















Part of the Bacton Energy Hub Project

**Regulatory SIG – Supplementary
Report**
Government Funding of Low Carbon
Hydrogen Projects

1. SIG Participants

Name	Affiliation	Company logo
Ian Phillips (SIG Lead)	Energy Transition Advisory Limited (Formerly with Storegga)	
Karen Freeman (Project Manager) Rob Bush	EEEGR	
Shirley Allen Sara Cole-Hamilton	Pinsent Masons	
Iain Anderson	Spirit Energy	
Andy Arnold	Northbrook Energy Advisory	
Daniel Bradley Nik Cole	Shell	
Kristina Dahlstrom Cecilie Ingversen	NSTA	
Martin Edwards	Energy Tracks Ltd	
Pierre Girard	Neptune Energy	
Ross Glover	iGas	

John Harley	Fluor	
Euan Harrison	Mace Group	
Jeroen Hoonhorst	Altwood Energy Advisors	
Pietro Negri	ENI	
Ian Sadler	Wood Plc	

This document was authored by:

- **Andy Arnold, Northbrook Energy Advisory Limited** (aarnold01@northbrookenergy.co.uk)
- **Martin Edwards, Energy Tracks Ltd** (medwards@energytracks.co.uk)
- The document was reviewed by **Jeroen Hoonhorst, Altwood Energy Advisors** (jhoonhorst@altwoodenergyadvisors.com) and **Ian Phillips, Energy Transition Advisory Limited** (ian.phillips@energytransitionadvisory.co.uk)

2. Table of Contents

1. SIG PARTICIPANTS	2
2. TABLE OF CONTENTS	4
3. IMPORTANT NOTICE	5
4. EXECUTIVE SUMMARY	6
4.1. BACKGROUND	6
4.2. FUNDING MECHANISMS	6
4.3. RECOMMENDATIONS.....	7
5. GLOSSARY.....	8
6. BACKGROUND.....	10
7. UK GOVERNMENT HYDROGEN AND CCS FUNDING SCHEMES	11
7.1. THE INDUSTRIAL ENERGY TRANSFORMATION FUND (IETF)	11
7.2. THE NET ZERO INNOVATION PORTFOLIO (NZIP).....	11
7.3. THE NET ZERO HYDROGEN FUND (NZHF).....	12
7.4. INDUSTRIAL STRATEGY CHALLENGE FUND (ISCF).....	13
7.5. INDUSTRIAL DECARBONISATION AND HYDROGEN REVENUE SUPPORT (IDHRS)	13
7.6. CCUS INFRASTRUCTURE FUND (CIF).....	13
7.7. HYDROGEN PRODUCTION REVENUE SUPPORT	13
8. BACTON ENERGY HUB IN CONTEXT	14
9. BACTON ENERGY HUB - ANTICIPATED FUNDING SUPPORT	15
9.1. NET ZERO HYDROGEN FUND (NZHF).....	15
9.2. CCUS INFRASTRUCTURE FUND (CIF).....	16
9.3. SUMMARY	17
10. BACTON ENERGY HUB – DEVELOPING A FINANCEABLE PROJECT	18
10.1. UK EMISSIONS TRADING SCHEME	18
10.2. CCS T&S NETWORK BUILD-OUT	18
10.3. INTEGRATED HYDROGEN SUPPLY	19
10.4. ALTERNATIVES TO BLENDING	19
11. UK INFRASTRUCTURE BANK	21
12. USEFUL REFERENCES	22
APPENDIX 1 – HYDROGEN FUNDING LANDSCAPE.....	23
APPENDIX 2 – HYDROGEN INVESTOR ROADMAP	28

3. Important notice

While the information contained in this document is believed to be accurate at the time of printing, no representation or warranty, express or implied, is given by the authors¹ or any other person whatsoever on the completeness, accuracy or fairness of the information contained in this document, nor is any responsibility accepted for any errors, misstatements in, or omissions from, this document or any direct or consequential loss howsoever arising from any use of, or reliance on, this document or otherwise in connection with it. No responsibility or liability is accepted for any loss, cost or damage suffered or incurred as a result of reliance on any such information, opinions or beliefs. Where third-party information has been used in this document, the authors have not independently verified such information and the authors do not represent or warrant that this information is accurate.

¹ Authors: Andy Arnold, Northbrook Energy Advisory Limited (aarnold01@northbrookenergy.co.uk) and Martin Edwards, Energy Tracks Ltd (medwards@energytracks.co.uk). Review comments by Jeroen Hoonhorst, Altwood Energy Advisors (jhoonhorst@altwoodenergyadvisors.com)

4. Executive Summary

4.1. Background

Bacton Energy Hub (BEH) is a strategic infrastructure opportunity that will support the UK to reach its ambitious net zero 2050 targets and to be a global leader in delivering low carbon energy solutions. The BEH project is a CCUS²-enabled hydrogen production project under the UK government's taxonomy for low carbon hydrogen production (blue hydrogen).

With the shortage of existing industrial users in the Bacton region, the BEH core project proposal is dependent on blending up to 20% by volume of hydrogen within the natural gas national transmission system (NTS) and/or local distribution networks for consumption by existing domestic, power and industrial consumers. BEIS plans to decide on the viability and value-for-money of allowing hydrogen blending in the NTS by the end of 2023, and on hydrogen for heating in 2026. The former decision is critical to support the core project and the latter decision will impact on the full build-out of the project (which envisages expansion to 100% hydrogen supply and significant substitution for natural gas).

