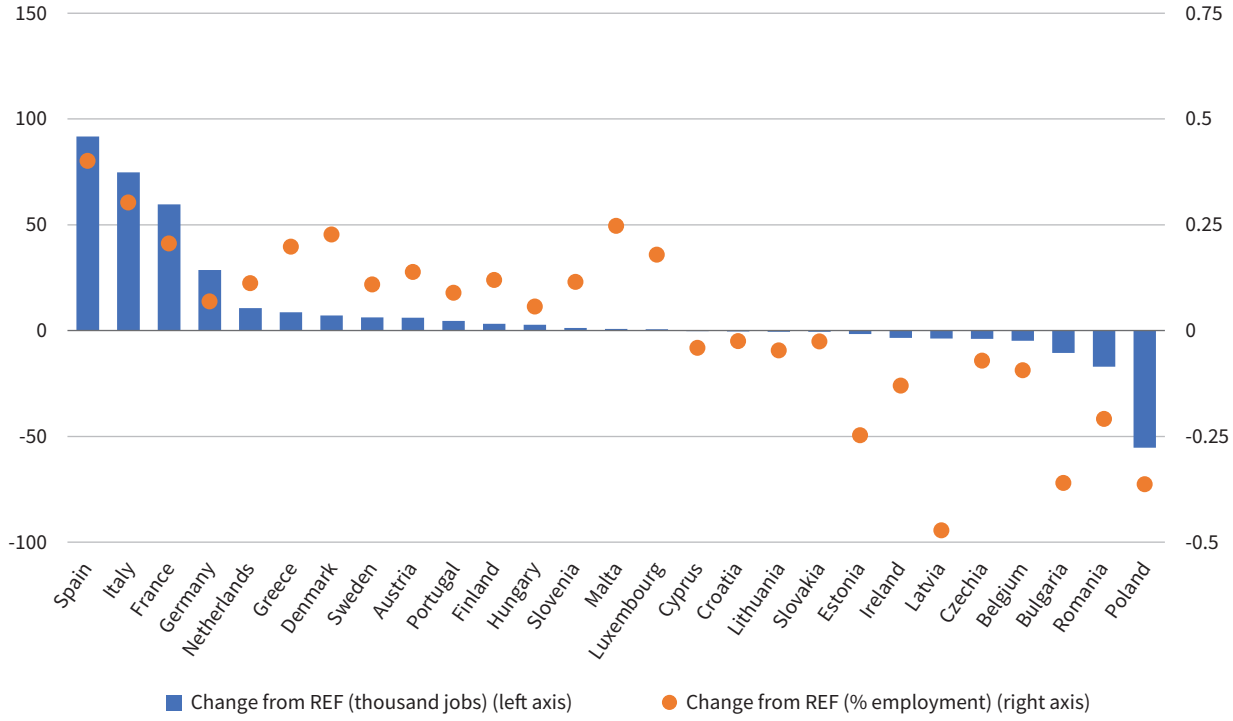
Source: *Fragkiadakis et al (2022)*

Figure 8: Greenhouse gas intensity in REF, 2030 (kt CO_2eq per €1 million GDP)



Source: *Fragkiadakis et al (2022)*

Figure 9: FIT55 impact on employment by country, 2030



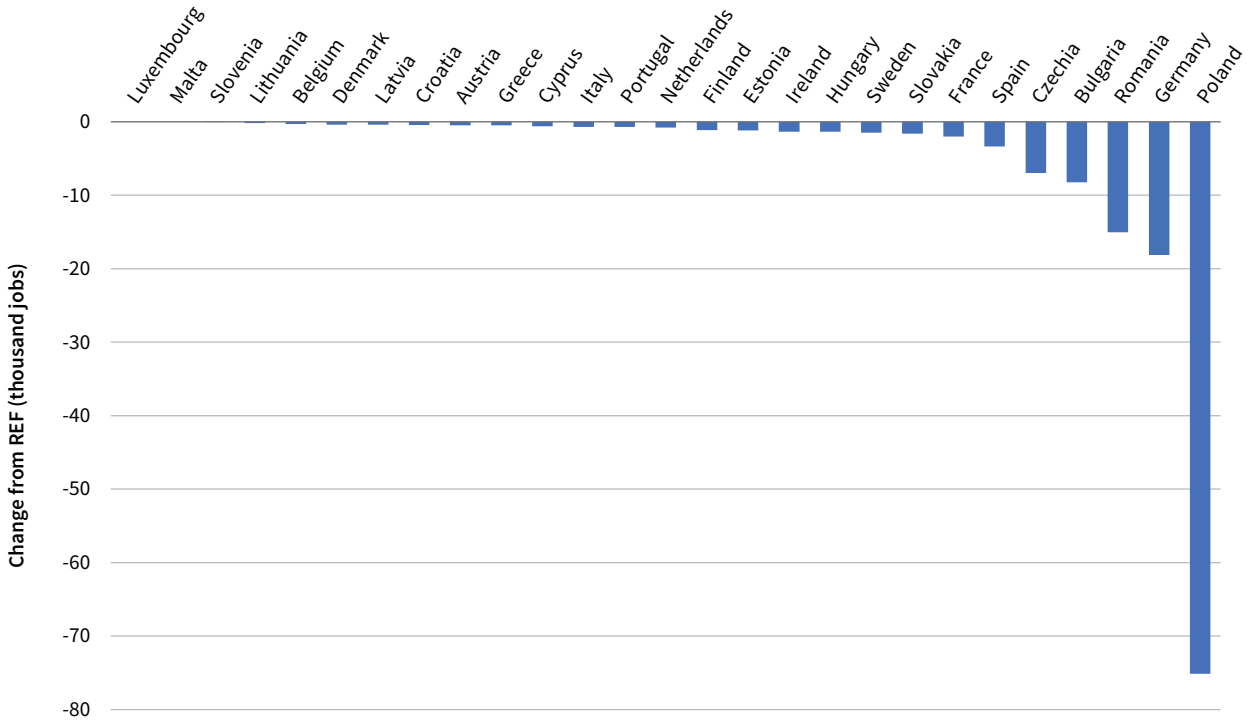
Source: *Fragkiadakis et al (2022)*

Spain, Italy, and France have low shares of employment in fossil fuel sectors and low GHG intensity in 2030 under REF. At the same time, they require relatively high additional investment to meet FIT55 objectives. As a result, these Member States record the highest positive effects on employment. These positive impacts are mainly associated with job creation in the construction sector, which is associated with high labour-intensive renovation expenditure. Furthermore, Spain is a key producer of wind turbines, including delivering to the rapidly growing domestic market. Similarly, Germany and Denmark have positive employment projections not only in the construction sector but also in sectors producing low-carbon technologies.

Most Member States follow the sectoral patterns described for the EU, in terms of job losses in agriculture and energy-intensive industries. However, with regard to energy-intensive industries, some Member States gain competitiveness in the internal EU market, as their production processes are already less carbon intensive in REF and as a result less exposed to price increases arising from EU climate policy. Germany, for example, sees employment gains in energy-intensive industries but losses in other industries, primarily due to the jobs lost in the automotive industry. Poland, Romania and Bulgaria, on the other hand, have the highest GHG intensity as well as the highest employment in fossil fuel sectors in 2030 under REF. In these countries, the expected positive impact of additional investments does not outstrip the negative impact of job losses related to fossil fuel-based technologies and related reduced competitiveness.

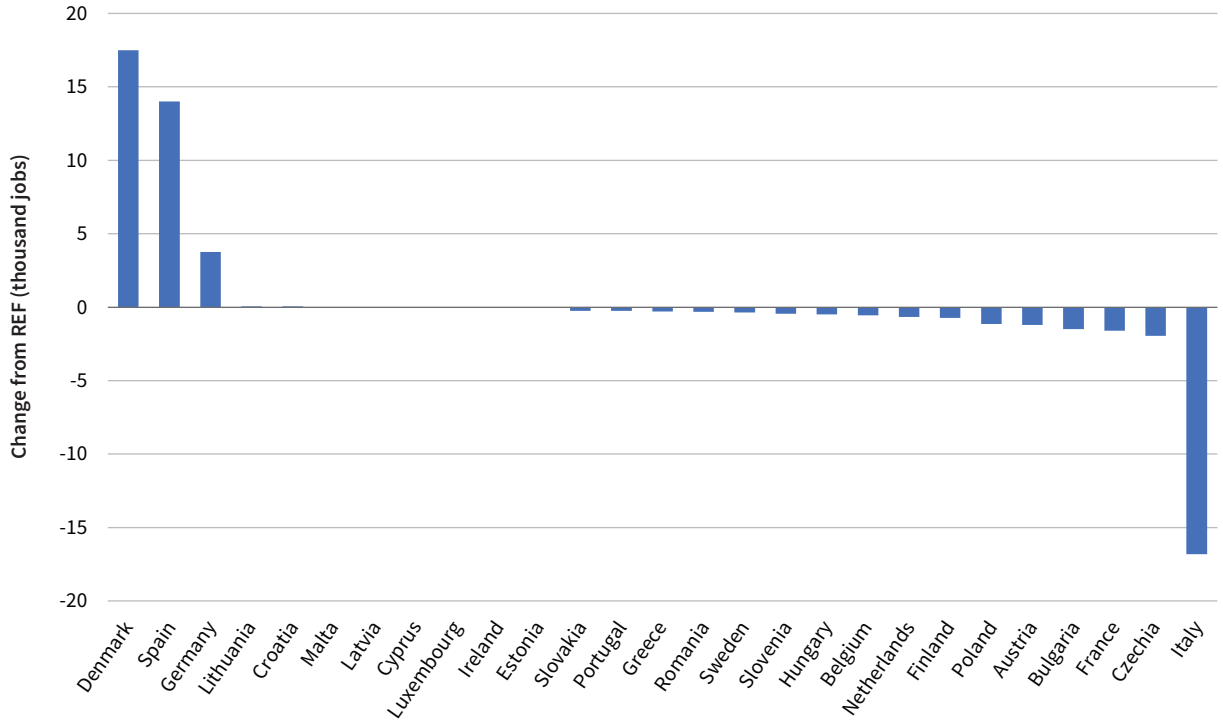
At sectoral level, the falling demand for fossil fuels affects employment in the mining and quarrying sector (Figure 10), while the production of wind and solar manufacturing (positive impact) and the drop in competitiveness (higher price of products protected by the Carbon Border Adjustment Mechanism) affect the manufacturing of machinery and equipment (Figure 11). The impact on construction (Figure 12) is driven by the additional investments in building refurbishment and renovation as well as construction in the power sector.

Figure 10: Impact of FIT55 on employment levels in the mining and quarrying sector at national level, 2030



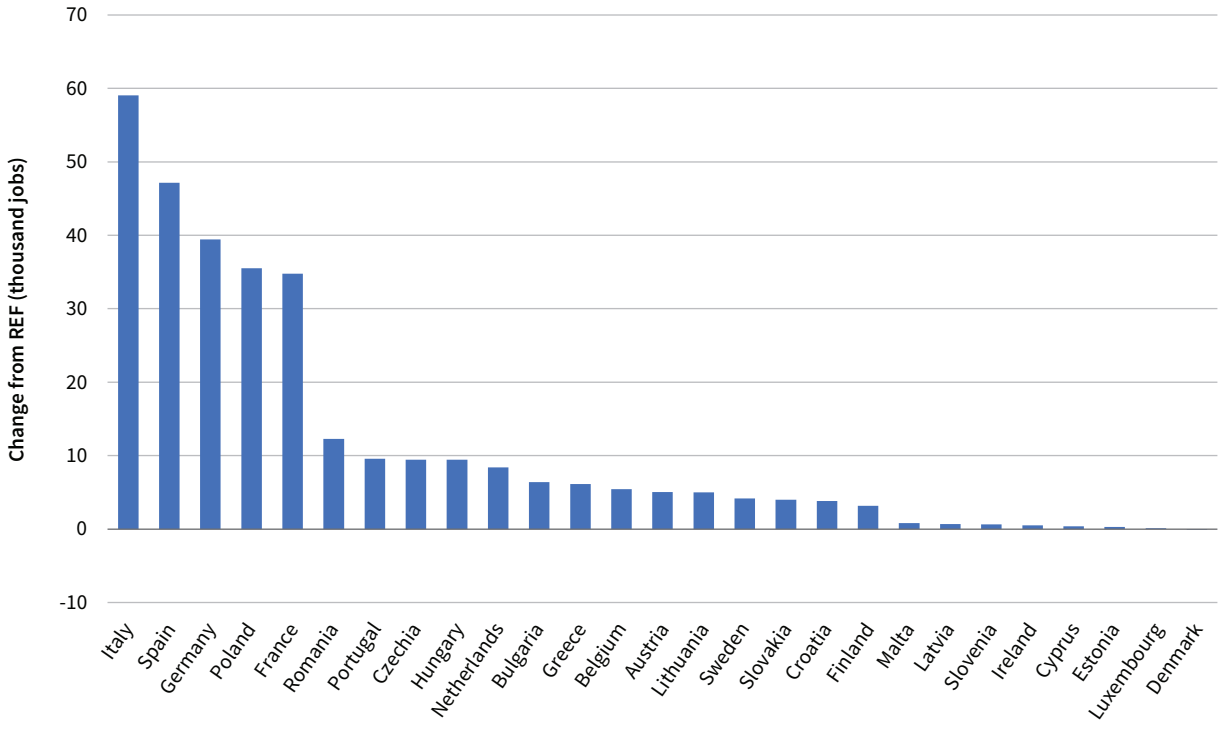
Source: *Fragkiadakis et al (2022)*

Figure 11: Impact of FIT55 on employment levels in the manufacture of machinery and equipment sector at national level, 2030



