SIF Round 3 Project Registration

Date of Submission

Mar 2024

Project Reference Number

10098730 (1)

Initial Project Details

Project Title

Carbon and Hydrogen Transportation to SAF production facilities

Project Contact

Matthew Hammond

Challenge Area

Whole system network planning and utilisation to facilitate faster and cheaper network transformation and asset rollout

Strategy Theme

Net zero and the energy system transition

Lead Sector

Gas Transmission

Project Start Date

01/03/2024

Project Duration (Months)

3

Lead Funding Licensee

NGT - National Gas Transmission PLC

Funding Licensee(s)

NGT - National Gas Transmission PLC

Funding Mechanism

SIF Discovery - Round 3

Collaborating Networks

Wales & West Utilities

Technology Areas

Carbon Emission Reduction Technologies

Hydrogen

Project Summary

The aviation industry is responsible for around 8% of the UK's carbon emissions. Sustainable Aviation Fuel (SAF) has the potential to reduce lifecycle CO2 emissions by 70% compared to conventional jet fuel. National Gas are developing UK wide hydrogen and carbon dioxide backbones to enable wide-scale hydrogenuptake and carbon capture and storage. Hydrogen and carbon dioxide are bothfeedstocks for the Power-to-liquid (PtL) process for producing SAF and othersustainable liquid fuels. This project will explore how hydrogen and carbonnetworks could support UK Sustainable Aviation Fuel (SAF) production and accelerate the aviation industry in moving towards Net Zero.

Add Third Party Collaborator(s)

Premtech Ltd

Rolls Royce PLC

University of Bath

Airbus Operations Limited

A&G Jefferson

Project Budget

£131,907.00

SIF Funding

£118,707.00

Project Approaches and Desired Outcomes

Problem statement

In 2019, International Aviation emissions were recorded at the highest level in history at 36.8 MtCO2e. Sustainable Aviation Fuel (SAF) has been identified as a short-medium term solution to the decarbonization of the aviation industry, as SAF can be blended with Jet Fuel in existing infrastructure. SAF has the potential to reduce UK emissions by nearly 40% in 2050 (26.4 mtCO2), however production is limited at small volumes due to the requirement of green hydrogen and carbon dioxide as the feedstock.
In order to meet the UK's Net Zero ambitions, National Gas will repurpose natural gas pipelines to transport Net Zero gases such as Hydrogen and Carbon, our first transitional project is called Project Union. In the recent National Critical Infrastructure report, carbon and hydrogen "backbone" networks have also been identified as key enablers for Net Zero in the UK. NGT have carried out studies into the feasibility of using existing transmission infrastructure for both hydrogen and carbon dioxide transport.

Video Description

https://youtu.be/442doTK6mhs

Innovation justification

The links between UK gas networks and SAF production have not yet been investigated. The SAF Power-to-liquid process utilises hydrogen and carbon dioxide as feedstocks.

Project Union will build a hydrogen backbone for the UK, connecting production, storage and users, providing security of supply. A CCUS backbone will remove carbon emissions from industry and transport them offshore for storage, however, we believe considering industrial uses for carbon such as in SAF production would benefit consumers in the long run. It will enable Union and CCUS to not only decarbonise industry and power but also support the decarbonisation of transportation.

Relevant state of the art

In the UK, SAF is only produced on a small scale. However, the recent SAFMandate states the equivalent to ~10% (~1.5 billion litres) of jet fuel must be madefrom sustainable sources by 2030, with demonstrators coming online from 2026. In 2023, the first SAF was blended at 38% into the CEPs and Brussels Airport received the first SAF-blended fuel which was used for flights.

Beyond incremental innovation

The use of Carbon and Hydrogen networks for supplying SAF production has not previously been explored. The SIF programme will provide networks the capability to access a new market.

Readiness Levels

Current SAF Power to Liquid technology -- TRL 5-6.
SAF production links to our network TRL 2-3, After Beta, ~TRL 6-7.
IRL -- Current IRL-1 (no previous work). After Discovery, ~IRL-2. After Beta, ~ IRL-7.