4.2. Funding mechanisms

The current UK Government (co-)funding mechanisms set out in the Ten Point Plan³ and the Hydrogen Strategy⁴ are focussed on decarbonisation of industrial clusters, through the £240m Net Zero Hydrogen Fund (NZHF), the £140m Industrial Decarbonisation and Hydrogen Revenue scheme (IDHRS) and the £1bn CCUS Infrastructure Fund (CIF) for CO₂ transport and storage (T&S). Track-1 Phase 2 shortlisted projects have been announced – including blue hydrogen projects; and the expectation is that the Track-2 cluster sequencing process will occur within the next year.

Opportunities for government co-funding for current blue hydrogen projects are relatively clear, however the BEH project is too immature to easily qualify for many of the schemes currently open and will have to apply for future funding opportunities as and when they become available. Possible opportunities include:

- NZHF Strand 1 DEVEX funding (in the anticipated 1H23 application window), but only if the project can demonstrate a credible timetable to complete FEED within the specified window (ca. 2 yrs), and a “demonstrated demand” for hydrogen (the 2023 BEIS decision on blending is critical). BEH would also be expected to demonstrate line of sight to a CO₂ T&S solution.
- Revenue support for the BEH blue hydrogen project in operation through the hydrogen business model would target the proposed levy from ca. 2025.

There is no obvious CAPEX funding path currently outlined for blue hydrogen projects reaching FID in the period after 2025.

Support for CO₂ T&S infrastructure development might be available through the BEIS Track 2 process (possibly in early 2023) in parallel to the NSTA licence round, providing that consortia are formed and BEIS will accept applications that lie outside the established “industrial

² Carbon Capture, Utilisation and Storage

³ [The ten point plan for a green industrial revolution - GOV.UK \(www.gov.uk\)](https://www.gov.uk/government/consultations/the-ten-point-plan-for-a-green-industrial-revolution)

⁴ [UK hydrogen strategy - GOV.UK \(www.gov.uk\)](https://www.gov.uk/government/consultations/uk-hydrogen-strategy)

clusters” (and therefore more dependent on CO₂ shipping from remote emitters via Great Yarmouth port for example).

Support for end-users in fuel switching may be available through the IETF and Industrial Fuel Switching scheme, although whether these will accommodate studies, design and works (if required) related to 20% blended hydrogen is to be determined.

Further discussion with BEIS is recommended to clarify and identify future funding options to progress BEH through the next feasibility stage. However, given the planned BEIS focus on preferred industrial clusters, BEH may have to be carried by private initiatives for a large part.

4.3. Recommendations

The BEH Regulatory SIG recommends the following actions to support the further development of this important infrastructure hub in relation to establishing government co-funding:

1. Bacton Energy Hub (blue hydrogen project)
 - a. BEH commercial consortium formation (2022)
 - b. Examine feasibility of application for NZHF Strand 1 funding in the 1H2023 application window and develop forward plan accordingly. Factors include:
 - BEH feasibility and readiness
 - CO₂ T&S solution feasibility (in parallel with NSTA licence round)
 - Earliest possible BEIS resolution on blending, and on hydrogen for eating
 - Project Union⁵ development (integrating Bacton) and alternative 100% hydrogen market development (including potential hydrogen export via repurposed interconnector)
 - c. Discussion with BEIS to clarify and identify future funding options for BEH, identify funding options for each stage of the project, focus on next feasibility/select stages.
 - d. Influence/facilitate the progression of a CO₂ T&S network (either through BEH consortium or third party)
 - e. Influence in on-going BEIS consultations for business models, including hydrogen transport and storage (which includes questions on blending)
 - f. Investigate non-government private sources of funding for BEH
2. CO₂ T&S Infrastructure development
 - a. Bacton CO₂ T&S consortium formation – in parallel to the NSTA carbon license round
 - b. Achieve BEIS/NSTA/UK Government support required to consider Bacton as a CO₂ T&S hub on its own merits as strategic long-term carbon storage infrastructure to be included within Track-2 (or potentially later and/or alternative) funding mechanisms.
 - c. Develop Bacton CO₂ T&S network application through Track 2 process (or alternative mechanism agreed with BEIS/NSTA)
3. Hydrogen end-users and transportation
 - a. Investigate support for fuel switching through the Industrial Energy Transformation Fund (IETF) and Industrial Fuel Switching schemes – determine whether these will accommodate studies, design and works (if required) related to 20% blended hydrogen and/or later 100% hydrogen utilisation

⁵ [Making plans for a hydrogen ‘backbone’ across Britain | National Grid Group](#)

5. Glossary

The following abbreviations are used in this document.

