THE SOLENT CLUSTER

HELPING TRANSFORM OUR REGION

SOCIOECONOMIC REPORT

THE SOLENT CLUSTER

CONTENTS

INTRODUCTION

The Government has set targets for the UK to reduce its greenhouse gas emissions to Net Zero by 2050. Low carbon industrial clusters provide the opportunity for low carbon investment that will grow regional economies, protect skilled jobs, and create new employment opportunities in the energy technologies and industries of tomorrow.

The Solent Cluster is the only project of its kind in the region and is backed by companies with the technical expertise and global track record of delivering cost-effective low carbon solutions. This effort could position the Solent at the centre of low carbon fuel production in the UK and make a major contribution to the country's Net Zero ambitions by 2050.

Founding members include the Solent LEP, The University of Southampton and ExxonMobil, with a membership now exceeding over 100 from a wide range of organisations. Anchored in Southampton, The Solent Cluster is based in one of the largest and most successful industrial areas in the UK, supporting around 90,000 businesses and a £50bn economy.

This region currently contains the **largest industrial cluster by direct greenhouse gas (GHG) emissions from industry (5 $MtCO_2e$/year)**[1] not yet included in the Industrial Decarbonisation Challenge. The reduction of GHG emissions in this area would **make a significant contribution towards the UK achieving its goal of Net Zero by 2050**.

Current emissions come from a variety of industries, such as additive manufacturing, refining and chemical production.

...one of the largest and most successful industrial areas in the UK, supporting around **90,000 businesses** and a **£50bn economy**

With around 200,000 large vessel movements each year, the ports of Southampton and Portsmouth are major trade and commercial hubs. In support of the region's strong maritime heritage, the reduction of GHG emissions in the region could **strengthen the UK's trading position in a lower carbon economy**, in conjunction with the Solent Freeport. The region is also close to the UK's busiest airports, and existing pipeline connections to Heathrow and Gatwick will also support the reduction of GHG emissions in the aviation sector using Sustainable Aviation Fuel (SAF).

These activities required to reduce GHG will also build on the Levelling Up agenda already underway in Southampton through the Transforming Cities Fund.

[1] According to data from the NAEI large point source database, 'direct emissions' refers to emissions from point sources at the sites (i.e., Scope 1 emissions)

THE SOLENT CLUSTER

A VISION FOR THE FUTURE

CARBON CAPTURE AND STORAGE (CCS)

CCS involves harnessing the carbon emissions from industrial processes, transporting the carbon, and then storing it underground to prevent it being released into the atmosphere, which in turn can prevent future temperature increases.

HYDROGEN FUEL

Hydrogen is best suited to lower emissions to those sectors which are not easily electrified. There are two hydrogen production solutions which pass the UK Government's Low Carbon Hydrogen Standard.[2]

- **'Blue' hydrogen** produced by reforming natural gas, with CO_2 captured and stored using Carbon Capture and Storage (CCS).
- **'Green' hydrogen** produced via electrolysis, where water is split into oxygen and hydrogen, powered by renewable electricity.

SUSTAINABLE AVIATION FUEL (SAF)

SAF is fuel for aeroplanes produced without fossil fuels. Instead, it is made from sustainable or waste resources and can reduce emissions from aviation.

ANCHOR PROJECTS

To contribute towards the UK's goal of Net Zero by 2050, six potential anchor projects are under evaluation for The Solent Cluster region:

1 The **Solent Blue hydrogen plant**, which has an estimated capacity of 1.4 Gigawatts (GW) and, if approved, could begin operations in 2030. The hydrogen could replace natural gas for industry. A secondary expansion phase, if approved, could increase the estimated capacity to 2.8 GW, and could come online in 2035.

2 A potential **Sustainable Aviation Fuel (SAF) plant**, which has an estimated fuel production capacity of 200,000 tonnes (200 kt) per year, and, if approved, could start operating in 2032. A secondary expansion phase, if approved, could be completed by 2035, and would increase estimated fuel production capacity to 400 kt per year.

3 **Carbon capture** at the Marchwood **Energy from Waste (EfW) Plant** owned by Veolia.

4 The **English Channel Offshore Storage**, which, if approved, would transport CO_2 captured in The Solent Cluster region and potentially beyond, and store it under the seabed in a saline aquifer.

5 6 **Two green hydrogen plants**, with a combined estimated capacity of 400 MW to produce hydrogen from renewable electricity.

[2] UK Low Carbon Hydrogen Standard, April 2023

ECONOMIC IMPACT

— SUSTAIN —

70,000

JOBS OVERALL

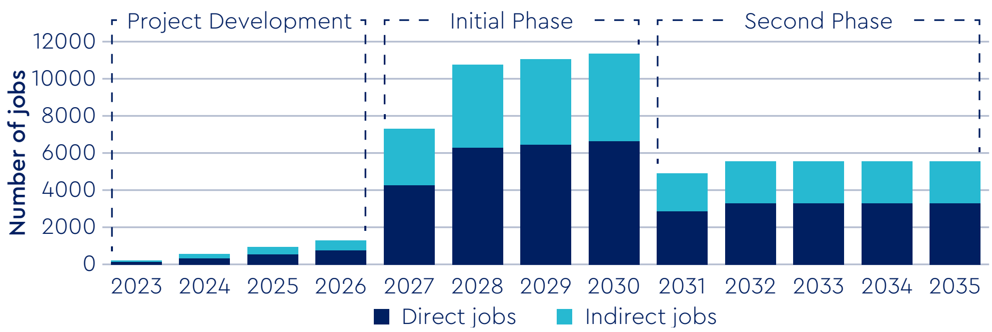
BOTH DIRECTLY AND INDIRECTLY

— CREATE —

18,900

JOBS BY 2035

FIGURE 1



Total number of jobs created by capital expenditure in The Solent Cluster from 2023 to 2035. From project development, as well as the initial phase and second phase of construction.

INVESTMENT

The Solent Cluster is a cross-sector collaboration of international organisations, including manufacturers and engineering companies, regional businesses and industries, leading logistics and infrastructure operators, public sector organisations and academic institutions, some with decades of proven expertise in carbon capture and storage and hydrogen technology. One of The Solent Cluster's strategic priorities is to **support the development of a world-class talent base**, to help people at all stages of their careers to build the skills needed to respond to new technologies and drive an innovative knowledge-based economy. Alongside supporting the UK's transition to Net Zero, **The Solent Cluster will promote inward investment to fuel this vibrant region**.

