ERM

Socio-economic benefits of European e-SAF production

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Acronyms and ABBREVIATIONS

Acronym	Description
CAPEX	Capital Expenditure
CCS	Carbon Capture and Storage
CCUS	Carbon Capture, Utilisation, and Storage
DA	Delegated Act
EEA	European Economic Area
EU	European Union
ETS	Emissions Trading System
FEED	Front End Engineering Design
FOAK	First-of-a-kind
FID	Final investment decision
FT	Fischer-Tropsch
FTE	Full time equivalent
GHG	Greenhouse gas
GVA	Gross Value Added
MENA	Middle East and North Africa
MTJ	Methanol to Jet
OPEX	Operating Expenditure
PPA	Power Purchase Agreement
PtL	Power-to Liquid
RED	Renewable Energy Directive
RWGS	Reverse water gas shift
SAF	Sustainable Aviation Fuel
STIP	Sustainable Transport Investment Plan

Acronym	Description
TCI	Total Capital Investment
TEA	Techno-economic assessment
TRL	Technology Readiness Level
WACC	Weighted Average Cost of Capital

Executive Summary

This report was commissioned by Transport and Environment (T&E) to provide an evidence-based assessment of the wider socio-economic impacts of scaling up Electro Sustainable Aviation Fuel (e-SAF) production in Europe.

There is increasing pressure to decarbonise aviation in Europe (including the EU, EEA and UK). SAF mandates have been introduced, including specific sub-targets for e-SAF, under regulations such as ReFuelEU Aviation and the UK SAF mandate. While the environmental rationale for e-SAF is well established, there has been less analysis of the wider economic and industrial implications associated with the scale-up of e-SAF production in Europe.

The study quantifies investment requirements, economic value, employment effects, and broader system impacts associated with e-SAF production in Europe, using a combination of modelling, published data, and case studies of selected projects.

Key findings:

- **Investment and Economic Value:** Achieving 100% of mandated e-SAF targets by 2050 requires substantial investment, particularly in renewable energy, hydrogen production, and CO_2 capture. The estimated Gross Value Added (GVA) from capital investment could exceed €1.2 trillion by 2050, with ongoing operations contributing up to €49 billion in GVA per year.
- **Employment Effects:** Once operational, the sector could sustain up to 140,000 long-term jobs annually by 2050.Construction of e-SAF facilities could generate between 3.4 million and 6.7 million person-years of employment by 2050, depending on whether the share of European supply is 50% or 100% of mandated targets.
- **Skills and Workforce:** The transition to e-SAF production will require technical skills in engineering, plant operations, and renewable energy. However, evidence indicates persistent shortages of these key technical skills. Many skills from traditional industries (e.g. refining and petrochemicals) are transferable, but targeted training and reskilling programmes will be needed, such as those associated with the EU's Net Zero Academies.
- **Local Economic Impacts:** Case studies of e-SAF production projects in Teesside (UK), León (Spain), Normandy (France), and Brandenburg (Germany) showcase the potential local economic impacts, including job creation, investment, and workforce development. Each individual project has the potential to create several hundred highly skilled jobs, creating significant re-skilling and upskilling opportunities in these regions.
- **Energy Security:** In 2023, the EU-27 imported 35% of its kerosene and 96% of its crude oil used for EU jet fuel production. Increasing domestic e-SAF production is expected to reduce reliance on imported fossil jet fuel.
- **Wider System Impacts:** Scaling e-SAF production is expected to stimulate demand for renewables, hydrogen, and advanced manufacturing, with potential cost reductions for these adjacent sectors. Shared infrastructure and asset repurposing may offer additional efficiencies. The production of co-products (e.g., e-diesel, e-naphtha) alongside e-SAF can be used in other markets (e.g., plastic manufacturing, shipping).

Overall, this report highlights that scaling up e-SAF production in Europe could deliver significant economic and employment benefits, support energy security, and facilitate industrial transition. However, realising these outcomes will depend on continued policy support, investment, and targeted workforce development.

1. INTRODUCTION

1.1 CONTEXT

Europe's aviation sector is at a pivotal moment as it seeks to decarbonise in line with its decarbonisation/zero-emissions targets. Sustainable Aviation Fuels (SAFs), including e-SAF, are central to this transition. The ReFuelEU Aviation regulation and UK SAF mandate set clear mandates for progressive increases in SAF blending, including specific sub-targets for e-SAF.

While the environmental benefits of e-SAF are well recognised, its wider economic and industrial potential often receives less attention. Scaling up e-SAF production offers significant benefits, including:

- Creating high-quality jobs,
- Stimulating investment, and
- Strengthening Europe's existing industrial base, with positive spillovers into hydrogen, chemicals, and renewables.

With over half of global announced e-SAF capacity to date and strong policy support, growth in European e-SAF production could deliver substantial socio-economic advantages – from workforce upskilling to reducing reliance on imported fossil aviation fuels – reinforcing Europe's competitiveness in the global energy transition.

1.2 AIMS OF THE STUDY

This study aims to provide a comprehensive, data-driven assessment of the industrial opportunity presented by e-SAF in Europe for policymakers, investors, and industry stakeholders. The study covers all 27 EU Member States, plus Norway, Iceland and Liechtenstein (EEA countries) as well as the UK (hereafter referred to as "Europe").

The study examines the economic impact of e-SAF deployment, including annual revenue potential, direct and indirect job creation, and implications for workforce upskilling. Case studies of four planned e-SAF projects are included to highlight the local economic benefits of scaling up e-SAF production in Europe. The analysis also explores wider benefits for Europe, including evaluating the potential to reduce Europe's reliance on imported fossil aviation fuels and benefits to the wider energy system transition.

2. Investment requirements for e-SAF production

Many of the socio-economic benefits associated with the scale-up of e-SAF production in Europe are associated with the initial capital investment in the projects and sustained operational expenditure throughout the lifetime of a project. In this analysis, the investment requirements associated with a typical e-SAF value chain were estimated. This covered cost estimates for the renewable energy required to produce hydrogen, the hydrogen production, CO_2 capture and transport, electrolysis and fuel synthesis. This section outlines the methodology used to derive these costs for a typical e-SAF value chain, producing 100 kt/year e-fuels. This technology used here is based on the reverse water-gas-shift and Fischer-Tropsch (RWGS-FT) reactions, which has similar CAPEX to the alternative e-SAF technology, such as the methanol-synthesis and methanol-to-jet reactions (MTJ).[1]

Figure 1 represents the value chain for producing (SAF), highlighting the CAPEX costing boundary. It begins with flue gas being and water as feedstocks, supported by renewable electricity from wind and solar. Processing stages includes CO_2 capture, electrolysis for hydrogen production and storage, and the Reverse Water Gas Shift (RWGS) reaction to form syngas. This syngas undergoes Fischer-Tropsch synthesis to produce syncrude, which is then upgraded via hydrocracking into SAF, diesel, and naphtha. Electricity demand spans all major steps, which is all supplied by the renewable power plant.

Project developers and technology licensors assert that the Reverse Water Gas Shift–Fischer-Tropsch (RWGS-FT) pathway can achieve a Sustainable Aviation Fuel (SAF) selectivity of approximately 75% (i.e. 75 kt/year SAF from a 100kt/year e-fuel plant) without requiring additional co-product upgrading steps, such as naphtha reforming. Should naphtha reforming become necessary, its inclusion would fall within the uncertainty range typically associated with Class 5 cost estimates for the CAPEX of the e-fuels production chain. A Class 5 CAPEX estimate typically occurs in the pre-feasibility stage of a project is an early-stage and is typically derived from correlations of cost and flow parameters (Appendix 8.1).

2.1 Value chain cost modelling approach

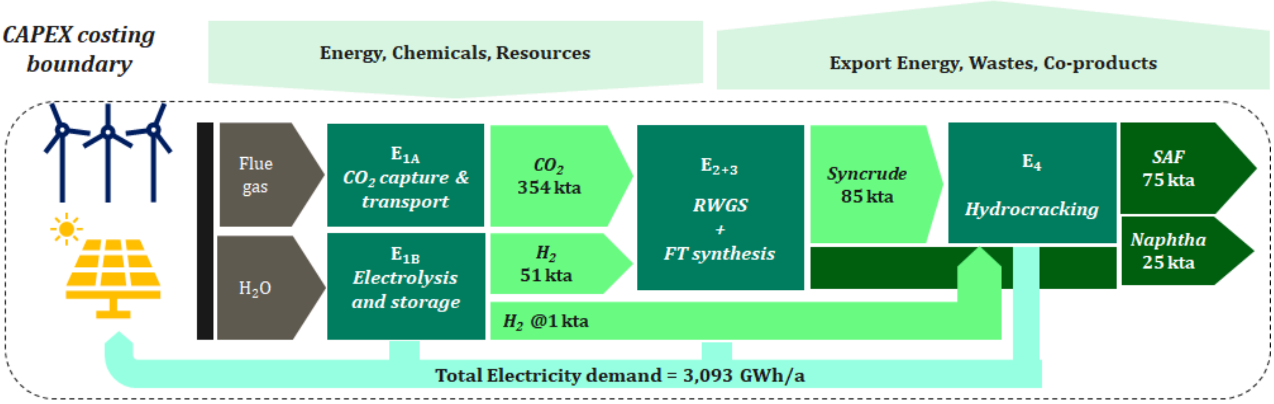

Figure 1: Border THE E-fuels production CHAIN and system flows

The components of the production chain for e-fuels production are shown in Figure 1. The following approach was taken to derive the capital and operating costs:

1. *Technical data for each element in the chemical conversion train*

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[1] This assumes that 54% (wt) of the product slate is e-SAF. This is a conservative estimate, and many e-fuel project developers are aiming for a higher fraction of e-SAF.

Mass and energy balances were derived from a combination of published literature and internal modelling approaches. Each element has a set of products and feedstocks, and may also have energy utility, chemical or resources flowing inwards and wastes, export energy or co-products flowing outwards.

2. *Economic data of each element in the chemical conversion train*

   Capital and fixed operating costs for each major process were estimated using developer announcements, literature, and industry reports, and checked against ERM's internal knowledge.

3. *Production chain modelling*

   The technical and economic data of each element is scaled to meet a specified production scale of the last element (i.e. 100 ktpa e-fuels). This process scales all intermediate products and primary feedstocks, as well as cross boundary flows. The aggregated flows across the boundary are combined with unit costs, such as energy, waste disposal or chemical costs, to arrive at total variable operating costs while the intermediate stream flows were used to determine the CAPEX of each element in the value chain. This CAPEX formulations are shown in Appendix 8.1.

For all elements in the production chain model, the sources used to derive the mass, energy and capital cost data, are detailed in Appendix 8.2.

2.2 SYSTEM FLOWS

Figure 1 also summarizes the material and energy flows across the e-SAF value chain, highlighting the connectivity of flow vectors between processing elements, as well the scales . The production chain requires a renewable electricity input of 3,093 GWh/year, with electrolysis being the most energy-intensive stage. The major material inputs include 354 kta of biogenic CO_2 captured from flue gas and 51 kta of H_2 produced from water. These components are used for syngas production via RWGS and subsequent Fischer-Tropsch synthesis to produce 85 kta of intermediate product, syncrude, along with 20 kta of naphtha. Finally, the refining and hydrocracking of the syncrude delivers 75 kta of SAF as the primary output and a naphtha stream of 6 kta as a co-product.

2.3 CAPEX AND OPEX RESULTS

Figure 3 shows the capital investment distribution for six major components in the e-fuels production chain. Each cost component is split into equipment and delivery costs, and other direct and indirect costs. A detailed breakdown of this cost structure is given in Appendix 8.3.

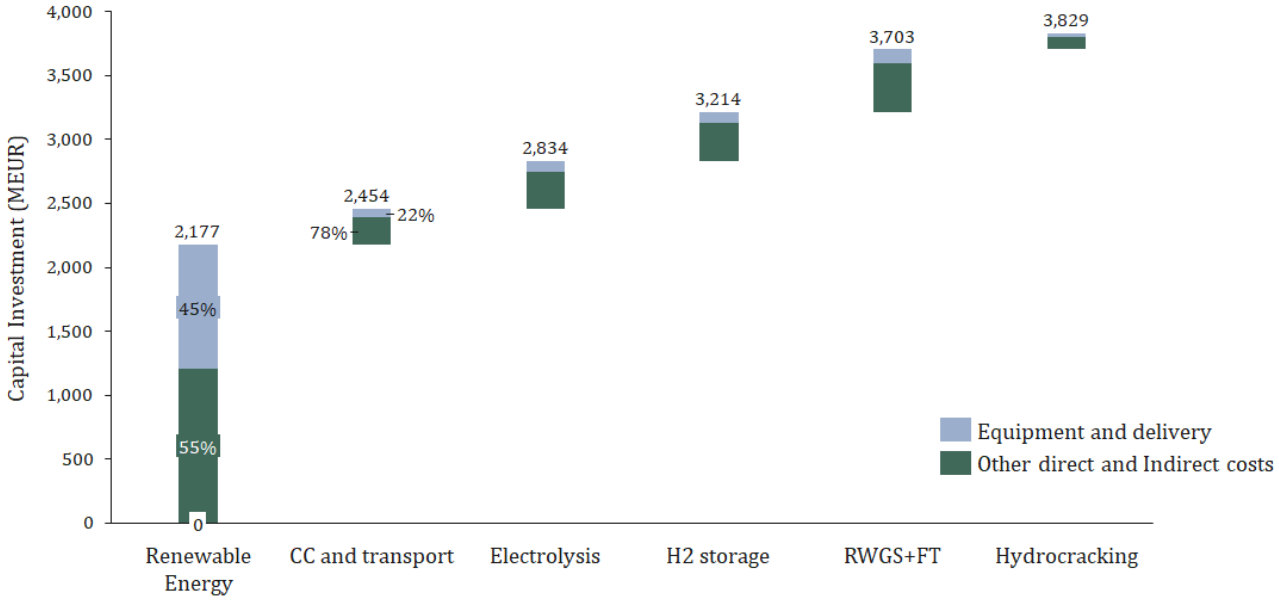

Figure 3: Capital investment cost build-up accross the e-fuel synthesis production chain

The total capital investment (TCI) starts at €2,177 million for the renewable energy generation and reaches €3,829 million at the end of the production chain, where the hydrocracking plant is installed. The CAPEX estimates that we have based our calculations on are at a Class V level of accuracy (-50% / + 100%), which is standard practice for this type of work. As such, the TCI of the whole value chain could be as low as €1,914 million or as high as €7,658 million. All subsequent assumptions are based on the best estimate for TCI (€3,829 million) but it is important to note the large potential range of TCI and the impact this has on later estimates of Gross Value Added (GVA) and jobs.

The investment costs for renewable energy generation make up 57% of the TCI, and is assumed to be a combination of solar, onshore and offshore wind installations, each contributing 43%, 41% and 16% of renewable energy required. The proportions of energy contributed are based on the typical mixture of these renewables for a stable grid in the South-Central EU (Concawe 2024[2]). The CAPEX values of renewable generation are typically the highest in a e-fuels value chain because they have the lowest utilisation rates, as inferred by the capacity factors (See appendix 8.2).

Renewable energy costs contributions are followed by the PEM electrolysis plant and hydrogen storage facilities, which together make up 20% of the TCI. Here we have assumed limited utilisation of the PEM electrolyser (following the capacity factor of 45%) and 5 days of storage required for full load operation of the e-fuels plant (Concawe 2024[3]), based on plant in the long term having dedicated renewables. The combined chemical conversion plants, which is the RWGS+FT and hydrocracking plants, contributes 13% of the TCI. The primary cost driver behind these elements is the RWGS reaction process, which is still a nascent technology. Lastly, the carbon-capture unit, which is the most mature technological element of the e-fuels

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[2] Concawe (2024): E-Fuels: A technoeconomic assessment of European domestic production and imports towards 2050 – Update [Link]

[3] Same as reference above

production, makes up the remaining 7% of the TCI. For the carbon-capture, hydrogen and chemical conversion plants, the costs of equipment and delivery are, on average, only 22% of the investment costs of each individual element of the e-fuels production chain, with the majority (78%) being other direct and indirect capital costs such as piping networks, control systems and infrastructure. The contribution of indirect costs for the renewable energy facilities is below 55%.