Source: *Fragkiadakis et al (2022)*

Figure 12: Impact of FIT55 on employment levels in the construction sector at national level, 2030



Source: *Fragkiadakis et al (2022)*

Table 9: Top five and bottom five NUTS 2 regions in terms of absolute employment changes in FIT55 relative to REF, 2030

NUTS 2 region	Absolute difference from REF (thousand jobs)	% change from REF	NUTS 2 region	Absolute difference from REF (thousand jobs)	% change from REF
Largest employment declines			Largest employment gains		
West – RO42	-4.01	-0.8	**Île-de-France – FR10**	30.10	0.3
Wielkopolskie – PL41	-4.83	-0.3	**Andalusia – ES61**	21.02	0.6
South-West Oltenia – RO41	-6.52	-1.0	**Madrid – ES30**	14.95	0.4
Opolskie – PL51	-17.53	-1.5	**Catalonia – ES51**	12.53	0.3
Śląskie – PL22	-19.68	-1.1	**Lombardy – ITC4**	11.44	0.2

Source: *Fragkiadakis et al (2022)*

At regional level, employment impacts follow the national patterns closely. The five most negatively affected regions, in both relative and absolute terms (Table 9), are found in Poland, Romania and Bulgaria. In particular, the regions of Opolskie (PL51) and Śląskie (PL22) in Poland register the highest losses, with 1.5% and 1.1% of jobs lost, respectively, compared with REF in 2030. This is primarily due to coal mining activities, as over 40% of all coal miners in the EU in 2019 were in PL22 and 8% in PL51. The sector will see a drop in employment of around 42% compared with REF in 2030. Similarly, South-West Oltenia (RO41) in Romania, which is the region employing the third largest number of coal miners in the EU (nearly 8% of the EU total in 2019), is found to be next most affected, with an overall employment loss of 1% compared with REF in 2030. The three regions described above (PL22, PL51 and RO41) are also the ones with the biggest job losses in absolute terms. In Bulgaria, while the South-East region (BG34) employs the fourth largest number of coal miners in the EU, this is not the region most negatively affected. That is because BG34 is projected to have significant compensatory employment gains in the construction sector.

The regions that register the highest employment gains in FIT55 are found in Spain, France and Italy, in line with the findings at national level. The highest job increase in absolute terms is seen in Île-de-France (FR10) in France, which is the largest employing region in the EU. Here, an increase of 30,000 jobs compared with REF is projected. The main sectors gaining jobs are land transport (H49) and electricity sectors (D35), followed by construction (F43) and manufacturing of electric equipment (C27). In C27, Île-de-France was the fourth largest employing region in the EU in 2019, and employment in this sector and region is expected to increase by 13% compared with REF due to the demand for energy-efficient electric appliances. The Andalusia region (ES61) in Spain is among the top three regions in terms of both absolute and relative job gains, with 21,000 more jobs than under REF. Despite the high losses in agricultural jobs, the region is projected to have large employment gains in the construction sector, due to both renewable power plant installation and building renovation. Other Spanish regions, such as Madrid (ES30), Murcia (ES62), Canary Islands (ES70) and Catalonia (ES51) are in the top five regions throughout the EU in terms of relative or absolute job gains compared with REF.

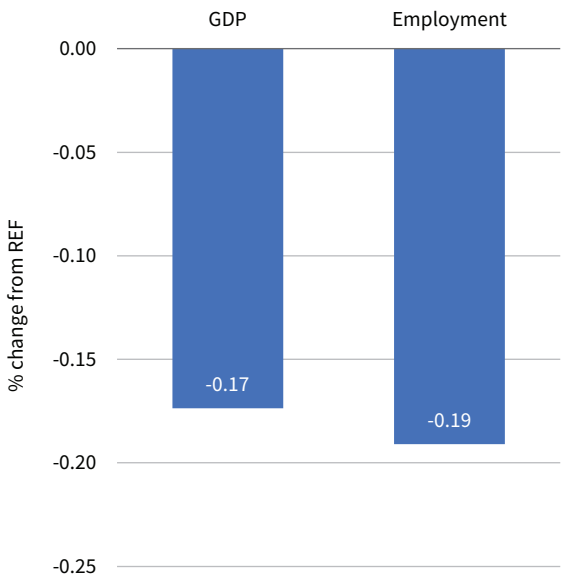
In addition to the central FIT55 policy scenario, the modelling exercise also generates projections for 2030 employment based on adjustments to the modes of funding of greening investment (FIT55_Crowd) and of recycling of carbon tax revenue (FIT55_SocSec).

FIT55_Crowd scenario results

In the first of the two alternative scenarios, FIT55_Crowd assumes that the financing of the additional FIT55 investments is based on own resources and thus leads to a crowding out of other investments. In this self-financing case, firms and households need to cancel competing expenditures in order to find the finance for the energy and climate investments, since the model does not assume any idle capital. Overall, GDP drops (Figure 13) due to higher production costs associated with (i) carbon prices and more expensive energy and (ii) the fact that the clean energy transition is more capital intensive and hence puts stress on capital markets and costs, since rigid capital markets are assumed. Higher production costs damage competitiveness and welfare. Investments and exports drop due to these higher production costs and to the overall induced economic effects. In addition, the reallocation of investments may have a negative effect on both GDP and employment due to a lower multiplier effect of clean energy investments that are based on imported commodities. So, whereas, in the FIT55 scenario, investments increased due to loan-based financing that did not crowd out other types of investments, in this crowding-out scenario both GDP and employment decline compared with REF in 2030.

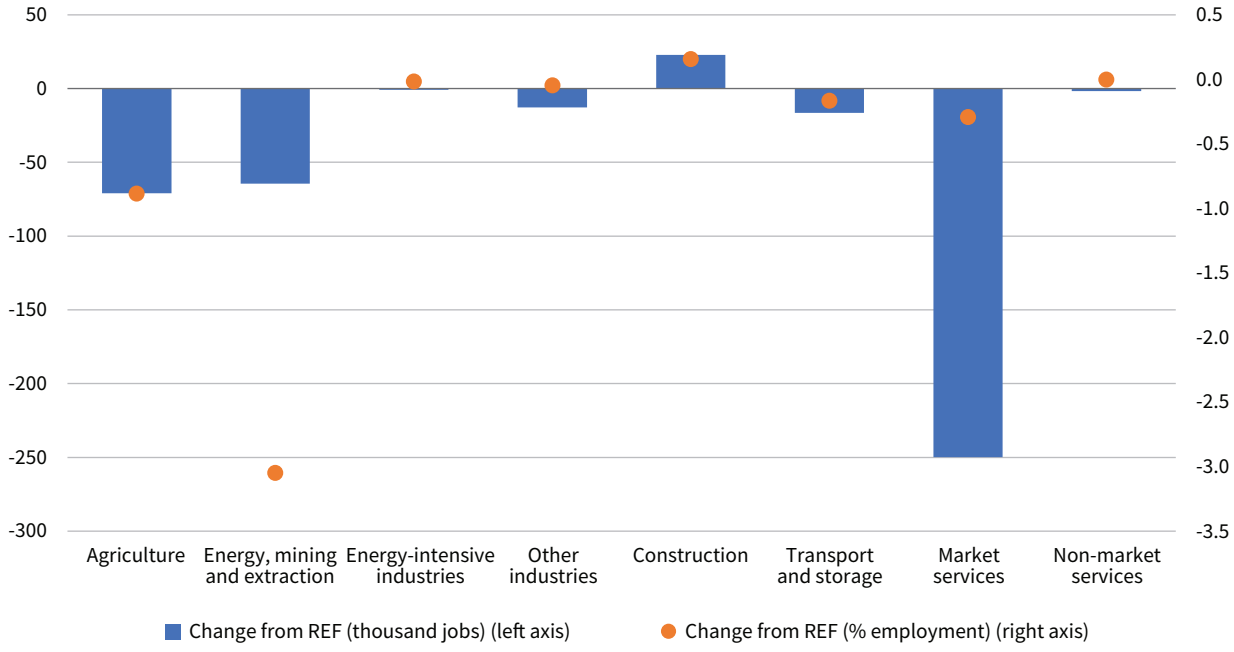
Employment in market services is reduced by 250,000 jobs compared with REF (Figure 14). This is driven by the overall economy-induced effects of lower demand for exports and investments, and by lower household consumption of market services as disposable income is reduced. Construction is the only sector that records a slight positive employment impact: 23,000 additional jobs compared with REF.