The infrastructure under consideration for the six potential anchor projects would represent an estimated **investment of more than £11.9 billion by 2035**. This could help drive local economic growth, and support local opportunities and improve job prospects.[i]

REGIONAL ECONOMIC IMPACT

It is estimated that total capital expenditure (CapEx) between 2023 and 2035 could sustain **70,000 jobs** (both directly and indirectly). At the peak of construction, activities in the initial phase, the potential anchor projects in the Solent region, could support **11,300 full-time equivalent jobs each year**. As shown in Figure 2 (see page 9), **59%** of these jobs would be direct and **41%** would be indirect.

Over **18,900** of these jobs could be newly created but the remaining jobs could represent jobs displaced from other parts of the economy.

- **Created jobs** would be newly-created roles within potential anchor projects in the Solent region. These would include jobs from manufacture of materials, detailed project design/testing, as well as engineering and project management jobs.
- **Displaced jobs** refers to roles that already exist in the Solent area, such as in the construction sector, and for which full employment demand for workers can be assumed. Therefore, workers employed in these roles within The Solent Cluster anchor projects would be displaced from other similar roles in the Solent area. The types of jobs associated with the development of the potential anchor projects include (but are not limited to):
  - Development of building projects (i.e., construction of buildings, electrical wiring, installation of complex machinery)
  - Engineering design activities for industrial processes (i.e., pipeline routing, process design for each plant, seismic acquisition/processing)
  - Other specialised construction activities
  - Activities of head offices (e.g., project management)
  - Manufacture of metal structures (i.e., manufacturing pipelines, manufacturing metal parts for complex machinery)

Operational expenditure would sustain the need for skilled workers in the Solent region

- It is anticipated that a shift from engineering and construction roles to permanent operational and maintenance roles would occur as the infrastructure is developed. This operational expenditure is estimated to sustain in the order of **200 direct and indirect jobs each year**.
- A potential fuel switch at Fawley Petrochemical complex could help to sustain the existing permanent and contractor workforce currently on site. Preserving these jobs would support: (i) skill development in new lower carbon sectors, and (ii) local social stability. By safeguarding these jobs, **over 10,000 indirect jobs would also be sustained across other companies** – a significant potential benefit both economically and socially.[3]
- Potential additional and continued capital development in the Solent region, such as for a liquified CO_2 import terminal, could also help **sustain the need for large numbers of skilled workers**, particularly in the construction and project management sectors.

[3] Using a type 1 FTE multiplier of 5.11 from the ONS for SIC code 19 (Manufacture of Coke And Refined Petroleum Products), which is consistent with the Blue Book estimates.

SKILLS AND EDUCATION

One of The Solent Cluster's strategic priorities is to develop a world-class talent base, which can respond to new technologies and drive an innovative knowledge-based economy. It could therefore play a key role in the Levelling Up agenda.[4]

APPRENTICESHIPS

Prior to The Solent Cluster's core components operating, a large number of roles would be upskilled by large local employers, including through apprenticeships. Opportunities for upskilling would include front-end engineering design, operations as well as other disciplines such as welding, electrical and pipefitting.

EDUCATIONAL INSTITUTIONS

Increasing demand for STEM-related skills will arise from industrial emissions reductions. Collaboration between industry and education providers will enable future training provision to be tailored to meet industry needs and sector specific demands.[5]

Particularly, the number of students undertaking training in construction courses and project management needs to be increased.[6] The most relevant further education categories for industrial emissions reductions include engineering and manufacturing technologies and construction and planning and the built environment.

SHARING THE KNOWLEDGE

The potential blue hydrogen and Sustainable Aviation Fuel projects, if approved, would support the development of the Solent region and would create **opportunities to export knowledge from the region both nationally and internationally**. The need for SAF production facilities needed to meet the UK's expected 2030 SAF mandate means that any knowledge gained from the development of SAF facilities in the Solent region would likely be in high demand.

The exceptional position of the Solent as a national hub for global trade and investment by being designated a Freeport will be enhanced by the development of the anchor projects. The massive public and private investment to be undertaken could create a hotbed for innovation and promote regeneration by **creating highly skilled jobs and ensuring sustainable economic growth**.

By enhancing consumer spending, economic growth is expected to boost local businesses across the Solent region and would provide opportunities for developing supply chains underpinned by the availability of low carbon power, skilled labour, and access to CCS infrastructure. These components could **act as a magnet to other industries looking to reduce their GHG emissions**.

AN INVESTMENT OF MORE THAN

£11.9 BN

BY 2035

— OVER —

£4.4 BN

GROSS VALUE ADDED TO THE UK ECONOMY BY 2035

NATIONAL ECONOMIC IMPACT

Gross Value Added (GVA) represents the value of goods and services produced through activities associated with The Solent Cluster after subsidies and taxes are applied. It is a good metric for assessing the contribution The Solent Cluster will make to the wider UK economy.

The total Gross Value Added (GVA) to the UK economy that could be generated by The Solent Cluster might reach **£4.4 billion by 2035**.

This means that from the £11.9 billion investment in The Solent Cluster, over £4.4 billion gross value added could be generated for the UK economy, 58% directly, 42% indirectly.

It is estimated that GVA would peak in the late 2020s when the initial phase of construction would take place and would be sustained through the 2030s by the second phase of construction (Figure 2). Without this investment, there is a risk of the Solent and wider South of England regions being left behind as the energy transition takes place in other locations across the UK and globally.