The investment requirements for green H_2 and its associated renewable energy supply for an e-fuels plant are comparable to the equivalent facilities needed for ammonia and e-methanol plants of a similar scale.[4] On the other hand, the investment for green steel manufacturing may be an order of magnitude higher, given that ~50 kta of green H_2 is required for a 100 kta e-fuel plant while a typical steel mill in the EU will demand about 200-300 kta.[5]

The investment requirements for CCU in e-fuels production is expected be in a similar order of magnitude as for CCU in urea and methanol production. Modern urea plants have a typical production capacity of 1 Mta, requiring about 0.7 Mta of CO_2[6] while about 0.35 Mta is needed for e-fuels plant. Similarly, e-methanol plants are expected to have an average capacity range of 0.2-5 Mta, corresponding to a demand of 0.3-0.7 Mta of CO_2.[7]

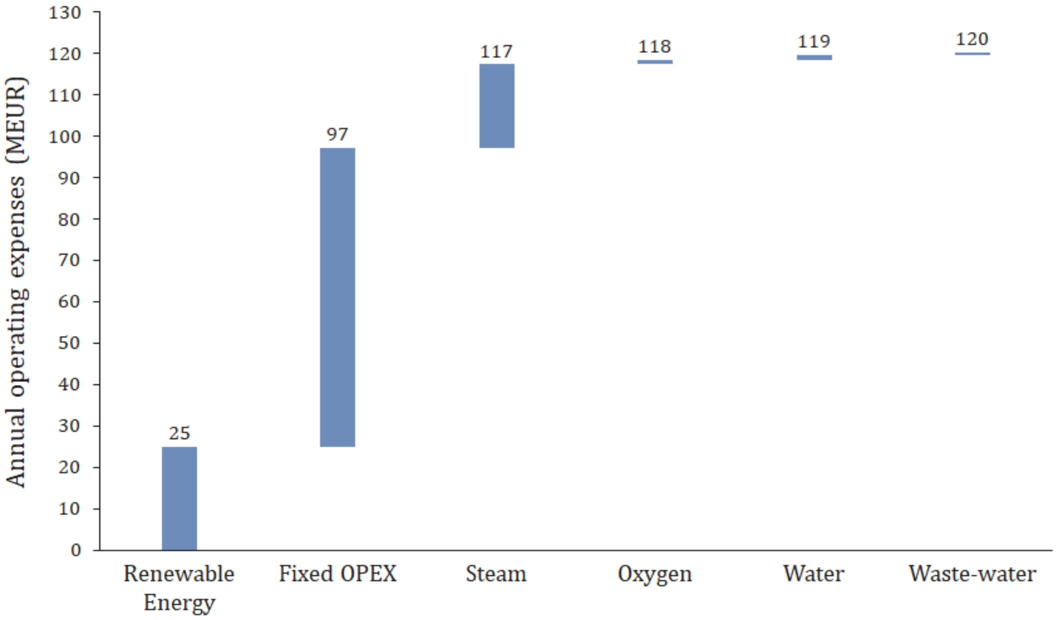

Figure 4: OPEX buildup accross the e-fuels production chain

Figure 4 shows annual operating expenses (OPEX) profile of key cost components in e-fuel production. The largest contributor at €72M is the combined fixed operating expenses of the carbon-capture, hydrogen production and the chemical conversion elements. This cost is primarily driven by the costs of replacing the electrolysis stack, which will occur at least once

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[4] ICS (2024): Turning Hydrogen Demand Into Reality: Which Sectors Come First [Link]

[5] Typical steel mill in Europe is about 4 mta, requiring 50 to 80 kg H2 per tonne of steel. (Hydrogen Europe: steel from solar energy [Link])

[6] Ureaknowhow.com (2010): World scale urea plants [Link]

[7] Based on capacities of planned e-methanol plants.

in the project lifetime. Other general expenses like maintenance, labour and overheads are also included. Following the fixed OPEX of the carbon-capture to e-fuel production stages is the renewable facility OPEX at €25M, which is driven primarily by maintenance costs. The variable OPEX quantifies the costs of resources, such as utilities and wastes disposal. The cost of the low-pressure steam that is required for the carbon-capture plant at €20M dominates the variable OPEX, whilst the remaining costs components such as wastewater treatment (€0.8M), oxygen (€1M), and water (€1M) are minimal.

3. SOCIO-ECONOMIC BENEFITS OF E-SAF PRODUCTION IN EUROPE

Scaling up e-SAF production in Europe has the potential to unlock billions in annual revenue, generate substantial Gross Value Added (GVA), and create thousands of high-quality jobs across the e-SAF value chain. This section quantifies these benefits, highlighting the potential impact on European employment and investment.

Quantifying revenue potential, GVA and job creation first requires the ramp up of European e-SAF production to be quantified. In this analysis, we have estimated production of e-SAF in the EU-27, EEA and UK (Europe) for two years (2030 and 2050) based on two cases:

- **100% PtL sub-target:** European production meets all (100%) of the mandated volumes from the ReFuelEU Aviation and UK SAF mandates[8]
- **50% PtL sub-target:** European production meets 50% of the mandated volumes

The first case where European production supplies all of its own demand is supported by T&E's database of planned e-SAF production projects, which indicates that European production could meet all mandated volumes by 2030.[9] The second case represents a case with competition from non-EU producers, which may limit Europe's share of total supply, as discussed further in Section 5. The volumes of e-SAF under each of these scenarios are compared with the total anticipated jet fuel demand in 2030 and 2050 in Figure 5.

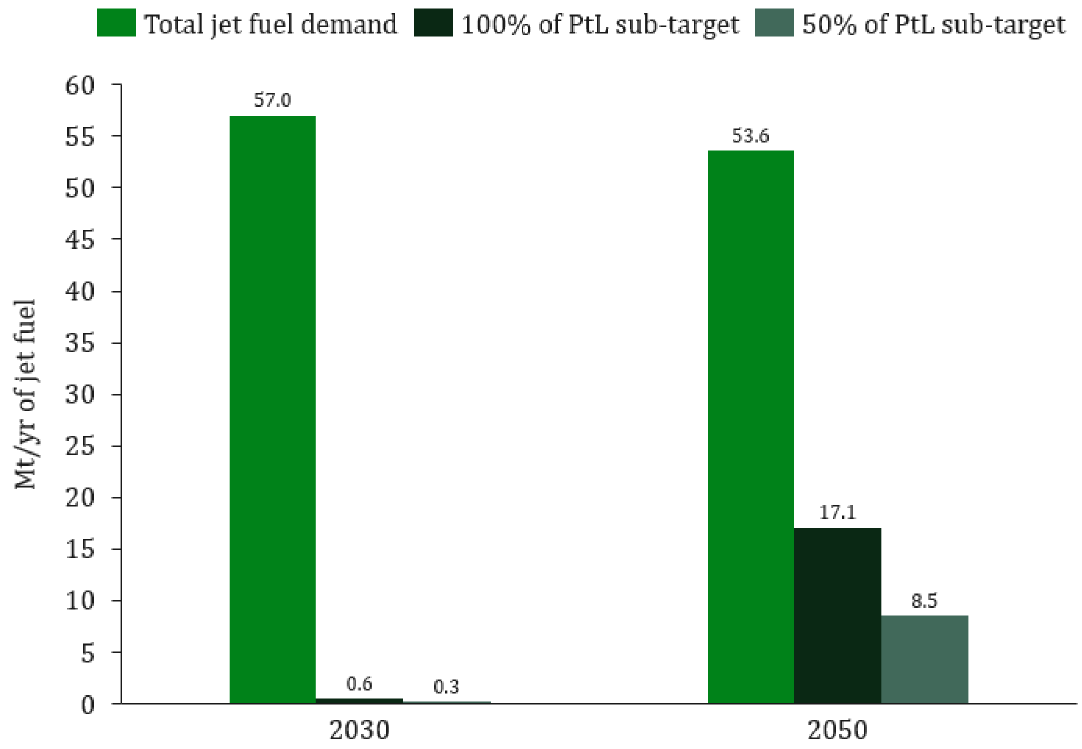

FIGURE 5: SCENARIOS FOR THE SCALE OF E-SAF DEPLOYMENT IN EUROPE

Another factor which will impact the socio-economic benefits of e-SAF production is the fraction of spend retained within Europe (for example, through sourcing of equipment and services

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[8] Given that the UK SAF mandate does not have a 2050 target, this scenario is based on extrapolation from the 2040 target

[9] T&E CO2 Transport (2025): CO2 Transport for e-Fuels Production in Europe [Link], T&E Database [Link]

from within Europe). If larger fractions of components are imported, this will reduce European socio-economic benefits. For example, up to 90% of commissioned wind projects in Europe have installed European-manufactured wind turbines.[10] On the other hand, 75% of solar panel modules are manufactured in China so it is likely a large fraction of these will be imported into Europe.[11]

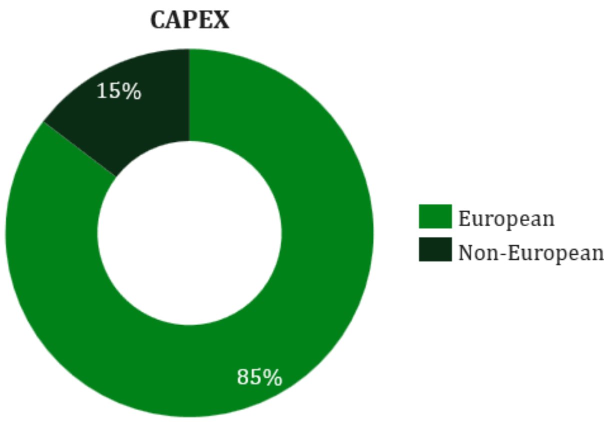

Figure 6: Fraction of Capital expenditure assumed to be spent within europe vs outside of europe

Figure 6 shows the fraction of capital expenditure from the e-SAF production value chain which is assumed to be spent within Europe (85%), compared to outside of Europe (15%). It is assumed 100% of operational expenditure occurs within Europe. More detail on the modelling of these socio-economic benefits and key assumptions can be found in Appendix 8.5.

3.1 Annual Revenue Potential

The future price of e-fuels in Europe is uncertain, and will depend on multiple factors including national penalties, production costs, and the supply demand balance. We have assumed here that e-fuels market revenues, plus any public subsidy support, is sufficient to cover production costs associated with the entire value chain. The estimated production cost for e-SAF at a typical European plant is approximately **~€6,000/tonne e-SAF.** On this basis, the annual revenue potential from e-SAF production in Europe could reach **over €100 billion by 2050**, if European production meets all (100%) of the mandated volumes from the ReFuelEU Aviation and UK SAF mandates (Table 1). A portion of this revenue may be underpinned by public subsidies, through direct grants (e.g., the UK's Advanced Fuels Fund[12]) or double-sided auctions (e.g., the EU's Sustainable Transport Investment Plan[13]), which help bridge the gap between production costs and market prices.

It is expected that long term offtake contracts will be needed for e-SAF plants to achieve FID. Given that these offtake contracts will likely involve pricing mechanisms that reflect production costs (e.g. cost-plus pricing), it is unlikely that revenues will be significantly higher than production costs.

Table 1: Annual revenue potential from e-SAF production

	2030	2050

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[10] WindEurope (2024): Wind energy in Europe [Link] (Page 39)
[11] IEA: Solar PV Global Supply Chains [Link]
[12] GOV.UK Press release (2025): £63 million lift-off for clean aviation fuels [Link]
[13] European Commission (2025): Sustainable Transport Investment Plan factsheet [Link]

50% PtL sub-target	€1.8 billion	€51.8 billion
100% PtL sub-target	€3.7 billion	€103.5 billion

3.2 Gross Value Added (GVA)

Gross Value Added (GVA) measures the contribution of a sector or activity to the economy by calculating the value of goods and services produced, minus the cost of inputs. It reflects how much economic output is generated from the build out of the value chain to support e-SAF production in Europe. Whether capital comes from public subsidies or private sources, the GVA impact remains the same because it captures the value created within the economy. However, if public money is spent on alternative causes, the GVA generated from this public money may be higher or lower than public money spent on e-SAF, depending on exactly what the public money was spent on.

Total GVA is comprised of two parts:

- **Direct GVA** refers to the economic value generated by activities within the e-SAF production chain, such as the construction and operation of the facilities themselves.
- **Indirect GVA** captures the additional value created in supporting sectors such as equipment manufacturing, supply of construction materials and logistics services.

Broadly, the magnitude of GVA generated scales with the magnitude of investment. For example, if the TCI into the e-SAF value chain is 100% more than estimated in Section 2, the associated GVA generated would approximately double. Similarly, if the TCI into the e-SAF value chain is 50% of that estimate in Section 2, the magnitude of GVA would be approximately halved.

In addition, within this report the GVA created from the initial capital investment in facility development associated with e-SAF production (Figure 7) has been distinguished from GVA created from ongoing operation expenditure during the phase where e-SAF and other e-fuels are produced (Figure 8). This distinction matters because capital investment generates a one-off surge in economic activity over several years during the construction phase, whereas operational expenditure drives recurring value over the lifetime of the facility. Separating these effects helps to distinguish between the immediate impact on the economy from a surge in construction and the sustained benefits to regional economies over the lifetime of the projects within the value chain.

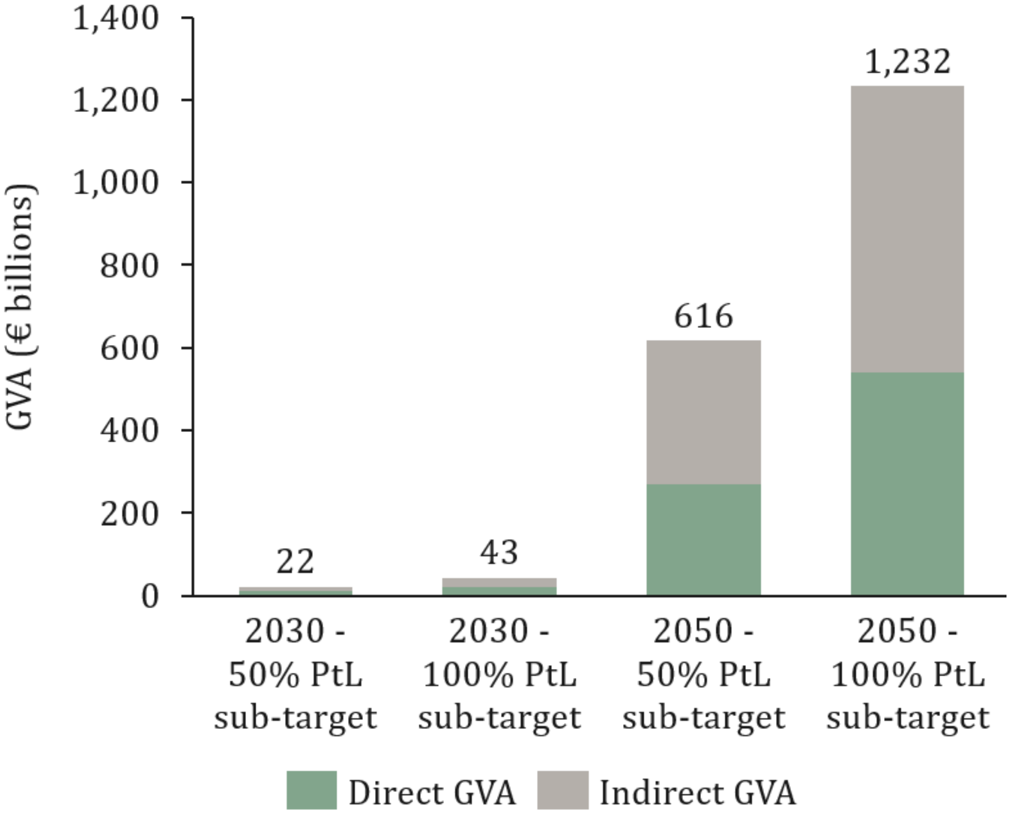

Figure 7: Gross Value Added to europe from capital investment over several years in e-saf facility development and construction

Figure 7 illustrates the Gross Value Added (GVA) to Europe resulting from cumulative capital investment in facility development and construction under different PtL sub-target scenarios for 2030 and 2050. The economic contribution rises sharply over time, from €22 billion in 2030 to €616 billion at a 50% PtL sub-target scenario.

Under the scenario where 100% of the e-SAF needed to meet the PtL sub-target in 2050 is produced in Europe, investment associated with the e-SAF production value chain over the years between now and 2050 would lead to over €1.2 trillion (€1,200 billion) in GVA.

Figure 8: Gross value added per year from ongoing operational expenditure in e-SAF production

Figure 8 shows the annual GVA generated from ongoing operational expenditure (OPEX) during the production phase under different PtL sub-target scenarios. Unlike the one-off impact of capital investment, these values represent recurring economic contributions year after year. The chart shows GVA rising from €0.9 billion annually in 2030 to €24.5 billion under a 50% PtL scenario and €49.1 billion at 100% PtL deployment by 2050. Under this 100% PtL deployment scenario, the GVA per year associated with operations in the e-SAF production value chain (€49.1 billion) would be a similar magnitude to the current GVA per year of Slovenia (€40.6 billion).[14]

Variations in the total spend can influence the amount of GVA generated. In this analysis, it has been assumed that new e-fuel production will require additional renewable capacity to be built, in line with the additionality requirements set out in the Delegated Act.[15] However, in some countries with highly renewable grids, additionality rules will not apply, and so e-fuel production could occur without significant new build of renewables, meaning the GVA impacts could be halved. This is because renewables account for approximately half the investment requirements considered in this study. A breakdown of GVA by component of the e-SAF value chain is included in Appendix 8.7.

