UK Energy Storage – Socio-economic benefits of South Dorset hydrogen storage

Quod, March 2025

Version 5.0

Scope

- Headline messages for government support.
- Alignment with national policies and strategies.
- Alignment with local / regional policies and strategies.
- Economic impacts.
- Support for the hydrogen economy including case studies

About Quod

Quod is an independent planning and economics consultancy, specialising in modelling the economic impacts of major infrastructure projects using Government guidance and appraisal techniques, including the Green Book. Recent projects include airports (Heathrow, Gatwick, Luton and City), nuclear power stations (Hinkley Point C, Sizewell C, Bradwell B and Wylfa Newydd), transport (Lower Thames Crossing, Holyhead Freeport, Crossrail 2) and mining projects (Woodsmith (potash) and Curraghinalt (gold)).

Headlines for getting Government / local support

Headline messages

- The South Dorset hydrogen storage facility represents the sole planned material scale salt cavern hydrogen storage project within the South of England, an area forecast to likely contain the largest national hydrogen demand from 2040 onwards.
- Its strategic location can support numerous government objectives:
  - Net Zero by 2050, decarbonising industrial clusters, the SAF mandate and marine fuel strategies.
- Via its size, location and planned pipeline connections, it can help decarbonise industrial clusters and power generation in both Southern England and the wider UK.
- It can also play a significant regional role in the decarbonisation of industry;
  - The Solent Region – one of the largest industrial and CO2e emissions areas in the UK,
  - the Great South West
- Proximity to the UK's largest airports, major ports and trade hubs of Southern England means the facility can help decarbonise UK aviation and shipping, both key UK industrial sectors;
  - it can play a vital role for renewable fuels at Portsmouth and Southampton ports
  - It can support SAF and decarbonisation of Heathrow and Gatwick airports.
- Its unique location provides the sole at scale storage element in Southern England, critical for the operation of the planned UK-wide Project Union Hydrogen Backbone hydrogen pipeline system, the main enabler for the UK's overall future hydrogen network.

Economic Impact

- **South Dorset Storage Economic impacts:**
  - Contribute **£1.5 billion annually to the overall economy** which represents the contribution towards Net Zero nationally and boosting local low carbon industries
  - Construction of the facility can contribute:
    - **£285 million in GVA** and support up to **2,100 jobs directly** and
    - **£380 million in GVA** and support up to **a further 5,100 jobs in the supply chain**
  - Operations of the facility over its 30+ year lifespan alone can contribute:
    - Directly up to **£420 million in GVA annually** creating approximately **50 highly skilled jobs directly on site**
    - up to an **additional £360 million GVA annually** creating approximately **85 jobs in its supply chain**

Alignment with national policies and strategies

The Government needs to build a domestic hydrogen industry to deliver its transition to net zero – and grow the economy (1/2)

- Incorporating hydrogen into the national energy mix is necessary for Government to be able to achieve its near term and long terms aims for transitioning to net zero
- A fast and material shift in the energy system is required in order to meet the Government's **totemic 2030 target** of a net zero power system, and **national net zero by 2050**
- In addition to power, Government envisages hydrogen playing a role in the decarbonisation and growth of other sectors, so it can deliver its **number one mission of economic growth**
- Government forecasts hydrogen's principle uses to include:
  - Sustainable Aviation Fuel (SAF) – underlined by Government support for airport growth, including Heathrow's third runway
  - Industrial applications – using hydrogen as an alternative fuel in applications such chemicals and manufacturing where it is hard and/or expensive to electrify
  - Power – dispatchable and long-duration flexible capacity can be fuelled by hydrogen
  - Marine – driven through decarbonising fuels through hydrogen and its derivatives
- As such, Government policy is directing the growth of the domestic hydrogen industry – its production, storage, and application – and is looking to industry to shape and deliver it all

The Government needs to build a domestic hydrogen industry to deliver its transition to net zero – and grow the economy (2/2)

