CARBON-FREE EUROPE
A TECHNOLOGY-INCLUSIVE CLIMATE INITIATIVE

DECARBONISATION DOUBLES NEW EU JOBS BY 2050

DECARBONISATION AS INDUSTRIAL STRATEGY

A JOBS IMPACT ANALYSIS FOR EUROPE'S CLEAN ENERGY AND WORKFORCE TRANSITION

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Decarbonisation as Industrial Strategy
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Executive Summary

Europe's Decarbonisation as a Driver of Jobs, Competitiveness, and Economic Resilience

The EU's clean energy transition is not just about climate. It is a strategic opportunity to revitalise its industrial base, create millions of high-quality jobs, and reinforce Europe's global competitiveness. With major frameworks like the **Clean Industrial Deal (CID)** and the **Competitiveness Compass**, the European Commission is now explicitly linking decarbonisation to industrial strength, energy security, and long-term economic stability. This report advances that vision by quantifying the labour market impacts of a technology-inclusive pathway to net-zero by 2050.

Based on the data from the **2024 Annual Decarbonisation Perspective (ADP)**, this **Job Impact Analysis** shows that a full-scale transition to net-zero emissions by 2050 could generate **4.65 million net new jobs** across the EU. Crucially, this twice as many jobs as would be created under a business-as-usual scenario—**an additional 2.32 million jobs made possible by adopting a technology-inclusive approach that accelerates and diversifies decarbonisation**. These jobs will be anchored in clean energy manufacturing, infrastructure construction, and industrial supply chains, providing economic benefits well beyond emissions reduction.

A Technology-Inclusive Strategy Maximises Jobs and Industrial Output

The pathway to 4.65 million new jobs is clear, but only if the EU leverages all available technologies. A **technology-inclusive approach**, using a full mix of renewables, nuclear, hydrogen, and carbon management, is the most **cost-effective** and **resilient** strategy. It prevents over-reliance on any single technology, smooths price fluctuations, and allows each Member State to build flexibly on its strengths.

This approach avoids the structural and financial risks of narrow or delayed electrification. It distributes job creation across Europe and strengthens clean energy supply chains in manufacturing, construction, and services.

Clean Energy is Already Creating Jobs But Workforce Policy Must Catch Up

Decarbonisation does not eliminate jobs, it transforms them. **Construction** is the single largest driver of new employment, supporting both supply-side (generation, infrastructure) and demand-side (efficiency, electrification) deployment. **Industrial manufacturing and clean energy supply chains** will see sustained job growth. Emerging technologies like **hydrogen electrolysis** and **direct air capture (DAC)** will together add over half a million jobs by 2050, especially in infrastructure, engineering, and professional services.

However, job creation will not be evenly distributed over time, space, or sectors. **Demand-side jobs ramp up faster**, while supply-side investments create more total employment in the long run. Anticipating these shifts and training workers accordingly will be essential.
Moreover, while fossil fuel job losses will be offset by clean energy investments, this transition must be managed. **Job displacement will occur mainly in fossil fuel-producing countries outside the EU**, but Europe's own fossil-based workers must be supported through targeted reskilling. Without intervention, labour shortages, especially in construction, grid expansion, and manufacturing, will undermine the economic and emissions benefits of the transition.

Decarbonisation is a Competitiveness Strategy

Europe's industrial future depends on its ability to deliver clean energy at scale, supported by secure supply chains and a trained workforce. Smart policy design and effective, on time implementation will determine whether Europe captures or loses these economic benefits.

- Clean energy manufacturing, especially in wind, solar, batteries, and electric vehicles, must be scaled to prevent job leakage and supply vulnerabilities.
- Strategic investment in **public-private partnerships** can bridge financing gaps and support workforce development at scale.
- **Regulatory reforms** are needed to accelerate market access for new technologies like hydrogen and carbon removal.
- **A unified EU innovation strategy**, tied to employment outcomes, can outline the path to streamlining R&D funding and accelerating cleantech deployment and skills development together.

Europe has already taken important steps, but implementation momentum must accelerate. The CID, Net-Zero Industry Act, and Action Plan for Affordable Energy offer the right building blocks, but their success will depend on effective, timely implementation that actively links climate targets with industrial scale-up and labour market readiness.

A Strategic Window for Action

The next few years will determine whether Europe leads the global clean energy race or falls behind faster-moving economies.To ensure success, the EU must:

1. **Scale <u>all</u> clean energy industries** to secure long-term competitiveness.
2. **Invest in workforce development** to match labour supply with job demand.
3. **Align industrial, climate, and labour policy** to deliver on the promise of the CID and unlock job growth and competitiveness in parallel.

The energy transition is already underway. With the right decisions now, Europe can turn decarbonisation into the foundation of its next industrial era. **But without a skilled, ready, and supported workforce, even the best clean energy and industry plans will fall short**.

This report provides a clear, evidence-based roadmap. It quantifies job creation potential by year, sector, and Member States, and offers targeted policy actions to turn modelling into measurable economic impact in Europe.

Introduction

Decarbonisation As An Industrial Imperative for Europe

Far from solely being an environmental necessity, decarbonisation has progressively emerged as a defining force of Europe's economic and industrial landscape.[1] It is transforming how and where energy investments are made, opening new markets, and reshaping existing industries. The EU has significantly transformed the goals and instruments of its external energy policy, including political narratives and decisions becoming more geopolitical,[2] as emphasised by the recently published Competitiveness Compass and Clean Industrial Deal—both highlighting a new approach to the EU's industrial strategy centered around its decarbonisation goals. **The message is clear: Europe sees clean energy as integral to securing its industrial leadership in the 21st century. Its ability to lead in this space will increasingly define how its economy thrives.**

Without a robust and scalable clean energy sector, Europe risks not only falling behind technologically, but also undermining its economic sovereignty and missing the opportunity to anchor new industries and value chains on its territory. Alternatively, accelerating the deployment of low-emission energy sources and technologies could ease pressure on the raw materials market and offer consumers greater protection from high prices.[3] In this context, understanding the full range of impacts from the energy transition, particularly on employment, is not just relevant but urgent.

Why Decarbonisation Impacts Employment

A critical yet often overlooked dimension of this industrial transformation is its potential impact on employment. Beyond its contribution to net-zero objectives, the clean energy industry has an immense potential for spurring employment, particularly in industrial manufacturing, energy infrastructure, and supply chains. Scaling up clean energy technologies—from renewables to grid infrastructure and low-carbon manufacturing—requires a substantial workforce across engineering, construction, digital services, and supply chains among others. In 2023 alone, the EU's renewable energy sector supported an estimated 1.8 million direct and indirect jobs, underscoring the sector's existing labour footprint and future potential.[4] Additionally, value chains in renewables and sustainable technologies are more labour intensive than extractive fossil fuels.[5] As such, beyond its environmental benefits, the clean energy transition offers a historic opportunity to revitalise European labour markets, generate high-quality jobs, and strengthen industrial ecosystems.

However, this opportunity is at risk of being missed due to **one fundamental issue: a lack of data and visibility.** Currently, there is limited understanding of the employment potential and labour requirements associated with the EU's clean energy push. Without clear metrics and projections, the EU cannot adequately plan for workforce needs, nor can it anticipate where skills gaps or regional imbalances may emerge. This creates a twofold risk. On the one hand, Europe could fall short in training the workforce with necessary skills to implement its climate targets.[5] On the other hand, it may miss the chance to strategically capitalise on a promising labour market with a large potential of job opportunities.[6]

Recent research by the European Commission's DG EMPL underscores that growing skills and labour shortages are already hampering hiring into new opportunities, especially in construction, energy production and distribution, and transport sectors.[7] While the DG EMPL study focused on sectors linked to the installation of wind and solar generation technologies, it highlights the urgent need for future studies to expand this sectoral coverage, which is precisely what our analysis sets out to do. **This study seeks to fill that gap by offering a data-driven analysis of clean energy's employment impacts across the EU.**

Understanding Employment Needs Within a Technology-Inclusive Approach

The latest findings from Carbon-Free Europe's (CFE's) Annual Decarbonisation Perspective (ADP) 2024 demonstrate that over-reliance on a narrow set of technologies makes Europe's energy transition more expensive, more vulnerable to supply chain disruptions, and maintains energy dependence to non-European markets. Its conclusion underscores a critical element of the transition: the need for a diversified, technology-inclusive energy strategy.

An industry can be decarbonised if supply is diversified, energy saved, and clean technologies are deployed.[8] **Yet, this diversity adds another layer of complexity to workforce planning.** Different technologies demand different skill sets, training and regional infrastructure. A technology-inclusive energy policy, therefore, must be matched by an equally adaptive and inclusive workforce strategy. This includes anticipating which Member States are likely to benefit or face challenges and ensuring that educational and training institutions are responsive to evolving needs.[9] The employment effects of such an approach remain underexplored. **As such, this study takes a closer look at whether a broad technology mix translates into broader employment opportunities.**

Aligning Industrial Ambitions with Workforce Realities

A successful clean energy transition depends not only on deployment technologies at scale, but also on having a workforce strategy that can keep pace. Recent EU policy frameworks increasingly reflect this reality. The Competitiveness Compass calls for better integration between workforce development and industrial planning. The Clean Industrial Deal prioritises retaining clean energy jobs within Europe, while the Action Plan for Affordable Energy emphasises making energy transition economically viable for workers and industries alike. These policies signal political alignment around the economic promise of decarbonisation[2]—but implementation remains a challenge. The EU still lacks a comprehensive mechanism for matching industrial ambition with decarbonisation and labour market perspectives.

To unlock the full employment potential of clean energy technologies, market signals must be reinforced by stable, well-designed policy instruments and investment strategies, e.g., long-term support schemes or international climate mechanisms.[10] These frameworks are essential for triggering the sustained growth of renewable markets and the jobs that follow.

By examining the intersection of clean energy technologies, labour markets, and policy frameworks this study aims to provide a roadmap for building a workforce that supports the energy transition. In doing so, it reinforces the thesis that **decarbonisation is not just an environmental goal, but a strategic and industrial imperative**—and that its success will hinge, in large part, on the EU's workforce.