The shift towards e-SAF production may reduce demand for fossil jet fuel in Europe, but the negative impact on wider European GVA is likely to be modest. Since most the of GVA associated with fossil jet fuel lies upstream in crude oil production, which is largely outside

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[14] Where Slovenia's GVA is $47.4 billion per year, assuming an exchange rate of $1: €0.856 – (Word Bank, Gross value added at basic prices (GVA) (constant LCU) - European Union. [Link])

[15] EU EUR-Lex: Delegated regulation - 2023/1184 [Link]

Europe, any changes in GVA are likely to predominantly impact the refining sector. Furthermore, jet fuel accounts for only around 6% of refinery output. Typically, decisions on refinery closures are driven more by declining gasoline and diesel demand than by jet fuel production. The road fuel market is the main market for refinery fuels, with around ~20% of output being gasoline and ~40% being diesel and gasoil. Therefore, trends such as the electrification of light and medium duty vehicles are more likely to have a meaningful impact on demand for European refined products, compared to jet demand. The International Energy Agency (IEA) estimates up to 1–1.5 million bpd of refining capacity could be at risk by 2030 as demand falls.[16] Therefore the impact of increased e-SAF production on refinery GVA is unlikely to be significant. E-SAF production creates new economic activity from capital and operational investment in the value chain, partially offsetting any potential decline in refining GVA.

3.3 Direct and Indirect job creation

Job creation is one of the most visible socio-economic benefits of e-SAF value chain deployment. This analysis includes:

- **Direct jobs** for example associated with plant construction and operations, and
- **Indirect jobs** in supporting sectors such as logistics, equipment manufacturing, and utility supply.

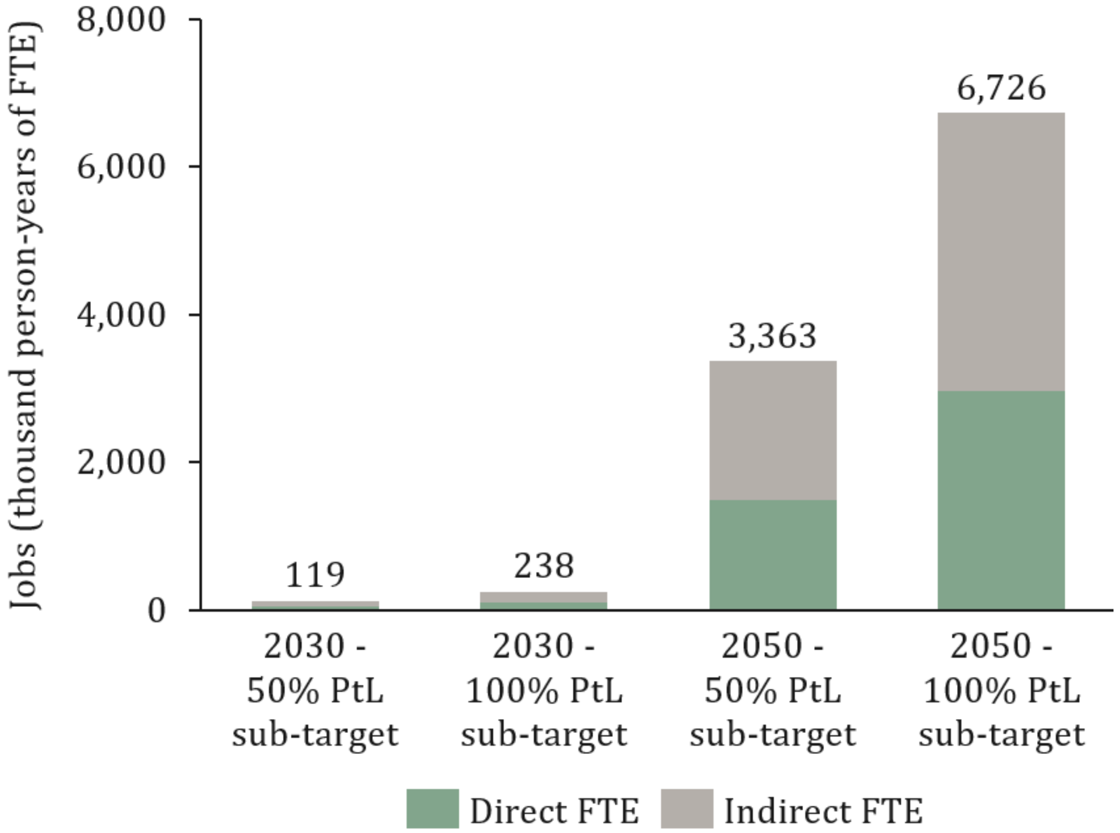

Figure 9: Jobs created in EUROPE FROM CAPITAL INVESTMENT OVER SEVERAL YEARS IN E-SAF FACILITY DEVELOPMENT AND CONSTRUCTION

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[16] S&P Global (2024): Europe's refining sector braces for major downsizing as margins stall [Link]

Figure 9 shows the cumulative jobs created in Europe from capital investment in facility development and construction, across the e-SAF production value chain, under different PtL sub-target scenarios for 2030 and 2050. The jobs that arise for capital investment are predominantly in the construction phase of a project, so will be temporary over the 3-4 years that it takes to construct the components of the value chain. Therefore, the results in Figure 9 are shown in terms of person-years of full-time equivalent (FTE). One person-year FTE represents one person, working one job full time for one year. Therefore, if the construction of the e-SAF production value chain is assumed to span over 3 years, the same person will account for 3 person-years of FTE.

During the period of capital investment for a typical e-SAF production value chain generating 75 ktpa e-SAF, ~13,000 direct and ~16,000 indirect person-years of FTE are expected to be generated.

Considering employment impacts across Europe, these are anticipated to rise significantly over time, from 119 thousand person-years FTE at a 50% PtL share in 2030 to over 6.7 million person-years FTE at full PtL deployment by 2050. This illustrates the scale of short-term employment stimulus linked to infrastructure build-out.

In the EU, around 15 million people are directly employed by the construction sector.[17] Under a scenario where 100% of the 2050 PtL sub-target is met by European production, there are estimated to be 2.95 million direct person-years FTE employment created. If all build out to support the e-SAF production value chain were to occur over a 5-year period, this could account for up to 3.9% of construction jobs in the EU.

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[17] EBC Construction: Facts & Figures [Link]

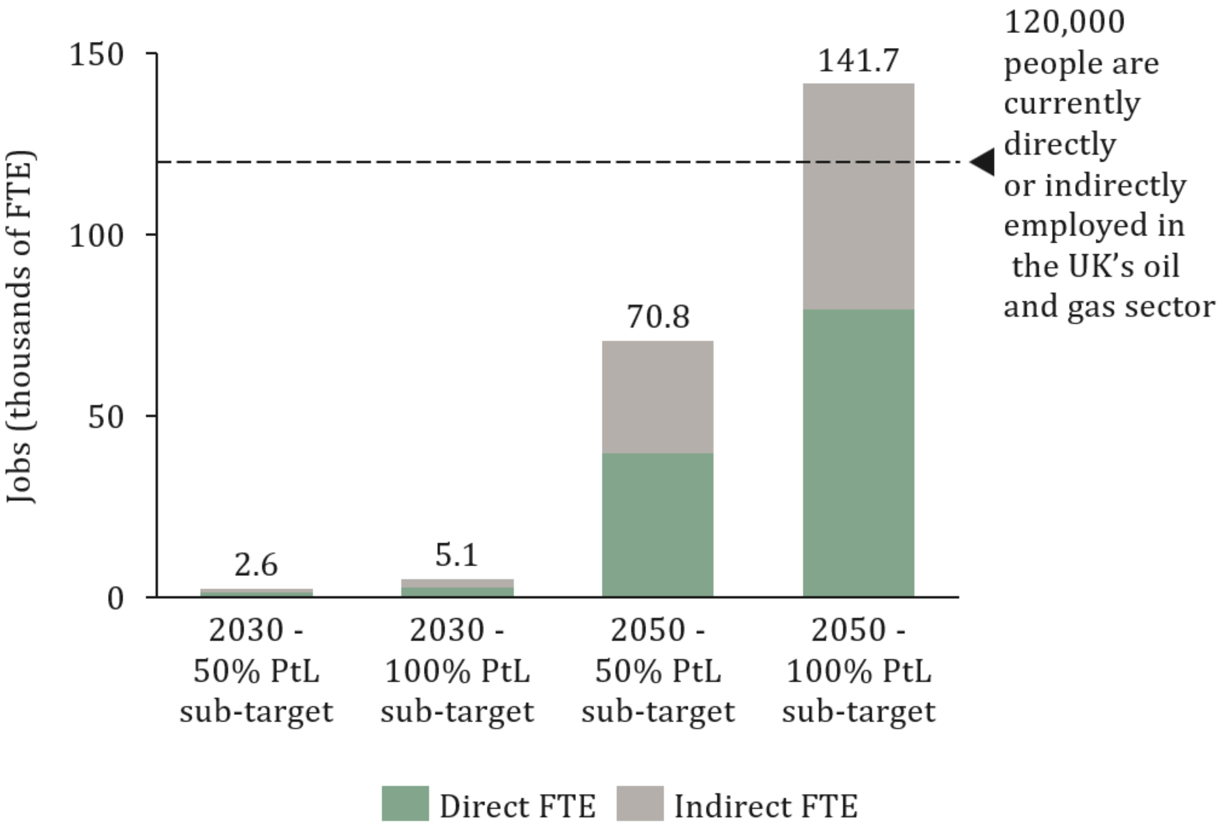

Figure 10: Long-term jobs sustained through ongoing operations at e-SAF production plants[18]

Figure 10 illustrates the number of jobs sustained annually through ongoing operations at production plants in the e-SAF value chain under different PtL sub-target scenarios. Unlike the one-off employment impact from construction, these roles represent permanent positions that support continuous e-SAF production. Direct jobs include plant operations and maintenance, while indirect jobs arise in supporting sectors such as steam/water supply, logistic services and insurance.

During ongoing operations for a typical e-SAF production value chain generating 75 ktpa e-SAF, ~300 direct and ~250 indirect jobs are expected to be sustained. Across Europe, Figure 10 shows a sharp increase from 2,600 jobs in 2030 to 70,800 jobs at a 50% PtL share and 141,700 jobs sustained at full PtL deployment by 2050.

For context, the dashed line compares these figures to the UK's oil and gas sector, which currently employs around 120,000 people, highlighting the scale of employment opportunities created in the long term. Under the scenario where 100% of the 2050 PtL sub-target is met by European e-SAF production, the number of direct and indirect jobs created (141,700) is approximately 10% the number of workers currently associated with the manufacture of chemicals and chemical products in the EU (1,368,000).[19]

Increasing investment in the e-SAF production value chain creates opportunities for the renewable energy sector, as the build-out of renewable energy generation capacity accounts for roughly half of the total investment considered in this analysis. Where low-carbon

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[18] GOV.UK (2025): Clean Energy Industries Sector Plan [Link]

[19] EUROSTAT: Employed persons by detailed economic activity (NACE Rev. 2 two-digit level) (2008-2026) [Link]

electricity generation capacity is already in place, the number of jobs created that are associated with e-SAF production could be halved. Additionally, prioritising local suppliers and contractors will boost job creation, while relying more heavily on imported equipment or services will limit the number of jobs which could be created from the scale-up of e-SAF in Europe.

Similarly to GVA, even as EU-produced fossil kerosene is displaced by e-SAF, this may not immediately lead to a reduction in EU based refining jobs. Given that fossil jet fuel is only a minor percentage of a typical refinery's output, a reduction in fossil jet production may therefore not have an immediate impact on European refining jobs.

3.4 Upskilling and reskilling opportunties

Alongside GVA and job creation, there will be upskilling and re-skilling opportunities associated with the scale-up of e-SAF production in Europe. The transition to large-scale e-SAF facilities will require a workforce equipped with a wide range of skills, including (but not limited to) in:

- **Electrical, mechanical, and civil engineering** needed to construct wind and solar farms and other components of the e-SAF value chain (e.g., electricians, grid line workers, solar PV installers [20]).
- **Process engineering** needed to understand the chemical processes, mass and energy balances, and optimisation of production systems (e.g., engineers and technicians specialising in chemical processes,[21]).
- **Plant operations and maintenance** across the e-SAF value chain including operations of wind/solar farm, hydrogen electrolysers, carbon capture units, and fuel synthesis plants.
- **Construction** and enabling works for the value chain such as welding, joining, construction management and health and safety workers.[22]

However, across Europe there is consistent evidence of shortages in key technical occupations critical for the e-SAF production chain. For example:

- CEDEFOP's report on "Meeting the skills needs for the green transition"[23] highlights the large numbers of online job adverts relating to green roles, particularly for electric power generation engineers and renewable energy consultants.
- Germany's BIBB analysis emphasises that occupations in mechatronics, energy electronics and electrical engineering take significantly longer to fill than other roles, indicating shortages in skills for these roles.[24]
- In Italy skills shortages in STEM occupations are widely recognised as a persistent challenge.[25]
- The IEA identifies skilled trades as the most constrained roles, particularly electricians, grid line workers, solar PV installers, pipe and gas fitters as well as welders.[20]

All these skills will be vital for future scale-up of the e-SAF value chain, highlighting the need for targeted training programmes such as apprenticeships and other technical training schemes. Programmes such as the EU's Net-Zero Industry Academies are already preparing

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[20] IEA (2025): World Energy Employment [Link]
[21] Green Skills for Hydrogen (2023): European Hydrogen Skills Strategy [Link]
[22] CEDEFOP (2021): The green employment and skills transformation [Link]
[23] CEDEFOP (2025): Meeting skill needs for the green transition [Link]
[24] BIBB: FAQ - Shortage of skilled workers [Link]
[25] CEDEFOP (2016): Italy: Mismatch priority occupations [Link]

workers for low-carbon careers (see case study box for more details). Expanding these programmes and tailoring them to the e-SAF production value chain will be key to addressing skills gaps and building an inclusive workforce.[26]

Case study - EU Net Zero Industry Academies: [27]

The Net Zero Industry Academies initiative forms a significant component of the EU Commission’s strategy to train Europe’s workforce for the net-zero economy and were established as part of the Net Zero Industry Act.[28] The Net-zero Industry Academies are organisations, consortia or projects with three main functions, to:

1. Develop learning programmes, content and learning and training materials for training and education.
2. Roll-out content via local education and training providers (ranging from businesses to vocational education and training centres to social partners such as trade unions), depending on local needs.
3. Develop credentials for education and training providers, in order to facilitate the transferability between jobs and the cross-border mobility of the workforce.

Each Net-zero Industry Academy **aims to train 100,000 learners within three years** from their establishment. The following academies are relevant to support the e-SAF value chain:

- **Solar Academy** launched in December 2023 to address the estimate need for 66,000 manufacturing jobs in the value chain by 2030.[29]
- **Hydrogen Academy** was launched in January 2024 to address the needs of the 180,000 skilled workers that are estimated to be needed by 2030.[30]
- **Wind Academy** is currently in development.

More academies may also be launched in the future, depending on the specific needs that will emerge in key net-zero technology sectors in the coming years.

At the same time, many skills from traditional industries such as oil and gas, chemicals, and manufacturing are highly transferable to the e-SAF production value chain. Workers with experience in plant operations, safety, engineering, and logistics can transition into new roles with targeted reskilling. For example, H2VE provides electrolyser installation courses at their Centers of Vocational Excellence in Italy, Greece, Germany, Poland and Latvia.[31] Similarly, the MiCRET project is developing stackable micro credentials in system installation, grid integration, health & safety, and smart-digital skills for European workers looking to upskill themselves as renewable energy technicians.[32] Upskilling is particularly important for regions experiencing de-industrialisation, where e-SAF projects can provide opportunities by converting existing industrial expertise into future-proof jobs.

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[26] IEA (2022): Skills Development and Inclusivity for Clean Energy Transitions [Link]

[27] EU-EC (2024): GROWTH - With the Net-zero Industry Academies, the Commission acts to train Europe’s workforce for the net-zero economy [Link]

[28] EUROPEAN PARLIAMENT AND OF THE COUNCIL (2024): Regulation (EU) 2024 [Link]

[29] European Solar Academy: Urgent demand for solar skills in Europe [Link]

[30] HyAcademy [Link]

[31] H2VE [Link]

[32] Micret: The Project – MiCRET [Link]

By investing in accessible training, apprenticeships, and reskilling initiatives, the e-SAF sector can support a diverse workforce and ensure that the benefits of the clean energy transition are widely shared. Aligning these efforts with EU Just Transition policies and national workforce strategies will help promote inclusive growth and social resilience across Europe. Examples of upskilling and reskilling opportunities at planned e-SAF production plants are described in more detail through the case studies in the next section.