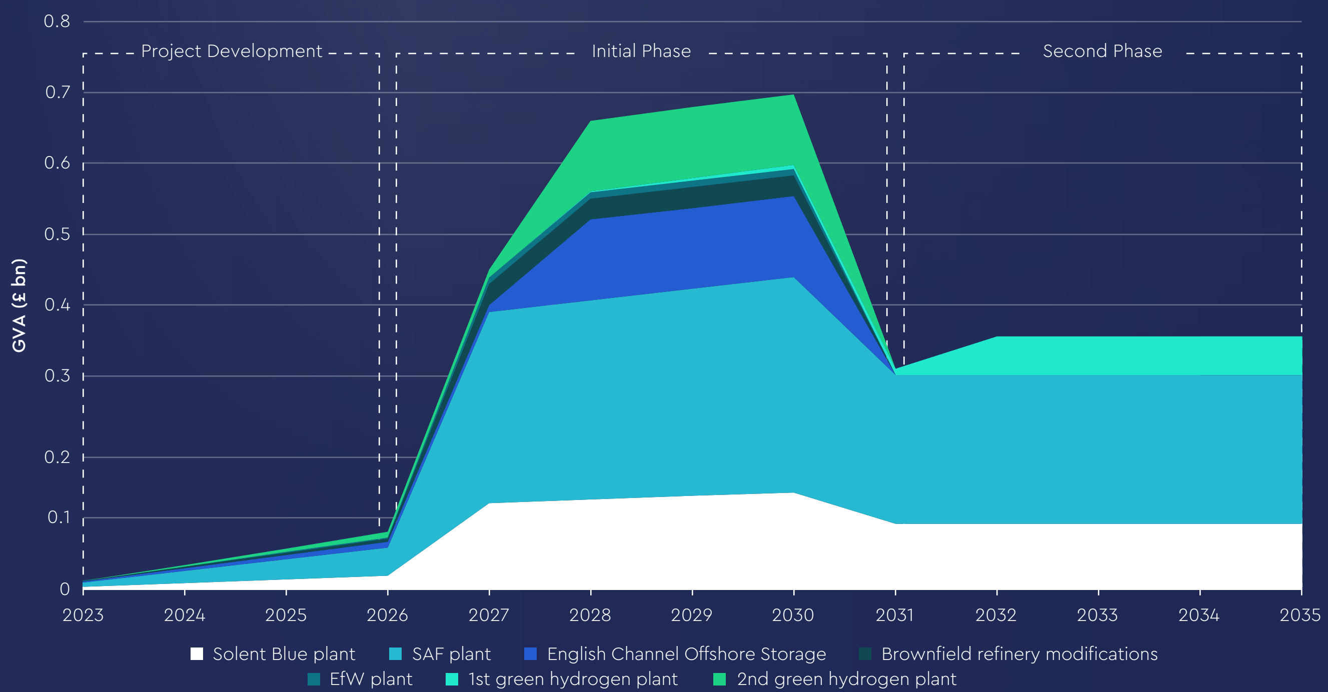
ESTIMATED KEY TAKEAWAYS

£11.9 Billion – Capital expenditure to develop The Solent Cluster

£4.4 Billion – Gross Value Added to the UK economy due to capital expenditure in The Solent Cluster

70,000 Jobs – Direct and indirect jobs sustained by capital expenditure by 2035

FIGURE 2



Direct and indirect gross value added generated by each core component of The Solent Cluster. Due to CapEx investment (2023–2035) during project development, as well as the initial phase and second phase of construction.

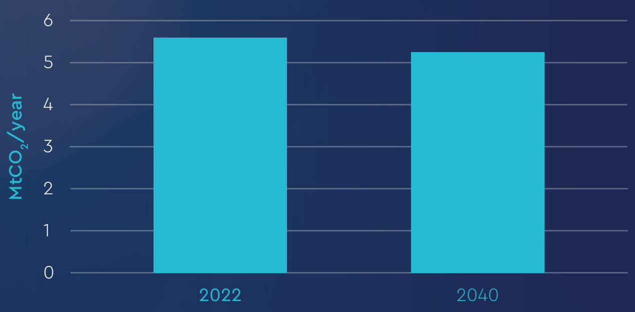
[4] Levelling Up the United Kingdom: Executive Summary (publishing.service.gov.uk)
[5] Enabling Skills for Industrial Decarbonisation Supply Chain – IDRIC
[6] Low Carbon Skills Report – Solent LEP

ENVIRONMENTAL IMPACT

With the fourth largest industrial hub of England, the Solent has several large industrial emitters and power stations.[7]

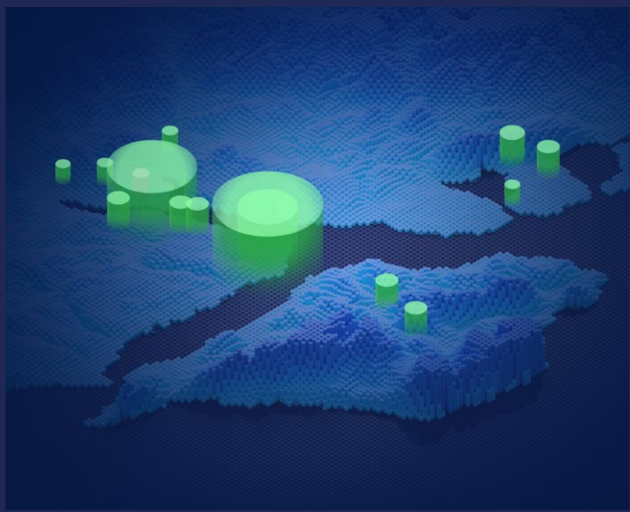
Without a series of projects as ambitious as those under evaluation by The Solent Cluster (i.e., business as usual), the Solent's direct emissions would remain stable; they are forecast to reach 5.3 million tonnes of carbon dioxide equivalent by 2040 as shown in Figure 3.

FIGURE 3



Emissions slightly decrease between 2022 and 2040 due to a forecasted decrease in power production from natural gas, as more power generation is provided by the increase in renewable capacity in the UK.

FIGURE 4

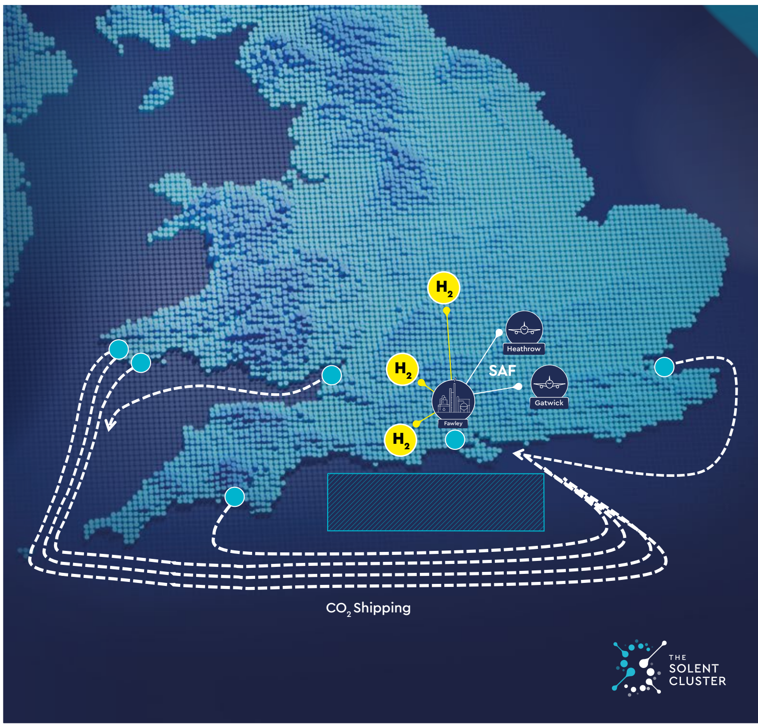


Large emitters in the Solent area (size of the circle proportional to their current emissions)