Abbreviation	Explanation
ATR	Auto-Thermal Reforming (a method for manufacturing “blue” hydrogen with minimal CO ₂ emissions)
BEH	Proposed Bacton Energy Hub
CCS	Carbon Capture and Storage
CCUS	Carbon Capture, Utilisation and Storage
CIF	CCUS Infrastructure Fund
CO ₂	Carbon dioxide
EEGR	East of England Energy Group – a trade body
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
EU ETS	European Union Emissions Trading Scheme
GSMR	Gas Safety (Management) Regulations 1996
HSE	UK Health and Safety Executive
IETF	The Industrial Energy Transformation Fund
IHA	Industrial Hydrogen Accelerator
MW	Megawatt – a unit of energy supply
NGG	National Grid Gas PLC, a company that owns and operates the National Transmission System that distributes gas in the United Kingdom.
NOAK	“n th ” of a kind project – i.e. proven
NSTA	UK North Sea Transition Authority – the offshore oil and gas regulator, formerly known as the Oil and Gas Authority (OGA)
NTS	The UK National Gas Transmission System
NZHF	Net Zero Hydrogen Fund
NZIP	The Net Zero Innovation Portfolio
OFGEM	UK Office of Gas and Electricity Markets

Abbreviation	Explanation
OPRED	UK Offshore Petroleum Regulator for Environment and Decommissioning
PUWER	Provision and Use of Work Equipment Regulations 1998
SIG	Special Interest Group
SMR	Steam Methane Reforming (a well-established method for manufacturing “grey” hydrogen – it involves significant CO ₂ emissions)
UK ETS	UK Emissions Trading Scheme

6. Background

Hydrogen is seen as critical in reducing emissions from heavy industry, and in power, transport and potentially heat.

The UK Government's ambition for up to 10GW of low carbon hydrogen production capacity by 2030, with at least half of this coming from electrolytic hydrogen (subject to affordability and value for money) is set out in the Hydrogen Strategy (August 2021)⁶ as updated by the recent Energy Security Strategy (April 2022)⁷.

As per the Prime Minister's 10 Point Plan in 2020⁸ and these underpinning strategies, the UK Government is committed to ensuring low carbon hydrogen production is both feasible and attractive as an investment proposition and is implementing a support framework founded on three main pillars:

- i. Upfront funding for innovation, development and capital expenditures
- ii. Ongoing revenue support through the hydrogen production revenue support scheme (or Hydrogen Business Model)
- iii. Access to low-cost financing through a newly established UK Infrastructure Bank (UKIB)

Early deployment of Government funding is targeted towards blue hydrogen production linked to the Track 1 Clusters (HyNet and the East Coast), together with independent electrolytic hydrogen production. The expectation is that as these early projects are de-risked, the market for hydrogen and carbon develops, private investment will remove the need for future Government funding support.

Against this background, it is by no means certain that Government funding for Bacton Energy Hub will be available in the form described.

This Supplementary Report is focused primarily on direct UK Government support for the Bacton Energy Hub project through a combination of grant funding, hydrogen revenue support and/or CO₂ T&S business model support, together with role of the UK Infrastructure Bank in improving access to lower cost capital.

It does not consider sources of private sector investment, but notes that the EU Parliament's recent decision to approve the inclusion of natural gas (and nuclear) within the EU Taxonomy for sustainable economic activity, opens the door for blended blue hydrogen to attract green funding (Article 8 EU 2020/852). Not considered are Local Authority grant funding and incentives primarily aimed at innovation and development of local supply chains (except, as discussed later, UKIB support for local authority financing of regional strategic infrastructure projects). Such funding schemes would form a part of the BEH feasibility stage workstreams.

⁶ [UK hydrogen strategy - GOV.UK \(www.gov.uk\)](https://www.gov.uk/government/consultations/uk-hydrogen-strategy)

⁷ [British energy security strategy - GOV.UK \(www.gov.uk\)](https://www.gov.uk/government/consultations/british-energy-security-strategy)

⁸ [The ten point plan for a green industrial revolution - GOV.UK \(www.gov.uk\)](https://www.gov.uk/government/consultations/the-ten-point-plan-for-a-green-industrial-revolution)

7. UK Government Hydrogen and CCS Funding Schemes

Annex 1 provides a helpful schematic summary of the existing UK-wide funding schemes for support of low carbon hydrogen production. The blue hydrogen project central to the Bacton Energy Hub requires the build-out of an offshore CO₂ transportation and storage (T&S) system with a hub at Bacton, or shipping of CO₂ emissions to another T&S hub (probably via Great Yarmouth port), and funding schemes for such projects are also identified below.

7.1. The Industrial Energy Transformation Fund (IETF)⁹

A £315m fund allocated in the 2018 Budget and managed by BEIS, available until 2025 for industries with high energy use to fund the development and deployment of technologies that introduce energy efficiencies and low carbon solutions. Applies to Technical Readiness Level (TRL) 7+ technologies¹⁰ to encourage early deployment. The focus of these funds is on industrial end-users and is therefore likely to be relevant for the Bacton Energy Hub project to support customers (either of blended gas or potentially pure hydrogen) in relation to fuel switching studies, engineering and deployment as required.

7.2. The Net Zero Innovation Portfolio (NZIP)¹¹

A £1 billion fund, announced in the 10 Point Plan to accelerate the commercialisation of low-carbon technologies, systems and business models in power, buildings, and industry. Covers 10 priority areas, including support for technologies hydrogen, advanced CCUS, direct air capture and industrial fuel switching. NZIP includes three hydrogen relevant schemes:

- **Industrial Hydrogen Accelerator (IHA) (see Annex 1)** - now closed, end-to-end industrial fuel switching - feasibility and demonstration (innovation level). >50% of H₂ end-use must be for industrial processes, with H₂ generation technology operational by January 2025;
- **Industrial Fuel Switching (IFS)** - innovation funding to support development of fuel switching aimed at end-users, generally at a TRL 4-7 maturity, so potentially relevant to BEH hydrogen end-users; and
- **Low Carbon Hydrogen Supply 2 Competition (Stream 1 Phase 2)** – now closed to new applicants (i.e. those not successful in Phase 1), this scheme awarded grant co-funding aimed at innovation in technologies in low carbon hydrogen production to reduce the cost of production. Several of the technologies applicable to the Bacton Energy Hub project were investigated as part of this competition.