Size and Scale

We have brought together key industry stakeholders to represent each part of the SAF supply chain (partners, working groups & advisory board) which supports the innovation challenge of whole system planning for faster asset role out. Each will feed into the project to increase the value the project provides, whilst keeping the core team small and offering value for money for the

consumer.

BAU

The proposed innovation is novel with low readiness levels, therefore has riskassociated with the delivery. It is dependent on the development of a hydrogen and carbon network in the UK, which is currently being developed by NGT andindicated on the National Infrastructure Commission Report.

Counterfactuals

SAF production has strict environmental requirements meaning only green hydrogen can be used to realise environmental benefits. We aim to accelerate the large-scale production & offshore access of SAF across the UK, rather than having reliance on localised production of green hydrogen.

Impacts and benefits selection (not scored)

Environmental - carbon reduction – indirect CO2 savings per annum

Revenues - creation of new revenue streams

New to market – products

New to market – processes

New to market - services

Impacts and benefits description

Pre-innovation baseline

Aviation accounted for 7% of UK emissions in 2018. Sustainable Aviation Fuel (SAF) has the potential to reduce lifecycle emissions by up to 70% compared to conventional jet fuel.

SAF is currently only being produced at small scale on one site in the UK. The recent SAF Mandate and Advanced Fuel Funds competition has announced the funding of five projects to build SAF plants between 2026 and 2028. The projects include a range of SAF production methods including waste gasification, alcohol tojet fuel and PtL. Where hydrogen is required for SAF production, this will be produced by electrolysis. Where carbon is required as a feedstock, it will be produced from gasification or Direct Air Capture.

National Gas Transmission (NGT) are creating a hydrogen backbone for the UK through Project Union, which is currently undergoing pre-FEED work. The secondNational Infrastructure Assessment by the National Infrastructure Commission (NIC) has recommended that the government forms a plan for a carbontransmission network across the UK to transport and store at least 50 MtCO2. NGT has carried out feasibility work to understand how the existing transmissionsystem could be used to transport carbon and create a carbon network alongsideProject Union. We will determine the opportunity for connecting SAF facilities tohydrogen and carbon networks to accelerate SAF production.

Forecast benefits

The potential links between hydrogen and carbon networks and SAF production have not previously been explored. A Discovery project would bring together keyaviation and gas transmission and distribution stakeholders to identify these opportunities by

assessing the current and projected SAF production landscape, determining the potential volumes and locations for SAF production in line with Project Union and a UK-wide carbon network, investigating the design of a network connection to SAF facilities considering the technical requirements, and developing the business case for this solution.

The Sustainable Aviation industry coalition reported that SAF use in the UK could deliver between 1.2 and 2.8 Mt of carbon emissions savings in 2035 and 26.4MtCO2 in 2050. However production is currently limited by the requirement to use electrolysis to produce hydrogen as well as point source CO2 limiting PtL production to 10s kT/year. Gas transmission and distribution networks are efficient ways to transport gases, and could couple large scale production of hydrogen and carbon to SAF (and other sustainable liquid fuels) production across the UK.

Teams and resources

Project Partners

A&G Jefferson was co-founded by Andy Jefferson, an independent consultant with over 30 years' experience in tackling strategic and operational challenges across the UK aviation industry, including through the UK Sustainable Aviation coalition, which includes the likes of British Airways, EasyJet, Virgin Atlantic, Airbus, Rolls-Royce and all the major UK airports.

Premtech are a designer with extensive experience in delivering projects to meet National Gas's requirements, including projects of all sizes and complexity, from simple component upgrades to full AGI rebuilds. In addition, Premtech have experience in fuel pipeline design which will feed into the SAF pipeline considerations in this project.

Wales & West Utilities is a regulated gas distributor that is committed to netzero and transitioning its network to transport green gases such as biomethane and hydrogen. WWU recently carried out an assessment of the opportunity for hydrogen in aviation, and have strong links to the Hydrogen South West cluster which includes Airbus, EasyJet and Bristol airport.