Pan-European Results

Job Growth and Industrial Opportunities when Decarbonising

As Europe accelerates toward its 2050 net-zero goals, the energy transition is not just reshaping how and where we invest, it is redefining what the European workforce looks like. The following findings draw on CFE's ADP to assess how a strategic, technology-inclusive approach to decarbonisation can deliver long-term employment benefits across the EU. They show how clean energy investments will create new industrial opportunities, shift employment benefits across the EU. Each finding is supported by scenario-based modelling comparing the ADP's Core decarbonisation pathway to a Baseline trajectory,[11] helping quantify the cost of inaction. The cost of inaction not only for climate targets, but for Europe's labour market and economic competitiveness.

For further detail on the definition and selection of the Core and Baseline (Base) scenarios, please see the ADP technical documentation. The methodology underpinning how these scenarios were further used in this analysis is described in the Method section at the end of this report.

Understanding these modelling foundations is key, as they underpin the evidence for how and where Europe's clean energy industries are already growing. What this section makes clear is that without scaling and supporting these industries, Europe will fall short on emissions goals but, more importantly, on its economic potential. **Decarbonisation is a strategy for growth.**

#1 Decarbonisation Will Create Millions of Additional Jobs by 2050

The energy transition is a generational opportunity for employment in Europe. Adopting a technology-inclusive decarbonisation pathway (Core scenario) is expected to create **2.32 million more net new jobs by 2050** than business as usual—**delivering a total of 4.65 million net new jobs by 2050**. This approach not only doubles the employment opportunities, it is also more cost-effective (saves ~500 billion EUR by 2050; net costs data), allowing Europe to achieve net-zero by 2050 while reducing overall energy system costs compared to a business-as-usual (Baseline) scenario. The job gains are anchored in industrial activity (construction, manufacturing, engineering, grid expansion, and supply chain development) adding around 2.4% to the total labour force of 191 million in 2020 (Eurostat),[12] and positioning Europe as a global leader in clean energy and industrial resilience.

In contrast, under the Baseline scenario, in which consumer technologies were frozen at their 2021 levels, and no carbon policies were implemented to influence energy supply, this is a dramatic shift. Europe will still see some job growth, but far less: only 2.33 million new jobs by 2050, with higher system costs and failure to achieve net-zero. The decarbonisation pathway evaluated in our Core scenario incorporates efficiency and electrification measures that not only drive emissions reductions, but also multiply employment efforts with **1.56 million more jobs by 2035** and **2.32 million more jobs by 2050**. Direct clean energy jobs in grid infrastructure or industrial retrofitting create strong ripple effects throughout the economy, generating indirect growth through equipment supply chains and additional jobs in supporting industries and services.

This finding underscores our central thesis: clean energy is not an environmental necessity but an economic engine; decarbonisation is an integral part of an industrial strategy.

The decarbonisation of Europe's economy, if done with the right mix of technologies and policies, will reinforce the EU's industrial base, create local employment, and support broader economic resilience.

This growth is not guaranteed. Capturing the job potential requires active planning and investment, as illustrated by our modelling approach. The model combines scenario-based projections of energy system transformation with detailed employment impact calculations, tracking how investments in various technologies and sectors translate into direct, indirect, and induced jobs across EU Member States (see Box 1 below for job types). The findings that follow will unpack how and where these jobs emerge, and what policymakers can do to prepare the workforce and industrial ecosystem to capture them.

Job Type Definitions

- **Direct Jobs** include employment in construction, plant operation, and professional services.
- **Indirect Jobs** include upstream supply chain jobs such as manufacturing, transportation, and utilities.
- **Induced Jobs** result from increased spending by workers employed in direct and indirect roles (e.g., retail, education, services).

Figure 1: Net Employment Impact of Core vs Baseline (Base) Scenario

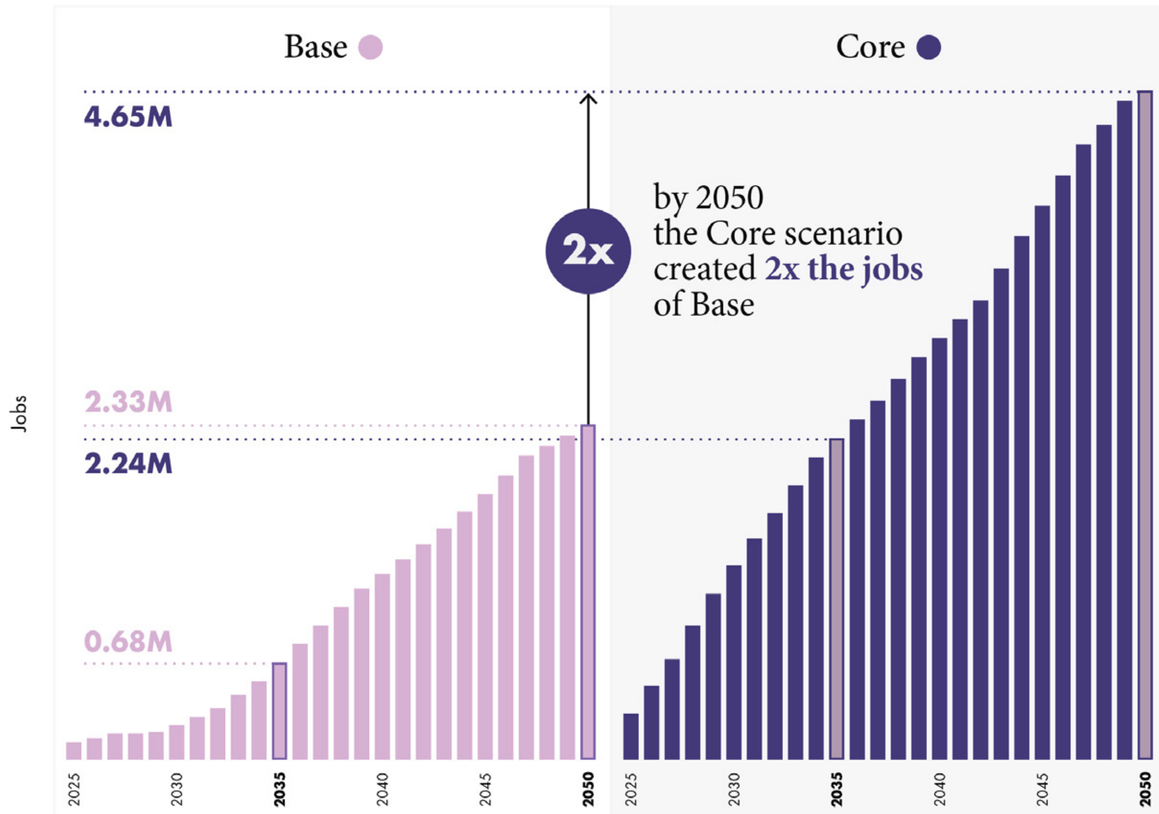

Figure 1. Net new jobs per year until 2050 under the Core decarbonisation and baseline (Base) scenario. Core scenario includes expanded investments in clean energy infrastructure, electrification, and carbon management. Reference lines for 2035 and 2050 of each scenario are included.

Figure 2: Employment Growth – Demand- vs. Supply-Side

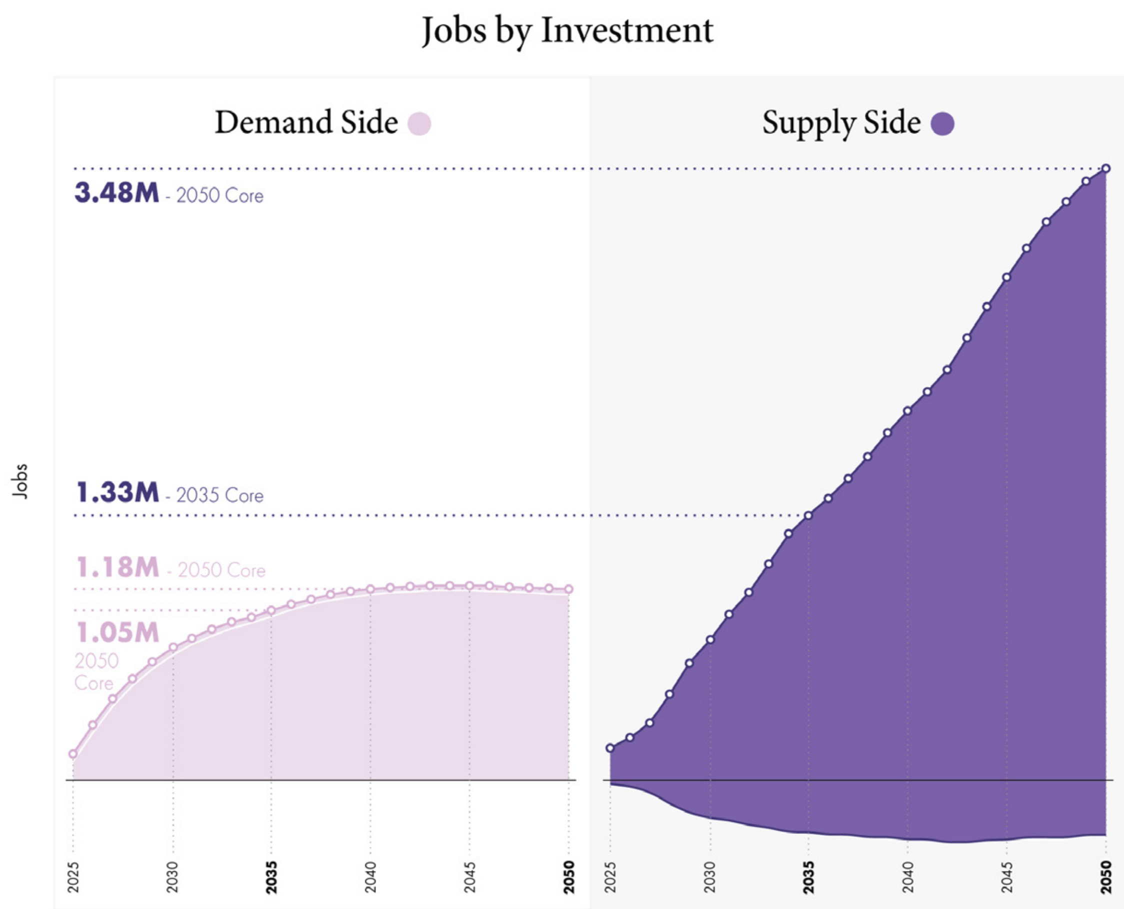

Figure 2. Timeline of net new jobs from demand-side and supply-side activities under the Core scenario. Demand-side job growth surges early, followed by expansive supply-side job creation through 2050. Reference lines for 2035 and 2050 for net job growth are included.