⁹ [Industrial Energy Transformation Fund - GOV.UK \(www.gov.uk\)](https://www.gov.uk)

¹⁰ [Competition overview - Net Zero Hydrogen Fund – Strand 1 Development Expenditure \(DEVEX\) - Innovation Funding Service \(apply-for-innovation-funding.service.gov.uk\)](https://www.gov.uk)

¹¹ [Net Zero Innovation Portfolio - GOV.UK \(www.gov.uk\)](https://www.gov.uk)

7.3. The Net Zero Hydrogen Fund (NZHF)¹²

A £240m fund administered by Innovate UK (part of UKRI) on behalf of BEIS consisting of development and capital grant co-funding to be delivered between 2022-2025 to support the commercial deployment of low carbon hydrogen production projects, including on-site transport and storage infrastructure, and to be deployed during the 2020s.

In its April 2022 published response to the consultation on the NZHF, the Government set out its position on the capital grant allocation methodology, split into 4 strands:

- Strand 1: DEVEX for Front End Engineering Design (FEED) studies and post FEED costs. Application window closed June 2022. A second Strand 1 funding window is anticipated in early 2023.
- Strand 2: CAPEX for projects that do not require revenue support through the hydrogen business model. Application window closed July 2022, a second funding window is anticipated in 1H 2023.
- Strand 3: CAPEX for non-CCUS-enabled projects that also require revenue support through the hydrogen business model. First allocation round limited to electrolytic projects (BEIS).
- Strand 4: CAPEX for CCUS-enabled projects that require revenue support through the hydrogen business model. Only open to Phase 2 shortlisted projects in CCUS cluster sequencing process (as released July 2022).

The budget for Strands 1 & 2 is £90m, with the majority primarily allocated to Strand 2. Award of initial grants for those projects applying to the first allocation window of Strands 1&2 is likely before end-2022, with expenditures to be completed before Q1 2024 for strand 1 and Q1 2025 for strand 2. To be eligible, projects must demonstrate demand for hydrogen at the time of application.

Strand 3 electrolytic allocation rounds are expected in both 2022 and 2023 with awards in 2023/4.

Government intends that CCUS-enabled projects applying for a hydrogen business model support through Phase 2 of the CCUS cluster sequencing process shall have the opportunity to apply for NZHF capital co-funding. A Strand 4 EOI process will be launched in summer 2022 following announcement of the Phase 2 shortlisted projects, with a Strand 4 application process in 2023.

The government response anticipates that further funding across all Strands will be available beyond 2025 that will bring the total quantum of funding to £500m between 2022-2030.

Assuming the Bacton Energy Hub project will require hydrogen production revenue support, it is clearly too immature to meet the timeline for the initial Strand 4 allocation round for capital funding, particularly as the CO₂ T&S network has yet to be determined.

In summary, the Bacton Energy Hub project appears to be too immature (or non-eligible as a blue hydrogen project) to qualify for support under almost all the NZHF Strands as currently defined. The only exception might be an application for Strand 1 funding in the BEIS projected 1H 2023 window (see following sections).

¹²https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1067275/nzhf-consultation-government-response.pdf

7.4. Industrial Strategy Challenge Fund (ISCF)¹³

It is noted that £171m of development funding was awarded in March 2021 to nine projects, linked to six UK industrial clusters, through *UKRI's Industrial Strategy Challenge Fund decarbonisation of industrial clusters phase two: deployment competition*. Studies and works must be completed by 2024. There is no indication from UKRI of any further funding under this banner.

7.5. Industrial Decarbonisation and Hydrogen Revenue Support (IDHRS)¹⁴

BEIS has set up the IDHRS scheme, providing up to £140m to fund new hydrogen and industrial carbon capture business models. The funding envelope will be announced in 2022 allowing the award of the first contracts for CCS-enabled hydrogen and industrial carbon capture facilities from 2023. It is anticipated this funding will be allocated solely to the cluster projects. The Bacton Energy Hub project appears too immature to qualify for IDHRS support. BEIS intention is for all revenue support for hydrogen production to be levy funded from 2025 at the latest, subject to consultation and legislation being in place (see below).

7.6. CCUS Infrastructure Fund (CIF)¹⁵

£1bn fund to support the capital costs of strategic CCUS infrastructure, focussed principally on the cluster projects to establish early industrial carbon capture projects and primarily to build-out the T&S networks for each cluster. BEIS will continue to progress the design of the CIF alongside the development of Cluster Sequencing and the process to identify 'Track-2' clusters. With the Bacton Energy Hub project reliant on a CO₂ T&S offshore pipeline and storage infrastructure build-out from Bacton, then a future application to this fund is anticipated by T&S networks (Track 2 or potentially later) seeking to establish a hub at Bacton. Such T&S network(s) may or may not be operated by the same commercial consortium that develops BEH blue hydrogen. There is zero allocation from the CIF for capital for hydrogen projects.