Bath University will be the lead academic partner on this project and have extensive technical knowledge of SAF and liquid fuels production and use andare part of UK-HyRES, a consortium of academic and industrial partners leading research on hydrogen and alternative liquid fuels, including SAF. Bath will require access to scientific journals to support their peer review activities.

Airbus are an aircraft manufacturer with experience in engaging with SAF related projects. In 2022, an Airbus A380 flight was fuelled by 100% SAF, with Rolls-Royce as a partner.

Rolls-Royce manufacture engines for the aerospace industry, with a focus on high efficiency, noise reduction and sustainability. Newer Rolls-Royce engines can run on blended SAF-jet fuel mixtures and they are currently working towards 100% SAF engine certification.

Resources Required

The Discovery work will be desk-based studies. Some academic materials arerequired for the Peer review activities. These costs are included in the materials section.

External Parties

This project will engage with the aviation industry through the Sustainable Aviation coalition which has representation from aviation trade associations including IATA and the British Aviation Group, airlines including British Airways and easyJet, airports including Heathrow and Manchester Airport Group, airline manufacturers including Airbus and Boeing, and SAF producers/project developers including Lanzatech, Willis Lease and Velocys. By engaging with this coalition we feel the aviation industries needs will be well understood across the full SAF supply chain, giving the project the best chance of success.

Project Plans and Milestones

Project management and delivery

Project Management Approach

The Discovery phase will be undertaken through 5 Work Packages, utilising agile project management methodologies to complete the planned activities within 2
month period. We will aim to run tasks in parallel and summarise in a concise report to conclude the findings. Requests for information (RFIs) & actions will be tracked utilising SharePoint space with partners to ensure timely/efficient sharing of information.

Dependencies

WP3 -- SAF Production from Hydrogen and Carbon and WP4 -- Gas Network Connection Design work packages are dependent on the requirements developed as part of WP2 and the stakeholder engagement activities in WP5. Additionally, the business case developed in WP2 is dependent on the findings from WP3, WP4 and WP5.

Risk Management Strategy

Risks will be managed through the project as depicted in the risk-register. The project meetings will take stock of progress against the project plan and the risks associated.
The key risks for the project are managing the vast amount of information required from the aviation industry and gas networks, and not allowing for scope creep at this stage of the project. SAF production is currently only commercially and environmentally viable using green hydrogen for the production which should beconsidered in the network connection.

The Discovery phase is vital to providing insight into these key risks and mitigating/eliminating them prior to the Alpha phase development. There areseveral risks associated to project management and meeting the SIF requirements that will be managed by the project team through the project set up and delivery.

Policy and Regulation

At present there are policy and regulatory risks associated to the deployment of hydrogen across the UK. The latest National Infrastructure Commission report regarding hydrogen infrastructure in the UK is very positive and reduces the risk to looking into projects associated to the NTS. The SAF industry will be decarbonising our future, if we do not start to consider the source of UK supply, we will have to source from global suppliers

Supply interruptions

There will be no supply interruptions associated with the delivery of this project.

Interaction with consumers

This project will not interact with gas consumers. The project considers the potential future connection between gas networks and Sustainable Aviation Fuel producers as offtakers, which do not currently exist.

Key outputs and dissemination

Discovery Phase

The SIF Discovery phase provides a useful platform to bring together key partners and stakeholders to understand the current SAF landscape, determine the future technical and commercial requirements for growing the SAF market in the UK, investigating how gas networks could support the growth of SAF in the UK and identifying what a potential demonstrator could look like. An outline business case will be developed to understand rough costs and benefits associated with the project approach.

NGT will gather all information from partners outputs and combining them into a single Discovery report. NGT will lead on the Alpha application, taking the outputs from the project and determine the route to Beta required. NGT will be responsible for the requirements & business case with support from Bath University who will conduct an academic peer review. NGT will be

responsible for implementation and roll-out of the proposed solution, safety considerations, and competitiveness of the approach compared to the current market.