4. Case studies

In this section four leading projects are presented to showcase the local economic and industrial benefits of scaling up e-SAF production in Europe.

4.1 Project Skyfuel Teesside, ETFuels, UK

Developed by ETFuels and located in Redcar, Teesside, Project SkyFuel has been awarded a £5 million grant from the UK Department for Transport's Advanced Fuels Fund to produce e-SAF. SkyFuel Teesside will convert green hydrogen and biogenic CO_2 into sustainable jet fuel using methanol synthesis and Methanol-to-Jet (MtJ) technology.[33]

Figure 11: Project SkyFuel Teesside, ETFuels[34]

Teesside is one of the UK's most significant industrial clusters, historically dominated by steelmaking, chemicals, and heavy manufacturing. While these sectors have provided thousands of jobs for decades, the region has faced structural decline, with major closures such as the Redcar steelworks in 2015 resulting in substantial job losses.[35]

However, in addition to SkyFuel Teesside, there are several high-profile initiatives associated with the energy transition in the Teesside which together are likely to provide substantial future employment opportunities in the region. For example, Net Zero Teesside Power is a £4 billion project led by bp and Equinor to build the world's first commercial-scale gas-fired power station CCS.[36] Alongside this, the Northern Endurance Partnership is developing CO_2 transport

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[33] ETFuels (2025): ETFuels awarded UK government grant to develop methanol-to-jet facility [Link]
[34] ETFuels Our Projects [Link]
[35] House of Commons (2018): Future of the former steelworks site in Redcar constituency [Link]
[36] NZT: Net Zero Teesside | The UK's first decarbonised industrial cluster [Link]

and offshore storage infrastructure to serve multiple industrial emitters in the region.[37] These initiatives are expected to create thousands of construction jobs and hundreds of long-term roles.

SkyFuel Teesside involves an investment of over £450 million (10% of the magnitude of Net Zero Teesside Power). This investment is anticipated to deliver:

- **75 skilled roles** supported during the development phase.
- **Around 1,000 construction jobs** at peak build.
- **50 long-term operational positions**, including supervisors, operators, and specialist engineers.

While SkyFuel Teesside will create a wide range of jobs, the overall number of roles is relatively small compared to larger energy transition projects in the region, such as Net Zero Teesside Power.

Most jobs at SkyFuel Teesside will be filled by local workers, with ETFuels working with regional contractors such as Johnson Matthey and local construction firms. These roles will leverage Teesside's existing industrial base, particularly from the chemicals sector, drawing on existing expertise while creating new opportunities for upskilling, reskilling, and apprenticeships.

As a first-of-a-kind (FOAK) project, SkyFuel Teesside is expected to provide technical and operational experience relevant for future e-SAF developments, which helps the UK build the skills, experience, and supply chains needed to deliver domestic e-SAF projects. This directly supports the UK Government's Modern Industrial Strategy[38] and aims to accelerate the growth of a high-value, low-carbon sector in Teesside and the wider UK.

4.2 Proyecto Compostilla Green, RIC Energy, Spain

Proyecto Compostilla Green led by RIC Energy will be located in Cubillos del Sil (León), Spain. The project aims to produce sustainable aviation fuel (e-SAF) from green hydrogen and biogenic CO_2 captured from a nearby biomass plant. With an electrolysis capacity of 250 MW, Compostilla Green will deliver an estimated 40,000 tonnes of green hydrogen and 59,000 tonnes of e-SAF annually. Compostilla Green's project site also benefits from existing electricity infrastructure, water resources, and proximity to rail and road networks.

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[37] Northern Endurance Partnership: Home [Link]

[38] GOV.UK Invest 2035: the UK's modern industrial strategy - GOV.UK [Link]

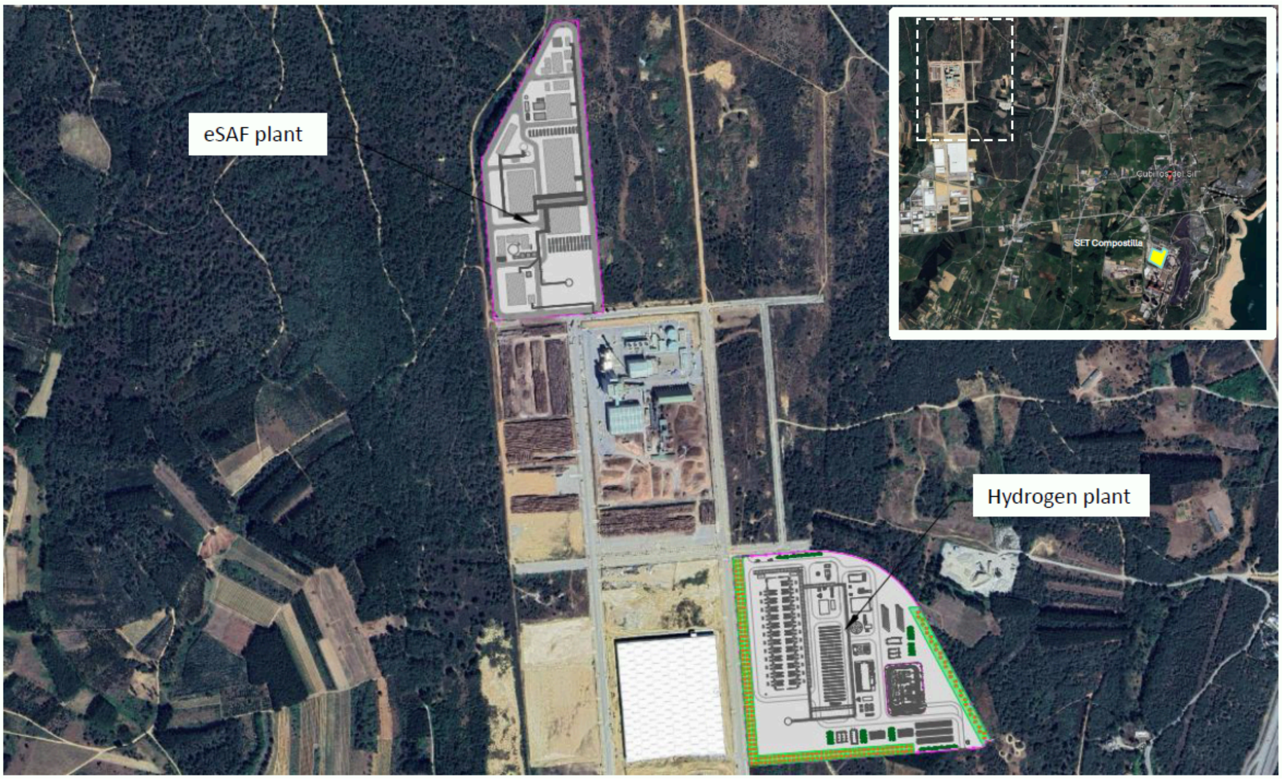

Figure 12: Proyecto Compostilla Green, León, Spain

The closure and dismantling of the nearby Compostilla thermal power plant has resulted in high unemployment and economic uncertainty in the region.[39] Furthermore, the decline in coal mining (the major industry of the area) has exacerbated these challenges.[40]

Compostilla Green is the primary energy transition project in the vicinity of the Compostilla thermal power plant. By investing in new, sustainable technologies associated with e-SAF production, it offers an opportunity for local regeneration and future job creation.

To drive this reindustrialisation, Compostilla Green invest more than €700 million in capital, supported by more than €81 million in public grants[41]. The project is expected to generate over €38 million in fiscal contributions (property, construction, and income taxes), attracting further local and regional investment.

This investment will create a wide range of highly skilled jobs, including:

- **~7,800 jobs** (2,000 direct, 3,500 indirect, 2,300 induced) **during construction.**
- **900 jobs** (240 direct, 400 indirect, 260 induced) **long-term operational positions**, with an ambition that 80% of operational roles are sourced locally.

Roles created will span engineering, operations, maintenance, construction, logistics, and cross-functional areas such as legal, finance, and health & safety.

The project will prioritise upskilling and reskilling of the local workforce, including planned training programmes to be delivered in partnership with the Red Cross, University of León, and local vocational centres. Opportunities in engineering, research and development will also arise

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[39] Enel Green Power (2023): Demolition of Compostilla thermal power plant towers [Link]
[40] Portalpueblos: Economy of Cubillos del Sil [Link]
[41] RIC Energy: RIC Energy, definitive awardee of the H2 Valles program with its eSAF Compostilla Green project, in León [Link]

from partnerships with local businesses such as Cidaut,[42] Ingenest,[43] and Ciuden[44]. Special measures are also in place to support former workers from the Compostilla coal plant who are applying for jobs at Proyecto Compostilla Green.

4.3 Project DEZiR, Verso Energy, France

Project DEZiR is an e-SAF initiative led by Verso Energy, in Petit-Couronne, Normandy, France. Traditionally oil refining has been the predominant industry in Petit-Couronne, but the closure of the refinery in 2013 led to around 470 job losses.[45,46]

A key energy transition project in Petit-Couronne, Project DEZiR aims to produce up to 81,000 tonnes of e-SAF per year, using green hydrogen and biogenic CO_2. Over its 25-year lifespan, the DEZiR project is anticipated to avoid more than 5 $MtCO_2$ by replacing fossil-based kerosene.

Electricity for Project DEZiR will come from renewable sources owned by Verso Energy (wind and solar) via existing grid infrastructure, and hydrogen will be produced on-site. Biogenic CO_2 will be transported approximately 15 km via a dedicated pipeline from a nearby paper mill (owned by BEA). By sourcing biogenic CO_2 from BEA, the project provides an additional revenue stream for the paper mill whilst also helping to sustain jobs in the existing industry.

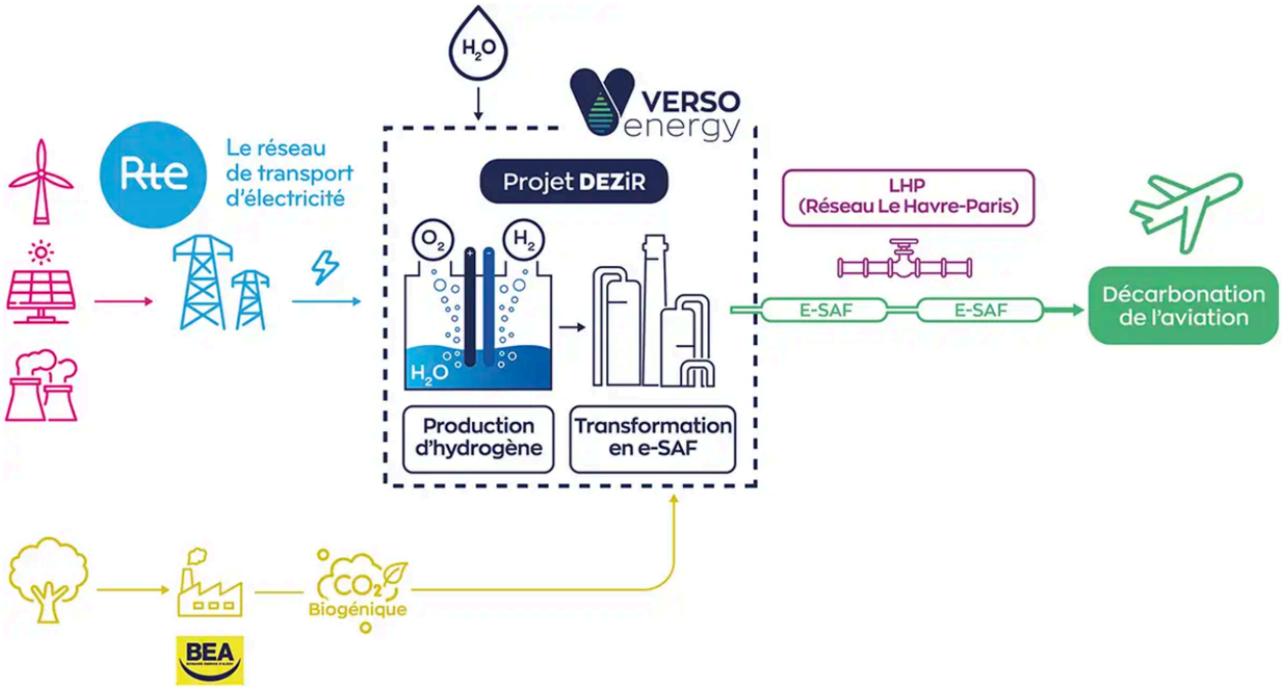

Figure 13: Schematic Diagram of Project DEZiR[47]

Beyond sustaining existing employment at BEA's paper mill, Project DEZiR also creates opportunities for upskilling workers from the paper mill in carbon capture as well as other workers in the region (e.g., those that used to work at the refinery) looking to transition into

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[42] Cidaut: Home [Link]
[43] Ingenest: engineering services [Link]
[44] Fundación Ciudad de la Energía [Link]
[45] Bloomberg (2013): France's Petit -Couronne Refinery to Shut After Bids Rejected [Link]
[46] Petroplus: Internal restructuring | Factsheet 72620 [Link]
[47] The DEZiR project: Production of e-SAF from CO_2 and hydrogen - DEZiR consultation [Link]

roles in hydrogen production, plant operations, and maintenance. Currently, Verso Energy employs approximately 80 staff across renewable and e-SAF projects, and this will increase:

- During the **construction phase** when around **800 direct and indirect jobs** are expected during the three-year build period with at least 20% of the workforce is targeted to be sourced locally for civil works and site preparation.
- During the **operations phase**, around **250 long-term jobs** will be created across engineering, maintenance, operations, management, and administrative roles, recovering more than half of the 470 jobs lost when the Petit-Couronne refinery closed.

In addition, partnerships with local high schools (lycées) and engineering institutes will support internships and technical training as part of Project DEZiR. Early outreach at the local lycée has shown strong interest from students keen to work on the project. These programmes aim to build a pipeline of skilled workers for commissioning and long-term operations.

Project DEZiR is co-located with a major fuel depot (Dépôt Rouen Petit-Couronne , DRPC) which will be used for jet fuel storage. Another local player, Compagnie Industrielle Maritime (CIM), will support with blending the e-SAF produced at DEZiR into pipelines. These pipelines will support efficient distribution to Parisian airports, strengthening the circular economy in France and leveraging existing jet fuel transport routes. Project DEZiR has a partnership with Groupe ADP, who run the Parisian airports to support e-SAF offtake.

The project has entered the Front-End Engineering Design (FEED) stage, awarded to Rely (a Technip Energies venture).[48] The design is intended to be replicable across multiple sites, with four locations secured in France, two in Finland, and one in the US. This replicable design aims to support the scale up of e-fuels across Europe.

4.4 Concrete Chemicals, Zaffra & ENERTRAG, Germany

The Concrete Chemicals project, developed by Zaffra in collaboration with Enertrag (a renewable energy and hydrogen producer), will be located in Brandenburg state in Germany.

The state is already home to several companies producing energy transition related technologies such as high-performance photovoltaics and electrolysers for hydrogen production.[49] Brandenburg also has the highest installed renewable capacity per inhabitant in Germany.[50] This manufacturing base and low-carbon expertise means Brandenburg could become an important location for e-SAF production.

Concrete Chemicals is designed to deliver a drop-in e-fuel solution that can be blended directly with fossil jet fuel, for use at the nearby Berlin airport. Since Germany currently imports around 95% of its fossil fuels, this project also seeks to address that dependency by establishing domestic e-fuel production capacity, improving energy security and reducing reliance on imported jet fuel. [51]

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[48] Verso Energy (2025): Awards FEED Contract to Rely for the DEZiR Project [Link]
[49] Brandenburg Invest: Products for the energy transition and climate action [Link]
[50] Brandenburg (2024): Region of the Future [Link]
[51] Clean Energy Wire (2024): Germany, EU remain heavily dependent on imported fossil fuels [Link]

Figure 14: Illustration of project conCrete chemicals[52]

The facility is expected to require approximately 500 GWh of electricity annually, with 200–300 MW of renewable capacity dedicated to the PtL process and on-site hydrogen production. The project will be integrated into Germany's 'hydrogen core network' (Wasserstoff-Kernnetz) with about 85% of the hydrogen to be supplied via pipeline, with the remaining 15% produced on-site using electrolysis. Biogenic CO_2 will be sourced from a nearby industrial site to minimise transport, with the project owning and operating the CO_2 capture plant to manage risk and ensure supply security.