7.7. Hydrogen Production Revenue Support¹⁶

The Energy Bill submitted to Parliament in July 2022 sets out the enabling legislation for the hydrogen production revenue support contract (alongside both (i) carbon capture revenue support contracts (ICC); and (ii) transport and storage revenue support contracts, (T&S)), which, once enacted, will allow UK government to award such contracts through a competitive allocation process established by the Secretary of State for BEIS.

The Energy Bill also establishes the legislative framework for the long-term funding of such revenue support through a levy applied to energy consumers via gas and electricity suppliers. This replaces the need for the NZHF to be utilised for long-term revenue support.

¹³ [UKRI awards £171m in UK decarbonisation to nine projects – UKRI](#)

¹⁴ [Net Zero Strategy: Build Back Greener - GOV.UK \(www.gov.uk\)](#)

¹⁵ [The Carbon Capture and Storage Infrastructure Fund: an update on its design \(accessible webpage\) - GOV.UK \(www.gov.uk\)](#)

¹⁶ [Energy Security Bill Policy Statement Carbon Dioxide \(CO₂\) Transport and Storage, Hydrogen and Industrial Carbon Capture Business Model support \(publishing.service.gov.uk\)](#)

8. Bacton Energy Hub in Context

The Bacton Energy Hub base project is a CCUS-enabled hydrogen production project under the UK government's taxonomy for low carbon hydrogen production (blue hydrogen). It comprises proven technologies, including the autothermal reformation (ATR) of methane to hydrogen and the capture of CO₂ and ancillary GHGs at the Bacton gas terminal – both gas terminal emissions, including interconnector and from the reforming process - with compression and pipeline transportation of the CO₂ for storage in depleted natural gas fields and/or saline aquifers offshore in the UK SNS.

The Hydrogen Investor Roadmap¹⁷ (see extract in Annex 2) sets out the government's Delivery Plan to 2035, which include the overall frame in which the Bacton Energy Hub (BEH) project can expect to benefit from government support and funding.

The Hydrogen Investor Roadmap shows not only the timing of the initial funding allocations under NZHF, but also the publication of the final design of the hydrogen business model (end-2023) and hydrogen transport and storage business model (end-2024). The value for money (VFM) case for blending is not expected before mid-2023, critical for the BEH core project that aims to deliver hydrogen into the NTS by 2030. The hydrogen for heating policy decision is only expected in 2026 which may impact the viability of the BEH build-out, and thus potentially also the BEH core project if investability depends on clear line of sight to the build-out case.

A tentative schedule aligned with an in-service date of 2030 and government policy is proposed:

- Final investment decision (FID) required by mid-2027
- Hydrogen heating decision in 2026
- Launch of FEED and post-FEED activities late 2025 (Define Stage)
- Pre-FEED studies and activities 2024-5 (Select Stage)
- Launch of consortium in 2022 and preliminary studies mid-2023 following government's decision to approve blending within NTS (Feasibility Stage)

¹⁷https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1067408/hydrogen-investor-roadmap.pdf

9. Bacton Energy Hub - Anticipated Funding Support

The following section considers the implications of the Hydrogen Investor Roadmap and CCUS Investor Roadmaps (see Annex 2) for the timing and likely funding support for the BEH project.

- ATR technology will be commercially demonstrated in the Track-1 cluster projects and therefore no further new technologies are expected to be deployed in the BEH project. With technology readiness at TRL 7+, the BEH project will likely be an “nth of a kind” (NOAK) project. The primary innovation fund, the NZIP Industrial Hydrogen Accelerator, has already closed and would have been unlikely to be open to the BEH project for this reason.
- The BEH project’s primary hydrogen demand assumption is for blending into the NTS, initially at 20% in 2030 but increasing to 100% by 2040. Assuming blending receives government support, end-use for hydrogen in this case is principally in commercial and domestic heating and in power generation, based on existing offtakers from the NTS
- Future rounds of funding under the NZIP Industrial Fuel Switching or the Industrial Energy Transformation Fund (IETF) may be applicable to the BEH project but only in relation to potential industrial end-user switching.

9.1. Net Zero Hydrogen Fund (NZHF)

As noted above the Bacton Energy Hub project appears to be too immature (or non-eligible as a blue hydrogen project) to qualify for support under almost all the NZHF Strands in 2022 and 2023 (the only allocations currently defined), the only possible exception being in Strand 1:

- Strand 1: DEVEX grant co-funding at 50% for up to £15m for FEED and post-FEED costs. BEH may potentially apply in the projected 1H2023 application window, but only if the project can demonstrate a credible timetable to complete FEED within the specified window (ca. 2 yrs), and a “demonstrated demand” for hydrogen. The current BEH project is reliant on NTS blending, which itself is reliant on government support that is not expected before end-2023. Without demonstration of demand for hydrogen (i.e. a direct customer) then the BEH project will be too immature and timed-out from NZHF funding before 2024 at the earliest. BEH would also be expected to demonstrate line of sight to a CO₂ T&S solution.
 - Strand 2: CAPEX grant co-funding at 30% for up to £30m for project execution. This strand applies to projects that do not require hydrogen business model revenue support. At this stage it is assumed that the BEH project will require hydrogen production revenue support.
 - Strand 3: Not applicable to BEH core project (see above). CAPEX grant co-funding earmarked solely for electrolytic hydrogen projects and the current BEH project does not envisage early integration of blue and green hydrogen generation as a means to develop an integrated project and one that could access this grant funding strand.
 - Strand 4: CAPEX grant co-funding assigned to CCUS-enabled hydrogen projects that connect to Track-1 clusters with grant allocations expected in 2023. BEH is too immature.
-