- In particular, the Climate Change Committee's report to the UK Government on the level of the Seventh Carbon Budget highlights some important messages for hydrogen and hydrogen storage:
  - An urge to fast-track hydrogen infrastructure development including networks and storage to get them available from the 2030s given the investments have long lead-times.
  - Hydrogen storage will play an important role in helping provide low-carbon sources of generation for balancing the electricity system and manging low-wind periods through use in gas Carbon Capture Storage (CCS) and hydrogen power stations.
  - Synthetic fuels e.g. Sustainable Aviation Fuel (SAF) and shipping fuel are produced domestically and require a supply of hydrogen as feedstock

The South Dorset storage facility can play a critical role in providing hydrogen storage and to be operational in the early 2030s.

Government, National Grid and NESO recognise hydrogen as critical to the future energy mix

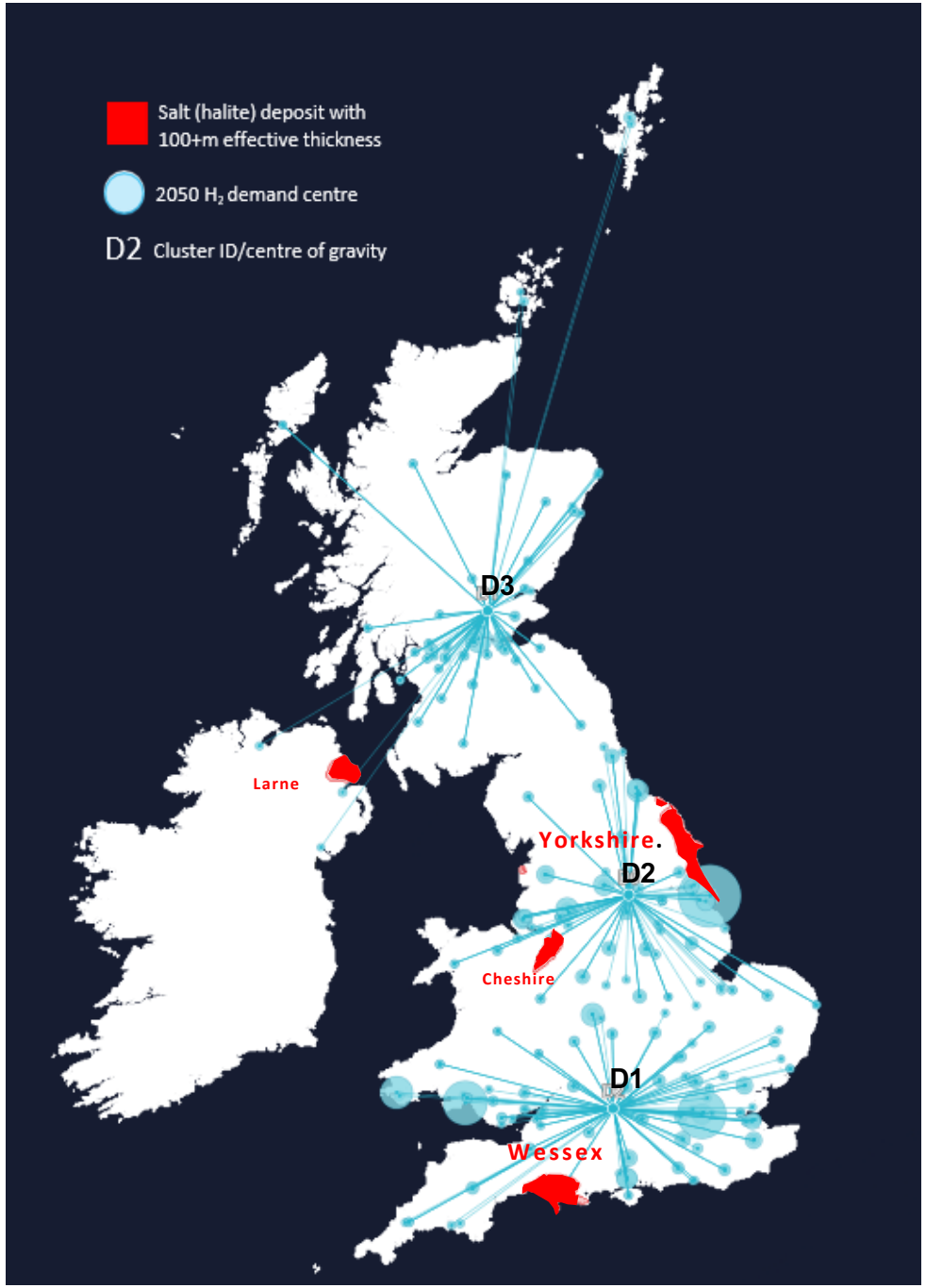
- UK Government's top two priorities are economic growth and clean power
- There are different routes to achieving this target with different roles for hydrogen – shaped by the degrees of Government intervention, market forces, and customer behaviours
- National Grid's four Future Energy Scenarios include a range of technology mixes
  - The high hydrogen scenario has an annual demand for 18 TWh of hydrogen storage by 2035, and 49 TWh by 2050
  - The FES's central scenario is a "holistic transition", which has an annual demand for 3 TWh of hydrogen storage by 2035, and 19 TWh by 2050
  - The difference is accounted for by how hydrogen is proposed to be deployed: in a higher hydrogen scenario, it is used for peak power demand, which drives up storage needs
  - For all scenarios, a pathway to achieve a minimum of 5 TWh of storage by 2035 is considered "low regret"
- The newly-formed National Energy System Operator (NESO) has produced two scenarios for delivering the 2030 target using different mixes of technologies, which have different levels of reliance on hydrogen
  - At the higher end, the "new dispatch" scenario requires 2.7GW of CCS and hydrogen dispatchable power capacity, by 2030, to flexibly manage periods of low renewables output
  - At the lower end, the "further flex and renewables" scenario requires only 0.3GW of CCS and hydrogen by 2030, where there is a high rollout of renewables, and hydrogen serves only to reduce network constraints