During **construction**, the project is projected to create **around 1,500 jobs**, with **250 long-term operational roles** once the facility is running. Most direct jobs will be in technical maintenance and operations, with additional indirect employment generated through suppliers and related services.

Concrete Chemicals aims to support the local community through:

- **Building local talent** by planning apprenticeships, internships, and partnerships with schools and colleges, as the project develops.
- **Protecting existing jobs** by capturing CO_2 from an existing industrial site, helping maintain local employment and the viability of established industries.
- **Engaging local contractors and suppliers wherever possible**, leveraging their knowledge of the existing industry in the region.

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[52] Enertrag: Concrete Chemicals [Link]

- **Prioritising community engagement** with proposed town hall meetings and information sessions to ensure transparent communication and foster local acceptance, highlighting anticipated benefits for the community.

At the national level, a key objective of the Concrete Chemicals project is to help establish a robust domestic supply chain for e-fuel and hydrogen technologies in Germany. By leveraging Brandenburg’s strong manufacturing and supplier base the project aims to support the growth of local industries and the creation of new technical know-how. Both Zaffra and Enertrag intend to export their expertise and supply chain model to other regions, supporting European competitiveness in the emerging e-fuels sector.

5. IMPACTS OF SCALING E-SAF PRODUCTION ON ENERGY SECURITY

Scaling up e-SAF production in Europe may also affect its dependence on fossil fuel imports, and hence energy security. As shown in Figure 13, in 2023, **the EU-27 imported 35% of the kerosene it consumed**. This kerosene mostly came from the Middle East, with three countries – Kuwait, UAE, and Saudi Arabia – being the source of 54% of imports. Note that the EU-27 also exported significant kerosene volumes (25% of total use; mainly to the UK and Switzerland), and the proportion of EU-27 demand met by *net* imports (i.e. total imports minus total exports) was 11% in 2023.

EU kerosene **production uses crude oil as a feedstock, which is nearly all imported**. Figure 13 shows that in 2023, the EU-27 imported 96% of crude oil consumed. This oil comes from a variety of regions, most notably the US, Norway, Kazakhstan, Saudi Arabia, and Libya.

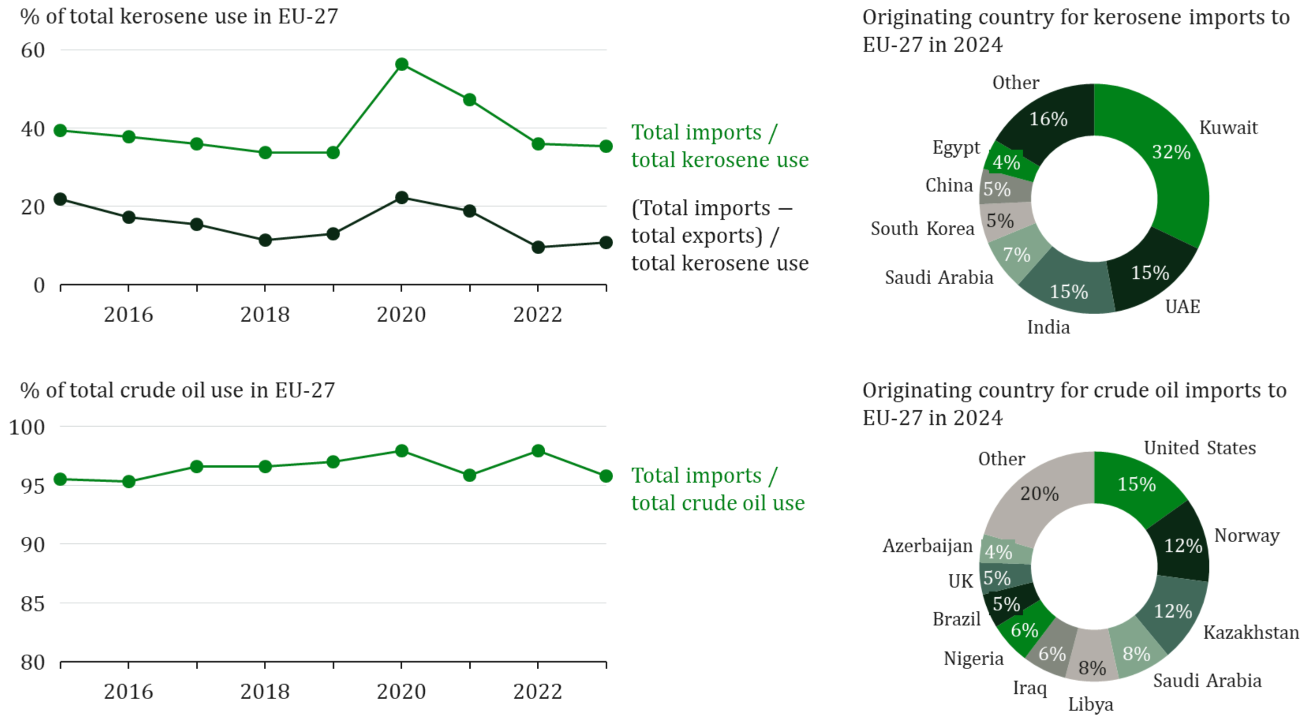

FIGURE 15 FOSSIL FUEL IMPORTS TO EU-27 IN THE CONTEXT OF AVIATION[53]

EU-27 dependence on energy imports has remained relatively stable in the context of aviation (with the exception of the disruption in 2020 and 2021 from the COVID-19 pandemic). While the import dependency for kerosene has decreased slightly (from 39% in 2025 to 35% in 2023), there has been a slight increasing trend for the import dependency for crude oil.

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[53] Total imports and exports is taken as the "Extra-EU27" imports and exports of Jet fuel, kerosene type (code 27101921) and crude oil (code 2709) in the "EU trade since 1988 by HS2-4-6 and CN8" database from Eurostat (see Eurostat: Statistics [Link]). Intra-EU-27 imports and exports are not included. Total kerosene use is taken as the sum of kerosene-type jet fuel demand from domestic and international aviation from Eurostat (see: "Supply, transformation and consumption of oil and petroleum products" database at Eurostat: Database [Link]). Total crude oil use is taken as the "Refinery intake – observed" value from the same database. Note that the (total import - total exports) % is not plotted for crude oil since EU exports are very small (~0.2% of total use).

When considering how e-fuels may affect EU energy imports, it is important to first consider what would be displaced by e-fuels: domestically produced jet fuel or imported jet fuel. A significant determining factor here is how EU jet fuel production costs compare to imports, once additional import costs such as freight, insurance, handling, and port fees have been factored in. While there is a lack of publicly available cost data, jet fuel prices at key hubs have historically been closely linked to the cost of imported supply, reflecting the role of imports in balancing the market.[54,55] From this perspective, it is likely that e-fuels will initially displace imports. As the penetration of fossil kerosene alternatives increases (i.e. SAF, e-SAF), EU-produced fossil kerosene will be increasingly displaced. Importantly, because EU production of jet fuel still heavily relies on crude oil imports, displacement of EU production can still help to reduce the EU's overall energy import reliance.

This leads to the next question determining e-SAF's impact on EU energy security: what proportion of e-SAF will be produced locally versus imported? There is significant uncertainty on this topic, however key factors include:

- **Renewable / low-carbon electricity prices:** electricity costs play a central role in determining the overall costs of e-SAF production. In general, renewable and industrial electricity prices in Europe tend to be higher than other key regions such as the U.S. and Middle East and North Africa (MENA).[56,57] This is driven by a number of factors, such as lower capacity factors (in some areas), higher construction costs, and higher fossil fuel costs. However, it is important to recognize that electricity costs vary significantly across Europe.[58] In some cases, renewable energy costs in parts of Europe (e.g. solar in regions of Spain) can be competitive globally.[59]
- **Policy support:** EU policy support for e-SAF includes ReFuelEU Aviation, RED III, EU ETS, Innovation Fund, Member-State policies, the forthcoming Sustainable Transport Investment Plan (STIP)[60], and the Net-Zero Industry Act. The UK has policy support through its SAF Mandate, Revenue Certainty Mechanism, and Advanced Fuels Fund. Norway is expected to implement similar measures to the EU and implement ReFuelEU Aviation by 2027.[61] Importantly, European policy such as the ReFuelEU Aviation policy acts as strong demand-side support for e-SAF. Other geographies also offer policy support, notably the U.S., which offers large supply-side tax credits through the Inflation Reduction Act. Countries in regions such as the Middle East and South America are positioning themselves to generate value by exporting e-fuels to Europe, albeit with supply side support not yet clear.[62,63] Overall, while Europe has strong support, emerging policies in other regions could result in European production being outcompeted by imports from those other regions.
- **Costs of capital:** in general, Europe tends to have competitive weighted average costs of capital (WACC). For example, the WACC for renewables for Europe (3.7-4.7%) is on par with the lowest WACCs for other regions: 3.9% for Oceania, and 3.8-6.2% for Asia.[41] While e-SAF is more nascent technology and is expected to have higher WACCs compared to

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[54] Argus (2025): Jet fuel price: Argus jet fuel CIF NW Europe cargo [Link]
[55] FT (2025): European imports of Asian jet fuel hit record during peak summer season [Link]
[56] IRENA (2025): Renewable power generation costs in 2024 [Link]
[57] ICCT (2022): US Europe current future cost e-kerosene [Link]
[58] UK Government (2025): Europe electricity price date [Link]
[59] CRU (2025): Europe green hydrogen production cost can beat Middle East. [Link]
[60] European Commission (2025): Commission unveils the Sustainable Transport Investment Plan [Link]
[61] Argus (2025): Norway to implement ReFuelEU Aviation by 2027 [Link]
[62] Poly Consulting, (2025): Power-to-X in the Middle East [Link]
[63] IEA (2025): National Strategy for Green Hydrogen – Policies - IEA [Link]

renewables in the immediate future,[64] this generally indicates Europe can be competitive with respect to financing costs. EU policy also helps to decrease risk and the WACC.

- **Construction, material, and labour costs:** these costs tend to be higher in Europe versus other regions, which affects the competitiveness of EU production.[65,66] It is important to recognize that these factors vary significantly within Europe.[67]
- **Ability to meet sustainability criteria:** the EU sustainability criteria for e-fuels production include requirements for the CO_2 used and for renewable electricity procurement that are easier to meet in some regions than others. For example, e-fuels producers can use point source fossil CO_2 until 2036/41 only if that CO_2 is covered by a carbon pricing mechanism – which is only the case in some geographies, including Europe.

Currently, the EU is heavily reliant on fossil fuel imports for aviation (either via direct kerosene imports or imports of crude oil feedstock). Increases in local e-SAF production will reduce this external reliance and enhance EU energy security. However, there is the possibility for significant imports of e-SAF, as well as of intermediates (e.g. hydrogen, methanol) which would reduce these potential benefits.

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[64] Dentons (2025): Dentons - The challenge of project financing Europe's SAF projects [Link]
[65] IEAGHG (2018): Effects of plant location on the costs of CO2 Capture [Link]
[66] IRENA (2014): Global and Regional Potential until 2030 [Link]
[67] Eurostat (2025): Hourly labour costs [Link]

6. BENEFITS OF SCALING E-SAF PRODUCTION TO THE WIDER ENERGY SYSTEM TRANSITION IN EUROPE

The growing e-fuels industry could also have wider benefits for similar value chains such as renewable energy, hydrogen production, road and shipping fuels, low-carbon chemicals (LC chemicals), and CCUS.

6.1 REDUCING COSTS FOR ADJACENT INDUSTRIES

Increasing the global deployment of renewable energy technologies and electrolysers will decrease the costs of these components in several ways:

- As these technologies deploy, it is expected that practical learnings in their installation and operations will improve to reduce costs and increase efficiency. This will in turn drive larger economies of scale in their deployment in future as the technology derisks, leading to a decrease in the costs of green hydrogen that is required for other sectors such as industrial decarbonisation, shipping and chemicals .
- More confidence in technology deployment will drive the demand for larger equipment sizes, which reduces the unit costs. For example, according to IRENA[68], scaling an electrolyser from 10 megawatt to 1 gigawatt is expected to reduce specific equipment costs by around 45%.
- Greater demand will allow space for more technology suppliers to participate, which is expected to decrease costs through competition.

6.2 OPTIONALITY FOR PRODUCERS OF INTERMEDIATES

E-fuel intermediates such as hydrogen and methanol provide the benefit of market flexibility, as these commodities can serve multiple sectors. Diversification of the revenue streams will reduce the investment risk because it enables producers to access multiple markets. Green hydrogen, for example, has direct derivatives such as green ammonia can serve the agricultural sectors as a fertiliser. Green hydrogen also serves as a primary means of decarbonizing the steel industry and is a direct transport fuel. The production of e-methanol, in the methanol-to-jet pathway, could also be used in shipping decarbonisation.

6.3 UPSKILLING

The creation of an e-fuels industry can serve to improve the skills of the workforce that is expected to become available from the downstream O&G industry, as it shrinks in response to decarbonisation policy. This workforce will attain the necessary skills to operate and manage a more advanced and integrated system that expands the e-fuel production chain, which will be applicable to adjacent industries (example e-ammonia, LC chemicals). This transition of skills is expected to be facilitated under the EU’s Clean Industrial Deal[69].

6.4 SHARED INFRASTRUCTURE DEVELOPMENT

Another benefit is the possibility that e-fuels could have wider benefits for carbon capture and storage (CCS) networks. CCS is a key decarbonisation priority for Europe, and both CCS and e-fuels rely on similar infrastructure, in particular carbon capture units and CO_2 transport links (e.g. pipelines). This presents an opportunity for sharing of infrastructure. For example, a

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[68] IRENA (2020): Green Hydrogen Cost Reduction. [Link]

[69] Offshore Energy (2025): EU invites input for workforce transition from oil & gas to renewables. [Link]

portion of captured CO_2 could be used for e-fuels, with the rest taken to geological storage. This would help to lower the capture costs for both e-fuel production and CCS by increasing the economies of scale. The capture cost could be lowered further if the e-fuels plant is co-located, as excess heat produced by the e-fuels plant could be used for the capture process. Another possibility is for e-fuels sites to offtake CO_2 from CO_2 transport networks whose main focus is geological storage of CO_2. This would reduce the CO_2 transport cost for both e-fuels and CCS.[70]

E-fuels production facilities can benefit significantly from sharing infrastructure with hydrogen production plants. This integration reduces the need for duplicate storage systems, leading to substantial savings in capital expenditure for storage equipment. Hydrogen stored within shared infrastructure can supply the e-fuels plant with a stable and continuous feedstock while also supporting hydrogen refuelling for mobility applications. In addition to infrastructure and operational benefits, shared hydrogen systems can reduce compression costs for e-fuels plants.

6.5 POTENTIAL FOR ASSET REPURPOSING

As the energy system and sectoral demands changes over time, it is possible that components of the e-fuels value chain could be used for other purposes, if required.

- **Renewable energy generation** plants could be repurposed for grid supply. However, the renewable energy producer must consider technical requirements for grid connection[71]. The RE producer must adhere to grid connection codes, that set the rules and standards for how different participants link to the respective electricity networks.
- **CO_2 capture facilities** supplying CO_2 for e-fuels production could alternatively redirect captured CO_2 to permanent geological storage. This option would primarily depend on the availability and accessibility to CO_2 transport and storage infrastructure, such as pipelines and injection sites. The feasibility increases if the plant is already integrated into a network where a portion of its captured CO_2 is being sequestered, as this allows additional volumes to be routed to storage with relatively lower additional investment. In scenarios where the CO_2 is delivered as a gas at low pressure, which may occur if (i) the e-fuels plant is co-located or in proximity with carbon capture, or (ii) exclusively built for the e-fuels plant, then it is likely that additional investment costs will be required for the CO_2 liquefaction, piping and eventual geological injection.
- **Hydrogen** could be repurposed for other sectors such as industrial decarbonisation or chemicals/steel production. Large hydrogen storage capacities built to ensure that the e-fuels plant operate at full-load capacity would be especially advantageous in remote locations, as it allows buffer storage time for the wholesale distributors. However, it is likely to require an investment for additional compression station, since hydrogen transported in distribution systems are at high pressures (>250 bar).
- **Hydrogen (and CO_2 in some cases)** could be repurposed for e-ammonia, e-methanol or e-methane production, with required investment for the respective synthesis plants.
- **RWGS+FT and hydrocracker plants** could be repurposed to also use biomethane (directly or mass balanced through the gas grid). However, there would be design

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[70] T&E, ERM (2025): The challenge of sourcing sustainable CO2 for e-fuels [Link]

[71] DNV (2025): Grid connections for renewable energy [Link]; Landera et al (2023): A Review of Grid Connection Requirements for Photovoltaic Power Plants [Link]

considerations/adjustments required upstream of the FT reactor such as repurposing RWGS reactors for reforming or introduction of a dedicated methane reformer. For example, Topsoe's eREACT technology is nominally a RWGS reactor, but can also perform methane reforming.[72] The FT and the hydrocracking processing section could also be used to convert syngas from biomass gasification, in a hybrid bio/e-fuel plant.