9.2. CCUS Infrastructure Fund (CIF)

A CO₂ T&S network with a hub at Bacton will be necessary to support the BEH blue hydrogen plant (with separate or common ownership). Such T&S consortium(s) would be expected to emerge from the current NSTA carbon license round, with the BEH project being an anchor emitter customer:

- Bacton T&S consortia may be eligible for grant funding from the CIF, if the T&S infrastructure is designed to permit integration of future potential users such as bio energy / heat from waste (BECCS), local power generation and other carbon-emitting industries, as well as additional CO₂ storage that offers system resilience when linked to the national T&S capacity.
- BEIS states that “we will continue to progress the design of the CIF alongside the development of Cluster Sequencing and the process to identify ‘Track-2’ clusters”¹⁸. The Track 2 process is expected to be announced in 4Q 2022. The carbon storage license round under the NSTA closes in September 2022 with licenses expected to be awarded in early 2023¹⁹. The BEH project would be facilitated by the successful submission of CO₂ T&S cluster proposal(s) in Track 2 – however this is dependent on many factors, not least of which is that East Anglia does not appear to fit the “industrial cluster” model.
- Whilst the CIF is aimed at establishing CO₂ T&S networks for the industrial clusters, there may be scope for discussion with BEIS to extend its application to a CO₂ T&S hub at Bacton, linked to national gas infrastructure and the two interconnectors. The terms of the CIF are planned to be refined as the Track-1 cluster sequencing process develops.
- Where CIF funding for CO₂ T&S development is available, it may be in the form of capital grant funding or loans, equity or loan guarantees, all subject to value for money confirmation by government amongst other requirements (subsidy control, balance sheet, statutory consents). A government backed Revenue Support Agreement and Government Support Package (or equivalent) may be required to manage the full risk profile of the T&S Developer/Operator.

To support an application from a CO₂ T&S consortium in the BEIS Track-2 (or equivalent) process, the BEH blue hydrogen project would need to form a consortium, conduct preliminary studies and demonstrate sufficient project maturity, including customers for the hydrogen produced from an ATR, to be a credible emitter customer in the competitive award process expected sometime in 2023/4. In the absence of UK Government support for a blending hydrogen in the NTS, and an alternative 100% hydrogen customer base, reliance on the current cluster sequencing funding framework for Bacton Energy Hub is problematic and perhaps unlikely to attract private sector funding support.

¹⁸ [The Carbon Capture and Storage Infrastructure Fund: an update on its design \(accessible webpage\) - GOV.UK \(www.gov.uk\)](https://www.gov.uk/government/news/the-carbon-capture-and-storage-infrastructure-fund-an-update-on-its-design)

¹⁹ [North Sea Transition Authority \(NSTA\): Bids invited in UK’s first-ever carbon storage licensing round - 2022 - News - News & publications \(nstaauthority.co.uk\)](https://www.nsta.gov.uk/news-publications/nsta-2022-news-publications)

9.3. Summary

Opportunities for government co-funding for current blue hydrogen projects are relatively clear, however the BEH project is too immature to easily qualify for many of the schemes currently open and will have to apply for future funding opportunities as and when they become available. Possible opportunities include:

- NZHF Strand 1 DEVEX funding (in the anticipated 1H23 application window), but only if the project can demonstrate a credible timetable to complete FEED within the specified window (ca. 2 yrs), and a “demonstrated demand” for hydrogen (the 2023 BEIS decision on blending plays into this).
- Revenue support for the BEH blue hydrogen project in operation through the hydrogen business model would target the proposed levy from ca. 2025.

There is no obvious CAPEX funding path currently outlined for projects reaching FID in the period after 2025.

Support for CO₂ T&S infrastructure development might be available through the BEIS Track 2 process (2023?) in parallel to the NSTA licence round, providing that consortia are formed and BEIS will accept applications that lie outside typical “industrial clusters” (and therefore more dependent on CO₂ shipping from remote emitters for example).

Support for end-users in fuel switching may be available through the IETF and Industrial Fuel Switching scheme, although whether these will accommodate studies, design and works related to 20% blended hydrogen (as required) is to be determined.

Further discussion with BEIS is recommended to clarify and identify future funding options for BEH. However, given the planned focus on preferred industrial clusters, BEH may have to be carried by private initiatives for a large part.

10. Bacton Energy Hub – Developing a Financeable Project

The BEH project will need to develop a robust value for money business case to enable the project to compete for future grant co-funding in competition with projects in existing and future industrial clusters. The following considerations should be taken into account in the next phase of project development.

10.1. UK Emissions Trading Scheme

From January 2021, the UK has implemented the UK ETS, which is a replica of the EU ETS systems and for the 2021-2025 period continues with the same level of permit allocations as agreed under the previous EU scheme. Bacton terminals - Shell, Perenco, National Grid and the Interconnectors - all fall in the scope of the UK ETS. The progressive reduction in free allocation of emission permits and the likely increase in the carbon price, may provide an opportunity for a Bacton Energy Hub project to be self-funding. To reduce reliance on a revenue support scheme, the Government should introduce an underpinning carbon floor price within the UK ETS with a progressive increase over time in the floor price. This should provide sufficient encouragement to emitters to invest in alternative low carbon solutions to avoid the carbon cost burden.