Figure 13: Impact of FIT55_Crowd on EU GDP and employment, 2030



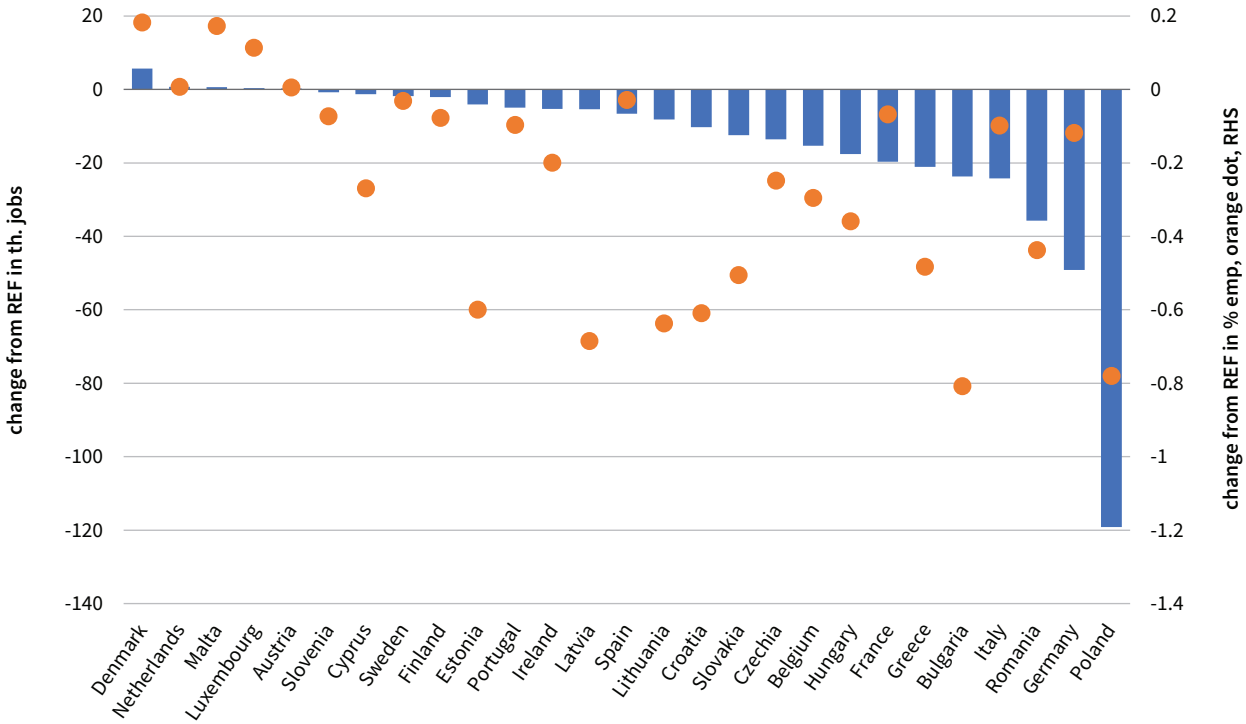
Source: *Fragkiadakis et al (2022)*

Figure 14: Impact of FIT55_Crowd on sectoral employment, 2030



Source: *Fragkiadakis et al (2022)*

Figure 15: Impact of FIT55_Crowd on employment by country, 2030



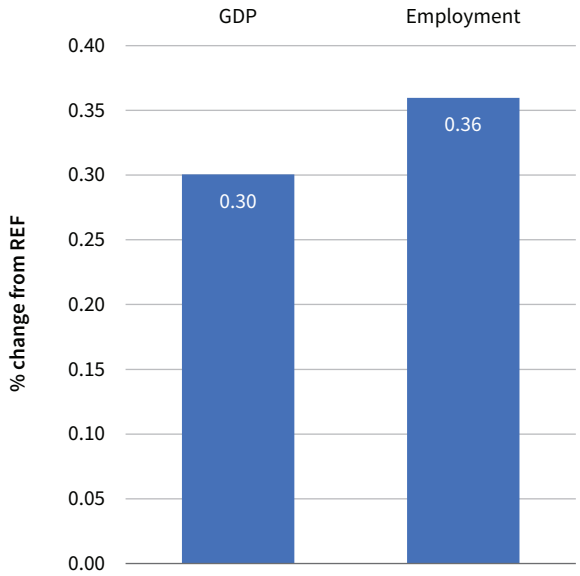
Source: *Fragkiadakis et al (2022)*

At national level, nearly all countries are subject to job losses due to increased energy and capital costs compared with REF (Figure 15). The additional green investments required crowd out other investments, with negative macroeconomic impacts. The effects on employment are determined by the loss of jobs in the energy sector and the lower export demand due to higher unit costs of production compared with REF. Poland has job losses in the coal mining sector, while Germany has job losses in the transport equipment and other manufacturing sectors. The significant decline in Polish employment is associated with the mitigation effort required by the country when implementing the Fit for 55 policy. While in other EU Member States a coal phase-out is already assumed in REF, in Poland coal power supply is still significant in 2030.

FIT55_SocSec results

In this second variant scenario, the assumption is that carbon tax revenues are directed not only towards the reduction of VAT (as in the central FIT55 scenario) but also towards the reduction of social security contributions paid by employers (or payroll taxes). The assumption is that half of the revenues are allocated to VAT reduction and half to social security contributions. Lower labour costs reduce the overall production costs of domestic industries and improve competitiveness, thus leading to positive macroeconomic outcomes (Figure 16), beyond those indicated in the central FIT55 scenario.

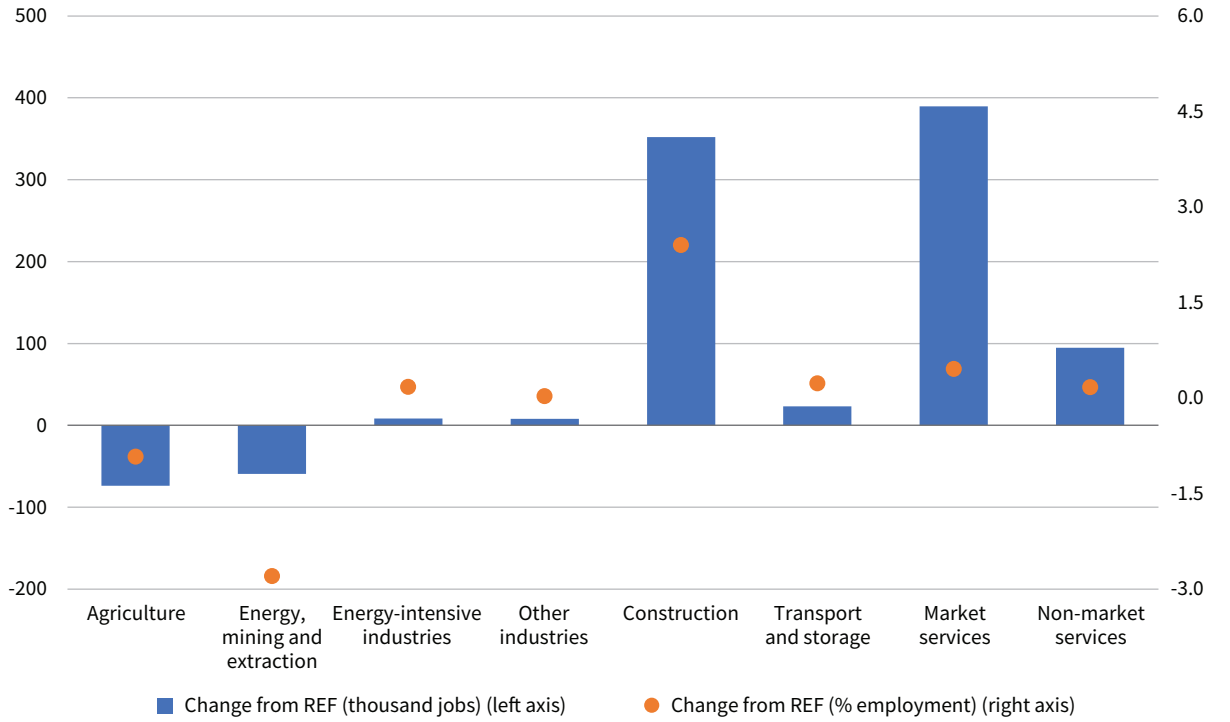
Figure 16: Impact of FIT55_SocSec on EU GDP and employment, 2030



Source: *Fragkiadakis et al (2022)*

Employment in market services increases by 390,000 jobs compared with REF (Figure 17). This is mainly driven by higher household consumption for market services as disposable income increases. Construction and all industries benefit from positive employment impacts compared with FIT55. Total employment increases by 743,000 additional jobs compared with REF.

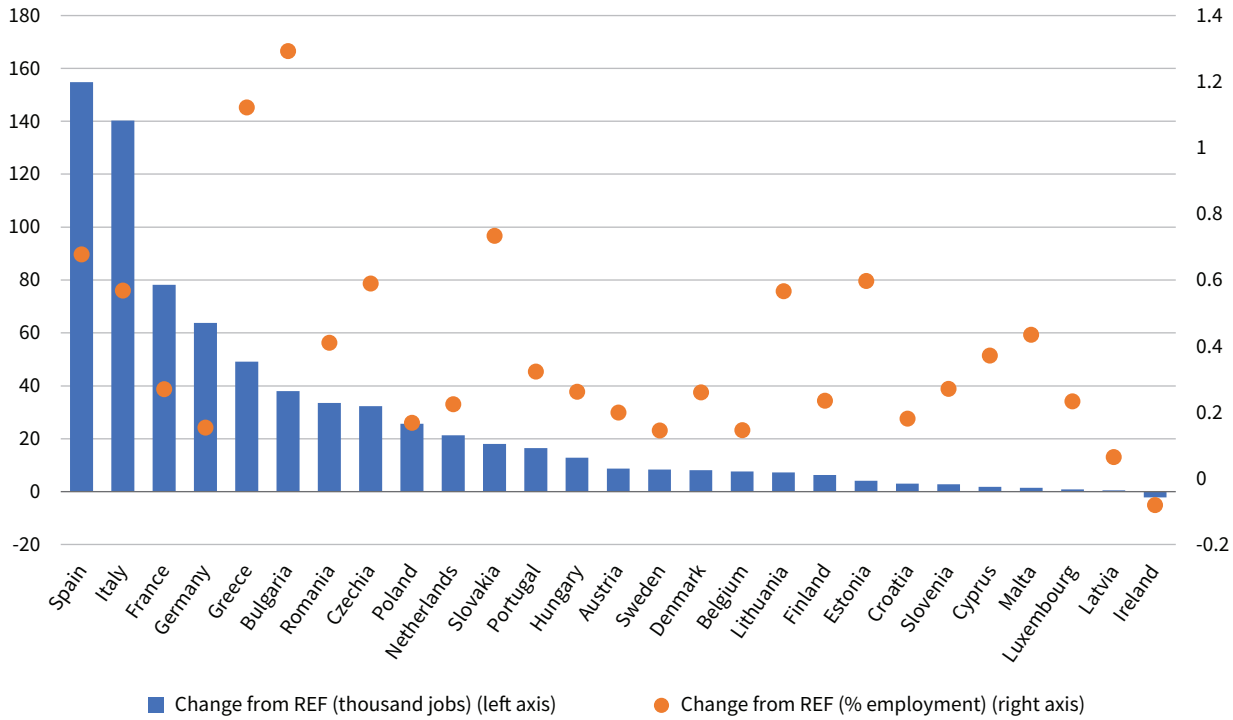
Figure 17: Impact of FIT55_SocSec on sectoral employment, 2030



Source: *Fragkiadakis et al (2022)*

At national level, the reallocation of half of the carbon tax revenues from VAT to employers' social security contributions reduction increases the competitiveness of domestic industries, with benefits for employment levels in all countries except Ireland compared with FIT55 (Figure 18).

Figure 18: Impact of FIT55_SocSec on employment by country, 2030



Source: *Fragkiadakis et al (2022)*

Key takeaways on the employment projections

- The employment projections based on the GEM-E3-FIT-FIT macroeconomic model foresee only modest deviations from a baseline reference scenario in 2030 arising from the implementation of policies to meet the EU's more ambitious Fit for 55 climate targets.
- There are modest positive gains in output and employment in both the main FIT55 policy scenario and a scenario envisaging carbon tax revenues being partly recycled to reduce employer labour costs.
- There are modest negative impacts where the greening investment required for Fit for 55 requires investment to be diverted from other sectors.
- In both the FIT55 and REF scenarios, the employment impacts fall unevenly across countries/regions as well as occupations and sectors.
- Southern European countries in particular benefit from greening investments due to their high renewable capability, while some central and eastern European regions, notably those with a high share of mining/extractive or agricultural employment, are projected to shed employment regardless of the scenario modelled. These are also the sectors that are projected to suffer employment losses more generally, though in most territories gains in construction and market services will compensate for these losses.

3 Jobs approach analysis of projected employment impacts

The employment projections in the previous chapter indicate how the employment structure may change by 2030 in line with the impacts of economic change more generally and with a focus on the specific impacts of Fit for 55 policies. In this chapter, we explore how the employment shifts envisaged are distributed across the job–wage spectrum, using an established empirical methodology developed in Eurofound's European Jobs Monitor project. The questions we are attempting to answer can be summarised as follows. Is the employment growth/decline foreseen in well-paid, medium or lower-paid jobs and what will be the aggregate impact on the employment structure? How do the Fit for 55 policy impacts modelled differ from a business-as-usual or reference scenario (incorporating prior EU climate policy commitments, for example those arising from the Paris Agreement)?

European Jobs Monitor 'jobs approach'

The Eurofound Jobs Monitor 'jobs approach' breaks down net employment shifts over time by 'job', where a job is defined as a given occupation in a given sector, for example a health professional in the health sector or a sales assistant in the retail sector (Eurofound, 2023b). Such a definition of a job has many advantages. It is intuitive and corresponds to what people would consider when describing their job, or to how an employer advertises a new job opening. It also maps to the horizontal and vertical divisions of paid labour in our societies, where sectors describe the range of productive activities in which firms and organisations engage across our economies, and occupations describe the implicitly hierarchical assignment of tasks and responsibilities within companies and organisations. And it takes advantage of the existence of occupational and sectoral classifications (ISCO-08, NACE Rev. 2.0) that are commonly applied in labour force surveys and comparable across countries.

The jobs-based approach requires not only the definition of a job in a conceptually coherent and empirically practical way but also some means of evaluating these jobs in relation to their quality. The analysis that follows relies mainly on a wage-based measure to rank jobs and to assign them to job–wage quintiles. Basic details of the methodological approach are set out below.

Methodological note on the jobs-based approach

The main steps of the jobs-based approach, simplified, are as follows.

1. Using the standard international classifications of occupations (ISCO-08) at two-digit level and sector (NACE Rev. 2.0) at one-digit level, a matrix of jobs is created in each country. Each job is an occupation in a sector. In total, there are 43 two-digit occupations and 21 one-digit sectors, which generates 903 job cells. In practice, many of the theoretical job cells do not contain employment; there are unlikely to be many skilled agricultural workers in financial services, for example. The country total of job cells with employment varies between around 400 and just over 800 and is largely determined by country size and EU-LFS sample size. The bigger the workforce, the greater the variety of possible job combinations that can be identified using EU-LFS data.
2. The jobs in each country are ranked based on the mean hourly wage. The job–wage rankings for each country used in this report are based on combining data from the EU-LFS annual data files for 2017–2019 and aggregated data from the Structure of Earnings Survey for 2018. These sources allowed the creation of country job–wage rankings for 27 Member States.
3. Jobs were allocated to quintiles in each country based on the job–wage ranking for that country. The best-paid jobs are assigned to quintile 5, and the lowest-paid to quintile 1. Each quintile in each country should represent as close as possible to 20% of employment in the starting period (jobs are assigned to quintiles based on their employment weights). Hereafter, the job-to-quintile allocations remain fixed for each country so that, in all of the charts that follow, a given quintile in a given country (however disaggregated) always refers to employment data in a specific group of jobs exclusive to that quintile. For presentation purposes, the focus is then shifted to the change in the stock of employment at quintile level projected for a given period in each country, for example, 2019–2030.