- **Product-slate adaption:** The FT reactor and the hydrocracker units in the e-fuels production chain can be adapted by changing the reaction conditions to vary the proportions of the product slate. For example, higher temperatures in the FT process produces shorter hydrocarbon chains. Higher temperatures also increase cracking severity in the hydrocracking step, leading to smaller product chains. The smaller chains may be used in gasoline production, oxygenate chemicals (e.g. alcohols, organic acids), and naphtha that can be used as a feedstock for olefin production to produce plastics. Alternatively, conditions may be changed to produce more diesel for road transport. These plant modifications are not expected to require significant capital investment (significantly lower than the initial plant CAPEX).[73]

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[72] Topsoe: EREACT [Link]

[73] De Klerk (2008): Fischer-Tropsch Refining [Link]

7. Conclusions and implications

The analysis in this report demonstrates that scaling up the e-SAF industry in Europe to meet 50% or 100% of mandated requirements from European supply could unlock substantial benefits, including:

- **Gross Value Added:** Scaling up e-SAF production could deliver significant Gross Value Added (GVA) to the European economy. Under the scenario where 100% of the e-SAF needed to meet the PtL sub-target in 2050 is produced in Europe, capital investment over the years between now and 2050 would lead to over €1.2 trillion in GVA. Ongoing investment in operations could lead to almost €50 billion in GVA per year, which is a similar magnitude to the current GVA of Slovenia.
- **Job Creation:** The scale-up of e-SAF could generate between 3.4 million (50% European supply) and 6.7 million (100% European supply) person-years of full-time employment[74] during the construction phase by 2050. Once operational, the sector could **sustain up to 140,000 long-term jobs annually, equivalent to ~10% of the current EU chemicals manufacturing sector**. The case studies in this report, such as SkyFuel Teesside (UK), Compostilla Green (Spain), DEZiR (France), and Concrete Chemicals (Germany), provide examples of how these projects are already planning to deliver thousands of construction jobs and hundreds of long-term operational roles at each plant. The number of jobs anticipated to be created at these plants are similar to the number of jobs expected to be created at the typical plant modelled in this study (Table 2).

Table 2: SUmmary of Job Creation Associated with typical e-SAF production plants

	Capital investment	Operations
Typical plant modelled in this study – whole value chain	29,000 (direct and indirect)	600 (direct and indirect)
Typical plant modelled in this study – fuel synthesis only	5,000 (direct and indirect)	210 (direct and indirect)
Project SkyFuel	1,000 (direct)	50 (direct)
Compostilla Green	7,800 (direct, indirect & induced)	900 (direct, indirect & induced)
Project DEZiR	800 (direct and indirect)	250 (direct and indirect)
Concrete Chemicals	1,500 (direct)	250 (direct)

- **Upskilling and reskilling:** It could also accelerate upskilling and reskilling opportunities, particularly in regions facing de-industrialisation, by creating roles in clean energy and sustainable fuels.

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[74] The jobs that arise for capital investment are predominantly in the construction phase of a project, so will be temporary over the 3-4 years that it takes to construct the components of the e-SAF value chain. Therefore, the results are described in terms of person-years of full-time equivalent (FTE). One person-year FTE represents one person, working one job full time. Therefore, if the construction of the e-SAF value chain is assumed to span over 3 years, the same one person will account for 3 person-years of FTE.

- **Energy Security:** A major benefit of expanding e-SAF production in Europe is the potential to displace imported fossil jet fuel with domestically produced sustainable alternatives. By producing more aviation fuel within Europe, the region can **reduce its dependence on external suppliers, strengthen energy security, and retain more value** within the European economy.
- **Wider Benefits:** Scaling up e-SAF production will stimulate demand for renewable electricity, hydrogen, carbon capture, and advanced manufacturing, driving innovation and investment across multiple energy transition sectors, bringing down costs and building skills. Furthermore, the growth of e-SAF could support the development of shared industrial clusters, and foster the emergence of **new supply chains and export opportunities for European expertise and technology**.

In conclusion, scaling up e-SAF production in Europe offers a clear opportunity to create high-quality jobs, enhance energy security, and drive industrial renewal. While not all benefits will be captured within the EU, the overall impact on employment, economic resilience, and industrial competitiveness could be substantial, even under a scenario where 50% of the mandated requirements come from European supply.

However, to fully realise these benefits, coordinated action is needed to address challenges of European e-SAF production such as higher electricity and construction costs in Europe and the need for continued policy support. Ensuring that a significant share of e-SAF demand is met by European production will require targeted investment, supportive regulation, and strategic partnerships across the value chain. Policymakers should also consider measures to maximise local job creation, support workforce transition, and foster innovation in related industries.

8. Appendix

8.1 CAPEX Scaling

The capital cost data of each element is scaled as shown in the equation shown below (where CAPEX $_{\text{S \& OD}}$ represents the original data of the element and scaled capex of the pathway element, and similarly for Capacity $_{\text{S \& OD}}$). From the scaled CAPEX data, fixed operation costs such as annual maintenance for the elements are calculated and summed across the pathway.

$$CAPEX_s = CAPEX_{OD} \times \frac{Capacity_s}{Capacity_{OD}}^{scale\ factor}$$

8.2 Conversion processes: Technological and economic data

A. Renewable Energy Generation

The energy mix for the south-central EU, where the project is assumed to be based is based on the typical mixture of these renewables for a stable grid in the South-Central EU (Concawe 2024)[75]. The wind (onshore) provides 41%, wind (offshore) 16% and solar provides the remaining 43% of the full load required. The capital costs (CAPEX) for photovoltaic and wind energy systems were referenced from Concawe (2024) while the capacity factors used in determining the installed costs are from IEA[76].

B. Carbon Capture and CO_2 Delivery

Capital expenditure (CAPEX) for carbon capture is based on capture from pulp and paper facilities and is primarily referenced from NETL (2022)[77] and NPC (2019)[78], which provide detailed cost breakdowns for capture technologies. Otherwise, mass and energy balance data which described the CO_2 recovery and utility requirements was taken from the Department for Business, Energy and Industrial Strategy (2022)[79]. For CO_2 compression, CAPEX estimates are drawn from Sydney et al. (2022)[80] and Eldrup et al. (2019)[81], with energy consumption of the compression units informed by Deng et al. (2019)[82]. Lastly, the CAPEX of the gas pipeline infrastructure (50 km) is referenced from Brown et al. (2022)[83] and Knoop (2014)[84].

C. Electrolysis

Economic data such as the CAPEX requirements and the technical data, which is primarily the energy consumption per kg of hydrogen produced during electrolysis, are sourced from the IEA

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[75] Concawe (2024): E-Fuels: A technoeconomic assessment of European domestic production and imports towards 2050 – Update [Link]

[76] IEA (2021): Net zero by 2050 [Link]

[77] NETL (2022): Cost and Performance Baseline for Fossil Energy Plants. [Link]

[78] NPC (2019): Dual Challenge: CCUS Chapter 2. [Link]

[79] UK Gov DBEIS (2022): Next Gen Carbon Capture Technology Technoeconomic Analysis. [Link]

[80] Sydney et al. (2022): Cost of Capturing CO2 from Industrial Sources [Link]

[81] Eldrup et al. (2019): A Cost Estimation Tool for CO2 Capture Technologies CO_2 Compression Costs. [Link]

[82] Deng et al. (2019): Techno-economic analyses of CO2 liquefaction: Impact of product pressure and impurities. [Link]

[83] Brown et al. (2022): The development of natural gas and hydrogen pipeline capital cost estimating equations. [Link]

[84] Knoop (2014): Improved cost models for optimizing CO2 pipeline configuration for point-to-point pipelines and simple networks - ScienceDirect [Link]

Future of Hydrogen report.[85] This source also provided the information on which the stack replacement frequency was calculated. The capacity factors considered for the electrolyser was the South-Central EU, taken from Concawe (2024).

D. Hydrogen Storage and Compression

For hydrogen storage and compression, both CAPEX and mass/energy balance data are referenced from Concawe (2024).

E. RWGS – FT and Hydrocracking

Mass and energy balance data for Reverse Water Gas Shift (RWGS), Fischer-Tropsch (FT), and hydrocracking processes are referenced from Bube et al. (2024)[86] and Lekel (2005)[87]. Mass balances data provided the relative mass flows of reactants (H_2, CO_2); product slate (SAF, diesel and naphtha) and waste products, while the energy flows provided the utility requirements (electricity, steam and cooling). CAPEX data is drawn from Tan et al. (2019, NREL) [88], Element Energy/Jacobs Consultancy (2018)[89], and Swanson et al. (2011, NREL)[90].

8.3 CAPITAL COST STRUCTURES

The equipment costs refer to payments made to the original equipment manufacturer for core process units, while other direct capital expenses include installation, service facilities, buildings, and land requirements. The indirect costs cover the general costs incurred during the construction of the facility such as engineering and management activities, labour, contractor and legal fees, as well as contingency funds for unforeseen risks.

TABLE 3: CHEMICAL PLANTS (CCU, H2, RWGS+FT AND HYDROCRACKING)

Item[91]	% TCI
Purchased equipment cost (TPEC)	20%
Delivery	2%
Installation, controls	14%
Service facilities	12%
Buildings	10%
Yard works	3%
Land	1%
Engineering and supervision	7%
Construction expenses	7%
Contractor fees	4%
Legal	1%
Contingency and start-up capital	15%

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[85] IEA (2019). Future of Hydrogen: Assumptions Annex. [Link]

[86] Bube et al (2024): Kerosene production from power-based syngas – A technical comparison of the Fischer-Tropsch and methanol pathway. [Link]

[87] Lekel (2005): Hydrocracking of Iron-Catalyzed Fischer−Tropsch Waxes [Link]

[88] Tan et al. (2019, NREL): Economic Analysis of Renewable Fuels for Marine Propulsion. [Link]

[89] Element Energy/Jacobs Consultancy (2018): Hydrogen Supply Chain Evidence. [Link]

[90] Swanson et al. (2011, NREL): Techno-Economic Analysis of Biofuels Production Based on Gasification. [Link]

[91] De Jong et al (2015): The feasibility of short-term production strategies for renewable jet fuels – a comprehensive techno-economic comparison [Link]

Working capital	5%
Total capital investment (TCI)	**100%**

TABLE 4: ONSHORE WIND ENERGY

Item (same source used for all renewables)[92]	**% TCI**
WTG Procurement and Supply	53.8%
WTG Civil Work	20.9%
Electrical - Collection System	4.1%
Indirect Costs	2.7%
EPC Fee	6.5%
EPC Contingency	4.4%
Owner's Services	6.5%
Electrical Interconnection	0.8%
Owner's Contingency	0.4%
Total Capital Investment Cost	**100%**

TABLE 5: OFFSHORE WIND ENERGY

Item	**% TCI**
WTG Procurement and Supply	35%
WTG Fabrication/Assembly/Installation	21%
Electrical Interconnection	12%
Onshore Transmission	2%
Offshore Transmission and Electrical	0%
Balance of Plant (BOP)	5%
Indirect Costs	4%
EPC Fee	8%
EPC Contingency	5%
Owner's Services	9%
Owner's Contingency	1%
Total Capital Investment Cost	**100%**

TABLE 6: SOLAR PLANT

Item	**% TCI**
Module Supply	32%
Inverter Supply	5%
Racking, Tracker and Balance-of-Plant (BOP) Equipment Supply	20%
Main Power Transformer and Substation	5%
Construction / Installation Labor	12%
Supervisory, Control, and Data Acquisition Subcontract	0.4%
Civil/Structural/Architectural Subcontract	6%
Indirect Costs	6%

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[92] USA EIA (2024). Capital Cost and Performance Characteristics for Utility-Scale Electric Power Generating Technologies [Link]

EPC Contracting Fee	4%
EPC Contingency	4%
Owner's Services	5%
Electrical Interconnection	1%
Owner's Contingency	1%
Total Capital Investment Cost	**100%**

8.4 e-SAF uptake scenarios

8.4.1 e-SAF uptake in EU-27

The total projected jet fuel demands (% e-SAF targets) for EU-27 are 43.7 (1.2%), and 43.2 (35%) Mt/yr in 2030 and 2050. These projections are based on the projections (Policy Option A1 scenario) in the EU impact assessment of ReFuelEU Aviation.[93] It is important to note that there is uncertainty over future jet fuel demand and therefore also uncertainty over the future corresponding e-SAF demand.[94]

8.4.2 e-SAF uptake in other EEA countries

In the addition to EU-27, e-SAF demand is also considered for the EEA countries of Iceland, Liechtenstein, and Norway. Liechtenstein is assumed to have zero e-SAF demand as it does not have an airport. To obtain the projected e-SAF demand for Norway and Iceland, 2023 demand for jet fuel is derived from Eurostat[95] by summing the demand from international aviation and domestic final consumption of jet fuel kerosene (non-bio portion). To obtain demand in 2030 and 2050, the volumes are scaled proportionally with the Policy Option A1 scenario used for EU-27 (see above). For instance, the EU-27 demand for jet fuel was 42.95 Mt in 2023 and is projected to be 43.66 Mt in 2030. This means that the Norway value in 2030 of 0.842 Mt is multiplied by (43.66/42.95 = 1.017) to obtain a final value of 0.856 Mt. It is then assumed that the e-SAF demand follows the same PtL % targets as ReFuel Aviation.[96]

8.4.3 e-SAF uptake in the United Kingdom

The projection of jet fuel demand for 2030 for the UK is taken from the DfT Cost Benefit Analysis of the UK SAF Mandate.[97] The projection for 2050 is taken from DESNZ' Existing measures scenario.[98] The relevant PtL % sub-mandate is taken from the UK SAF Mandate Compliance Guidance.[99] Note that the UK sub-mandate stops at 2040. To estimate the 2050 UK SAF mandate, it is assumed that the PtL mandate increases, such that the difference in the ratio of the PtL % from 2040 (4.9%) to 2050 matches the respective ratio from 2040 to 2050 within the ReFuel Aviation mandate (3.5). In other words, the PtL % for the UK in 2050 is assumed to be (4.9% × 3.5 = 17.2%).

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[93] European Union, (2021): Study supporting the impact assessment of the ReFuelEU Aviation initiative [Link]

[94] T&E, Ricardo, 2022: European CO2 Availability from Point Sources and DAC [Link]; T&E (2025): Down to Earth [Link]; Future Cleantech Architects (2024): ReFuelEU Aviation's Targets: A Feasibility Assessment [Link]

[95] Eurostat (2025): Supply, transformation and consumption of oil and petroleum products [Link]

[96] Argus (2025): Norway to implement ReFuelEU Aviation by 2027 [Link]; Icelandic Transport Authority (2024): Iceland_Action_Plan_2024 [Link]

[97] DfT (2024): Sustainable aviation fuel mandate: final stage cost benefit analysis. [Link]

[98] DESNZ (2025): Energy and emissions projections: 2023 to 2050. [Link]

[99] DfT (2025): SAF Mandate compliance guidance 2025. [Link]

8.5 METHODOLOGY FOR CALCULATING JOBS AND GVA

The GVA and Jobs associated with e-SAF production in Europe were calculated using the methodology outlined in Figure 16.