10.2. CCS T&S network build-out

The Bacton Energy Hub blue hydrogen project is positioned within a potentially critical CO₂ T&S offshore infrastructure hub at Bacton to support the UK Government's ambition to achieve net zero before 2050.

Although not an industrial cluster, a Bacton hub has distinct advantages:

- Domestically sourced supplies of natural gas produced under stringent emissions controls from the central and southern North Sea
- Straightforward access to abundant, large offshore carbon storage sites in depleted gas fields and saline aquifers through repurposed offshore pipeline infrastructure
- Ample onshore site footprint (at least for the core BEH project) to install a hydrogen ATR & CO₂ compression & injection facilities
- Adjacent to National Grid site for ease of transmission either as a blended natural gas-hydrogen stream through multiple NTS feeders or in a dedicated pure hydrogen feeder for National Grid's Project Union
- Ease of integration with offshore wind to provide an additional source of low carbon energy to generate green hydrogen in-situ to augment the hydrogen supply into the NTS
- Adjacent to two interconnectors to potentially form part of Europe's emerging hydrogen backbone
- Potential to import CO₂ from UK /European emitters either via Great Yarmouth (shipping) or via existing pipeline rights of way, for offshore sequestration

A Bacton CO₂ T&S network is likely to be oversized in anticipation of future demand and offers scale benefits (lower cost) and availability (accelerated decarbonisation) to latent CCS-enabled projects that could be developed in the region: primarily BECCS, power and imported

CO₂ using the deepwater port of Great Yarmouth. Such measures offer a value for money integrated solution with additional national UK storage resilience.

A consortium could be formed as early as 2022 to deliver an overall integrated project (or separate linked projects on hydrogen and CO₂ T&S) and seek funding support over several phases:

- Phase 1 - establish an offshore CO₂ T&S project, providing a sink for locally sourced GHG (Gas Plant, Great Yarmouth Power Station, others) – funding support under CIF (or alternative mechanism) as an addition to Track-2 (or later) clusters, potentially emerging from the current NSTA carbon storage license round.
- Phase 2 – integrated results of NTS and neighbourhood trials to formulate (2024-plus):
 - Blue hydrogen project – funding under NZHF as part of a Track-2 project under Strand 4 or later equivalent
 - Green (electrolytic) hydrogen project on site – funding under NZHF Strand 3 or later equivalent
- Phase 3 – expansion phase - assume self-funding (2030+):
 - CCS - import of CO₂ via Great Yarmouth; pipeline from East Midlands; local distribution area (BECCS)
 - Electrolytic hydrogen and ATR expansion at Bacton, local network and storage under relevant hydrogen business models

10.3. Integrated Hydrogen Supply

BEIS aims to run annual electrolytic allocation rounds aiming for price-competitive allocations under the NZHF. With the already favourable growth in offshore wind in East Anglia and increasing offshore capacity projections, introducing electrolytic green hydrogen production into the BEH project perimeter may be of benefit.

It offers integration and scale benefits into the hydrogen transportation and storage systems (gas field / above-ground storage, NTS/LDZ pipelines and distribution networks, rail and road truck, port distribution).

Electrolytic hydrogen would be produced from otherwise curtailed offshore wind and/or solar and attract early funding support under Strand 1 of the NZHF. New business models for H₂ transportation and storage infrastructure²⁰ are expected in late 2025 under the Hydrogen Investor Roadmap (Annex 2), and these would help inform the further shaping of the overall project.

10.4. Alternatives to Blending

As government support for NTS blending is by no means certain, the BEH Project should broaden to consider alternative, but not mutually exclusive, options.

Building a regional hydrogen market demand case could offer an alternative funding model under a future Strand 2 of the NZHF.

Bacton can be promoted as an early and reliable supplier into Project Union focused on a 100% H₂ transmission grid that connects low carbon hydrogen to storage and end-users

²⁰ [Proposals for hydrogen transport and storage business models - GOV.UK \(www.gov.uk\)](https://www.gov.uk/government/consultations/proposals-for-hydrogen-transport-and-storage-business-models)

progressed. Bacton could form a key link for introducing low carbon hydrogen supply from electrolytic hydrogen as well as blue hydrogen. Storage of otherwise curtailed electrolytic hydrogen could be carried out at more favourable sites on the Project Union system, allowing the stored hydrogen to be used for power generation when renewable electricity supplies are in short supply.

It is also pivotal in any UK-EU hydrogen backbone, with the two gas interconnectors at Bacton enabling the transport and trading of hydrogen seamlessly across Europe, creating competitive price convergence and transparency.

11. UK Infrastructure Bank

The UK infrastructure Bank²¹, launched in June 2021, is a government-backed policy bank, focused on increasing infrastructure investment across the UK. Its strategic objectives are to help tackle climate change through meeting the government's net zero emissions target by 2050 and to support regional and local economic growth.

It has £22bn of financial capacity and aims to deploy up to £3bn of debt and equity and £2.5bn of guarantees a year over the next 5 to 8 years.

It has a private sector arm investing £18bn of the balance sheet with the local authority function providing up to £4bn of low-cost loans to local authorities for high value and strategic projects of at least £5m.