Net employment change between starting and concluding periods (in persons employed) for each quintile in each country is added up to establish whether net job growth is concentrated in the top, middle or bottom of the employment structure. The EU aggregate charts are based on applying a common EU job–wage ranking (based on the weighted average of the standardised national job–wage rankings). The resulting quintile charts (see Figure 19 below) give a simple, graphical representation of the extent of employment change in a given period, as well as an indication of how that change is distributed across jobs of different pay. Figures should be read from the leftmost bar cluster (quintile 1, representing the lowest-paid jobs) to the rightmost cluster (quintile 5, representing highest-paid jobs). Net employment change is represented on the vertical axis.

Jobs approach results

The main aggregate projections from the GEM-E3-FIT modelling exercise detailed in the previous chapter are for employment in the EU to expand by 6.7 million in REF by 2030 compared with 2019 and for modestly greater growth taking into account the additional impact of the indicated Fit for 55 policies (an additional 0.2 million jobs) in the central FIT55 policy scenario. As the projected employment shifts are broken down by detailed sector and occupation, we can identify how these gains are distributed across the job–wage distribution.[7]

For the EU as a whole, in REF, employment growth is skewed to the higher quintiles (over 1.5 million net new jobs in each) but with robust growth (1 million to 1.2 million) in the bottom three quintiles as well. This is an upgrading pattern but less markedly upgrading than that observed in the EU in the preceding period (2011–2019, see Figure 19), when much of the greatest share of net new employment occurred in the top quintile. Aggregate employment growth is also projected, in both REF and FIT55, to be slower than in 2011–2019 (average 0.8% per annum up to 2019, compared with 0.3% per annum 2019–2030 in FIT55).

In FIT55, most of the additional employment projections are in medium-paid, and especially in low-medium-paid, jobs (quintile 2). There are only very small additional gains recorded in higher-paid jobs and in the lowest quintile. In later breakdowns, it becomes clear that the construction sector in particular accounts for much of this additional growth.

Figure 19: Recent employment shifts by job wage quintile compared with projected shifts, 2019–2030 (millions)

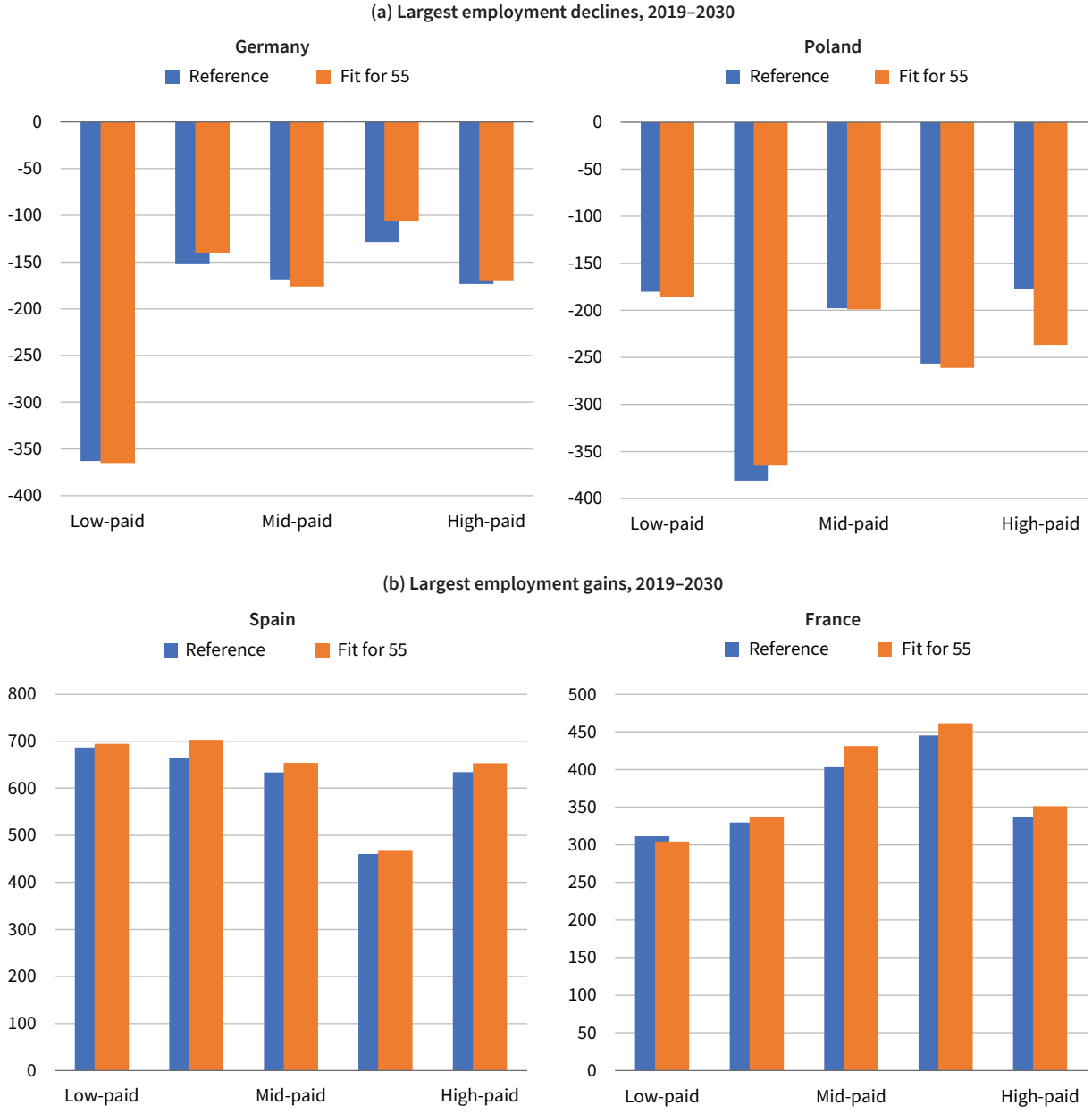
Sources: *Fragkiadakis et al (2022) and authors' elaboration based on European Jobs Monitor*

7 This assumes that national/EU job–wage rankings based mainly on 2018 earnings data (Structure of Earnings Survey) apply consistently over the period covered. In practice, one finding of the European Jobs Monitor analysis is that job or occupational wage rankings are quite stable over time.

Results by country and region

As already indicated, around the marginal employment increases projected at EU aggregate there is some variation across countries, with some faring better and some worse over 2019–2030. In total, seven countries were projected to have contracting headcount over the period in REF, mainly central and eastern European Member States, based on unfavourable demographic trends of low birth rates and emigration. The majority of countries, however, are projected to have employment growth. Smaller, less populous Member States (Malta, Luxembourg, Cyprus, Ireland) should experience relatively faster growth. It is in the larger, more populous Member States, however, that the largest headcount shifts are observed. In Figure 20, we compare the REF and FIT55 scenario predictions for the countries with the largest absolute projected gains and losses of employment over the period (see the annex for results for all EU Member States).

Figure 20: Country employment projections with (a) largest projected employment declines and (b) largest projected employment gains, FIT55 versus REF, 2019–2030 (thousand jobs)



Sources: *Fragkiadakis et al (2022) and authors' elaboration*

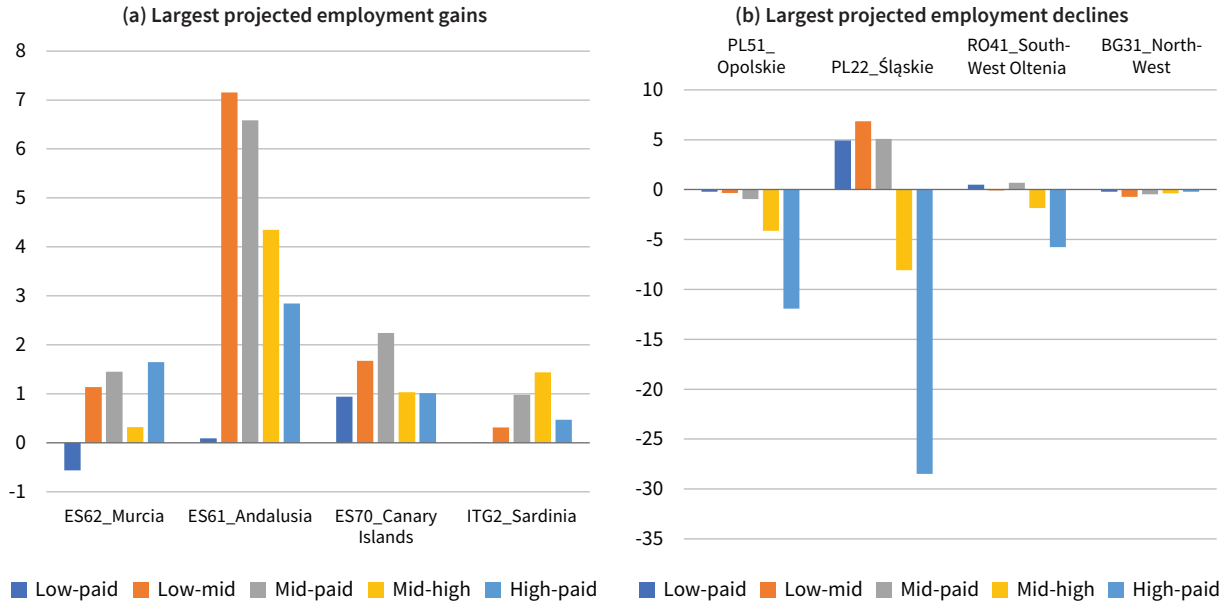
Employment in Germany and Poland is projected to contract by around 1 million and 1.2 million respectively in REF. While employment declines are across all quintiles, the sharpest declines are in low-paid jobs in Germany and in low-medium-paid jobs in Poland. In both countries, the occupational categories most affected are sales assistants and drivers/mobile plant operators. By sector, in Poland mining is the sector relatively most affected, shedding 48% of its 2019 employment levels (-103,000 jobs), but in absolute terms the biggest losses are projected in retail and manufacturing, where together employment will decline by nearly a million. In Germany, manufacturing and transport, and storage are the two sectors in which the largest employment losses are projected (just over 300,000 in each sector).

For France and Spain, projected employment gains in REF between 2019 and 2030 are 1.8 million and 3.1 million respectively. In France, projected growth is strongest in the middle and medium-high quintiles, with the largest headcount increases foreseen among teaching professionals and business, and administration associate professional occupations. Public services – health, education and public administration – in particular are projected to benefit from additional employment (in the range of 200,000–300,000 new jobs each), as well as the construction sector (+249,000). In Spain, the growth is more evenly spread but with a skew towards lower-paid jobs. This is explained by high projected growth in the following occupations in particular: cleaners/helpers, personal services workers and sales assistants. The sectors in Spain benefiting from employment growth are retail and accommodation, and food services (over 400,000 net new jobs each).

As with the EU projections, the additional impact of the Fit for 55 policies over and above the projected employment changes in REF is relatively modest in all Member States. Spain is projected to gain an extra 92,000 jobs, and France around 60,000. In Germany, Fit for 55 is associated with some small positive employment gains (30,000 net new jobs, mainly in the construction and utilities sectors), while in Poland that scenario foresees the destruction of 55,000 jobs. Mining alone accounts for 75,000 additional job losses in FIT55 in Poland, reflecting the continuing large share of employment in the sector and its exposure to the effects of climate policy. Unlike other countries, Fit for 55's negative impacts on employment in Poland are projected to be in the top job wage quintile. This is because many of the blue-collar occupations in the mining sector in Poland that are projected to shed employment (for example, plant and machine operators, some trades workers) are relatively well paid and located in the top job–wage quintile in this country.

The impacts of Fit for 55 are projected to be stronger in certain regions, based mainly on their sectoral employment composition. Figure 21 captures the difference between REF and FIT55 projections for 2030 for the four regions with the largest projected declines in employment and the four with the largest gains.