THE SOLENT CLUSTER CCS CATALYST FOR A NEW FUTURE

NOMINATED STORAGE AREA AND POTENTIAL CCS/HYDROGEN CUSTOMERS

- CO_2 Storage
- Potential CCS Customers
- H_2 Potential Hydrogen Customers



For illustration purposes only

[7] According to data from the NAEI large point source database

KEY INDUSTRIAL MEMBERS OF THE CLUSTER

FAWLEY PETROCHEMICAL COMPLEX

ExxonMobil's Fawley Petrochemical complex is the largest integrated refinery and chemical complex in the UK, producing:

- Diesel and petrol that fuels an estimated 1 in 5 vehicles on UK roads.[8]
- More than 10 per cent of the UK's consumption of jet fuel. The refinery directly feeds Heathrow and Gatwick airports through dedicated pipelines. The site is evaluating a fuel switch from natural gas to blue hydrogen to significantly support reduction of direct GHG emissions from its operations from 2030.
- A wide variety of specialty products, such as solvents, engine lubricants, and butyl rubber which has a variety of uses including in medical packaging and car tyres.

MARCHWOOD POWER LIMITED

With an installed capacity of 920 MWe, Marchwood Power Station is one of the UK's most efficient flexible gas-fired power stations. Blending hydrogen into the power station is a possible route to reduce the GHG emissions associated with gas-fired electricity generation.

MARCHWOOD ENERGY FROM WASTE (EfW) PLANT

Veolia's EfW plant transforms municipal solid waste into electricity, with a capacity of 16 MW, and feeds the National Grid. Veolia is evaluating the deployment in 2030 of post-combustion carbon capture technology to capture up to 90%[ii] of the plant's direct GHG emissions as part of its emissions reduction strategy.

[8] Fawley Refinery and Petrochemical Plant

THE IMPACT OF LOW CARBON ANCHOR PROJECTS

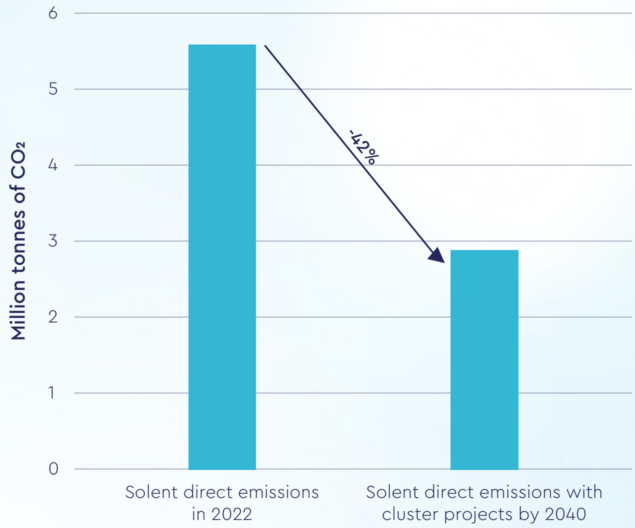
— DIRECT —
42%
REDUCTION OF EMISSIONS

The Solent Cluster anchor projects would result in **a direct 42%[iii] reduction of greenhouse gas emissions** in the Solent region by 2040 relative to 2022 levels.

INITIAL ANCHOR EMITTER PROJECTS

- The potential **Solent Blue hydrogen plant**, if approved, could start operation in 2030. This hydrogen will replace natural gas in local industry. The carbon emissions from the Solent Blue hydrogen plant will be captured and compressed, capturing 2.7 million tonnes of CO_2 per year.
- The potential **SAF plant** with carbon capture installed has an estimated fuel production capacity of approximately 200 kilo tons per year, and would, if approved, start operating in 2032.
- The potential carbon capture project at the Marchwood EfW plant, which would capture up to 90% of the site's GHG emissions.
- This means the Solent area would emit 2.4 $MtCO_2$ less direct industry GHG emissions in 2040 than in 2022, as shown in Figure 5.[iv]

FIGURE 5



Evolution of direct emissions from large emitters in the Solent region with the implementation of the anchor projects.[9]

FIGURE 6

Solent large emitters' potential fuel switch to hydrogen is the main contributor to CO_2 emissions reduction ($2.3\ MtCO_2$/year)

CA. **1.4GW** OF H_2

TO LOCAL INDUSTRY

»»» EQUIVALENT TO REMOVE CA. **1.4 MILLION** INDIVIDUAL CARS OFF THE ROAD

[9] Only direct emissions were used to compute Figure 5. Thus, indirect emissions (for example, linked to electricity consumed, or to the construction of the plants) are not considered in the graph.

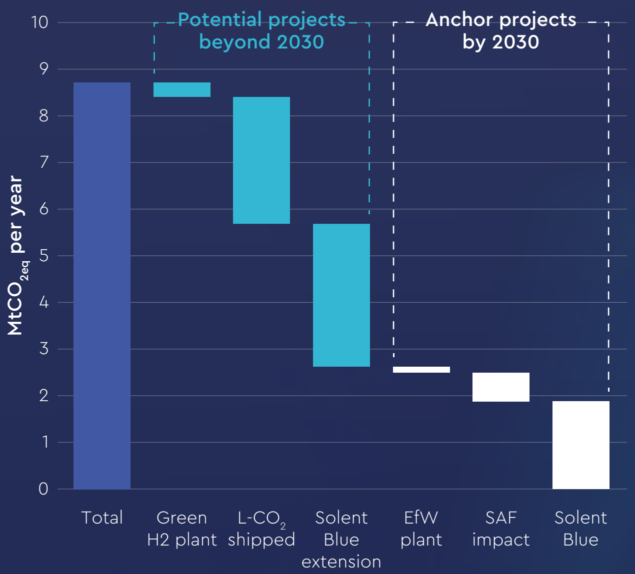
BEYOND 2030

- The capacity of the **Solent Blue hydrogen plant** could double, branching out to replace natural gas in other industrial plants, potentially outside the Solent area.
- **English Channel Offshore Storage** capacity could increase by 2033 to service the Solent Blue plant extension and liquefied CO_2 imports from other UK industrial sites. Moreover, it could store 10 million tonnes of CO_2 per year by 2035, and could offer CO_2 storage for emitters across Southern UK representing 11% of the Government's overall target.