#2 Plan for Early Employment Surge on Demand Side

Decarbonisation will not only create millions of new jobs—it will create them fast, and in distinct waves—and the next wave is already here. Europe is entering a critical decade where demand-side investments in building retrofits, heat pump installations, EV infrastructure, and energy efficiency are generating rapid job growth. These investments are not just job creators; they are essential enablers of the transition. Without them, supply-side development like clean energy manufacturing, transmission buildout, and hydrogen infrastructure will stall.

Our modelling shows that by 2050, supply-side investments will net 3.48 million additional jobs, three times the job creation of demand-side investments with 1.18 million jobs. But critically, demand-side jobs grow faster in the next decade, ramping up through 2035. **Without this early demand, the supply side won't move.** Demand-side sectors need to grow faster in the next decade because they are built around immediate capital expenditures and consumer-facing deployment such as retrofitting homes, replacing boilers, installing solar panels and heat pumps. These actions are what trigger larger shifts in the energy system. If homes are not electrified, the grid does not expand. If there is no consumer demand for clean fuels, no one builds a biofuels plant. Simply put, supply-side jobs won't materialise without strong and sustained demand-side momentum.

This also has direct consequences for workforce planning. Demand-side activities require different workers: more distributed, often more localised, with heavy labour needs in construction, installation, and trades. These are the sectors that will struggle the most if Europe does not invest in training and re-skilling. And this is where the risk lies: millions of skilled workers will be needed across the continent, many of whom may not be physically available in Europe today.[13] This early-stage demand-side employment surge is a key feature of the transition and will define initial labour market dynamics.

By the 2030s, supply-side sectors take over in scale. Transmission and distribution jobs ramp up sharply, reaching 1.60 million new jobs by 2050. The Biofuels sector becomes a major employer, especially in hard-to-abate sectors like aviation and shipping, growing to 0.88 million jobs. Offshore wind employment peaks in 2034 with 0.36 million jobs, before levelling out at 0.32 million in 2050 due to resource constraints in early-adopting regions. Meanwhile, fossil fuel sectors decline steadily. Coal alone will lose 0.13 million jobs by 2050. Natural gas employment on the other hand peaks in the late 2030s with 0.22 million additional jobs before tapering off. Rooftop solar, after early growth, loses around 0.19 million jobs by 2050 as available surface area is maxed out and efficiency gains reduce the need for large-scale deployment.

New sectors emerge and mature by mid-century. Hydrogen electrolysis and direct air capture (DAC), which remain small through the 2020s, become major sources of employment by 2050. Together the two emerging sectors create around 0.46 million jobs, many of which are in engineering, manufacturing, and professional services.

It all begins with demand. Without early-stage consumers and commercial uptake, the rest of the transition will not happen. The EU's job creation potential relies on a clear understanding: demand-side growth drives supply-side investments, and both depend on a workforce that Europe must actively train, attract, and deploy. Failing to act on this now risks stalling the energy transition, slowing industrial expansion, and falling short of Europe's economic and climate goals.

#3 Decarbonisation Will Lead Job Growth in Construction, Manufacturing, and Supply Chains, and Grid Expansion

Our model results show that the foundation of Europe's job growth in the energy transition to a decarbonised society lies in three sectors: construction, manufacturing, and supply chains, and grid and energy system expansion. These are the industrial engines that will power net-zero and they will create the demand for jobs through 2050.

Construction leads the way with **over 1.21 million additional jobs by 2050**. For reference, 12.6 million people worked in construction in the EU in 2020 (Eurostat dataset). That is an **increase of 8.7%**. It is the single largest driver of new employment, especially in the earlier stages of the transition. Whether it's building clean technology energy facilities, upgrading existing infrastructure, or retrofitting homes and commercial buildings for energy efficiency, nearly every clean energy investment begins with a constructive crew on-site. This is true for both demand- and supply-side activities, making construction a critical bridge between sectors. The scale of job growth in construction is particularly advantageous for the EU's industrial strategy, as it anchors clean energy investments in local economies, boosts skilled trades, and strengthens the domestic value chain for infrastructure development. These are high-intensity, labour-heavy jobs which makes them a prime target for near-term workforce strategies.

Clean energy manufacturing and the supply chains that support it follow close behind. As clean technology deployment scales, Europe will see surging demand for raw materials, fabrication capacity, component production, and engineering services. This means jobs in factories, workshops, and assembly lines in renewable sectors like wind turbine blades or solar panels but also in heat pumps, EV chargers, electrolysers, and transmission hardware. This sector will absorb a large portion of the workforce coming out of fossil fuel industries if the EU ensures domestic capacity is in place. The data suggests that the location of job creation will depend heavily on where clean manufacturing and deployment are scaled: domestic or abroad.

Grid and energy system expansion is the third pillar and one of the most crucial. Electrification across sectors, from transport to heating to industry, depends entirely on a modern, robust, and resilient grid. Europe will need to double down on transmission and distribution infrastructure, which alone will generate up to 1.5 million jobs by 2050. These roles range from grid planning and engineering to physical buildout, maintenance, and digital system integration. Without this expansion, no clean energy pathway, regardless of technology mix, will be technically feasible by 2050.

Europe's industrial future is directly tied to the success of its clean energy industries. Failing to scale these sectors means not just falling short of climate goals but also losing industrial competitiveness, missing out on millions of high-value jobs, and outsourcing opportunities to global competitors, creating trade and energy dependence and compromising energy security. And global competitors are already accelerating: estimates show that clean energy jobs worldwide are expected to more than double by 2050—from 57 million to 134 million—across sectors such as power, heat, transport, and desalination.[5]

Our modelling shows that a technology-inclusive pathway supports broader job distribution across sectors and Member States. Relying too heavily on a single energy source narrows the range of manufacturing and infrastructure needs, and limits the number and diversity of jobs created. In contrast, a diversified strategy that includes renewables, nuclear, hydrogen and carbon management spreads opportunity across sectors, supply chains, and Member States. **It's not just the most reliable, cheapest, and economic path to net-zero (ADP 2024), it's the most job-rich and economically resilient.**

For a detailed sectoral breakdown and comparison to baseline employment data, see Table A2 in the appendix, which uses EXIOBASE 2022 employment estimates for the EU27 as a reference point.

Figure 3: Employment Growth by Industrial Sector

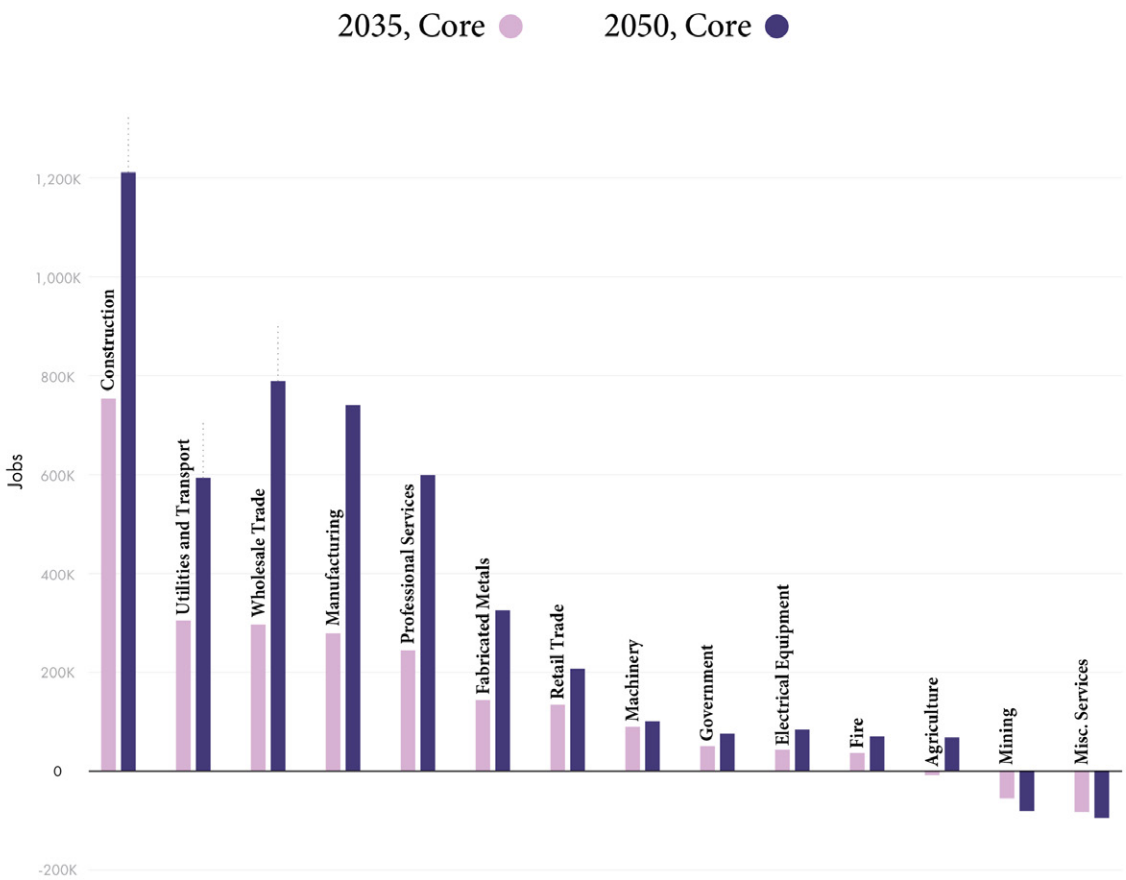

Figure 3. Sectoral job growth by 2035 (left) and 2050 (right) for the Core scenario, showing dominant employment contributions from construction, manufacturing and supply chains, grid infrastructure, and more.