Figure 21: Regions with (a) largest projected employment gains and (b) largest projected employment declines, FIT55 versus REF, 2030 (thousand jobs)



Sources: *Fragkiadakis et al (2022) and authors' elaboration based on European Jobs Monitor*

As previously indicated, the projected impacts are relatively greater in the declining regions (in the range of -0.8% to -1.5% for the Romanian and Polish regions featured in the left-hand panel) than in the regions with gains (in the range of +0.5% to +0.7% for the Italian and Spanish regions in the right-hand panel).

For three of the declining regions (Opolskie and Śląskie in Poland, and South-West Oltenia in Romania), the projected employment shifts are clearly downgrading, with most of the losses concentrated in well-paid, top quintile jobs. As already indicated for Poland at national level, the main locus of these job losses in both the Polish and Romanian regions is blue-collar jobs in the mining and extractive sector. The pattern of projected job loss in North-West Bulgaria is one of polarisation, with medium-paid jobs in manufacturing most affected.

For three of the regions where Fit for 55 policies are projected to generate most new employment (Andalusia and the Canary Islands in Spain, Sardinia in Italy), this growth is projected to be mainly in medium-paid jobs, with the construction sector in particular contributing to this growth. In Murcia (Spain), the pattern of growth is somewhat more upgrading.

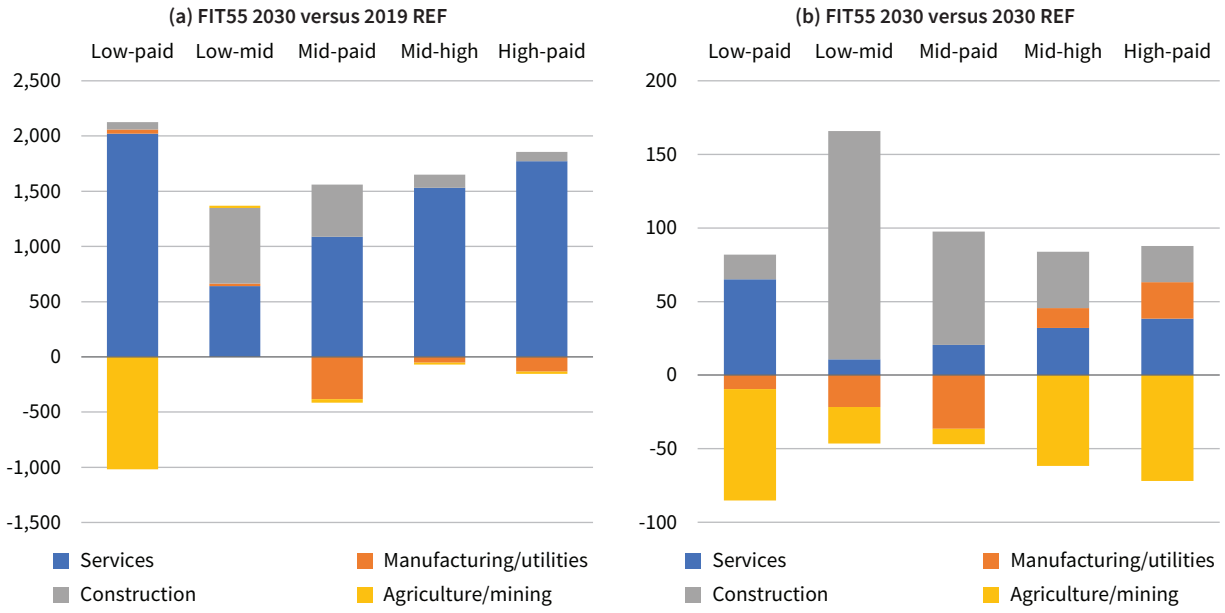
Results by sector

The importance of the construction sector is evident in the sectoral breakdowns below (Figure 22). These show the overall growth projected in 2019–2030 in FIT55 (left) and the differences between the reference scenario projected for 2030 and these projections updated to take account of the Fit for 55 policy implementation (right).

At aggregate EU level, most growth in employment is foreseen in the services sectors, a continuation of the long-standing services shift. Services in particular account for nearly all projected employment growth from 2019 to 2030 in the top and bottom quintiles, in the lowest- and highest-paid jobs. However, construction contributes disproportionately to overall employment growth. With an estimated 8% of total employment in 2030, it will contribute nonetheless to over a fifth of foreseen employment increases. This growth is concentrated in particular in medium- and low-medium-paid jobs. It tends to flatten what would otherwise be a more polarised pattern of growth. Employment in the other broad sectors – manufacturing and utilities, and agriculture and mining – is projected to contract; in agriculture and mining, this contraction will be mainly in low-paid employment (primarily agricultural work), while in manufacturing the contraction will affect relatively high-paid jobs.

The employment shifts that are more specifically attributable to Fit for 55 (right-hand panel) are much more modest in size but are skewed heavily towards construction sector gains. There will be some employment gains across the quintiles in the services sectors (with a polarised distribution) arising from Fit for 55. The negative impacts of Fit for 55 are projected to occur

Figure 22: Projected employment shifts by job–wage quintile in FIT55 2030 compared with (a) 2019 REF and (b) 2030 REF, EU, 2019–2030 (thousand jobs)



Sources: *Fragkiadakis et al (2022) and authors' elaboration*

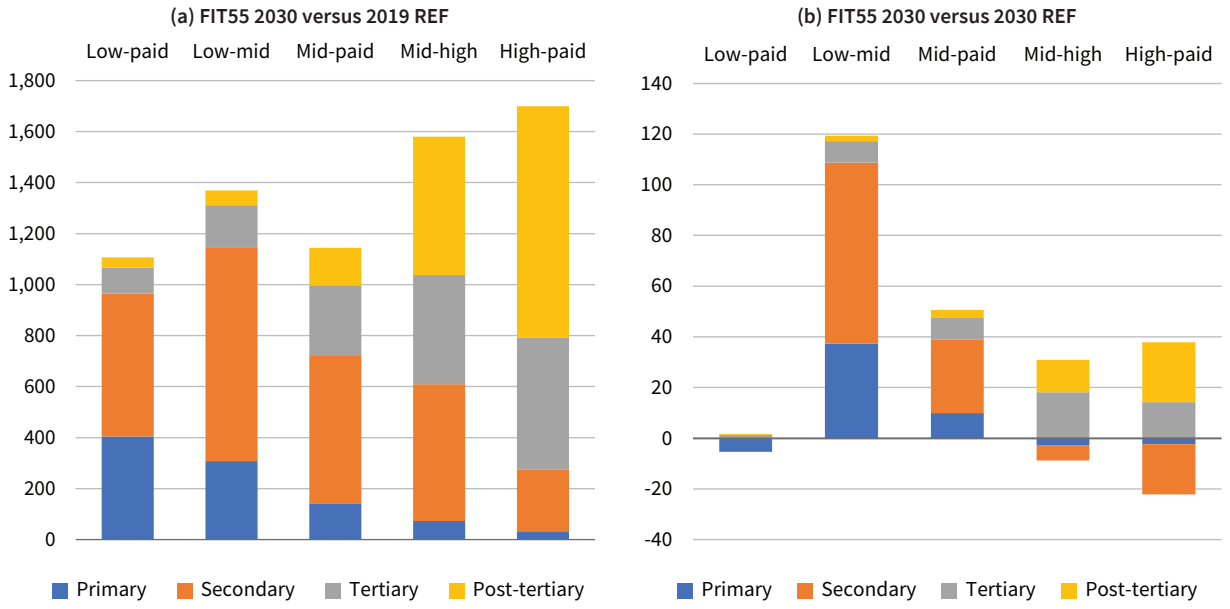
principally in the agriculture, and mining and extractive sectors (mainly low-paid agricultural jobs and higher-paid mining/extractive jobs). Fit for 55 is also projected to induce some upgrading of manufacturing sector employment, with a decline in medium-paid, mainly blue-collar production jobs, but some compensatory growth in well-paid jobs (mainly among business administrators and engineering professionals).

Results by qualification level and gender

What might such sectoral changes imply for the demand for workers of different qualification and skill levels? Figure 23 (right-hand panel) shows that the main additional impact of Fit for 55 is likely to be a boost to employment in jobs in which workers tend to have no more than secondary-level qualifications.[8] Employment shifts over 2019–2030 (left-hand panel) are more evenly distributed between those with and without tertiary qualifications, but, take together, those with tertiary, and especially post-tertiary, qualifications account for over three-quarters of projected growth in the EU in the top two job–wage quintiles.

Female workers account for around two-thirds of all net new employment in the EU in the last 20 years (Eurofound and JRC, 2021), narrowing pre-existing gender employment gaps. This trend is likely to continue, according to the 2030 employment projections, in which female employment accounts for 4.3 million of the 6.9 million overall increase (63%). Female employment growth will be polarised, increasing in particular in the bottom and top quintiles. Sectors accounting for much of this growth include food and beverages (low paid) and predominantly state-paid professional jobs in education, health and public administration (higher paid). Male employment growth is also strong in the main public services sectors and in construction over 2019–2030.

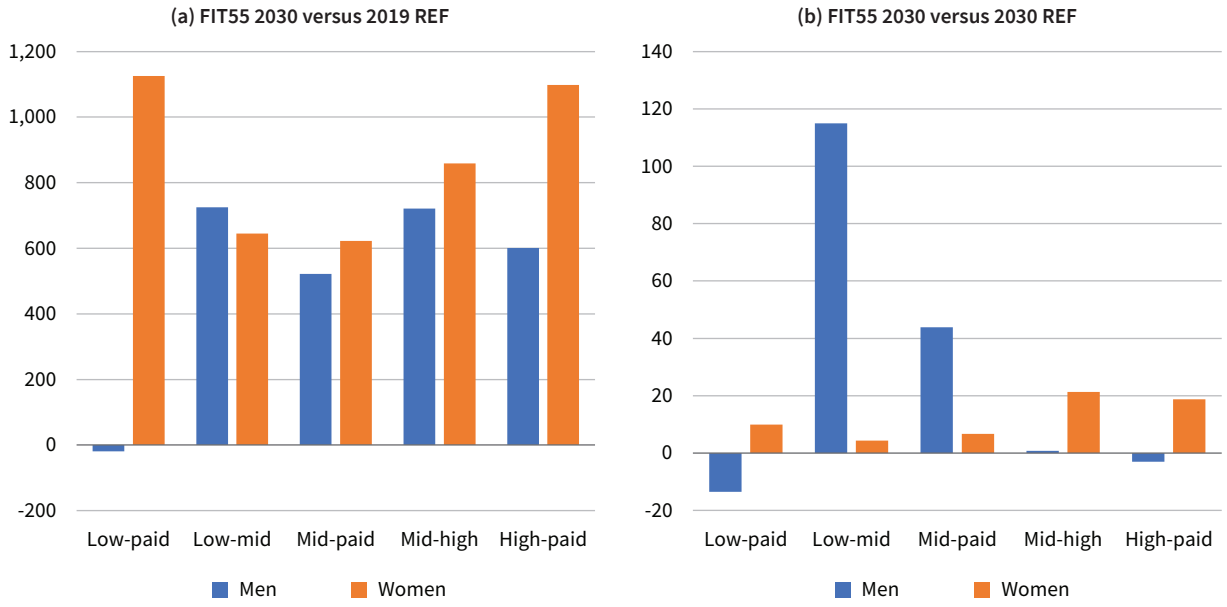
Figure 23: Projected employment shifts by qualification and job–wage quintile in FIT55 2030 compared with (a) 2019 REF and (b) 2030 REF, EU, 2019–2030 (thousand jobs)



Sources: *Fragkiadakis et al (2022) and authors' elaboration*

8 Education levels are not included as a separate variable in the E3M model. These estimates are therefore extrapolations based on the assumption that the 2019 sectoral employment composition by education level is held constant to 2030. The same applies to the gender breakdowns in the following figure.

Figure 24: Projected employment shifts by sex and job–wage quintile in FIT55 2030 compared with (a) 2019 REF and (b) 2030 REF, EU, 2019–2030 (thousand jobs)



Sources: *Fragkiadakis et al (2022) and authors' elaboration*

The employment shifts by gender that are more specifically attributable to Fit for 55 (right-hand panel in Figure 24) are, however, quite different. The Fit for 55 boost to the heavily male-dominated construction sector is evident in the outsized contribution of low-medium- and medium-paid male jobs to overall employment growth. So, while women account for nearly two-thirds of projected employment growth over the decade to 2030, Fit for 55 policies are seen as mainly benefiting male-dominated jobs.