AT NATIONAL LEVEL

- The jet fuel produced by the SAF plant will avoid emissions of 563 kilotons of CO_2 per year by producing jet fuel with 70% less emissions than fossil kerosene.[v]
- The Solent Cluster could reduce national overall emissions beyond 2030 by -9 million tonnes of CO_2 per year compared to 2022, 4% of the UK's emissions reduction target by 2035.

FIGURE 7



UP TO

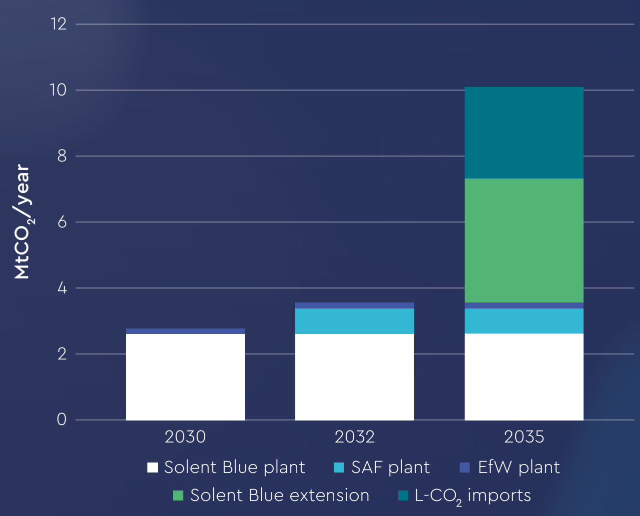
10

MILLION TONNES

PER YEAR OF CO_2 COULD BE CAPTURED BY THE PROJECT

- Two **new green hydrogen plants could be built by 2035**, and hydrogen produced would replace natural gas use.

FIGURE 8



Annual volumes of CO_2 captured from different sources.

ESTIMATED KEY TAKEAWAYS

5 $MtCO_2eq$ — Direct emissions of the Solent area in 2022

-42% — Impact of anchor projects on Solent area direct emissions

-2.4 $MtCO_2eq$ — Annual avoided emissions of the Solent area compared to 2022 with initial Cluster projects

-9 $MtCO_2eq$ — Total annual avoided emissions at a UK level through all potential Cluster projects, representing 4% of UK emissions reduction target between 2020 and 2035

CASE STUDY
POTENTIAL GREEN HYDROGEN PRODUCTION

The first potential investment of £380 million into green hydrogen production would provide:[10]

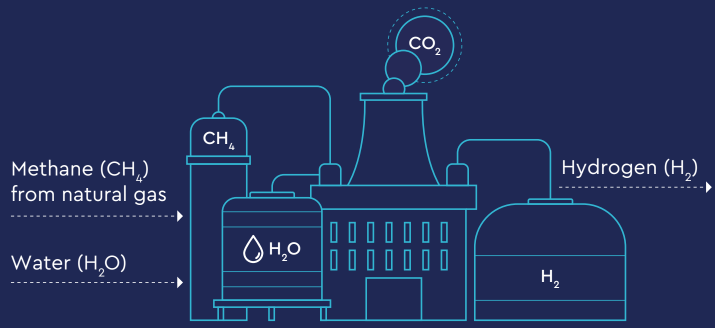
- **200 megawatts** of green hydrogen through electrolysis.
- **Over £200 million cumulative GVA**[11]
- **760 jobs**, 62% directly, and 38% indirectly
- The opportunity to future-proof jobs for those currently in oil and gas, as well as create new ones
- Opportunities for training and upskilling.

The second potential investment of £500 million in another green hydrogen production facility would provide:[12]

- Around **1,400** direct and **1,200** indirect jobs during construction
- Additional GVA of over **£200 million**
- 3 full time jobs and 9 additional jobs indirectly after the initial construction phase.

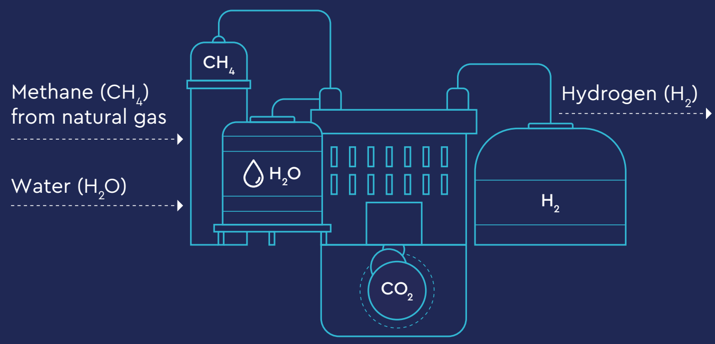
GREY HYDROGEN

Steam reforming from fossil fuel energy, without capturing the carbon dioxide emissions from the process



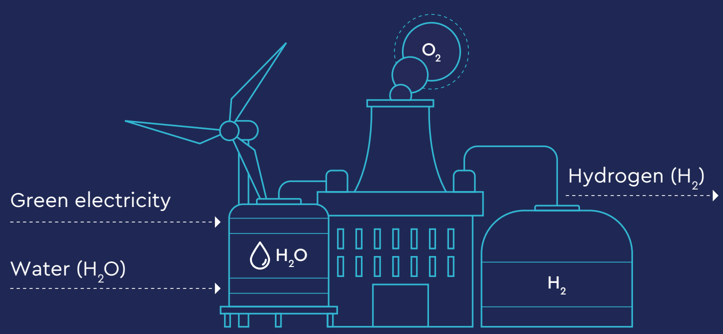
BLUE HYDROGEN

Steam reforming from fossil fuel energy, with the carbon dioxide emissions captured and stored safely underground using CCS