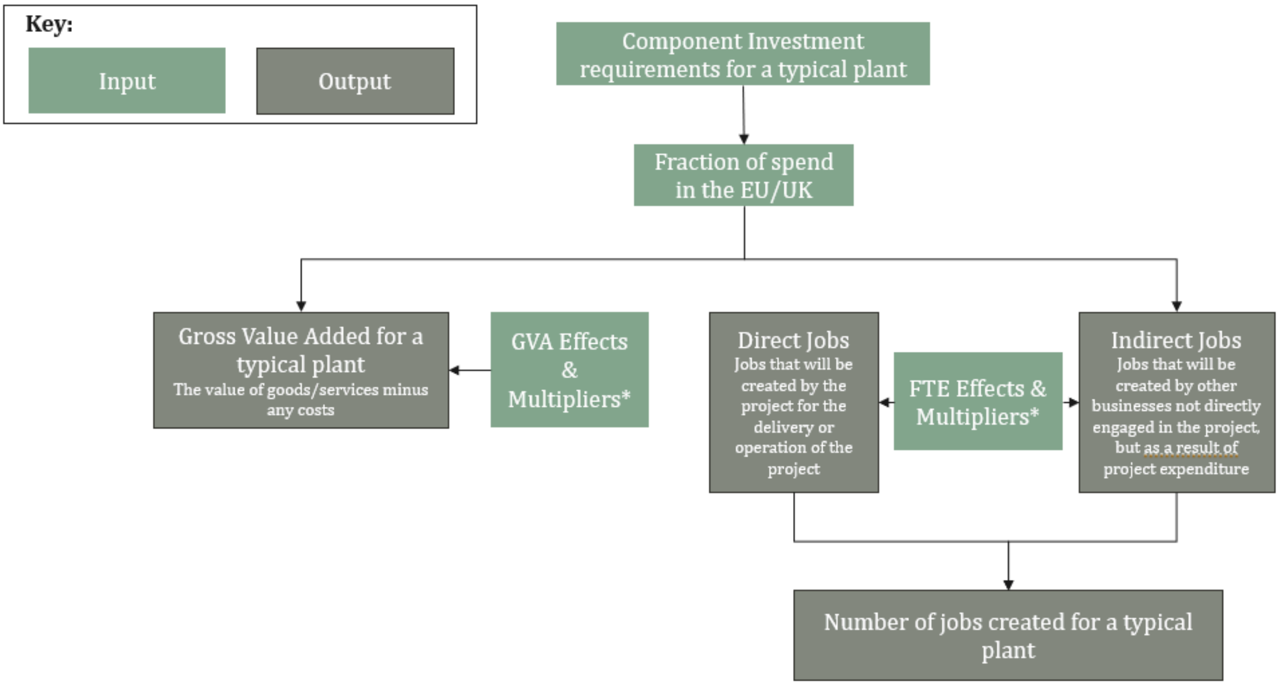

FIGURE 16: METHODOLOGY FOR CALCULATING JOBS AND GVA[100]

A key assumption made to generate the estimated jobs and GVA of e-SAF production in Europe is around the fraction of CAPEX or OPEX that is spent in Europe for each spend item for each component investment. For the majority of spend items, it is assumed that 100% of the spend is within Europe, as work is carried out on site (e.g., civil work, construction, operations). However, particularly for equipment purchased for each component of the e-SAF value chain (e.g., solar panel modules), this may be imported from outside Europe. It is important to make assumptions around how much of this spend occurs within Europe and therefore contributes to European GVA and job creation. Table 7 outlines the assumptions made in this analysis for the top 15 spend items within the e-SAF value chain which together account for >50% of total spend. Further assumptions were made for other spend items, but these become less significant in terms of estimated GVA/Jobs so are not shown here for brevity.

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[100] Effects and multipliers are based on the UK's ONS' input-output tables and the input-output tables of the Eurostat database for all other countries

TABLE 7: FRACTION OF SPEND IN EUROPE, FOR KEY SPEND ITEMS

Component	Spend item	% contribution to total spend	% spend within the EU/UK	Assumption for spend split
Onshore wind	Purchased equipment cost	14%	90%	Currently, up to 90% of commissioned wind projects have installed European-manufactured wind turbines.[101]
Solar	Module Supply	6%	25%	75% of modules are manufactured in China, assume the rest is supplied within Europe for European installers.[102]
Onshore wind	Civil Work	5%	100%	All work undertaken in Europe, UK or other EEA countries
Solar	Racking, Tracker and Balance-of-Plant (BOP) Equipment Supply	4%	25%	Assumptions consistent with information above that China dominates the supply chain for solar panel racking, tracking and other BOP facilities
Off-shore wind	Purchased equipment cost	3%	90%	Currently, up to 90% of commissioned wind projects have installed European-manufactured wind turbines.[85]
PTL - RWGS+FT	Purchased equipment cost	3%	75%	Majority of major process equipment (distillation columns, reactors, heat exchangers, compressors, and pumps) made in Europe, rest in US/China
Solar	Construction / Installation Labor	2%	100%	All work undertaken in Europe, UK or other EEA countries

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[101] WindEurope (2024): Wind energy in Europe [Link] (Page 39)
[102] IEA: Solar PV Global Supply Chains [Link]

Hydrogen storage and compression	Purchased equipment cost	2%	75%	Majority of major process equipment (distillation columns, reactors, heat exchangers, compressors, and pumps) made in Europe, rest in US/China.
PEM Electrolysis	Purchased equipment cost	2%	60%	60% electrolysers from Europe since European electrolyser capacity could be cost competitive if the electrolyser is installed in Europe[103]
Off-shore wind	Fabrication/Assembly/Installation	2%	100%	All work undertaken in Europe, UK or other EEA countries
Onshore wind	EPC Fee	2%	100%	All work undertaken in Europe, UK or other EEA countries
PTL - RWGS+FT	Installation, controls	2%	100%	All work undertaken in Europe, UK or other EEA countries
Onshore wind	Owner's Services	2%	100%	All work undertaken in Europe, UK or other EEA countries
PTL - Hydrocracking	Operations and maintenance	2%	100%	All work undertaken in Europe, UK or other EEA countries
PTL - RWGS+FT	Service facilities	1%	100%	All work undertaken in Europe, UK or other EEA countries

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[103] Hydrogen Insight (2025): ITM unveils 50MW PEM electrolyser priced at €50m that will be 'cheaper than Chinese alkaline machines in Europe [Link]

8.6 JObs and GVA by Country

In addition to reflecting the direct and indirect GVA and jobs which could be associated with e-SAF production in Europe, a simple GVA split between the countries was also carried out to approximate the longer-term potential for GVA and job creation each European country associated with e-SAF production.

The split between countries was based on T&E's database of projects under development (i.e. the production split in 2030). These splits are illustrated in Figure 17, with France having the largest segment (28%), followed by Norway (11%) and Spain (10%). The subsequent GVA and jobs results are heavily dependent on this database, which is likely to change as projects under development evolve.

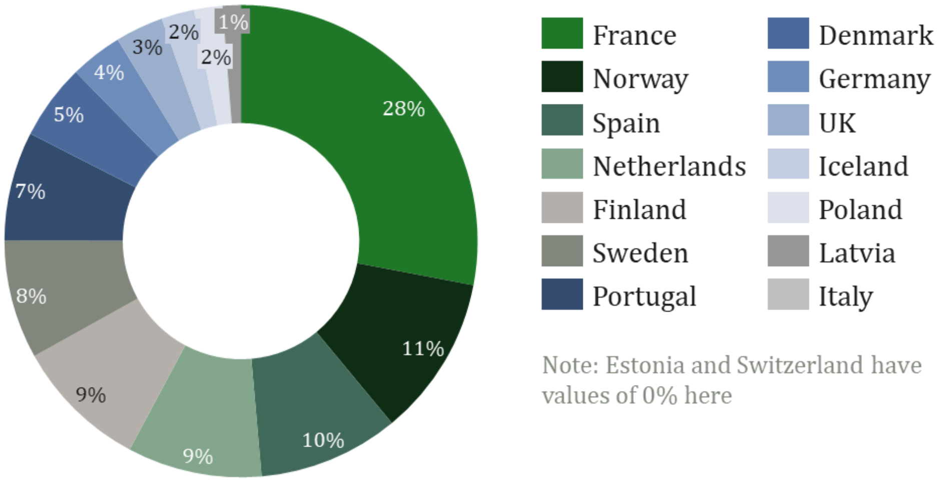

Figure 17: e-SAF production split between European countries

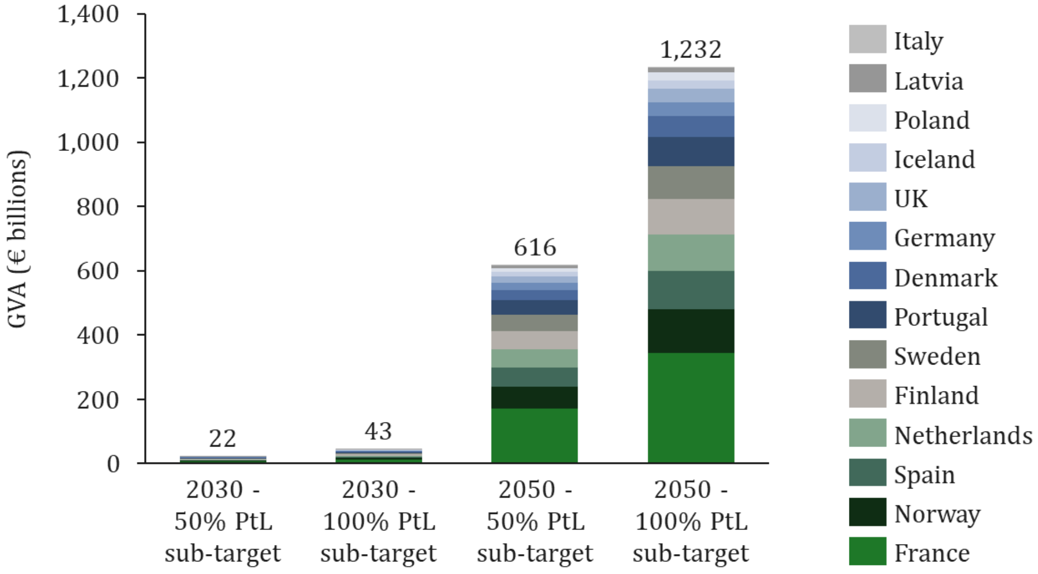

Figure 18: Gross Value Added for each country in Europe from Capital investment over several years in e-SAF facility development and construction

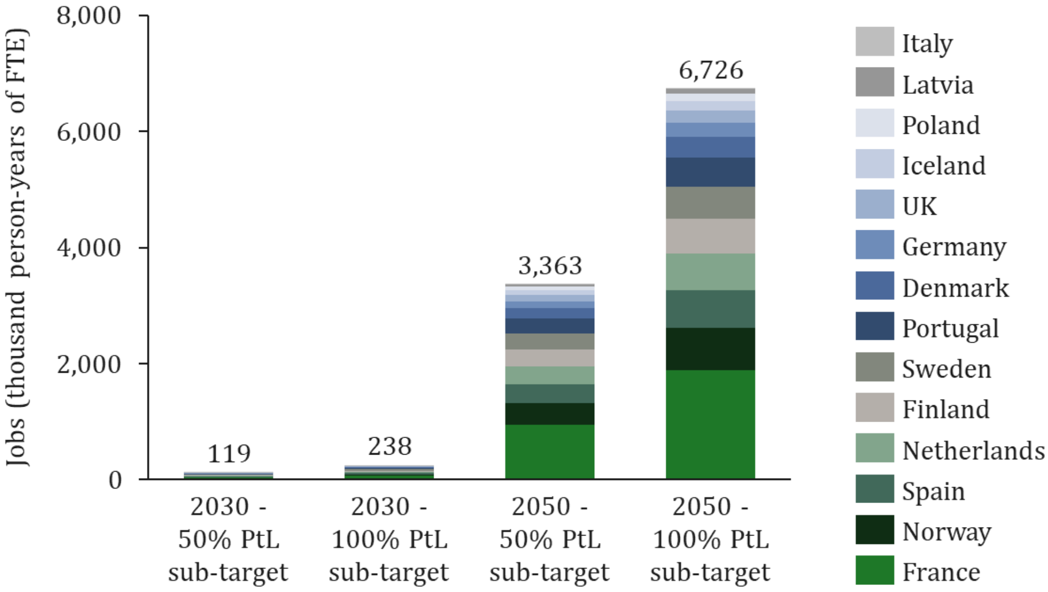

Figure 19: Jobs Created in European countries from capital investment over several years in e-SAF facility development and construction

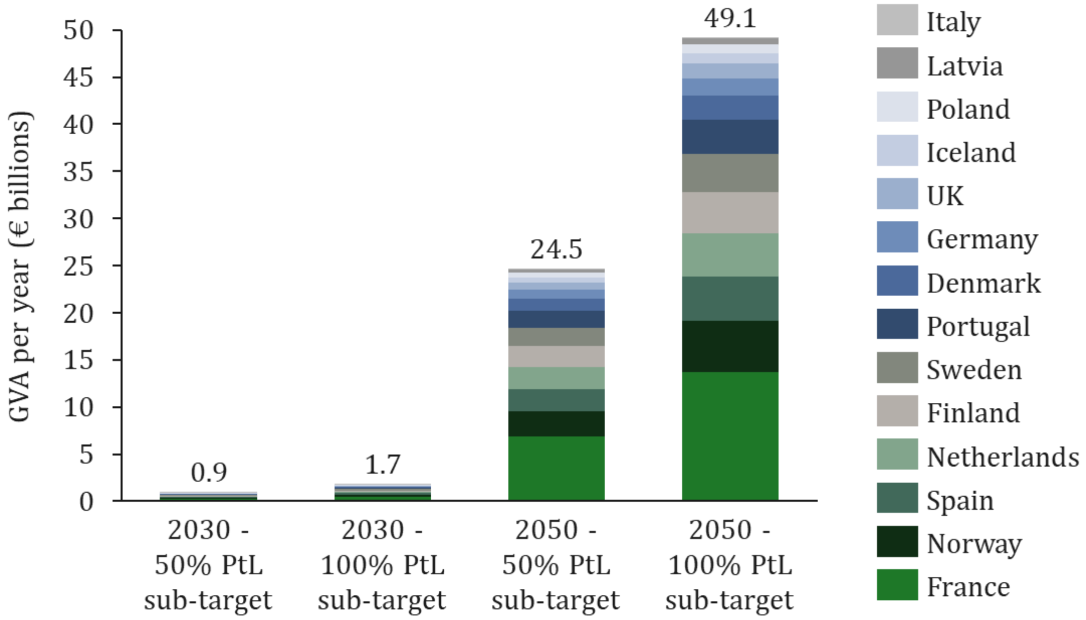

Figure 20: Gross value added per year from ongoing operational expenditure in e-SAF production in different European countries

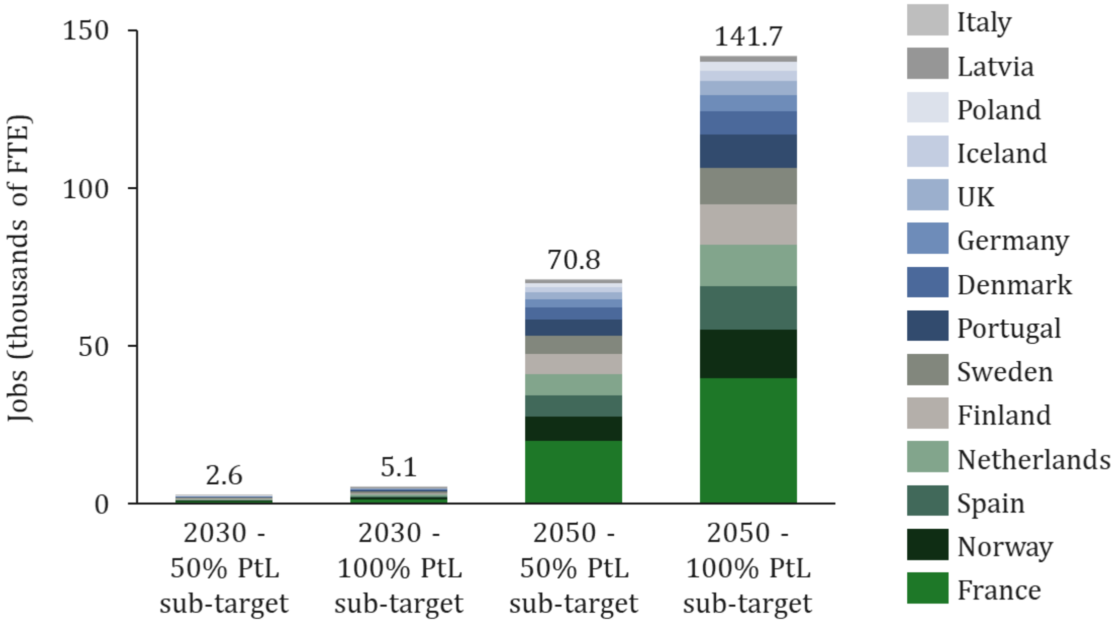

Figure 21: Long-Term Jobs Sustained Through Ongoing Operations at e-SAF production PLants in countries across Europe

8.7 Split by Component

The GVA and job creation associated with each component part of the e-SAF production value chain is illustrated in the following graphs.