Premtech will be responsible for the network connection demonstration plan including the concept connection design, considering both the transmission (NGT) case and a distribution (WWU) case.

A&G Jefferson will be responsible for bringing together all the stakeholders from the Sustainable Aviation network & Working Groups and represent their members including SAF producers, project developers, airlines and airports. Rolls-Royce and Airbus will lead on sharing information from previous SAF projects as well as defining their technical and commercial requirements.

Dissemination of key outputs and lessons learned

National Gas will take a lead on ensuring the project outcomes are publicised via the Smart Networks Portal, Social Media, and Discovery Show and Tell webinar, with support from the project partners. Lessons learnt will be shared into other future or parallel projects to ensure successful delivery of future activities.

Competitive markets

Whilst we are working with specific partners in this project, the implementation of this across the UK will be subject to competitive tender. The outputs of the project will enable a standard design for connections between SAF Producers and gas networks which could be replicated across various networks and industries.

Commercials

Intellectual Property Rights (IPR) (not scored)

Default Arrangement

For SIF projects, each Project Partner shall own all Foreground IPR that it independently creates as part of the Project, or where it is created jointly then it shall be owned in shares that are in proportion to the work done in its creation.The exact allocation of Foreground IPR ownership will be determined during the contractual negotiations with the Project Partners on the agreement for the project. On creation of Foreground IPR the creator of the IPR will notify the project partners to enable it to be recorded and ownership agreed in line with the contract terms.

Also if the party appoints a sub-contractor, the agreement with that sub-contractor should have similar IP provisions to those in this agreement and which at least achieve the same aims as the agreement regarding IP. Once the Project is completed, Relevant Background IPR will be licensed for use by the Project Partners in connection with another Project Partners' Foreground IPR solely to the extent necessary to use that Foreground IPR, upon terms to be agreed.

We intend to ensure each Project Partner will comply with Chapter 9 SIF Governance Document through the contractual terms governing the project. However, precisely how this is done will be subject to contractual negotiations with the Project Partners on the agreement for the project.

Value for money

Project Cost Breakdown and Funding

The total discovery project cost is £131,907 and we are requesting £118,707 of funding. National Gas Transmission (NGT) will be providing the compulsory 10% contribution in full.

NGT - £41,472 total project costs, £13,200 will be our compulsory contribution,with £28,272 of SIF funding sought.

Premtech - £39,799
A&G Jefferson - £6,000 with £5,000 contribution in kind.
Bath University - £19,700
Wales & West Utilities - £6,356
Airbus - £9,440
Rolls Royce - £9,140

Value for Money
There are no other Business-as-Usual (BAU) financial mechanisms for cover these costs outside of further Network Innovation Allowance (NIA) process funding. A successful SIF application would free up funding under NIA to be refocused on other Net Zero and transitional network projects. This initial Discovery Phase funding is potentially the first step in an innovation journey that will ultimately deliver improved network resilience and thus reducing risk costs whilst delivering significant additional advantages and wider benefits to all GB networks and consumers.

The project team delivers value of money by offering favourable labour rates recognising the unique experience and knowledge they bring. Each partner brings the following critical expertise to the project:

National Gas Transmission (NGT) provide expertise on gas transmission and a suite of projects that are exploring the role of hydrogen within the National Transmission System (NTS), including projects considering the effect of hydrogen on a variety of materials. Our base rates have been used for this project

Supporting documents

File Upload

CO2 and H2 Transport to SAF Facilities - Show and Tell slides.pdf - 3.0 MB
CO2 and H2 Transport to SAF Facilities - Closure Meeting slides for sharing.pdf - 1.6 MB
SIF Round 3 Project Registration 2024-03-27 10_53 - 88.6 KB
SAF Application - Innovation Funding Service.pdf (1) - 0.0 bytes
SAF Application - Innovation Funding Service.pdf - 0.0 bytes

Documents uploaded where applicable?

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