Government is actively stimulating the national hydrogen economy

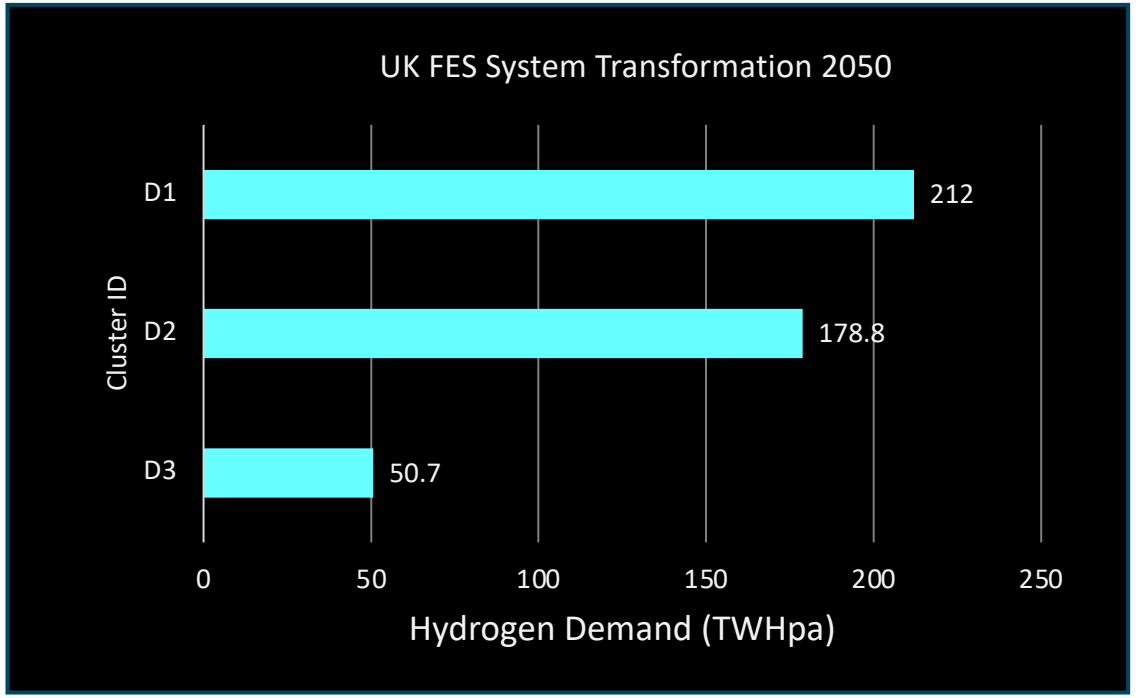
- To achieve the target mix, the UK needs urgently to build hydrogen production, hydrogen storage, and the supporting transportation infrastructure so it can be moved from production, to storage, and on to end users
- Government has put in place a range of policies and funding mechanisms to stimulate and sustain the hydrogen economy, including:
  - The Net Zero Hydrogen Fund allocated up to £240m for devex and capex development of hydrogen production projects
  - The Hydrogen Allocation Round 1 is promoting production projects that can come online by 2025, and HAR 2 will promote ~850MW of production projects
  - Government intends to support two hydrogen storage projects to be operational by the early 2030s, via the Hydrogen Transport and Storage Business Models
  - Consequently, Government intends to incentivise regional pipeline and storage infrastructure to be in construction by 2030
  - Hydrogen is a frontier technology to be supported by the National Wealth Fund
  - The SAF Mandate came into force this year, and will ramp up in coming years – hydrogen can be converted into SAF and help meet the Mandate.
  - Hydrogen is included within the NESO's remit to plan national energy networks, alongside electricity
- The Government's December 2024 Hydrogen Update to the Market reinforced these points

The location of production, storage and end users matters

- The location of energy production infrastructure in the UK is shifting: from consolidated industrial clusters near fossil fuels, to dispersed sites across the country, including substations and coasts near offshore wind
- The south and south east of England demands a significant portion of the UK's energy supply, but the majority of production continues to happen elsewhere
- In order to be supplied by low carbon energy, new transportation and storage infrastructure is necessary
- This new infrastructure comes with a significant cost, whether transporting the significant increase in demand for electricity, or newer forms of power such as hydrogen



Hydrogen demand is likely to be greater in the south than anywhere else by 2050



The South Dorset storage facility is strategically located to meet the needs of future hydrogen demand in the south.

The Solent Cluster matters because…

- It is a large employer
  - The Solent region is one of the largest and most strategically significant industrial areas in the UK supporting a £50 billion economy and 90,000 businesses.
  - Over 500,000 jobs are based in the Solent region and the area hosts major industries including manufacturing, refining, chemical production, maritime, defence and aerospace engineering and power generation sectors.
- Its location means it has a strategic national role
  - The region is well connected to elsewhere in the UK through road, rail and other infrastructure.
  - It contains major ports such as Southampton and Portsmouth – both of which are major trade and commercial hubs connecting UK to the rest of the world.
  - It is in proximity to Gatwick and Heathrow Airports – the two busiest international airports in the UK. Fawley pipelines originating from Boorley Green, near Southampton within the Solent Region, travels to Heathrow Airport and to Gatwick Airport.
  - Decarbonisation of this industrial cluster along with the aviation and maritime sectors will make a significant contribution towards achieving Net Zero.
- Transport remains the biggest component of energy consumption in the UK. Hydrogen can play a critical role in decarbonising the aviation and maritime sectors, especially at these major hubs.
- The strategically located South Dorset storage facility can assist with the hydrogen demand required to decarbonise these sectors.