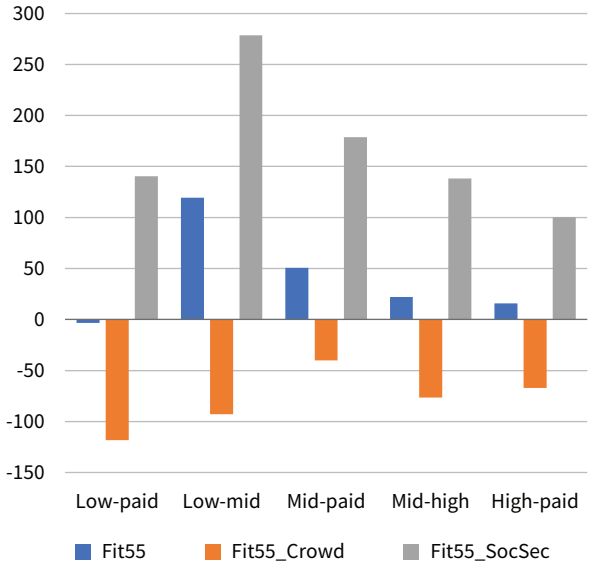
Alternative policy scenarios

As mentioned, two variants of the main FIT55 scenario were included in the 2030 projection exercise. Each of the scenarios includes in the model the core policies of the Fit for 55 package, but they differ in relation to (i) the mode of financing climate investments (by loans or by crowding out of other investments in other sectors) (FIT55_Crowd) and (ii) the extent of recycling of revenues generated from the Emissions Trading System (FIT55_SocSec).

Where the investment flows required to implement Fit for 55 are required to be generated endogenously, displacing investment that would otherwise have occurred in other sectors (FIT55_Crowd), these more restrictive assumptions lead to aggregate projected employment impacts that are modestly negative. Employment would decline by about 400,000 in the EU in 2030 compared with the reference estimates.

On the other hand, the recycling of ETS revenues to reduce VAT as well as employer social security contributions (FIT55_SocSec) generates additional employment compared with the central policy scenario (FIT55). The earmarking of revenue to reduce taxes on both the employer and worker sides boosts consumption and employment. Though modest in the context of a workforce totalling over 200 million workers, the additional 836,000 jobs projected compared with REF in 2030 is four times as great as the EU employment dividend in FIT55. Figure 25 compares the employment shifts across the three different scenarios.

Figure 25: Deviations from the 2030 REF projections – employment shifts by job–wage quintile (EU) in the FIT55 and variant scenarios (thousand jobs)



Sources: *Fragkiadakis et al (2022) and authors' elaboration*

In FIT55_Crowd, the negative employment effects are skewed to the lower quintiles, with lower household consumption in particular having an impact on employment in low-paid service jobs. In FIT55_SocSec, the more positive employment effects follow a similar pattern to that in FIT55, with gains greatest in low-medium- and medium-paid jobs. The main broad sectors to benefit from increased labour demand are construction and low-paid private sector services.

Key takeaways on employment impacts

- Most projections of employment impacts of decarbonisation policies in the EU are of very modest net gains, but rarely much more than 0.5% compared with baseline. The projections from the GEM-E3-FIT model are consistent with the range of related earlier estimates.
- Two of the three scenarios for 2030 envisage small positive employment outcomes resulting from Fit for 55 policies, while the third envisages only marginal employment and output losses.
- Employment in countries of southern Europe (Spain, Italy and France) is projected to benefit most, according to the scenarios, arising from significant investments in renewable capacity and energy efficiency, while employment in countries in central and eastern Europe is more likely to contract, given their larger mining and extractive sectors and higher GHG intensity of production.
- While employment shifts overall are projected to improve aggregate job quality by 2030, extending trends observed over the last decade, the small boost to employment projections for Fit for 55 tends to occur in medium- and low-medium-paid jobs that do not require tertiary qualifications. This is a distinctive pattern compared with recent employment growth, which has been strongly concentrated in well-paid jobs.
- As much of the additional job growth projections occur in the construction sector, male-dominated employment is especially boosted by Fit for 55, although this is in a context of greater overall female employment growth in the reference scenario.

4 Conclusions

The European Union aims to become climate neutral with net zero GHG emissions by 2050, with an intermediate step in 2030 to achieve a 55% reduction in GHG emissions, as foreseen in the Fit for 55 policy package of the European Commission. This low-carbon transition requires timely and coordinated action by all actors and economic sectors and is bound to bring about a restructuring of the EU economy. The implications will expand beyond the energy system, to the wider macroeconomy and society. Key socioeconomic implications include the impacts on employment, which are the focus of this study. The quantification of the employment effects of the main Fit for 55 policies was performed with the use of the GEM-E3-FIT large-scale hybrid computable general equilibrium model, and involved a number of technological, macroeconomic and behavioural assumptions.

Overall, we find that at EU level the socioeconomic implications of Fit for 55 policies are not expected to be large in 2030, particularly since substantial decarbonisation effort is already incorporated in the reference scenario under currently existing policies. The overall impact on employment is small, as opposing forces play out in the process of adjusting energy-economic systems, partially cancelling each other out. At EU level, 204,000 jobs are created, mostly in the construction and market services sectors. Potentially greater gains in both output and employment may arise in a context of dedicated climate-related fiscal policies, in particular with regard to the recycling of carbon revenues. On the other hand, the source of finance for the large capital investment required by greening is crucial; if funds are available without the need to crowd out existing investment plans, the macroeconomic implications are positive. Where the financing of greening investments is not based on loans, both output and employment are projected to decline, albeit marginally.

Our results indicate that GDP and employment impacts are not uniform across EU Member States. Those that are suppliers of equipment and services needed for the clean energy transition benefit, whereas those that are based on fossil fuel production and consumption are negatively affected. Carbon-intensive sectors face larger challenges and competitiveness implications, while new emerging sectors provide economic opportunities and potential job creation. Some countries in southern Europe, such as Spain, Italy and France, benefit more, as they have a low and declining reliance on fossil fuels or carbon-intensive economic activities. Most of the benefiting countries have also already engaged in significant energy efficiency investments, which are labour intensive and characterised by small segments of the value chain being imported. In general, energy efficiency measures tend to be labour intensive with high domestic content, and will create jobs. In addition, the positive impact from energy efficiency investments is further boosted, for instance in Spain and Germany, from the domestic production of renewable energy capacity and of other low-carbon appliances and equipment. The deployment of renewable energy sources leads to job creation during the installation phase, but the largest benefits are reserved for countries that manufacture the related equipment such as wind turbines and photovoltaic panels. From both energy efficiency and renewable energy source deployment, the main beneficiary is the construction sector.

In this study, we examine two alternative ways of recycling carbon revenues from the ETS back to the economy: one is reducing VAT, and the other is reducing employers' social security contributions. Double dividends can emerge if we take into account the impacts of revenue recycling schemes, as on one hand they achieve the climate target and on the other hand they reduce distortionary taxation. We find a significant effect on employment results of the choice of how to recycle revenues from the ETS. Using them to reduce labour costs (for example, reducing employers' social security contributions) benefits most labour-intensive sectors, notably market services. An additional finding relates to the implementation of the Carbon Border Adjustment Mechanism, which acts in favour of energy-intensive sectors by protecting their competitiveness in the EU domestic market but increases the production costs for sectors that use these energy-intensive products as intermediate inputs.

It is important to note that the projections in this report do not capture the full effects of the policies examined. In the first place, only a core selection of Fit for 55 policies are included in the modelling. Also, climate policy is evolving rapidly, and additional greening policies have been introduced both as a direct result of the war in Ukraine (REPowerEU) and as a result of reassessments of geopolitical risks in part prompted by the war (for example, the EU's proposed Net-Zero Industry Act). Moreover, the models can estimate only the short-term expenditure and costs of, for example, renewable energy investments, and the employment/output impacts over the short to medium term up to 2030. The longer-term benefits of cleaner, cheaper energy and reduced reliance on external sources of supply remain outside the scope of the study but will make a

continuing contribution to the EU's societal and economic resilience as well as its climate objectives beyond 2030.

Key findings

- Most projections of employment impacts of decarbonisation policies in the EU show very modest net gains, rarely much more than 0.5% compared with the baseline REF scenario.
- According to our estimates based on the GEM-E3-FIT macroeconomic model, the employment impacts of the main Fit for 55 policies are likely to be marginally positive at EU aggregate level in the main model specification. A net 204,000 jobs are projected to be created in the EU Member States as a result of the Fit for 55 package, in addition to the baseline employment growth of 6.7 million net new jobs between 2019 and 2030.
- The employment effects vary across regions and countries based on their reliance on carbon-intensive industries on the one hand and their capacity to take advantage of greening opportunities on the other. Negative employment effects are more likely in some central and eastern European countries (for example, Poland and Romania) and regions with relatively high shares of workers still working in extractive industries; positive employment effects are projected in southern European countries (in particular, Spain and Italy) and regions with natural endowments (wind and sun), developing energy efficiency infrastructure and capacity to manufacture renewable energy equipment.
- With jobs in both energy efficiency improvements and renewable energy capacity development, the sector likely to benefit most in terms of employment is construction. There will also be increased employment in market services as relative prices favour a shift in the structure of the economy towards 'cleaner' sectors, reinforcing the employment shift to the services sector.
- While employment overall is projected to improve towards 2030, the small boost to employment projections resulting from Fit for 55 tends to occur in medium-low and medium wage jobs that do not require tertiary qualifications.

Policy pointers

- Even though overall employment projections for 2030 arising from Fit for 55 are mildly positive, the absolute employment impacts of Fit for 55 policies are higher in the regions negatively affected – for example, in Polish and Romanian regions with a relatively high share of employment in mining and extractive sectors – while positive employment impacts are more dispersed across regions. This supports the rationale for region-focused funding of supportive measures, such as the territorial just transition plans.
- Projected employment impacts are sensitive to the details of policy implementation. Potentially greater gains in both output and employment may arise in a context of dedicated climate-related fiscal policies where carbon revenues are recycled in order to reduce labour taxes.
- The source of finance for the large capital investment required by the green transition is also an important determinant of whether Fit for 55 will be employment-positive or -negative in practice. When funds are available without the need to crowd out existing investment plans, the macroeconomic implications are positive. However, when the financing of greening investments is not loan-based, both output and employment are projected to decline, albeit marginally.
- Policies aimed at lowering greenhouse gas emissions will have differential impacts on employment by sector and by occupation, increasing demand for some jobs and decreasing it for others. They have to work hand in hand with education, training and employment policies in order to prepare workers with the required skills and competences to contribute to the collective decarbonisation effort.

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All Eurofound publications are available at https://www.eurofound.europa.eu

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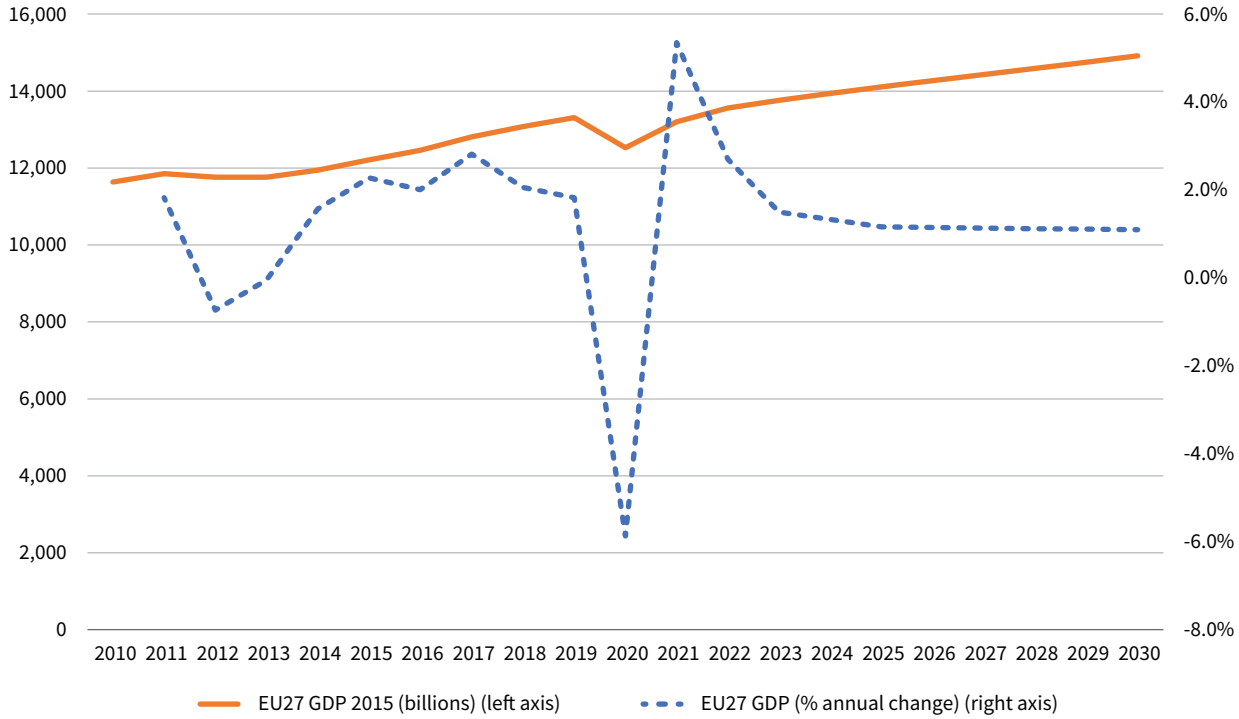
Annex