Definition: What do we mean by "largest increase in jobs"?

When we refer to "largest increase" or "most jobs," we mean the total number of new jobs added, not adjusted for population size or the existing workforce. This is different from proportional or per capita growth, which would measure job increases relative to the size of a region's labour force.

Figure 4: Regional Employment Growth Across the EU – 2050 Core Scenario

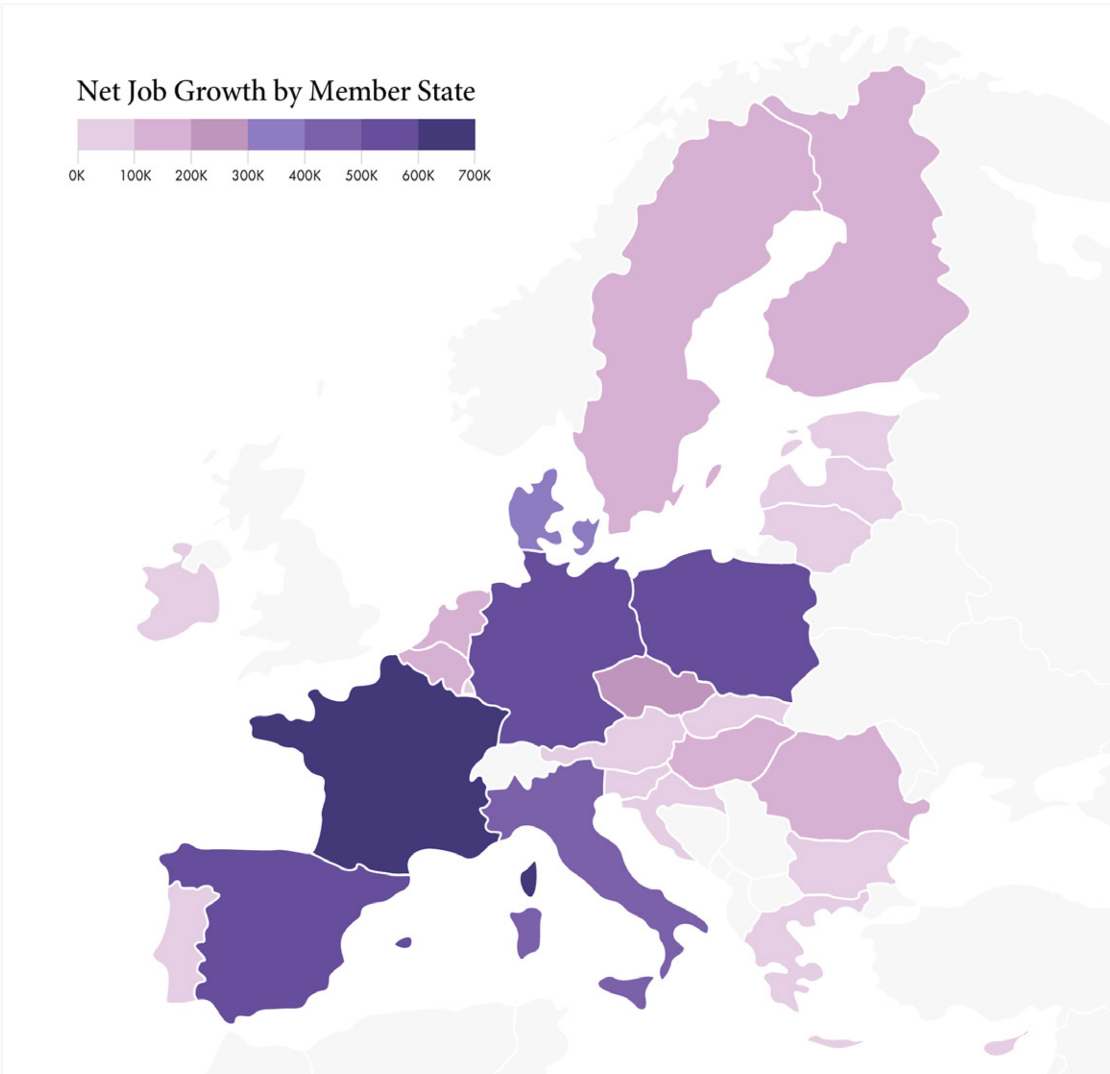

Figure 4. Total job creation by EU Member State under the Core scenario. Central European countries show some of the highest absolute employment gains, reflecting strong growth in manufacturing and renewables deployment.

#4 Large Member States to Gain the Most Clean Energy Jobs by 2050

The energy transition will not be geographically uniform. Some regions will emerge as job creation engines, while others will require more target support to manage industrial transformation. Based on our Core scenario, large Member States together will see the largest overall increase in clean energy jobs by 2050, led by large-scale deployment of onshore wind and solar, as well as buildout of clean energy manufacturing and supply chains.

This trend reflects both the underlying resource availability and the role these countries play in Europe's industrial base. The energy transition is not only creating jobs at the point of generation. It is also expanding the supply chains that make clean energy technology possible. From fabricated parts to construction materials, cleantech manufacturing is emerging as a key driver of economic growth, particularly in Member States with existing industrial capacity and strong connections to internal EU markets.

Importantly, this growth is not confined to one part of the continent. Every Member State sees job gains by 2050, though the scale and nature of those gains differ based on resource endowment, technological pathways, and local industrial strengths. Our modelling shows why a technology-inclusive approach is so important: it ensures that employment opportunities are diversified across countries and sectors, rather than concentrated in a handful of locations or industries.

Job losses will still occur, but they are increasingly concentrated outside of Europe as fossil fuel imports decline. Domestic fossil fuel sectors will contract further, but the bulk of labour impacts from fossil phase-outs will fall on exporters abroad. Still, transition policies must be regionally tailored—especially for those with strong fossil fuel legacies—to help workers move into high-demand clean energy roles, particularly in construction, manufacturing, and infrastructure development.

The data is clear: decarbonisation will generate widespread employment, but it will not happen automatically or evenly. Member States must align workforce development with emerging job markets, ensure training pathways match industrial needs, and strategically invest in sectors that offer long-term job stability. The transition offers a generational opportunity to build a more resilient and competitive Europe, if every region is equipped to participate.

#5 Emerging Technologies Will Create 0.46 Million New Jobs, If the EU Takes a Technology-Inclusive Path

As the clean energy transition matures, sector-specific job growth will begin to shift. While the next years are driven by construction, retrofitting, and grid expansion, the mid-2030s enable the rise and scaling of emerging technologies. This will trigger a new wave of employment opportunities across Europe. Technologies such as direct air capture (DAC) and hydrogen electrolysis will not only play a central role in achieving deep decarbonisation, they will also add 0.46 million new jobs by 2050, according to our Core scenario. The EU's ability to lead in clean technology and industrial competitiveness will hinge on embracing and investing in this diverse portfolio of solutions.
DAC job growth increases around 2033, scaling steadily to create 0.25 million jobs by 2050. These jobs are mostly concentrated in construction and manufacturing (~80%), with the remaining 20% in operations and maintenance (O&M), professional services, and system integration. DAC requires large-scale infrastructure buildout, skilled labour for component fabrication and installation, and long-term technical support. Thus, DAC will become a major contributor to short- and long-term employment.

Hydrogen electrolysis job growth on the other hand follows a similar trajectory, gaining traction through the 2030s and accelerating further into the 2040s to provide sufficient clean hydrogen for hard-to-abate industrial processes, long-haul aviation, and shipping. By 2050, hydrogen deployment will add 0.21 million jobs, around 60% of which are in capital expenditure-related activities and 40% in O&M. Hydrogen electrolysis job creation is heavily concentrated in professional services, including engineering, legal, and business development roles. This underscores the broad skill range needed to support industrial clean hydrogen production and infrastructure, touching everything from electrolyser manufacturing to pipeline installation and plant operations.

While many near-term jobs, especially in construction, are temporary by nature, DAC and hydrogen support long-term roles in advanced manufacturing, O&M, and technology services. In a later-stage net-zero economy, they become anchors of both emissions reduction and economic activity, thus, enabling an industrial strategy through decarbonisation.

The opportunity is clear, but the outcome depends on industrial readiness. If these technologies are not manufactured and deployed in Europe at scale, the associated job creation will shift to other global players. Our modelling shows the scale is real, but it is the EU's commitment to a technology-inclusive approach that will determine whether these jobs and their economic benefits are realised in Europe or lost to global competitors—an opportunity for both economic and workforce development.