The South Dorset facility can support the Government deliver its net zero and economic growth priorities

- **The project is in the right spatial location to support supply and demand regionally and nationally**
  - Storage sites need to be located across the UK's energy system, in order to sustain a low carbon grid
  - Storage is particularly necessary in the south of England, which has an outsized demand for power and hydrogen
  - Significant storage in the south is needed to facilitate the supply of hydrogen regionally, and balance supply and demand
  - It is also needed in the south to facilitate a national hydrogen backbone (Project Union)
  - The South Dorset storage facility is the principal storage opportunity in the south, best able to fulfil these requirements
- **Its regional demand offtake markets including priority sectors for Government**
  - The South Dorset storage facility can store the hydrogen needed to power the decarbonisation plans of the Great South West partnership, including decarbonising the Solent Cluster, which includes a concentration of the Government's priority sectors such as manufacturing, SAF, marine
  - There is local demand to sustain H2P, which has the clearest near-term use case (Government has a 7GW low-carbon dispatchable power target)
- **The project can support and grow the south coast's industrial and economic clusters**
  - The principle underpins Government's pro-cluster approach to industrial activity (Industrial Strategy Green Paper)
  - Opportunity to build on the agglomeration benefits of existing regional networks (skills, networks, social license)

Alignment with local / regional policies and strategies

The South Dorset storage facility has in principle local and regional policy support

- The Great South West (GSW) sets out several economic priorities for the region including *'Powering the UK's energy security as the country's clean energy powerhouse'*.
- One of the opportunities to achieve this priority is *'Hydrogen and biofuel production and storage'* to decarbonise power generation, critical minerals, agriculture, aviation and aerospace and maritime industries.
- GSW estimates production and storage of hydrogen and synthetic fuels at scale could help unlock over £11 billion in private investment and support more than 12,000 jobs in the country.
- A number of hydrogen clusters are being established in the South West including Langage Green Hydrogen. Hydrogen can contribute to GSW supplying up to 11% of Great Britain's clean power demand by 2035. The supply of hydrogen will require sizeable storage infrastructure.

- **The South Dorset storage facility can play an essential role in the UK's hydrogen economy and unlocking an energy cluster that links the South West, Solent, the South and wider UK.**

Economic impacts

The South Dorset storage facility will have direct, indirect and catalytic effects

- The project will make a major contribution to the local, regional and national economy.

- It will do that through the direct investment of nearly £800m to create the facility – one of the biggest regional investments in years - which will create jobs directly on site and in the supply chain locally and across the UK
  - Almost all of the investment spend is expected to be spent with UK suppliers
  - Other big regional investments include the A417 “Missing Link” between Cowley and Crickey Hill (£460 million) and the A30 Chiverton to Carland Cross Scheme (£330 million).

- The operational phase will create jobs and GVA (the local equivalent of GDP) on the site and contribute tax revenue

- These direct effects during both construction and operation will support more jobs at suppliers and in the wider economy through spending by employees and contractors

- Potentially most significantly, the South Dorset facility will have major catalytic benefits across the economy by supporting the transition to Net Zero nationally and boosting local low carbon industries within the Solent Cluster

Construction Phase Impacts

- Total capex of nearly £800m to develop 24 underground salt caverns and associated infrastructure over a four-year construction period.

Component	GVA	Jobs
Direct	£285 million	1,750 – 2,100
Multipliers	*0.7 – 1.3**	*1.8 – 2.4***
Indirect / induced	£200 million – £380 million	3,150 – 5,100
Total	**£485 million – £665 million**	**4,900 – 7,200**

**Range from bespoke mining projects to ONS values for construction sector*
*** Range from bespoke mining projects, reflecting higher capital intensity and supply chain impact than typical construction*

Operational Phase Impacts – Direct impact

Direct jobs

- The site is very capital intensive and highly automated, nevertheless is will create around **50 well paid jobs on site**.
- The created jobs will include management, supervisory, safety and operations, in an area with salaries below the UK average.