GREEN HYDROGEN

Electrolysis powered by elecricity from renewable sources



Three types of hydrogen production

[10] In US$ 2022 prices, £360 million
[11] Assuming 50% expenditure on materials vs labour and 10% materials from within UK
[12] Assuming electrical power generation of 1 kWe from green hydrogen costs £1,500 in CapEx with a 58% efficiency
[13] Statistics at DfT – Department for Transport
[14] Assuming each bus has a vehicle efficiency of 0.067 kg H2/km and a range of 100–150 km/day – Environmental Impacts and External Cost Benefits of Fuel Cell Buses
[15] Southampton Water | SGN
[16] Assuming natural gas emits 0.2 $kgCO_2e$/kWh and the total CO_2 emissions from Solent hospitals is 43.6 $ktCO_2$/year (NAEI large point source emitters, 2020). This would require 218 MWh/year hydrogen energy to replace all natural gas demand from these hospitals. Other hospitals not considered in this analysis include the Royal South Hants Hospital, Fareham Community Hospital, Ravenswood House Hospital (mental health), Lymington New Forest Hospital, Gosport War Memorial Hospital.
[17] Havant Borough Council – Climate Change and Environmental Strategy
[18] Portsmouth City Council Climate Change Strategy
[19] Southampton City Council – Net Zero Strategy Consultation Strategy
[20] Port of Southampton targeted for a flag-ship UK hydrogen hub
[21] New Forest District Council – Greener Housing Strategy

USES OF HYDROGEN IN THE SOLENT AND BEYOND

VEHICLES

Hydrogen can be consumed in fuel cells or internal combustion engines for applications, including buses, trains, ships and heavy goods vehicles (HGVs), especially when undertaking long journeys where the capacity of electric vehicles is more limited.

For example, there are currently over 400 buses in operation across the Solent.[13] **Just 3% of the output from green hydrogen produced in the Solent could be used to power all the buses across the region**.[14]

HEATING

SGN's potential H2 Connect pipeline would repurpose existing infrastructure to connect Solent hydrogen production with **up to 800,000 gas network connections**, including domestic, commercial, and industrial customers.[15]

If all available customers switched from using natural gas to hydrogen, this could:

- **Reduce emissions** by up to 3 Megatons of CO_2 equivalent a year.
- **Heat over 150,000 homes** in Southern England.
- Reduce direct GHG emissions in the four local major hospitals, reducing emissions by **44 kilotons of CO_2 equivalent per year**.[16]

LOCAL COUNCILS

Many councils in the region already support the use of low-carbon hydrogen to reduce GHG emissions in their local area. For example:

- Havant Borough Council wants to implement low carbon transport such as green hydrogen hubs for HGVs.[17]
- Portsmouth City Council has already used hydrogen to power a port work boat as part of the Clean Maritime Demonstration.[18]
- To support the city becoming Net Zero, Southampton City Council will support The Solent Cluster in pursuing opportunities to introduce low carbon fuel options, including hydrogen, across the region and to benefit the city.[19]
- The Port of Southampton is exploring the potential to become a hydrogen super-hub.[20]
- The New Forest District Council will install low carbon heating systems such as hydrogen boilers in all new build homes from 2025.[21]

SSE

As a 50% owner of Marchwood Power Limited and owner of two 45MW OCGTs (Burghfield and Chickerell), located in Southern England, SSE is a member of The Solent Cluster. SSE's strategy is to create value for shareholders and society by developing, building, operating, and investing in the electricity infrastructure and businesses needed to transition to Net Zero. To deliver this strategy, SSE has set out an ambitious investment plan to accelerate progress towards Net Zero. SSE has set out plans that could see the organization **invest up to £40bn across the decade up to 2032**, with a fully funded **£18bn five-year investment plan to 2027**. In doing so, SSE will **create more than 1,000 new jobs every year**. SSE's plans include investing in low carbon flexible energy, which will replace higher carbon alternatives and ensure energy security.

Developing a lower-carbon power station fleet will be vital to deliver SSE's goal to **cut carbon intensity by 80% by 2030**. SSE is developing projects that include Carbon Capture and Storage (CCS) and hydrogen technologies that will be critical to the transition to Net Zero, enabling enhanced renewables deployment by balancing the system.

THE NATIONAL POWER SYSTEM

Lastly, the power system stands to benefit from low carbon hydrogen. With renewable energy generation and power demand increasing, low carbon hydrogen can help to resolve some of the issues associated with daily through to inter-seasonal variability of supply and demand. For example, during periods of high-power generation, surplus energy can be used to produce low carbon hydrogen. When energy demand is greater than energy supply, locally stored low carbon hydrogen can be converted back to electricity and distributed to users.

To produce low carbon electricity in the UK, electricity generators are ramping up their hydrogen ambitions. In Southern England alone there are many power stations, all with their own emissions reductions plans including either co-firing a blend of hydrogen with natural gas, conversion to 100% hydrogen firing, or new-build sites designed to fire 100% hydrogen. The planned Solent hydrogen projects are well placed to meet potential low-carbon hydrogen demand, significantly reducing GHG emissions associated with the electricity supply to over 1 million households in the process.

CASE STUDY

MARITIME METHANOL

Low carbon methanol could become an opportunity for reduction of direct GHG emissions in the shipping industry.

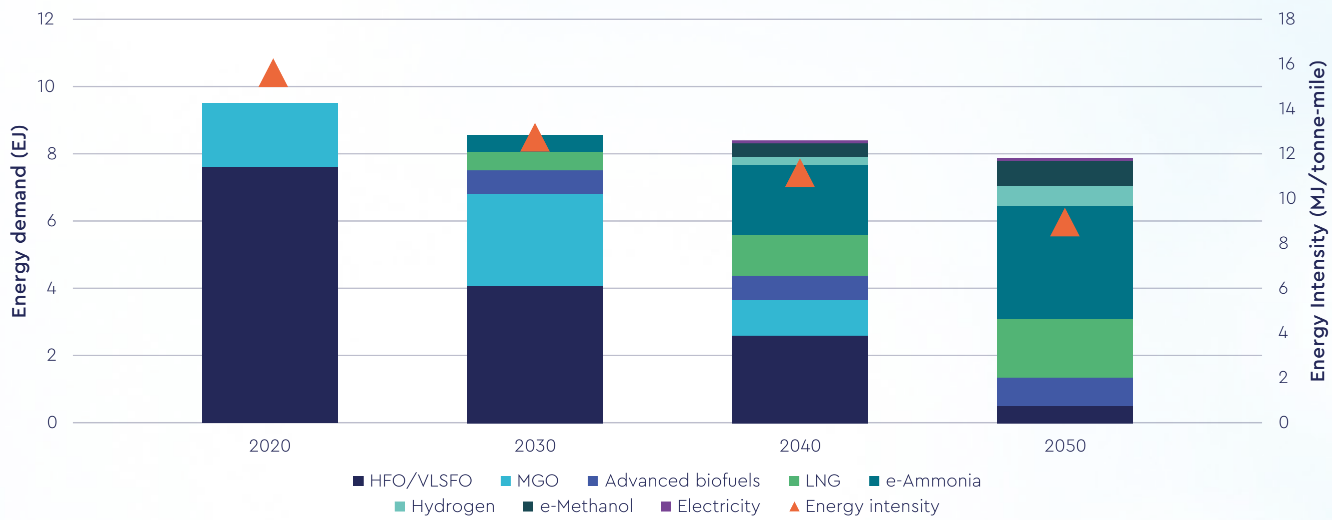
The potential Solent SAF plant could produce methanol as an intermediary product. The current evaluation anticipates all such methanol being transformed into jet fuel. However, depending on the chosen production pathway, **the potential SAF plant could also produce low carbon methanol for the maritime sector**.