Figure 5: Job Creation from Emerging Technologies – DAC and Hydrogen Electrolysis

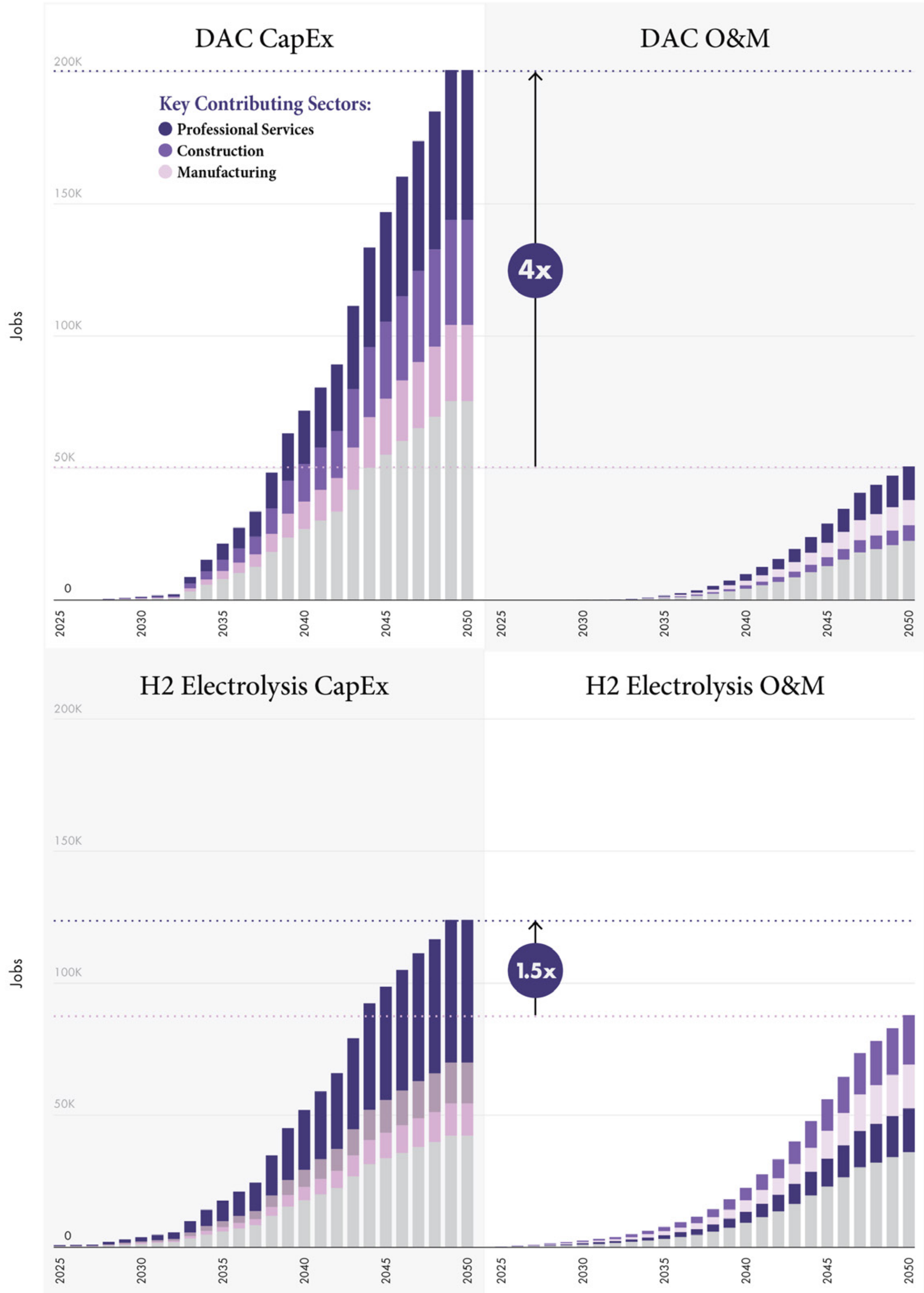

Figure 5. Growth in employment related to DAC (left) and hydrogen electrolysis (right) investments until 2050 under the Core scenario for both capital expenditures and O&M.

#6 Workforce Readiness and Mobility Are Prerequisites for Industrial Decarbonisation

This is an indirect finding, drawn from the employment dynamics outlined in the previous sections. While the modelling does not prescribe workforce policy as it assumes unlimited worker and resource availability, it makes clear that the scale and structure of job growth expected through decarbonisation will require a profound adjustment in Europe's labour capacity, particularly in the industrial trades.

The clean energy transition is not just about where and what sector jobs are created, it's about whether Europe has the workforce to fill them. Our modelling shows that the jobs created across the demand and supply sides of decarbonisation are overwhelmingly concentrated in sectors that rely on skilled, hands-on labour such as construction, manufacturing, electrical work, mechanical maintenance, and infrastructure operations. **These are not abstract roles in future industries; they are physical jobs that require real people, trained and ready to work.**

This creates tension. Europe's labour market has evolved over the past decades into one dominated by services and information-based work. Meanwhile, the energy transition is shifting demand back toward the industrial and technical trades. The result is a growing disconnect between where workers are and where they are needed.

The issue is not marginal. According to our modelling, the energy transition requires millions of additional workers in construction, grid expansions, manufacturing, and transport infrastructure. As highlighted in earlier findings, demand-side jobs ramp up rapidly in the near term, and supply-side jobs scale aggressively through 2050. But unless workforce planning is addressed head-on, labour shortages could confirm the structural barrier to delivering the infrastructure the transition depends on.

These workforce gaps are not evenly distributed across Member States. Some countries will see surges in demand for technical and industrial workers in sectors where training pipelines are weak or where skilled labour has been lost due to past deindustrialisation. The shift is not just sectoral, it is geographic, and it requires both national and EU-level attention.[9]

If current labour market trends continue, the physical labour shortage at domestically varying levels will slow down the build-out and operation of Europe's future energy system. The modelling indicates that projected labour demand may exceed available domestic workforce in key sectors, implying a need for additional labour inputs.

This is a question of quantity and timing. The early demand surge will stress labour markets quickly. And if that wave isn't met, the downstream growth in supply-side sectors may never fully materialise, upending any net-zero ambitions early. Workforce adaptation emerges as a fundamental component of meeting modelled labour needs across the transition to net-zero.

Our data speaks clearly: Europe must grow, move, and adapt its workforce to meet the demands of decarbonisation and associated industrial and service growth. Without action, labour shortfalls risk slowing the transition, increasing costs in the range of trillions of EUR, and undermining both competitiveness and climate goals.

Intra-European Results

A look in regional diversity

Europe's energy transition is a shared goal, but it is not a "one size fits all" process. The success of job creation across the EU will depend on a technology-inclusive approach that empowers every Member State to leverage its unique strengths. National contexts, ranging from energy infrastructure to labour force composition, will significantly shape not only the scale, but also the type and timing of employment growth. Our modelling shows that while all Member States see job growth under the Core scenario, the path each country follows varies significantly. A reality that must be recognised to ensure a fair and effective transition for all Europeans.
Technology inclusiveness and flexibility maximises job creation by allowing each country to pursue the energy solutions best suited to its geography, industrial capabilities, and labour market. Table A1 in the appendix provides a detailed comparison of relative job growth per Member State, benchmarked against current, 2022, employment levels. This enables a nuanced view that goes beyond just the absolute number of jobs, highlighting the impact of transition in both larger and smaller economies.

Some countries will lead in absolute job creation, others will see sharp increases in relative employment based on smaller starting labour markets. For example, France, Germany, Poland, Spain, and Italy each generate over 0.45 million new jobs by 2050. Meanwhile, smaller Member States such as Denmark, Czechia, and Finland experience significant gains relative to their size, reflecting strong deployment of clean energy and grid infrastructure. On the lower end, countries like Malta, Cyprus, and Luxembourg still see net job growth, but at smaller scales due to limited land area and population.

This diversity underlines the importance of a flexible and technology-inclusive approach. By enabling Member States to deploy the technologies best suited to their geography, industrial capabilities, and labour market, the EU maximises total job creation while ensuring broad participation in the clean energy economy.[14] For example, countries with advanced nuclear industries may drive job growth through long-term infrastructure projects, while others see rapid labour gains through distributed solar, onshore wind, or bioenergy.

These differences also carry important implications for skills and workforce transitions. The leading sectors driving employment in each Member State will vary. Some will need welders and machinists, other electricians and grid technicians. There may be mismatches between regions where displaced workers live and where new opportunities become available, creating a barrier even if former workers have the required skills.[9] The flexibility to match technology pathways to local strengths will help align labour supply with demand, easing the pressure on training systems and mobility programs.

What emerges from the data is not just diversity, it is interdependence. **No country can deliver the energy transition alone, and no country should be left behind. The strength of Europe's clean energy workforce will depend on a shared understanding of national differences and coordinated effort to scale the supply chains and skill pipelines needed to meet region-specific demand.** Regional differences in industrial capacity and workforce availability highlight the importance of understanding national-level employment dynamics.

This figure shows regional net job creation across the EU by 2050 under the Core scenario, disaggregated by sector (Utilities and Transport, Construction, Manufacturing) and by key clean energy technologies (Hydrogen Electrolysis, Direct Air Capture, On- and Offshore Wind, Rooftop Solar, Utility-Scale Solar, Nuclear). The maps highlight spatial variation in employment impacts, underscoring the role of regional energy infrastructure, technology deployment potential, and industrial capacity in shaping where clean energy jobs will emerge.