Direct GVA/GDP

- Hydrogen UK forecasts £280 million of direct operational GVA from 2TWh static storage.
- The South Dorset storage facility will provide 3TWh static storage, i.e. contributes **£420 million direct GVA**.

Operational Phase Impacts – Indirect impact

Indirect jobs

- 50 direct jobs on site.
- Apply multipliers of 1.6 – 1.8 (range from bespoke mining projects) resulting in **80 – 85 indirect jobs**.

Indirect GVA

- Hydrogen UK forecasts £240 million of indirect operational GVA from 2TWh static storage.
- The South Dorset storage facility will provide 3TWh static storage, i.e. contributes **£360 million direct GVA**.

Operational Phase Impacts – Wider impact

- Hydrogen UK report identifies approximately £100 million of GVA per TWh of the non-storage ('wider') component of the hydrogen economy.
- Rolling this forward to 2035, the AFRY report estimates there will be 115 – 216TWh of low-carbon hydrogen production in 2035 reliant on 3 – 5TWh of static storage. This implies the wider hydrogen economy is approximately £11.6 billion – £21.9 billion.
- The South Dorset storage facility has 3TWh of static storage can readily cycle up to 15TWh annually with a maximum theoretical cycling capacity of 30TWh. At 5 cycles/year it would therefore support between 7% (assuming 216TWh production) and 13% (assuming 115TWh production) of the wider hydrogen economy.
- Therefore, the South Dorset storage facility contributes **~£1.5 billion annually to the wider economy**. This represents the South Dorset storage facility's contribution towards Net Zero nationally and boosting local low carbon industries like the Solent Cluster – demand for hydrogen is estimated to be greatest in the south.

Operational Phase impact summary

Component	GVA/year	Jobs
Direct	£420 million	50
Multipliers		*1.6 – 1.7***
Indirect	£360 million	80 – 85
Total direct + indirect	**£780 million**	**130 – 135**
Wider impact	**~1.5 billion**	

**Range from bespoke mining projects applied to Method 1 of estimating indirect GVA.*
***Range from bespoke mining projects.*

- The South Dorset storage facility contributes **~£1.5 billion to the wider economy.** This represents the South Dorset storage facility's contribution towards Net Zero nationally and boosting local low carbon industries like the Solent Cluster.
- The Dorset economy is £9.5 billion per annum, which means this facility's contribution is **15% of Dorset's economy**.
- The 'green economy' is expected to grow by £37 billion - £57 billion per annum by 2030. The South Dorset storage facility will support around **£1.5 billion of this new economic activity in the 'green economy', or ~2.6-4% of its expected annual growth**.

Support for the hydrogen economy

Solent Cluster Local Industrial Decarbonisation Plan (LIDP)