Figure A1: EU GDP projection in REF



Source: *E3-Modelling estimates based on the DG Economic and Financial Affairs' summer forecast for 2022 and 2021 ageing report for 2025 to 2030*

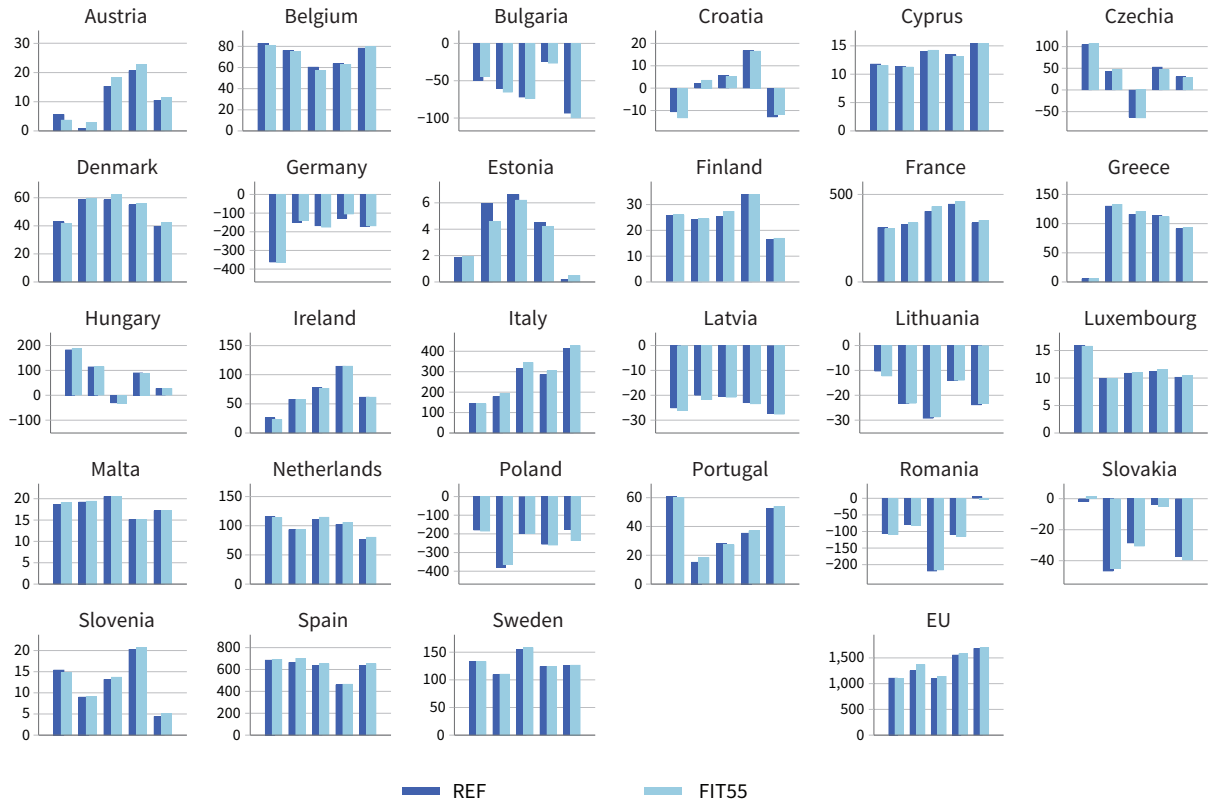
Table A1: GDP projection in REF by Member State (%)

Country	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
EU	**5.4**	**2.7**	**1.5**	**1.3**	**1.2**	**1.1**	**1.1**	**1.1**	**1.1**	**1.1**
Austria	4.6	3.7	1.5	1.4	1.3	1.3	1.2	1.2	1.2	1.2
Belgium	6.2	2.3	1.3	1.1	0.9	0.9	0.9	0.9	0.9	0.9
Bulgaria	4.2	2.8	2.3	1.8	1.3	1.3	1.2	1.2	1.2	1.2
Croatia	10.2	3.4	2.9	1.7	0.6	0.6	0.6	0.6	0.7	0.7
Cyprus	5.5	3.2	2.1	1.9	1.8	1.8	1.7	1.7	1.7	1.7
Czechia	3.5	2.3	2.0	2.0	2.1	2.0	2.0	2.0	1.9	1.9
Denmark	4.9	3.0	1.2	1.6	2.0	1.9	1.8	1.7	1.6	1.5
Estonia	8.0	1.6	1.9	2.3	2.7	2.6	2.6	2.6	2.5	2.5
Finland	3.0	1.8	1.2	1.1	0.9	1.0	1.1	1.1	1.2	1.3
France	6.8	2.4	1.4	1.1	0.9	0.9	0.9	1.0	1.0	1.0
Germany	2.6	1.4	1.3	1.1	0.9	0.8	0.8	0.8	0.7	0.7
Greece	8.3	4.0	2.4	1.4	0.4	0.5	0.5	0.6	0.7	0.7
Hungary	7.1	5.2	2.1	2.4	2.6	2.6	2.5	2.5	2.4	2.4
Ireland	13.6	5.3	4.0	3.1	2.2	2.0	1.9	1.7	1.6	1.4
Italy	6.6	2.9	0.9	0.7	0.5	0.4	0.4	0.4	0.3	0.3
Latvia	4.5	3.9	2.2	2.0	1.7	1.8	1.8	1.8	1.9	1.9
Lithuania	5.0	1.9	2.5	2.2	1.8	1.7	1.6	1.6	1.5	1.4

Country	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Luxembourg	6.9	2.6	2.1	2.1	2.2	2.1	2.0	2.0	1.9	1.8
Malta	10.3	4.9	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.9
Netherlands	4.9	3.0	1.0	0.9	0.9	0.8	0.8	0.8	0.7	0.7
Poland	5.9	5.2	1.5	2.0	2.6	2.5	2.5	2.4	2.4	2.3
Portugal	4.9	6.5	1.9	1.4	0.9	0.9	0.8	0.8	0.8	0.7
Romania	5.9	3.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.8
Slovakia	3.0	1.9	2.7	2.2	1.6	1.7	1.7	1.7	1.7	1.7
Slovenia	8.2	5.4	1.0	1.9	2.8	2.6	2.5	2.4	2.3	2.2
Spain	5.1	4.0	2.1	1.9	1.6	1.6	1.6	1.6	1.6	1.6
Sweden	5.1	1.3	0.8	1.4	1.9	2.0	2.0	2.1	2.1	2.2

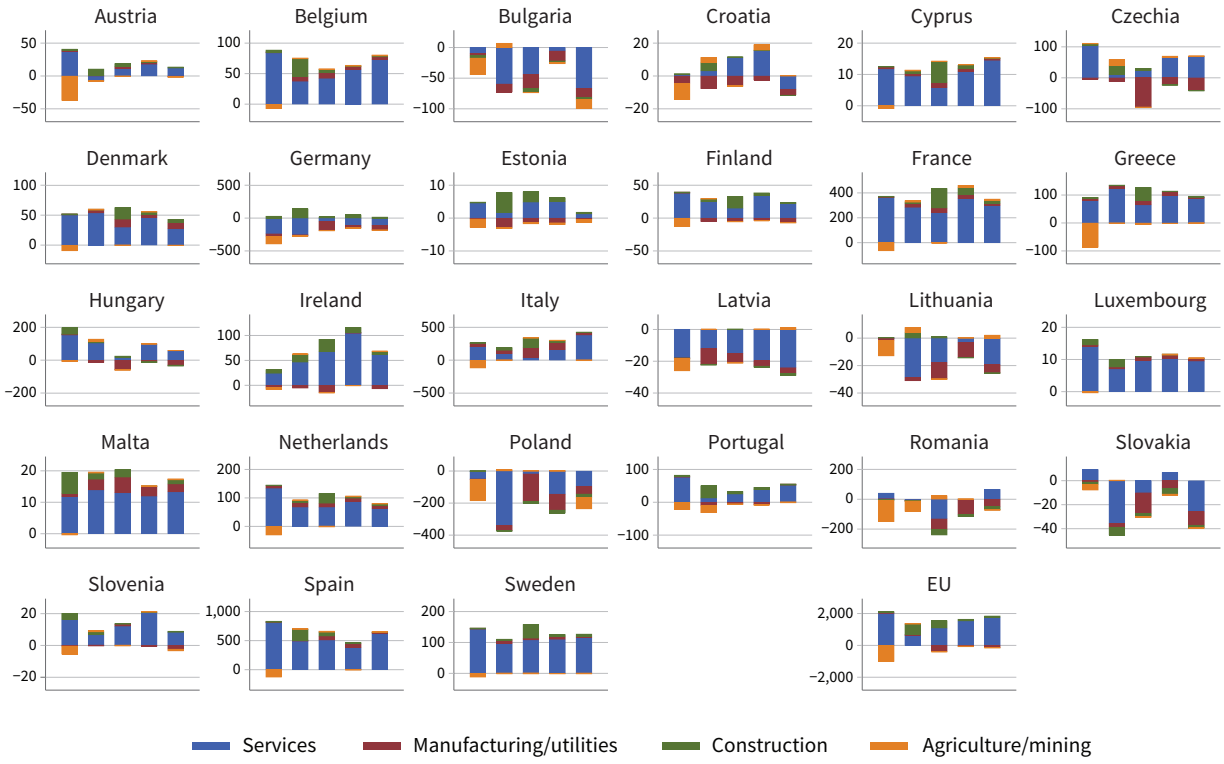
Source: *E3-Modelling estimates based on the DG Economic and Financial Affairs' summer forecast for 2022 and2021 ageing report for 2025 to 2030*

Figure A2: Employment change, by job–wage quintile, REF compared with FIT55, 2019–2030 (thousand jobs)



Source: *Authors' elaboration based on Fragkiadakis et al (2022) forecasts*

Figure A3: Employment change, by job–wage quintile and sector, REF compared with FIT55, 2019–2030 (thousand jobs)