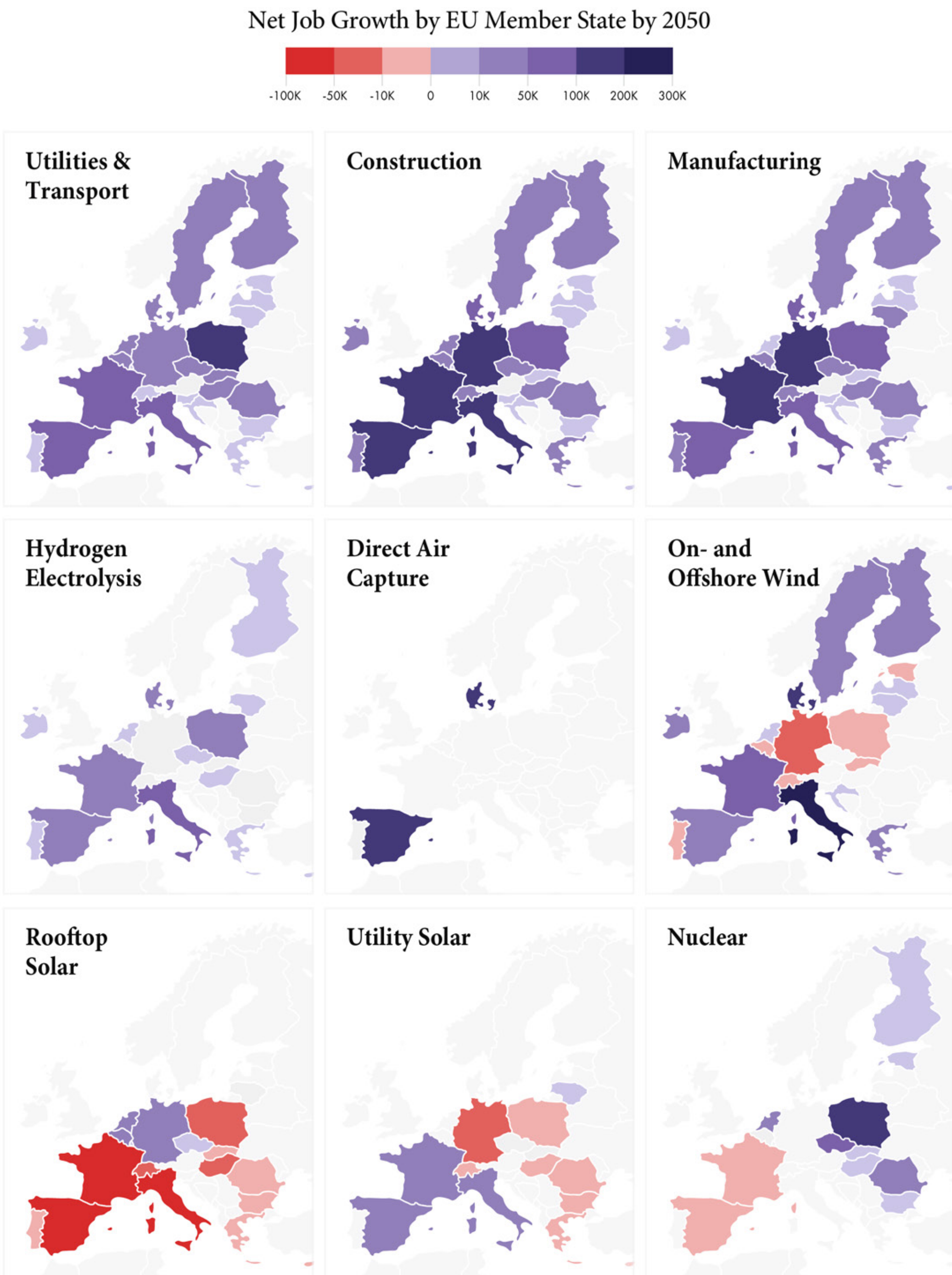

Figure 6: Geographic Distribution of Net Job Growth by Sector and Technology

From Potential to Delivery

The results presented above make one thing clear: Europe's clean energy transition holds enormous economic potential, but realising it is not guaranteed. Most importantly, **the additional 2.32 million net new jobs projected by 2050—on top of the 2.33 million** that would occur under business as usual—depend not just on whether decarbonisation happens, but on how it is implemented. Our modelling shows that a technology-inclusive doubles the employment impact and does so at lower cost, while also achieving net-zero. Prioritising early demand-side growth triggers deeper industrial expansion, emerging technologies reshape labour needs, and that workforce readiness becomes a decisive factor in success or failure. Realising this potential will require more than market forces alone, it will depend on smart and coordinated policy action.
The following chapter explores how the EU and its Member States can build on existing initiatives, like the Clean Industrial Deal, Net-Zero Industry Act, and Competitiveness Compass, to ensure that the **additional 2.32 million clean energy jobs enabled by decarbonisation are actually delivered through scale, strategy, and a skilled workforce** across Europe.

Align EU Industrial and Workforce Strategy to Deliver an Additional 2.32 Million Clean Energy Jobs

A technology-inclusive decarbonisation strategy will not only increase demand for clean energy manufacturing and a workforce that can support it, it is Europe's opportunity to lower energy costs, strengthen its industrial foundation, and generate high-quality jobs across Member States. But those additional 2.32 million jobs will not materialise without a decisive, strategic shift in policy and implementation. **To double the job creation potential and reach 4.65 million net new jobs by 2050, the EU must move beyond fragmented targets and implement a unified, technology-inclusive industrial strategy.** One strategy that aligns investment, manufacturing, and workforce development.[1] This strategy must embed employment objectives at the heart of clean energy policymaking and industrial planning, ensuring that climate and economic ambitions reinforce one another at every stage.

On the next pages are five priority policy actions the EU should pursue to turn the employment promise of a technology-inclusive net-zero transition into reality.

1. Scale Up Domestic Clean Energy Manufacturing

Policy Recommendation #1
The EU must leverage and fully implement its existing tools to scale domestic clean energy manufacturing and secure access to critical supply chain components to meet accelerating demand and job creation targets.

Industrial job growth–especially in manufacturing, construction, and supply chains–is rapidly being driven by surging demand for clean technologies like heat pumps, solar panels, and EV infrastructure (Finding #2). However, Europe has yet to overcome challenges to build a domestic manufacturing base capable of supporting the upcoming job growth. For instance, it continues to rely heavily on imports for key components of its clean energy value chain, particularly in the renewable sector. **While the EU has introduced policies to address these challenges, it has yet to fully capitalise on or effectively implement them to support a robust domestic manufacturing ecosystem aligned with these emerging job market demands. To close this gap, both the EU and Member States must move from policy development to coordinated implementation and enforcement of existing frameworks.**

A critical first step is the swift and harmonised rollout of the Net Zero Industry Act (NZIA), which aims to ensure that 40% of the EU's annual deployment needs in net-zero technologies are met through domestic production. This requires EU Member States to streamline permitting, prioritise strategic net-zero projects through special status and funding, and a heavy coordination by the EU through its Net-Zero Europe Platform to align national efforts and share best practices. Complementing this, the Critical Raw Materials Act must be implemented with a focus on securing long-term supply agreements, diversifying sources, and scaling domestic processing capabilities to reduce strategic dependencies on foreign suppliers. Moreover, the Important Projects of Common European Interest (IPCEIs) initiative must be better utilised through faster approval processes and broader participation by smaller Member States to support the entire cleantech value chain from innovation to industrial-scale manufacturing. Additionally, continued support is available through the Innovation Fund, which has proved instrumental for cleantech manufacturing in the EU.

As demonstrated in Finding #1, a **4 million+ job creation can only be achieved if clean energy production, not just deployment, occurs within Europe**. Beyond the existing frameworks, the CID has signaled growing political commitment to respond to this trend. The proposed Grids Manufacturing Package, backed by €1.5 billion in EIB counter-guarantees, and the proposed €100 billion Decarbonisation Bank, both reflect the EU's intent to reinforce cleantech supply chains and infrastructure manufacturing. The next wave of decarbonisation will trigger tremendous job growth, particularly in regions like Central and Eastern Europe, where industrial expansion can be a core driver of the transition (Finding #4). Failing to close the manufacturing gap will not only slow down progress towards decarbonisation targets, but also forfeit the opportunity to rebuild Europe's industrial core through climate action (Findings #5 and #6).

2. Embed Workforce Planning in EU Industrial Policy

Policy Recommendation #2
The EU must integrate targeted workforce development and labour mobility into its future industrial policies, to ensure that clean energy job growth is matched with the right skills across all Member States.

Industrial growth in clean energy industries will require a skilled workforce, but current gaps in vocational training, an aging labour pool, and regional disparities threaten to undermine this potential, as highlighted in Finding #6 and supported by recent findings from DG EMPL from the European Commission.[7] While the EU is explicitly tying its industrialisation with decarbonisation objectives, **it must also focus on preparing the workforce to meet emerging clean energy demands.**

The CID has already taken a step in that direction, by introducing its Union of Skills, a strategic initiative designed to equip the workforce with the necessary skills for the clean energy transition and to bolster competitiveness. The initiative focuses on reskilling, vocational training, skills mobility, and attracting talent while aligning education systems with industrial needs through initiatives like the Pact for Skills and micro-credentials. However, while this represents a significant recognition of the need to embed workforce development into the EU's industrial strategy, more can be done in the future. Tailored national frameworks are needed to match local workforce needs with evolving and emerging industry demands. **A "one size fits all" approach will not meet the diverse needs across Member States.** Instead, they should be supported and incentivised to develop **n**ational workforce strategies that integrate clean energy skills planning into their own industrial and economic development frameworks.

Moreover, the EU should scale-up existing programs, and prioritise the integration of large-scale upskilling and reskilling initiatives in industrial policies, particularly in transitioning regions. Expanding programs like the Pact for Skills to facilitate worker mobility and integrating workforce targets into Member State industrial strategies will ensure a smooth labour transition, given that sector-specific job growth will shift (Finding #5). This is critical for a competitive transition.

3. Streamline Market Entry for Emerging Clean Energy Technologies

Policy Recommendation #3
The EU should modernise and streamline its permitting and regulatory frameworks to facilitate market entry for emerging clean technologies, reducing administrative bottlenecks and enabling their full potential to drive industrial growth and create jobs.

While the EU has recently made progress towards developing a more competitive clean energy strategy through the CID, regulatory complexity continues to delay the deployment of new technologies like hydrogen, geothermal, carbon removal, or advanced nuclear despite their central role in achieving long-term decarbonisation and job creation (Finding #5). **These technologies face unclear approval processes, inconsistent permitting rules across Member States, and a lack of long-term integration into national energy planning.**

Yet, according to our findings, technologies such as direct air capture (DAC) and hydrogen electrolysis have the potential to add over half a million new jobs by 2050 (Finding #5). The EU recognises this reality and can rely on its existing and planned policies to act now. The effective implementation of the NZIA for net-zero technologies can lead to effective permitting policies, and the planned Industrial Decarbonisation Accelerator Act is set to highly focus on permitting for industry. This last tool will be particularly instrumental in accelerating the deployment of the domestic clean manufacturing capacity.

Regulatory reform is essential not only to de-risk investment, but to ensure technologies with high labour intensity contribute meaningfully to employment and resilience (Finding #2). To grasp this potential, the EU must streamline permitting procedures, define clear eligibility pathways for emerging technologies under the CID, and provide stable, long-term policy signals to support market entry and investor confidence.