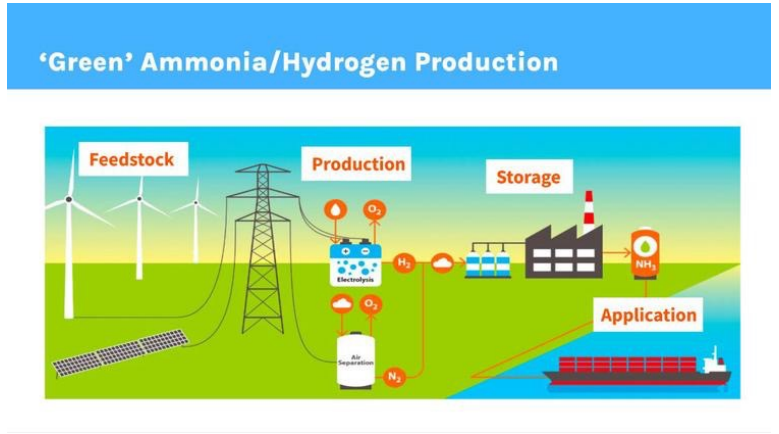
- The LIDP sets the progress and lays out a strategy for industrial decarbonisation of the Solent region to help achieve the UK Government's target of Net Zero carbon emissions by 2050. The Solent Region is one of the largest and most strategically significant industrial areas in the UK supporting a £50 billion per annum economy and 90,000 businesses.
- Out of six decarbonisation scenarios considered, the 'Deep Decarbonisation' scenario (99% decarbonisation by 2050) is deemed the most realistic and will require availability of low carbon hydrogen at scale. This will require large-scale hydrogen storage.
- Key sectors in focus requiring low carbon hydrogen include aviation and shipping. Hydrogen can be used for fuel switching to develop renewable fuels across aviation (SAF) and shipping (renewable methanol).
- Solent Region is uniquely placed as an existing industrial hub and connections to major ports and airports.
    - Contains the Portsmouth and Southampton ports. These are major trade and commercial hubs connecting the UK with the global economy.
    - ExxonMobil's Fawley site can play a key role in producing SAF and transporting it to Heathrow and Gatwick airports to meet SAF mandates. The importance of SAFs has been reaffirmed due to the government's recent support for the third runway at Heathrow Airport.
- Potential for integration with wider infrastructure development such as Project Union (National Gas) and H2 Connect (SGN).
    - Project Union will develop a transmission network of 100% hydrogen pipelines in the UK. H2 Connect will develop similar pipelines in the south of England and integrate with Project Union.
    - Opportunity to decarbonise the Solent Cluster and other industrial clusters around the country.

Local Use Case Study – Maritime

Southampton / Portsmouth port area

- Annual requirement of **~751 kilo tonnes of Heavy Fuel Oil equivalent** for ships to complete next leg of journeys
- To meet International Maritime Organisation (IMO) 2030 fuel targets would require **~150 kilo tonnes of ammonia**[1]

- 150 kilo tonnes of ammonia requires approximately **26.5 kilo tonnes (~0.9TWh) of hydrogen**[2]
- The South Dorset storage facility alone can store/meet this demand
- Portsmouth Port secured **£19.8m UK Government grant** from Zero Emissions Vessels and Infrastructure competition to support decarbonisation



[1]Opportunities for the UK to kick-start shipping's transition to zero greenhouse gas emission fuel, ARUP and UMAS
[2]Clean Hydrogen and Ammonia Synthesis […], Rivarolo et al, 2019

Use Case Study – Sustainable Aviation Fuel (SAF)

National and Heathrow Airport requirements

Year	SAF as a % of total UK jet fuel demand	Hydrogen required in the UK (kilo tonnes)	Hydrogen required at Heathrow (kilo tonnes)
2040	22%	~800	~700

- Government SAF mandate requires 22% of the expected 13.3m tonnes of aviation fuel to be sustainable by 2040, including a "power-to-liquid obligation" of 3.5%[1] [2]
- Hydrogen is an essential component of power to liquid e-kerosene
- Fawley pipelines run from Boorley Green travels to Heathrow Airport and Gatwick Airport.[3]
- Heathrow Airport has been using SAF since 2021.
- To meet the Government's SAF mandate, **~800 kilo tonnes (~27TWh)** of hydrogen will be required nationally and **~700 kilo tonnes (~23TWh)** of hydrogen will be required at Heathrow Airport in 2040.
- The South Dorset storage facility alone could store/meet this order of demand.

[1]https://www.gov.uk/government/publications/about-the-saf-mandate/the-saf-mandate-an-essential-guide
[2]https://www.gov.uk/government/collections/sustainable-aviation-fuel-saf-mandate
[3]https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN070005/EN070005-000329-4.1%20Statement%20of%20Reasons.pdf

Thank you

Andy Hunt

andy.hunt@quod.com