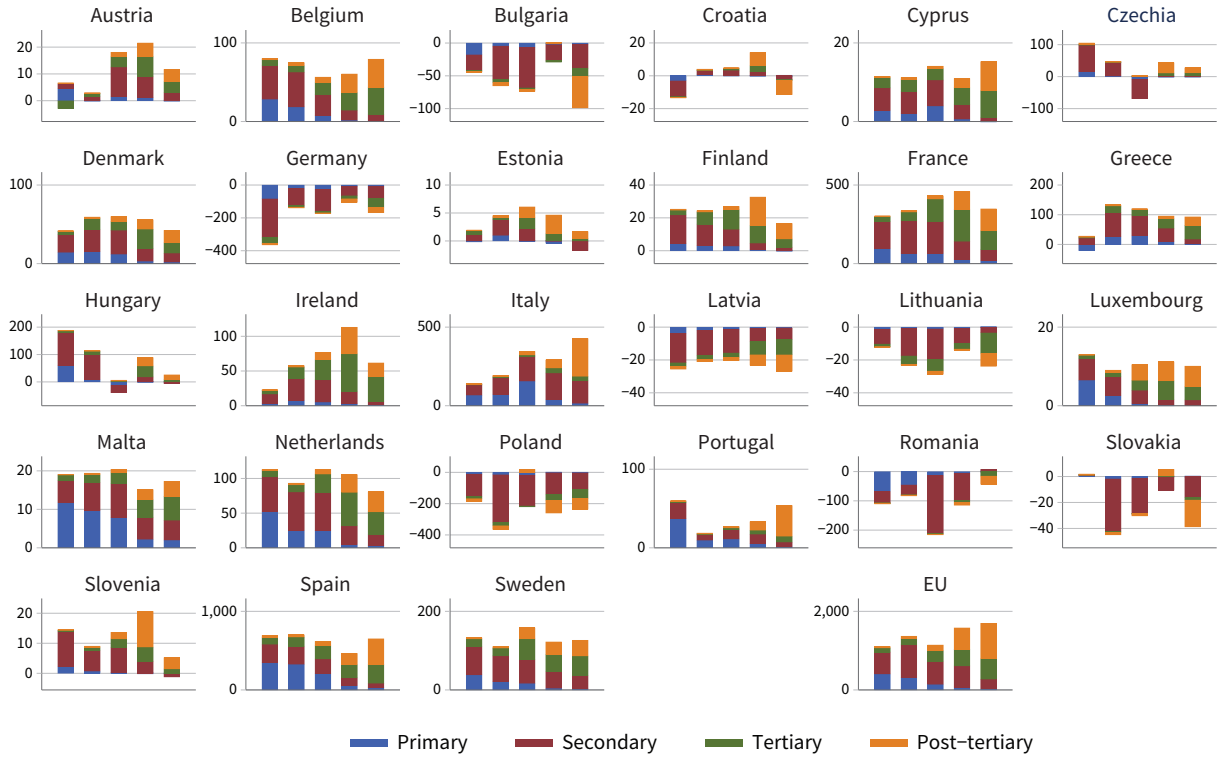


Source: *Authors' elaboration based on Fragkiadakis et al (2022) forecasts*

Figure A4: Employment differences, by job–wage quintile and sector, REF compared with FIT55, 2030 (thousand jobs)

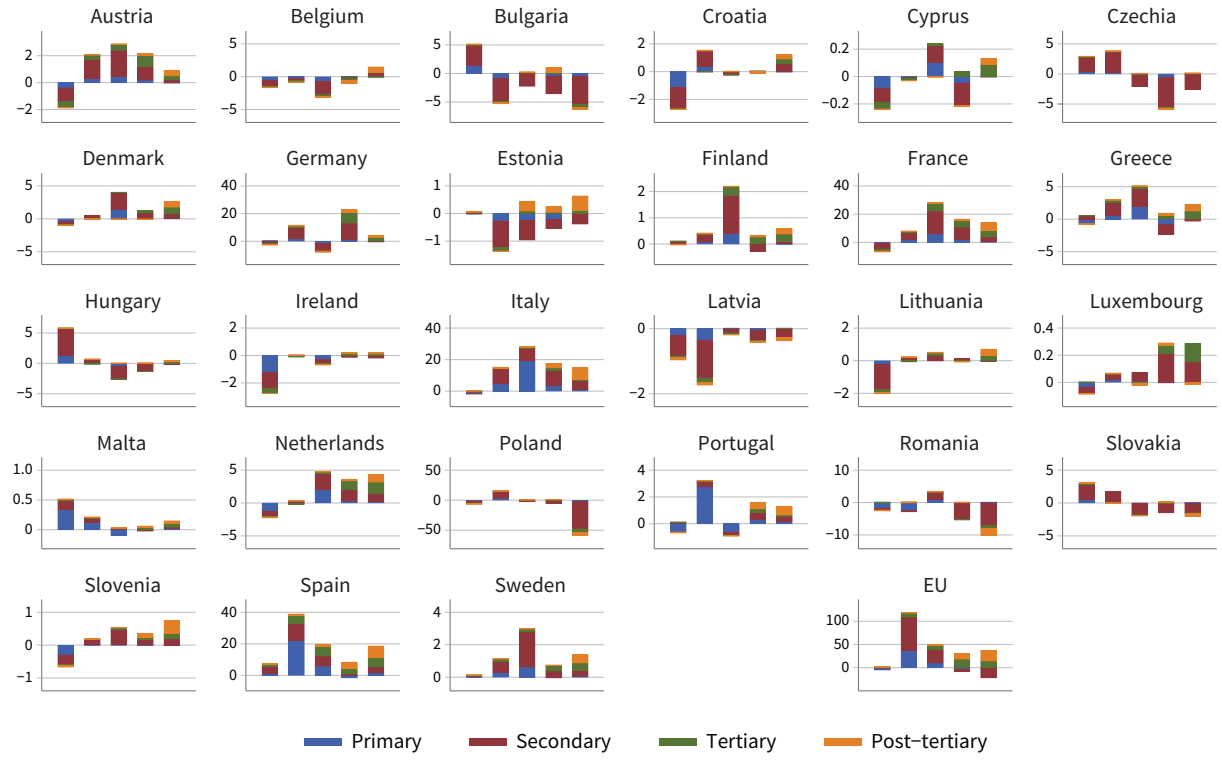
Source: *Authors' elaboration based on Fragkiadakis et al (2022) forecast*

Figure A5: Employment change, by job–wage quintile and education level, REF compared with FIT55, 2019–2030 (thousand jobs)



Source: *Authors' elaboration based on Fragkiadakis et al (2022) forecast*

Figure A6: Employment differences, by job–wage quintile and education level, REF compared with FIT55 2030 (thousand jobs)

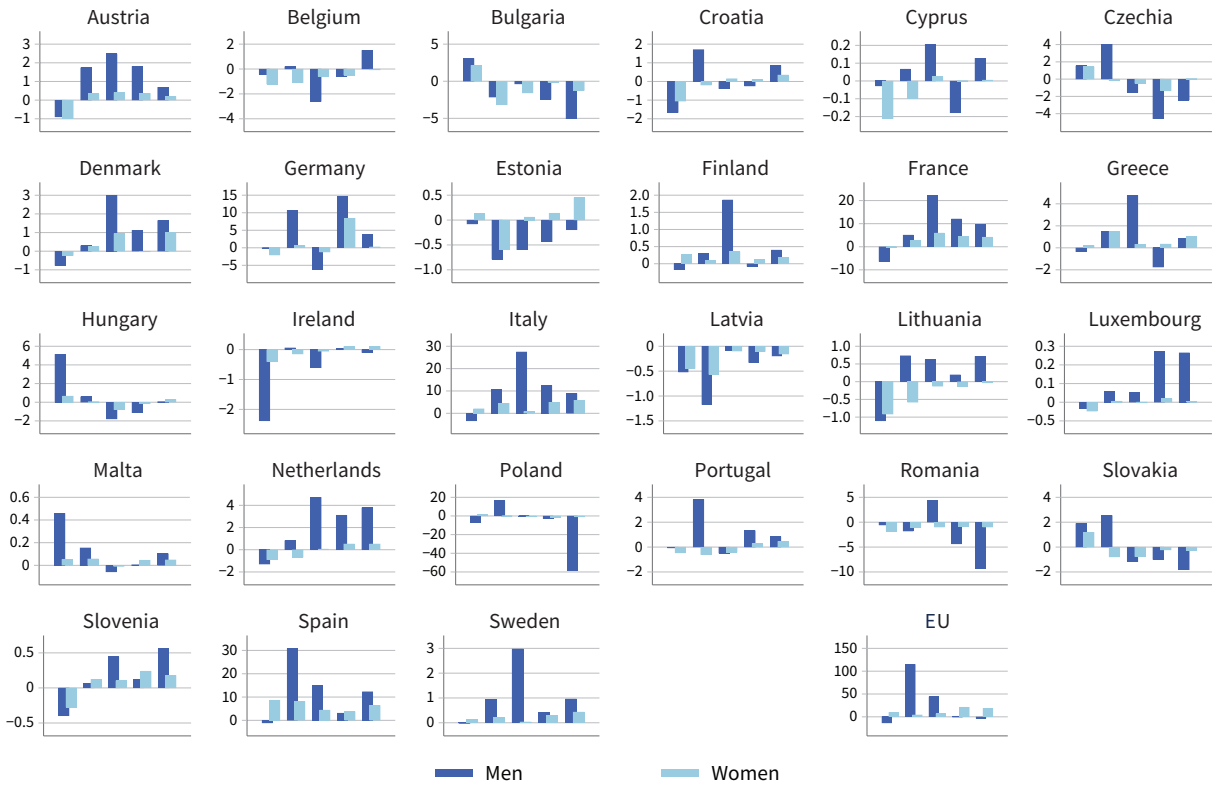


Source: *Authors' elaboration based on Fragkiadakis et al (2022) forecasts*

Figure A7: Employment change, by job–wage quintile and sex, REF compared with FIT55, 2019–2030 (thousand jobs)

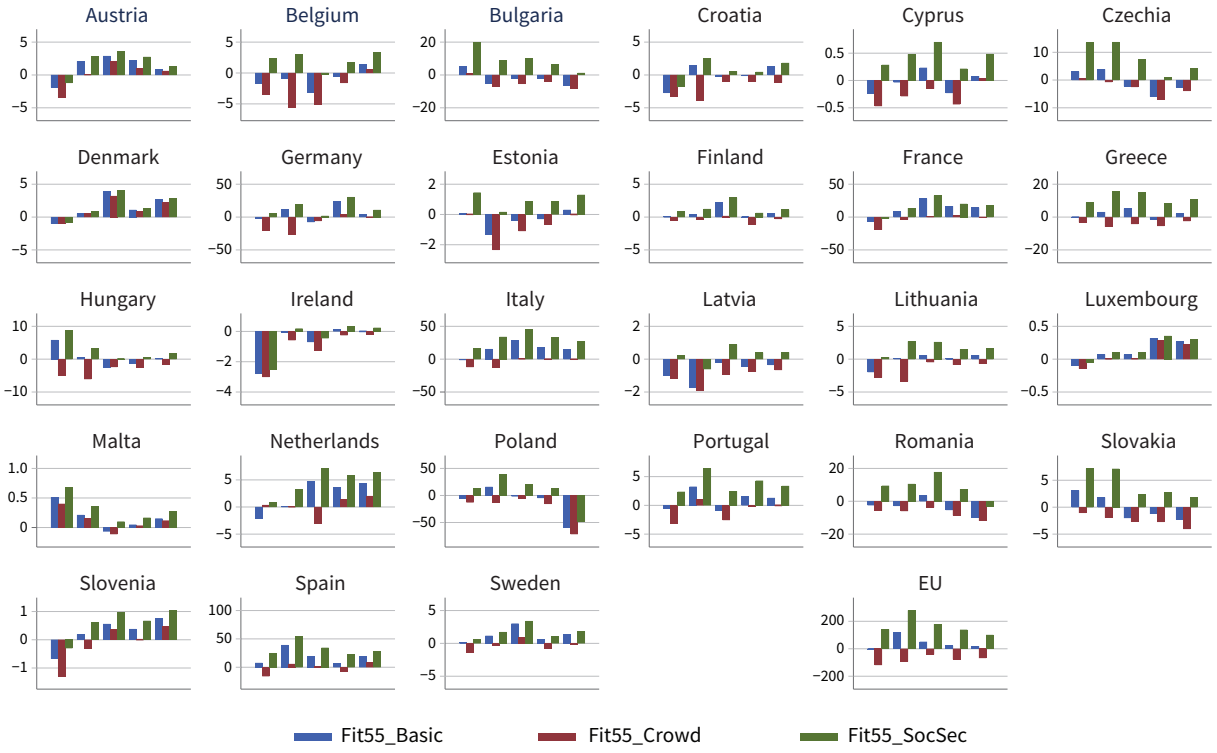
Source: *Authors' elaboration based on Fragkiadakis et al (2022) forecasts*

Figure A8: Employment differences, by job–wage quintile and sex, REF compared with FIT55, 2030 (thousand jobs)



Source: *Authors' elaboration based on Fragkiadakis et al (2022) forecasts*

Figure A9: Employment differences, by job–wage quintile, REF compared with each scenario, 2030 (thousand jobs)



Source: *Authors' elaboration based on Fragkiadakis et al (2022) forecasts*

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One of the core strategic objectives of the EU is to ensure that Europe becomes the first climate-neutral continent, with net zero greenhouse gas emissions by 2050. To achieve this objective, EU policymakers adopted the Fit for 55 policy package in 2021, which contained more ambitious intermediate decarbonisation objectives aimed at reaching a 55% emission reduction target by 2030. In this report, we provide projections from a global macroeconomic model of how this complex policy package may affect the sectoral and occupational structure of employment in the EU by 2030, and the impacts across different regions and countries. A core finding is that the employment impacts of Fit for 55 are likely to be marginally positive at EU aggregate level but will vary across countries, regions and sectors based on their reliance on carbon-intensive industries on the one hand and their readiness to take advantage of greening opportunities on the other.

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