4. Align EU R&D and Innovation with Clean Energy Projects

Policy Recommendation #4
The EU must create a unified, mission-driven clean energy R&D framework that links innovation funding to industrial deployment and workforce development, while leveraging existing tools.

Despite major clean energy targets, Europe's current R&D support and innovation landscape remains fragmented across Member States and EU Institutions, limiting progress and impact. The fragmentation disrupts scaling efforts for critical technologies for job creation such as hydrogen or DAC. As shown in Finding #5, these technologies will be major drivers of long-term employment, but only if innovation links to deployment and skills.
A coordinated EU-level framework would streamline funding instruments, set clear innovation priorities, and ensure technologies critical to supply chain resilience and emissions reduction receive consistent support for

industrial and workforce targets. This approach should be taken into account to enact the next Multiannual Financial Framework, which should support research and innovation for clean energy projects. Key research and innovation programs such as Horizon Europe should also be leveraged further, given that under the 2026-2027 Work Programme, the Commission plans to support it with €600 million.

To make this effective, the EU should pair increased R&D funding with predictable support tools such as fixed-price contracts, milestone-based subsidies, and more coordinated public funding to help de-risk cleantech development. A unified framework would also encourage partnerships across universities, industry, and vocational training centers to co-develop technologies and the talent needed to operate them. Innovation must not only reduce emissions, it must contribute to European supply chain resilience and employment (Finding #6).

5. Facilitate and Accelerate Financing for Clean Energy Projects

Policy Recommendation #5
The EU must actively scale up and streamline financing mechanisms for clean energy projects to ensure they receive sufficient funding. Adequate investment is critical not only to guarantee the successful deployment of these projects, but also to unlock their full potential for workforce development and long-term job creation.

The EU faces a significant funding gap for its energy transition needs—estimated at €400 billion in annual investment needs by 2030—and must leverage more efficiently its existing financing mechanisms to accelerate and support the development of clean energy projects. Funding is already available: initiatives such as the Innovation Fund and the upcoming Decarbonisation Bank offer significant funding sources for cleantech manufacturing. However, it must be leveraged efficiently through specific tools to support the long-term deployment of clean energy projects, and job growth.

Work is already underway to streamline financing mechanisms. The EU has announced plans to revise its InvestEU regulation to increase risk-bearing capacity and mobilise an additional €50 billion to achieve its goals, including cleantech manufacturing development. Programs are being developed, such as the upcoming TechEU investment programme in partnership with the EIB (2026) to bridge the financing gap and support disruptive innovation in cleantech. Existing mechanisms, such as public-private partnerships (PPPs) are another example of a proven mechanism for accelerating investment and could be leveraged. They play a central role in ensuring that workers have the skills needed to meet labour demand across clean energy manufacturing, grid expansion, and emerging technologies such as hydrogen and battery storage (Finding #5 and #6). The EU should encourage Member States to launch national PPP frameworks with dedicated workforce programs in clean energy sectors—that draw on both public funding and private sector expertise—with particular focus on regions undergoing industrial transformation (Finding #4).

To make financing accessible, the EU must enact enabling regulations that facilitate access to blended finance tools for clean energy projects, including loan guarantees, public co-investment, and green bonds. These tools can de-risk private investment in workforce programs and clean energy infrastructure, while ensuring alignment with national and regional decarbonisation priorities. Structured correctly, such policies can reduce fragmentation, improve deployment speed, and support skill transfer from legacy industries to future-fit sectors (Finding #2).

Call to Action

Invest Now to Secure Europe's Clean Energy Future

Europe stands at a pivotal moment. The energy transition is not just about reaching net-zero. It is about industrial renewal, securing affordable and reliable energy, and global competitiveness. With the right and timely investments, the EU can lead the clean energy race by scaling domestic industries, rebuilding supply chains, and strengthening its economy. But, without immediate and palpable action to build the industries and skills needed for the transition, the opportunity will be lost—claimed by global competitors.

This report shows that decarbonisation is not only an environmental imperative but also an economic opportunity. A technology-inclusive strategy is the most effective and most realistic pathway to achieve Europe's climate, employment, and economic ambitions. Our modelling reveals that the EU can create 4.65 million net new jobs by 2050 through clean energy manufacturing, infrastructure buildout, and industrial supply chains: A gain that is 2.32 million jobs greater and ~500 billion EUR cheaper than what business as usual would deliver. These additional jobs are only possible if the EU adopts a technology-inclusive approach, which is both more cost-effective and delivers net-zero by 2050. The economic benefits will reach across the European economy from construction and utilities to advanced manufacturing and carbon management, creating a local value and strengthening European industry. Importantly, the success of this transition and the realisation of millions of clean energy jobs depends on immediate, targeted investment in demand-side sectors. Early action on retrofitting, electrification, and consumer-facing technologies is essential to catalyse the broader supply-side expansion and keep the EU on track for net-zero and employment goals.

Without clear policy alignment, large-scale investment, and strategic workforce planning, clean energy job creation will falter and Europe will fall behind global competitors. It is a choice on investment, skilled workers, and industrial strategy.

A diversified energy portfolio is not optional, it is essential. Over-reliance on a narrow set of technologies increases the risk of supply bottlenecks, price volatility, regional imbalance, and missed job opportunities. In contrast, a technology-inclusive and diversified approach reduces risk, lowers costs, diversifies job creation, and provides flexibility for EU Member States to contribute and benefit based on their unique conditions including factors like available resources and local culture. This is not just about energy policy, it is an economic insurance policy for Europe's future from geopolitical and market disruptions.

Failure to act with intensity will have consequences. Without a concerted and coordinated approach on both a Pan-European and Member State level, jobs will go elsewhere. Even worse, the EU will continue to over-rely on foreign supply chains compromising energy costs, security, and economic independence. Europe cannot afford to continue to be reactive on a matter of European security and prosperity.

To secure its clean energy future and climate goals, the EU must:

1. **Scale all clean energy industries from renewables to next-generation technologies to rebuild and future-proof the European industrial base.**
2. **Invest in workforce development to fill the demand for 4+ millions of workers across construction, manufacturing, infrastructure, and services.**
3. **Align climate, industrial, and labour policies through initiatives like the Clean Industrial Deal to ensure that emissions reductions also deliver economic opportunity.**

It is a decision with immediate and lasting consequences for current and, even more, future generations. The analysis in this report provides the evidence. The tools already exist. What is needed now is the resolve to act—together.
A technology-inclusive energy strategy is the only path that delivers on all fronts: climate ambition, job creation, industrial competitiveness, and economic security. Europe's clean energy future will not be won by rhetoric, but by decisive investments to scale, speed, and align. Now is the time to act—not just for climate—but to build a stronger, more independent European economy for decades to come.

Data & Methodology

This appendix chapter outlines the methodology used to estimate the direct, indirect, and induced employment impacts of decarbonisation across the European Union, based on the 2024 Annual Decarbonisation Perspective (ADP) developed by Carbon-Free Europe and Evolved Energy Research (EER). The modelling links decarbonisation investments to employment outcomes through a combination of energy systems modelling, investment classification, and input-output (I-O) analysis.

This approach allows us to quantify the labour effects of different decarbonisation pathways across regions, sectors, and technologies using a consistent economic framework. This chapter provides a foundation for interpreting the results and facilitates future updates as new inputs become available. All results have been reviewed and validated in close collaboration with EER.

Overview of Methodology

The employment impact assessment was conducted in three main steps:

1. Energy Systems Modelling: Generation of investment pathways through demand- and supply-side decarbonisation scenarios.
2. Energy Investment Classification: Translation of physical energy system investments into economic categories for job impact modelling.
3. Input-Output (I-O) Modelling: Quantification of job creation using industry-linked employment coefficients and multipliers.

A schematic of the full modelling chain is shown in Figure 7.
Direct, Indirect, and Induced Jobs

- **Direct Jobs** include employment in construction, plant operation, and professional services.
- **Indirect Jobs** include upstream supply chain jobs such as manufacturing, transportation, and utilities.
- **Induced Jobs** result from increased spending by workers employed in direct and indirect roles (e.g., retail, education, services).

Step 1: Energy Systems Modelling

The ADP's employment scenarios are built on robust energy modelling using two tools developed and operated by EER:

- EnergyPATHWAYS model (for demand-side dynamics): Models the transformation of the energy demand through fuel switching and efficiency measures across 105 distinct technologies. These are mapped to 19 economic product categories that reflect sectoral investment needs and labour intensity. For further details on the EnergyPATHWAYS model, we refer to the model website.
- Regional Investment and Operations (RIO) model (for supply-side infrastructure): Performs capacity expansion and hourly system operation modelling across 510 distinct supply-side technology categories. These categories are translated into capital and operational investment requirements for power generation, fuels, transmission, storage, and carbon removal technologies.