Low carbon methanol fuel could be of interest as the Solent region includes the Port of Southampton. Owned and operated by Associated British Ports (ABP), the Port handles approximately **40,000 commercial vessel movements per year**. Among these vessels are many large cruise, container and automotive ships, as well as the Red Funnel Isle of Wight service.

ABP's ambition to reduce direct GHG emissions from its own activities are high.[22] ABP has committed to be Net Zero from its own operations by 2040, and to support the shipping industry's transition to a lower carbon future, including low carbon fuels deployment. In 2022, ABP introduced shore power capability to two of its cruise terminals in Southampton to allow compatible vessels to be emission free whilst alongside.

According to IRENA,[23] e-ammonia and LNG will be the main alternative fuels in the shipping sector. However, methanol will represent around 10% of shipping fuel in 2050 in this scenario.[24] Whilst low carbon methanol is not yet mature due to high feedstock and infrastructure costs, it offers an **85–95% reduction in GHG emissions** in comparison to heavy fuel oil which is currently used.

IRENA decarbonisation roadmap, 2021



KEY OUTPUTS REGARDING LOW CARBON METHANOL USE

up to **476 KT/YEAR** of low carbon methanol could be produced in the potential SAF plant

up to **700 KTCO$_2$** of CO_2 emissions would be avoided by using it in the shipping industry

[22] Cleaner Air for Southampton, Associated British Ports
[23] ABP Sustainability Strategy; Scope 1 and 2 emissions
[24] IRENA, Decarbonising shipping, 2021

CASE STUDY

SAF SUPPLY TO GATWICK AND HEATHROW

The UK government aims to reach Net Zero in the UK aviation sector by 2050 through the UK Jet Zero Strategy. The use of SAF is one of the strategy's six key measures.

SAF has the potential to reduce emissions from the aviation sector by 17% by 2050

In July 2022, the UK government announced that they would introduce a **SAF mandate in 2025 requiring at least 10% of jet fuel to be made from sustainable feedstocks by 2030**. To reach that objective, strong support has been provided for SAF production. The UK government has invested in the early-stage development of eight UK SAF plants through the Green Fuels, Green Skies competition.

It has recently announced that five projects will receive a share of the £165m Advanced Fuels Fund, which aims to take as many as possible through commercial-scale production.

Solent SAF production will significantly contribute to enabling GHG reduction for airlines fuelling in UK airports

HEATHROW AND GATWICK

SAF from the potential Sustainable Aviation Fuel plant could be sent to Heathrow and Gatwick airports through the existing pipeline network.

- Heathrow is amongst the **top ten largest airports globally** and strongly supports SAF use
- **95%** of the airport's total carbon footprint comes from aircraft fuel consumption
- Heathrow has an ambition to replace **90%** of fossil kerosene jet fuel supplied at Heathrow with SAF by 2050.[25]

SUPPORTING NATIONAL AIRPORT AMBITIONS

The potential SAF plant aims to produce significant volumes of SAF to supply the UK's largest airports. The potential Solent SAF plant, if approved, could produce an estimated 200 kt per year by 2030, **representing 16% of the national 2030 mandate**. SAF could reduce GHG emissions by at least 70% in comparison to fossil kerosene, so Solent SAF use would avoid an estimated 563 ktCO_2/year.[vi]

The UK would require a further six SAF plants of the same 200kt/year capacity to fulfil the entirety of the UK's 2030 mandate.[vii] If these additional six SAF plants were built in the UK, this is expected to generate over 100,000 jobs (direct plus indirect) for the duration of the projects. The knowledge and skills developed for the potential SAF plant could contribute to knowledge in support of this target, both for domestic and international production for import.

[25] Heathrow sustainability report, 2022

CASE STUDY

RESEARCH EXPERTISE AT THE HEART OF THE SOLENT CLUSTER

The University of Southampton is a research-intensive university with over 24,000 undergraduate and postgraduate students. Since 2021, the University of Southampton has been part of the **National Industrial Decarbonisation Research and Innovation Centre (IDRIC)** working with Industry across the country to deliver pathways to Net Zero.

The University has research strengths which are critical to The Solent Cluster and is working with industry to investigate critical research questions that need to be addressed in pursuit of a low carbon future. For example, the **CO_2 ports to pipeline (CO_2P2P)** project is developing a model for optimising CO_2 shipping and port infrastructure and storage.