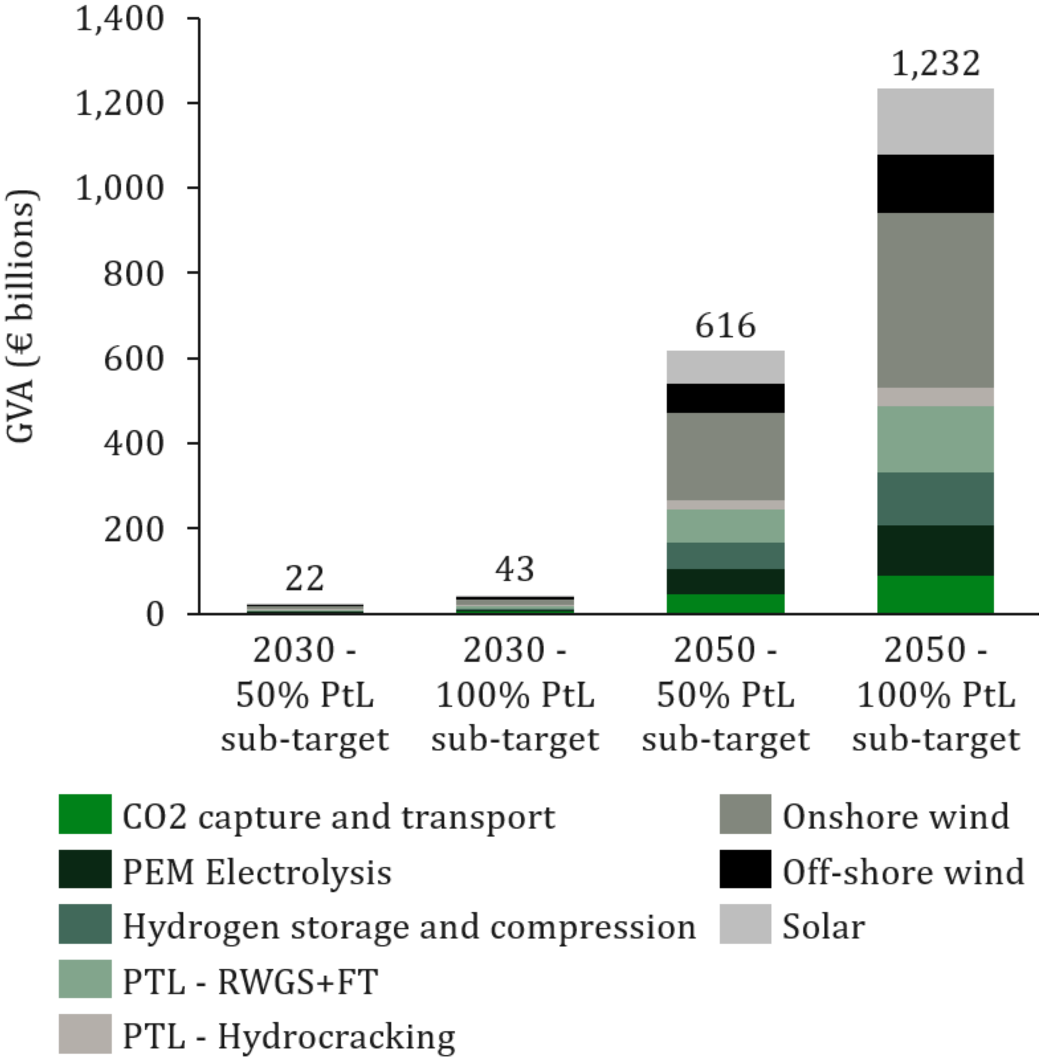

Figure 22: Gross Value Added for each Component from Capital investment over several years in e-SAF facilitiy development and construction in Europe

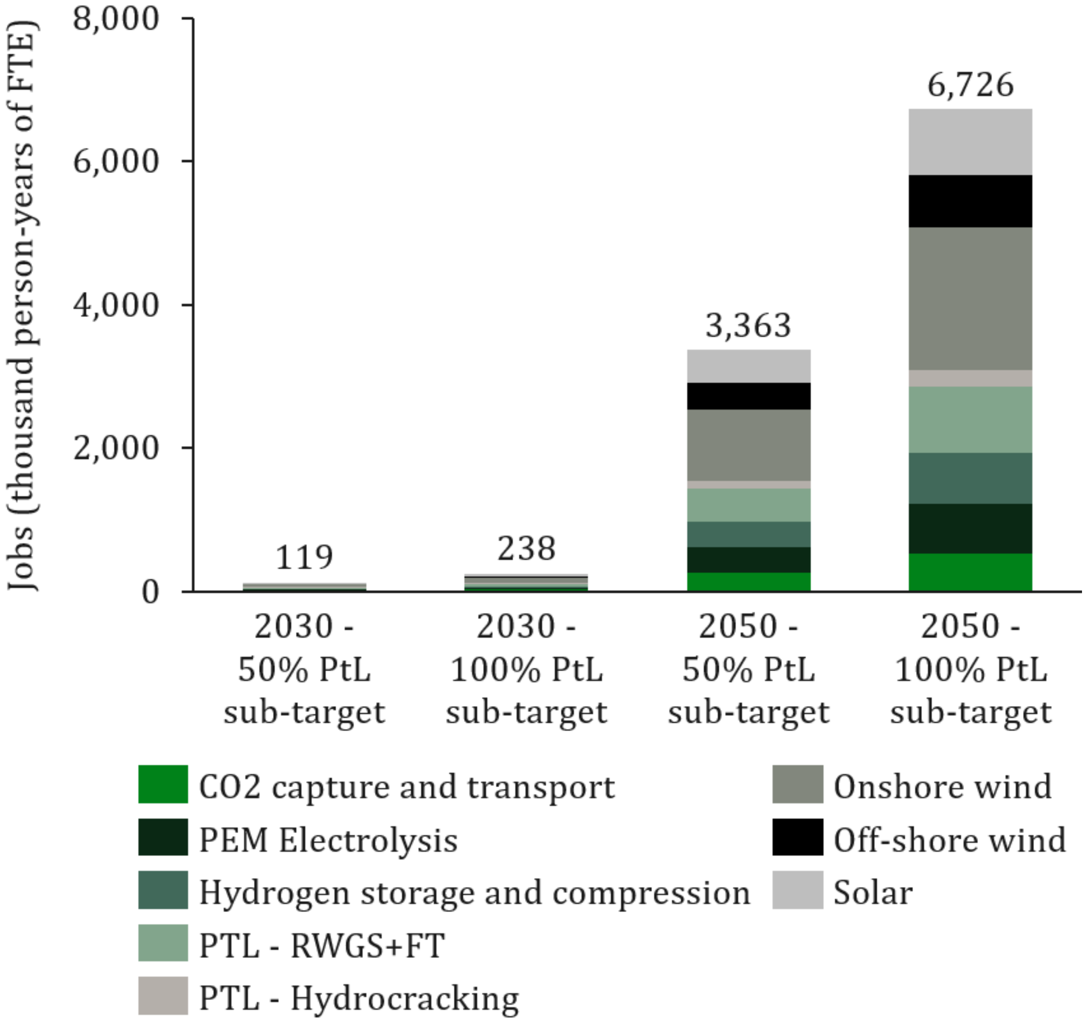

Figure 23: Jobs Created from capital investment in each component of the value chain over several years in e-SAF facility development and construction

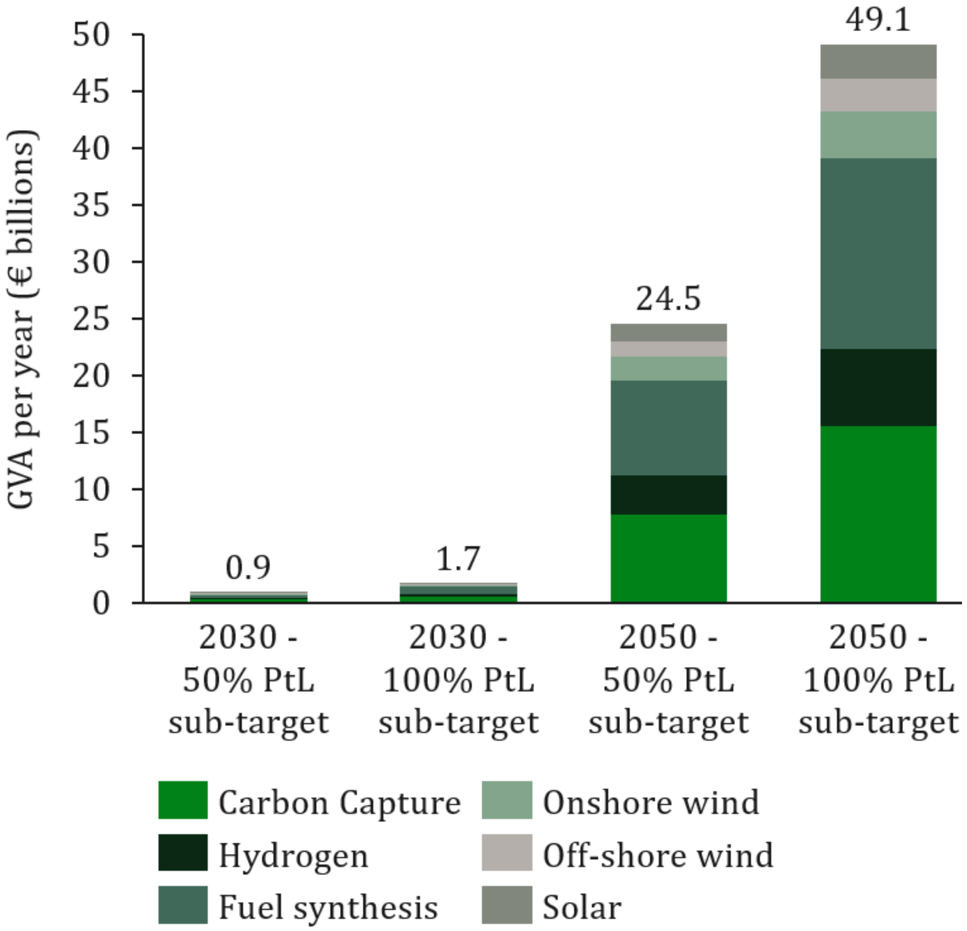

Figure 24: Gross value added per year from ongoing operational expenditure at each component of the e-SAF production value chain

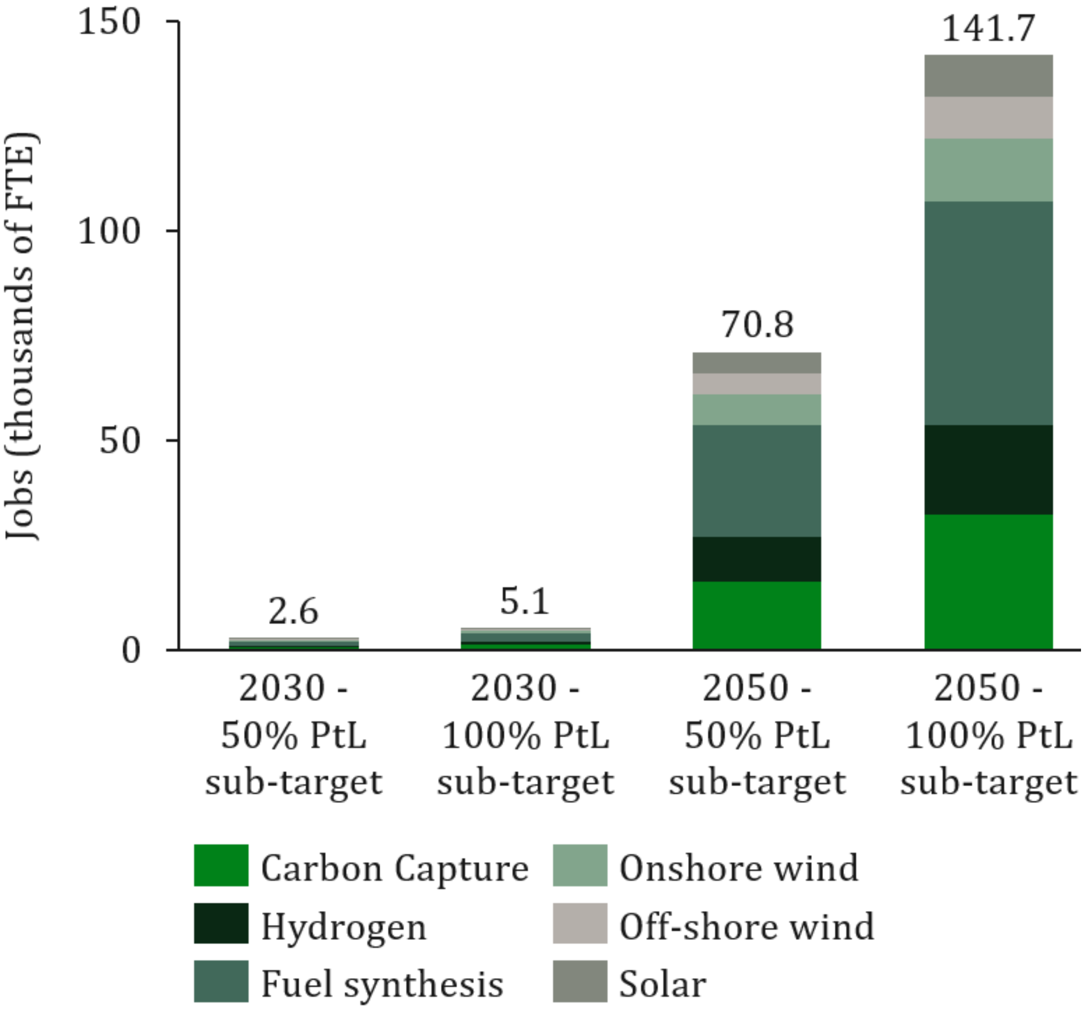

Figure 25: Long-Term Jobs Sustained Through Ongoing Operations at each component part of the e-SAF production value chain

8.8 Case study summary tables

Table 8: Summary of ETFuel's Project SkyFuel Teesside

	Project SkyFuel Teesside
Location	Redcar, Teesside, UK
Scale	~33,0000 tonnes per year of e-SAF
Electricity source	Wind and solar power (off-site, supplied via Protium[104])
Hydrogen source	Green hydrogen from Protium (next door)
CO_2 source	Biogenic CO_2 (sourced within the Teesside area)
e-SAF production technology	Methanol synthesis and methanol-to-jet
Current employees	15 (6 dedicated to Project SkyFuel Teesside)
Estimated number of employees during construction phase	1,000
Estimated number of employees during operation phase	50

Table 9: Summary of RIC Energy's Proyecto Compostilla Green

	Proyecto Compostilla Green
Location	Cubillos del Sil, León, Spain
Scale	59,000 tonnes per year of e-SAF
Electricity source	Wind and solar power (via existing grid infrastructure)
Hydrogen source	Green hydrogen produced as part of the project
CO_2 source	Biogenic CO_2 from the Forestalia / Cubillos del Sil biomass plant (on site)
e-SAF production technology	Fischer-Tropsch synthesis (FT-SPK route)
Current employees	10 people employed by RIC Energy and a further 10 direct contractors
Estimated number of employees during construction phase	7,835 jobs (2,084 direct, 3,459 indirect, 2,292 induced)

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[104] Protium (2022): Protium's Flagship Tees Valley Net Zero Hydrogen Project Expands To Nearly 70MW Capacity [Link]

	Proyecto Compostilla Green
Estimated number of employees during operation phase	902 jobs (240 direct, 398 indirect, 264 induced)

Table 10: Summary of Verso ENergy’s Project DeZir

	Project DEZir
Location	Petit-Couronne, Normandy, France.
Scale	81,000 tonnes of e-SAF per year
Electricity source	Wind and solar power (via existing grid infrastructure but owned by Verso Energy to ensure production is balanced)
Hydrogen source	Green hydrogen produced as part of the project
CO_2 source	350,000 tonnes of CO_2 captured from the biomass boiler at BEA (a paper mill) and transported 15 km via a dedicated CO_2 pipeline
e-SAF production technology	Methanol synthesis and methanol-to-jet
Current employees	75-80 people are currently employed by Verso Energy, working on a range of renewable energy and e-SAF projects including DEZiR
Estimated number of employees during construction phase	800 people per day over three years (direct and indirect)
Estimated number of employees during operation phase	250 people (direct and indirect)

Table 11: Summary of ZAFFRA’s Concrete Chemicals Project

	Concrete Chemicals
Location	Brandenburg, Germany
Scale	~40,000 tonnes of e-SAF per year
Electricity source	Wind and solar power (via existing grid infrastructure)
Hydrogen source	Generated offsite by a third-party owned by ENERTRAG and transported to the e-SAF production site via Germany’s hydrogen core network
CO_2 source	Biogenic CO_2 source close to the e-SAF production site, owned by the project

	Concrete Chemicals
e-SAF production technology	G2L™ eFuels technology which uses Topsoe's eREACT™-based electrified reverse water-gas shift (eRWGS) process, together with Sasol's LTFT™ (low-temperature Fischer-Tropsch) synthesis technology
Current employees	Several people from both Zaffra and ENERTRAG work on the project, but not full time
Estimated number of employees during construction phase	~1,500 people
Estimated number of employees during operation phase	250 people

ERM HAS OVER 140 OFFICES ACROSS THE FOLLOWING COUNTRIES AND TERRITORIES WORLDWIDE

Argentina
Australia
Belgium
Brazil
Canada
China
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