Figure 7: Method Flowchart – From Energy Systems Modelling to Job Impact Outputs

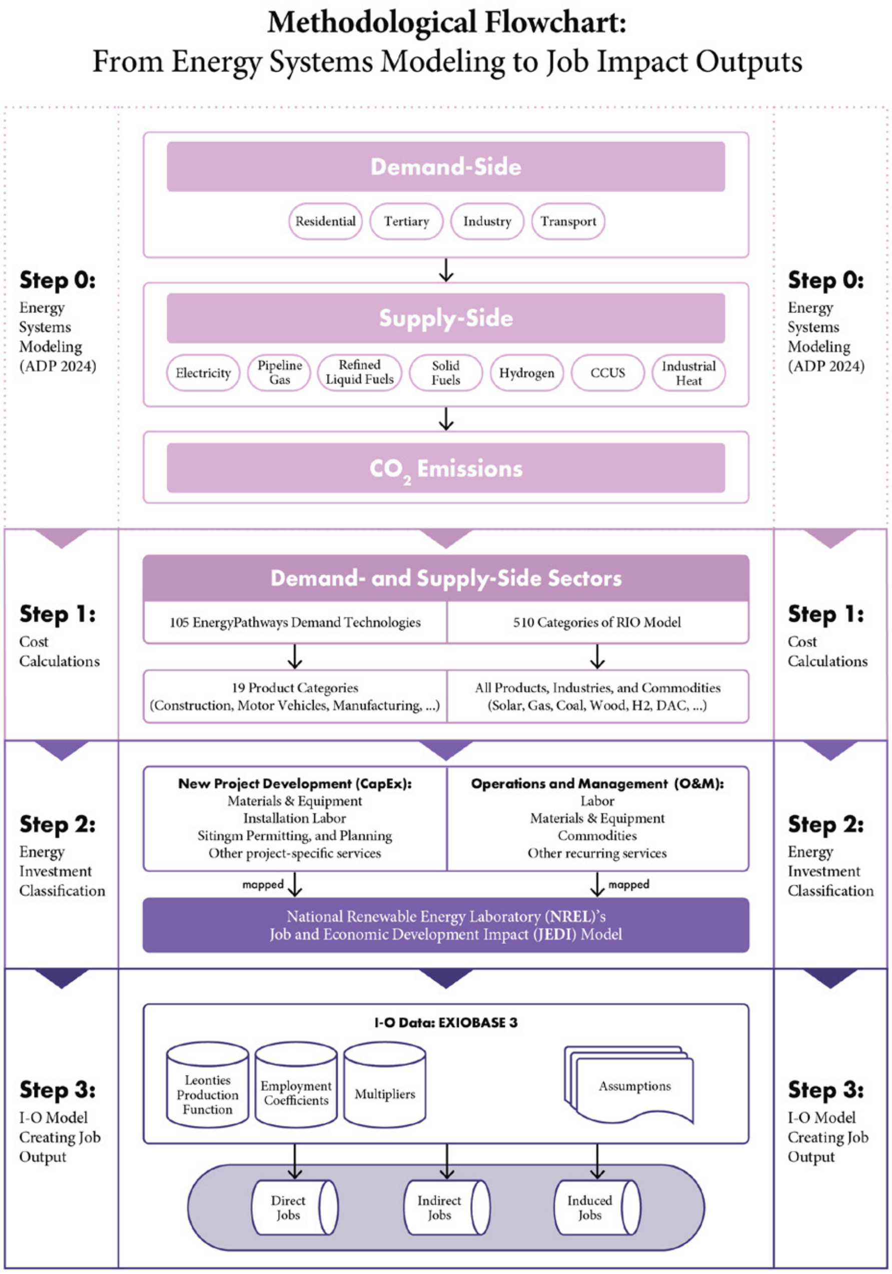

Figure 7. This flowchart illustrates the sequential steps used to calculate employment impacts from investments to reach a decarbonised energy economy. Starting with energy systems modelling, investment data is categorised and fed into a multi-regional input-output (MRIO) model, which applies economic relationships, employment coefficients, and multipliers to estimate direct, indirect, and induced job creation by year, country, sector, and technology.

The original ADP included a total of 12 scenarios which explore a different set of conditions to understand how changes in external factors such as economic growth, policy constraints, societal preferences, or technological adoption can impact the feasibility and outcomes of different pathways. For this employment impact assessment, we chose 3 scenarios to observe in deeper detail:

- Core Scenario: A high-ambition, cost-effective pathway to net-zero emissions by 2050, assuming rapid electrification and broad technological deployment.
- Baseline Scenario: A counterfactual pathway reflecting current policies and investment trends without accelerated decarbonisation efforts.
- Slow Electrification Scenario: A sensitivity scenario in which electrification and fuel switching is delayed by 20 years, requiring additional fossil backup and delaying industrial transformation.

The modelling results provide annual investment flows from 2025 to 2050 across all scenarios, segmented by year, technology, sector, and Member State.

Step 2: Energy Investment Classification and Sectoral Impact Modelling

To assess employment impacts, investment data from the ADP modelling is classified into economic categories reflecting how industries are affected by decarbonisation spending.

For new project development, investment costs are allocated into: Materials & Equipment, Installation Labour, Siting, Permitting, and Planning, and other project-specific services.

For operations and maintenance (O&M), expenditures are divided into: Labour (e.g., plant operation, technicians), Materials and Equipment (e.g., maintenance parts), Commodities (e.g., fuels or industrial inputs), and other recurring services.

These categories are mapped to industry-specific job impacts using the National Renewable Energy Laboratory (NREL)'s Job and Economic Development Impact (JEDI) models.[15] These models provide detailed industry breakdowns for solar PV, wind (onshore and offshore), biofuels, geothermal, and transmission infrastructure. Adjustments have been made to reflect European labour intensity and manufacturing conditions, using region-specific cost structures.

For emerging technologies, such as direct air capture (DAC) and hydrogen electrolysis, job profiles are based on cost and labour intensity estimates from Rhodium Group and Breakthrough Energy, with investment flows allocated into the same categories as above.

Step 3: Input-Output Modelling Approach

To convert investments into employment impacts, we apply multi-regional input-output (MRIO) analysis using the EXIOBASE 3 database (2022 version). EXIOBASE provides detailed economic linkages for 44 countries and regions, covering 163 sectors and 200 product classifications. EXIOBASE is developed and maintained by European research institutions, tracks inter-industry and international trade flows, provides sectoral and skill-level employment data, and supports estimations of both domestic and imported labour effects.
Model Structure and Key Concepts

- Leontief Production Function: Represents how much output each industry must produce to meet an increase in final demand.
- Employment Coefficients: Represent the number of jobs supported per unit of output for each sector.

- Multipliers: Capture the ripple effects across the economy as investments stimulate upstream and downstream activity.

Using this structure, the model calculates employment impacts per year, per country, per technology, and per sector, enabling deep analysis of job trends and regional distributions.

Assumptions and Limitations

The model rests on several assumptions:

- Linearity: Inputs (e.g., labour, capital) scale proportionally with output; industry structures remain constant over time.
- Stable Input Shares: The proportion of labour vs. capital in each industry is assumed to remain fixed.
- Learning Effects: Labour productivity improvements are incorporated via declining technology costs over time from energy systems modelling.
- No Input Constraints: Assumes that raw materials and labour can scale to meet demand, though feasibility checks were applied using demographic projections.
- Focus on Near-to-Mid-Term: While long-term projections are included, greater confidence is placed on shorter-term results, which are most useful for immediate planning.

Acknowledgments

This modelling effort was conducted in partnership with Evolved Energy Research (EER) who developed the underlying energy system pathways and investment scenarios. We thank EER for their methodological guidance, data access, and scenario expertise.

We also gratefully acknowledge the European Climate Foundation for their funding and support, which made this analysis and report possible.

Appendix

Table A1: Employment Growth by 2050 by EU Member State

Member State	Total Employment (2022, EXIOBASE)	Core - Net % Employment Growth by 2050	Base - Net % Employment Growth by 2050	Net Jobs due to Decarbonisation (Core - Base)
Austria	4,323,832	1.9%	0.3%	68,005
Belgium	4,970,030	2.9%	2.1%	38,987
Bulgaria	3,071,778	1.1%	0.9%	7,218
Croatia	1,653,770	1.6%	1.6%	-987
Cyprus	634,402	0.6%	0.6%	321
Czechia	5,069,266	4.2%	1.5%	134,091
Denmark	2,907,365	11.1%	1.6%	275,049
Estonia	653,527	2.3%	1.4%	5,592
Finland	2,579,123	5.8%	1.7%	106,777
France	28,423,723	2.2%	1.1%	297,127
Germany	42,459,612	1.4%	0.8%	260,053
Greece	3,956,735	1.6%	0.9%	25,103
Hungary	4,926,889	2.7%	0.4%	110,161
Ireland	2,484,258	2.0%	1.0%	23,408
Italy	23,062,735	2.1%	0.7%	324,217
Latvia	885,193	4.1%	1.4%	23,862
Lithuania	1,336,863	4.3%	1.4%	38,820
Luxembourg	319,977	4.3%	3.0%	4,111
Malta	241,109	0.2%	0.1%	150
Netherlands	9,299,144	1.2%	0.9%	25,801
Poland	19,057,872	2.9%	1.9%	184,500
Portugal	4,854,520	1.5%	0.9%	29,102
Romania	7,613,027	1.9%	1.2%	52,687
Slovakia	2,643,615	2.0%	1.3%	20,405
Slovenia	993,982	1.6%	1.1%	5,160
Spain	20,440,311	2.5%	1.7%	174,940
Sweden	5,295,720	2.7%	1.1%	84,449
EU27	**204,158,377**	**2.3%**	**1.1%**	**2,319,109**

Table A2: Employment Growth by 2050 by Industry in EU27

Industry	Total Employment (2022, EXIOBASE)	Core - Net % Employment Growth	Base - Net % Employment Growth	Net Jobs due to Decarbonisation (Core - Base)
Agriculture	13,619,229	0.5%	0.2%	41,300
Construction	14,037,665	8.6%	2.1%	921,791
Electrical Equipment	743,331	11.4%	7.3%	29,834
Fabricated Metals	4,965,968	6.6%	4.1%	124,883
FIRE	7,804,601	0.9%	0.6%	21,552
Government	14,511,451	0.5%	0.2%	49,946
Machinery	4,443,360	2.3%	1.2%	45,772
Manufacturing	4,416,196	16.8%	3.1%	604,391
Mining	1,659,537	-4.9%	1.6%	-107,644
Misc. Services	48,472,063	-0.2%	0.1%	-135,482
Professional Services	35,790,711	1.7%	0.7%	334,961
Retail Trade	11,716,267	1.8%	1.2%	64,405
TCPU*	24,534,890	2.2%	2.6%	-96,836
Wholesale Trade	17,443,107	4.5%	2.1%	420,148
Total	**204,158,377**	**1.9%**	**1.0%**	**1,898,873**

* TCPU = Transportation, Communications, and Public Utilities Sector

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