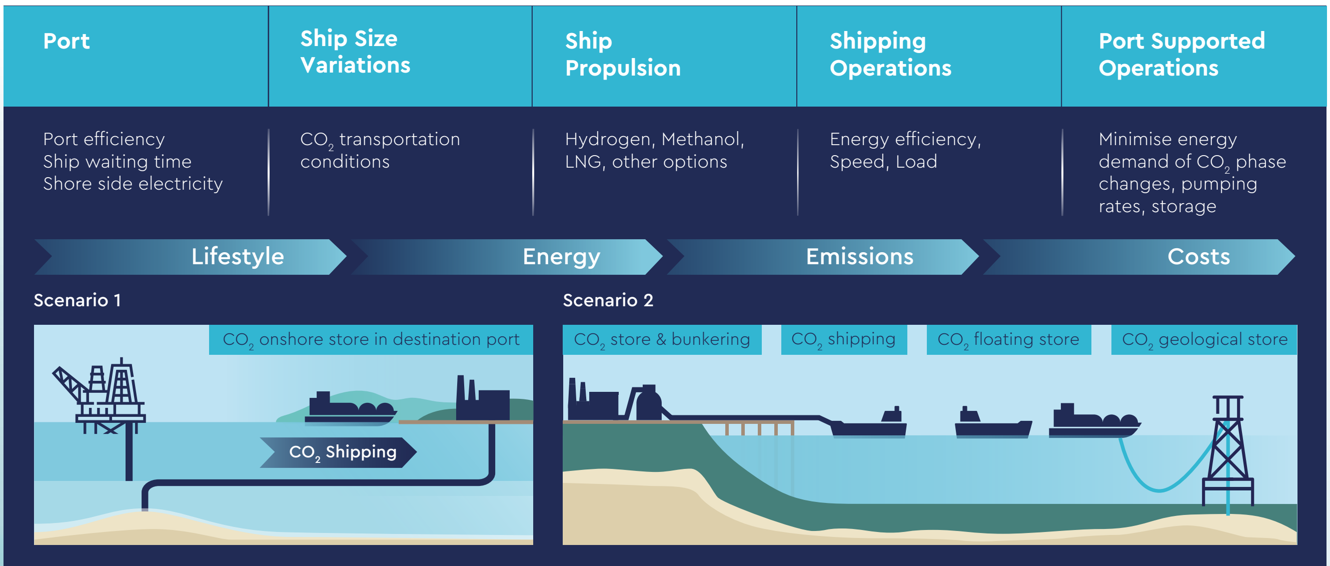
The project takes a deliberately UK-centric approach investigating specific UK sources, ports and shipping routes (cf. Northern Lights, ALIGN) and works closely with UK regulators to design seamless enabling regulations from source to geostorage.

The goals of this project are:

- Optimisation of effective methodology and development of supporting regulation of CO_2 transport by ships and transit storage of CO_2 in ports
- Development of regulatory frameworks and seamless connections between onshore and offshore regulators
- Measure and test wider public acceptance of CO_2 transport, port storage, and shipping of CO_2 (and other cryogenic potential future fuels (H2, NH3))

The optimisation of CO_2 shipping will include investigations of:

- Ship size, vessel availability, retrofit/new build, port capabilities, cargo size, storage and supply and transfer rates
- Whole-chain assessment of technical/economic/energy costs of CO_2 phase changes from capture to geostorage
- Enabling regulations for UK and international best practice to establish nascent industry and new commodity trade.



NOTE: This document was prepared for planning, analysis and discussion purposes only. Numbers and metrics for future years are hypothetical based on potential future management decisions and are subject to change, including as a result of changes in supply and demand for oil, gas, and petroleum products; the outcome of research and the development of new technologies; the ability to scale new technologies on a cost-effective basis; changes in law, regulation or government policy, including environmental regulations and international treaties; the preferences of customers; the impact of fiscal and commercial terms and the outcome of commercial negotiations; changes in demographics; general economic conditions; unforeseen technical difficulties or developments; and other factors discussed in this material. No decision regarding any plans or proposals discussed herein is final until relevant management has reviewed and approved or endorsed such plans. The companies referred to in this document have numerous affiliates. For convenience and simplicity, terms such as ExxonMobil and Veolia may be used in this document as abbreviated references to one or more specific affiliates or affiliate groups. Abbreviated references describing global or regional operational organisations, and global or regional business lines are also sometimes used for convenience and simplicity. Nothing contained herein is intended to override the corporate separateness of affiliated companies. While we have made every effort to ensure the accuracy of this report, neither ExxonMobil nor ERM make any representations or warranties (express or implied) regarding its quality, completeness or accuracy. Neither ExxonMobil nor ERM will, regardless of its or their negligence, assume liability for any reliance upon this report (whether foreseeable or unforeseeable) and any such liability is hereby excluded.

Please visit https://www.thesolentcluster.com/helping-transform-our-region/ for full information on all references

i Economic analysis undertaken by ERM on behalf of ExxonMobil. Economic improvements, such as GVA and job creation, are calculated from the investment figures by UK input-output tables and various business surveys produced by the Office of National Statistics (ONS). The macroeconomic model considers sectoral import/export statistics, average annual wages and division between direct and indirect impact.

ii Basis: Assumes retrofit installation of a carbon capture plant with CO_2 capture efficiency of 95% and assumed availability of 95%.

iii Basis: Assumed construction of 1.4 GW H2 plant, 200 KTA SAF plant both with operational availability of 90%, and CO_2 capture plant at Marchwood ERF facility, with operational availability of 95%. H2 plant uncaptured direct emissions of 17.75 tonnes CO_2 / hour resulting in 2.66 million tonnes per annum of CO_2 to storage, SAF plant uncaptured direct emissions of 34 t CO_2/ hour resulting in 0.79 million tonnes per annum of CO_2 to storage. Comparison against calculated baseline of Solent area emissions leads to 42% reduction in direct emissions for the Solent area.

iv Basis: Assumed 7,400 miles driven per annum at 138 g CO_2eq/km. Assumed 2900 kWh/year energy usage per household.

v Basis: Methanol production from Solent SAF plant assumed to be 473,000 tonnes per year. Assuming Heavy Fuel Oil (HFO) emits 83.8 g CO_2-eq/MJ (Source: IRENA), and that methanol energy per mass unit is 20.1 MJ/kg (Source), and that methanol provides 90% reduction of emissions in comparison to HFO (IRENA), this leads to avoided emissions calculated at 717 tCO_2eq/year.

vi Basis: Sustainable Aviation Fuel with 70% reduction in GHG emissions of 70% versus fossil kerosene jet fuel, per the proposed UK Government definition of SAF (Source). Fossil kerosene emission factor of 94 gCO_2e/MJ (Source: EU reference value) and assumed lower heating value of 42.8 MJ/kg. Assumption of 200,000 tonnes per annum of SAF production leads to 563,000 tonnes of CO_2 avoided per year.

vii Basis: Assumption of six SAF plants at 200,000 tonnes per annum each would supply 1.2 million tonnes per annum of SAF, which is approximately 10% of the UK estimated jet fuel capacity, and would meet the volume mandate anticipated to be set by the UK Government for 2025.

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