A Bacton Energy Hub project would appear to satisfy each of the UKIB 4 investment principles:

1. Drive regional and local economic growth or support tackling climate change
2. Infrastructure assets or networks or in new infrastructure technology
3. Deliver a positive financial return
4. Expected to crowd in significant private capital over time

The largest sector of the UKIB portfolio will be in clean energy, that includes finance for new green technologies, particularly low carbon hydrogen and carbon capture and storage.

Bacton Energy Hub has many of the compelling characteristics to attract low cost UKIB financial support, which is likely to further increase the interest of specialist infrastructure investors in these strategic assets linked to the European markets. As noted earlier, the EU's inclusion of natural gas within its sustainable economic activities will ensure Bacton Energy Hub falls within the remit of green infrastructure fund investors.

Private investors will require policy certainty on:

- UK Government support for a progressive increase in the UK ETS floor price and gradual reduction in free allowances
- Clarity and support for blending of hydrogen within the NTS, including the hydrogen business model support that may be applicable to blended hydrogen
- UK Government support for CO₂ T&S network at Bacton through a Revenue Support Agreement (RSA) arrangement and Government Support Package (GSP) or equivalent

²¹ [UK Infrastructure Bank \(ukib.org.uk\)](https://www.ukib.org.uk)

12. Useful references

Whilst preparing the document the Regulatory SIG identified the following public domain information sources that may be helpful

Resource	Web address
Offshore Energy UK (formerly Oil and Gas UK) Environmental legislation guidance	https://oilandgasukenvironmentallegislation.co.uk/activity-index.htm
Guide to hydrogen energy law and regulation	https://cms.law/en/int/expert-guides/cms-expert-guide-to-hydrogen/united-kingdom
HyLAW 23 partners, co-ordinated by Hydrogen Europe, that seeks the removal of legal barriers to the deployment of fuel cells and hydrogen applications	https://www.hylaw.eu/
UK HSE - Hydrogen safety	https://www.hsl.gov.uk/hydrogen-safety
UK HSE – COMAH guidance	https://www.hse.gov.uk/comah
OFGEM – guide to industry codes and standards	https://www.ofgem.gov.uk/energy-policy-and-regulation/industry-codes-and-standards
National Grid – Hydrogen testing and FutureGrid project	https://www.nationalgrid.com/uk/stories/journey-to-net-zero-stories/hydrogen-testing-heating-fuel-futuregrid
National Grid – long term electricity grid strategy (onshore and offshore)	https://www.nationalgrideso.com/document/262676/download

Appendix 1 – Hydrogen Funding Landscape

The following pages contain images of slides published by BEIS which may be helpful to anyone seeking to understand the Hydrogen Funding Landscape



Competition timings for BEIS Hydrogen funds launching 2022 and 2023

	NZIP Proposed Industrial Hydrogen Accelerator (IHA)	NZIP Industrial Fuel Switching (IFS) Phase 2	Industrial Energy Transformation Fund (IETF)	Net Zero Hydrogen Fund (NZHF)		NZHF and Hydrogen Business Model ²		
				Strand 1	Strand 2	Strand 3 (proposed)	Strand 4	
AIM	Demonstrate end-to-end industrial fuel switching to hydrogen to provide evidence on feasibility, cost and performance.	Support development of fuel switching and fuel switch enabling technologies, including hydrogen, for UK industry	Support the development and deployment of technologies that enable businesses to transition to a low carbon future.	Support development of new low carbon hydrogen production to grow the pipeline of projects in the UK.	Support low carbon hydrogen projects to take FID and begin deployment in the early 2020s, kickstarting the hydrogen economy.	Support electrolytic hydrogen projects to take FID and deploy at scale at the earliest opportunity.	Support for CCUS-enabled hydrogen projects. Must be able to connect to Track-1 clusters, as part of cluster sequencing	
ACTIVITY	Feasibility and demonstration	Demonstration	Feasibility, FEED and permanent deployment	FEED and post-FEED costs	Permanent deployment	Permanent deployment and operation		
FUNDING	Innovation funding	Innovation funding up to £6m/project	CAPEX grant co-funding, Total grant funding provided is: Feasibility studies, up to £7m Engineering Studies, up to £14m Deep Decarbonisation Deployment, up to £30m	DEVEX grant 50% co-funding for FEED and post-FEED studies, Grant awards of £80k-£15m	CAPEX grant 30% co-funding, Grant awards of £200k-£30m ³	CAPEX grant co-funding and ongoing revenue support via the hydrogen business model		
MATURITY	Innovation projects	TRL 4-7	TRL 7 +			TRL 7 +		
LOCATION	UK wide	UK wide	Within England, Wales or N. Ireland ¹			UK wide		
SCOPE	End-to-end project	Industry end-use	Industry end-use	Low carbon hydrogen generation	Low carbon hydrogen generation via electrolysis	CCUS-enabled low carbon hydrogen generation		
LINK	nzip_hydrogen@beis.gov.uk Industrial Hydrogen Accelerator https://bit.ly/H2NZIP	industry_innovation@beis.gov.uk Industrial Fuel Switching https://bit.ly/IFSH2	ietf@beis.gov.uk Industrial Energy Transformation Fund https://bit.ly/P2IETF	HydrogenProduction@beis.gov.uk Net Zero Hydrogen Fund https://bit.ly/H2NZHF				

¹ Sites based in Scotland can apply for funding from the **£34m Scottish IETF** run by the Scottish Government

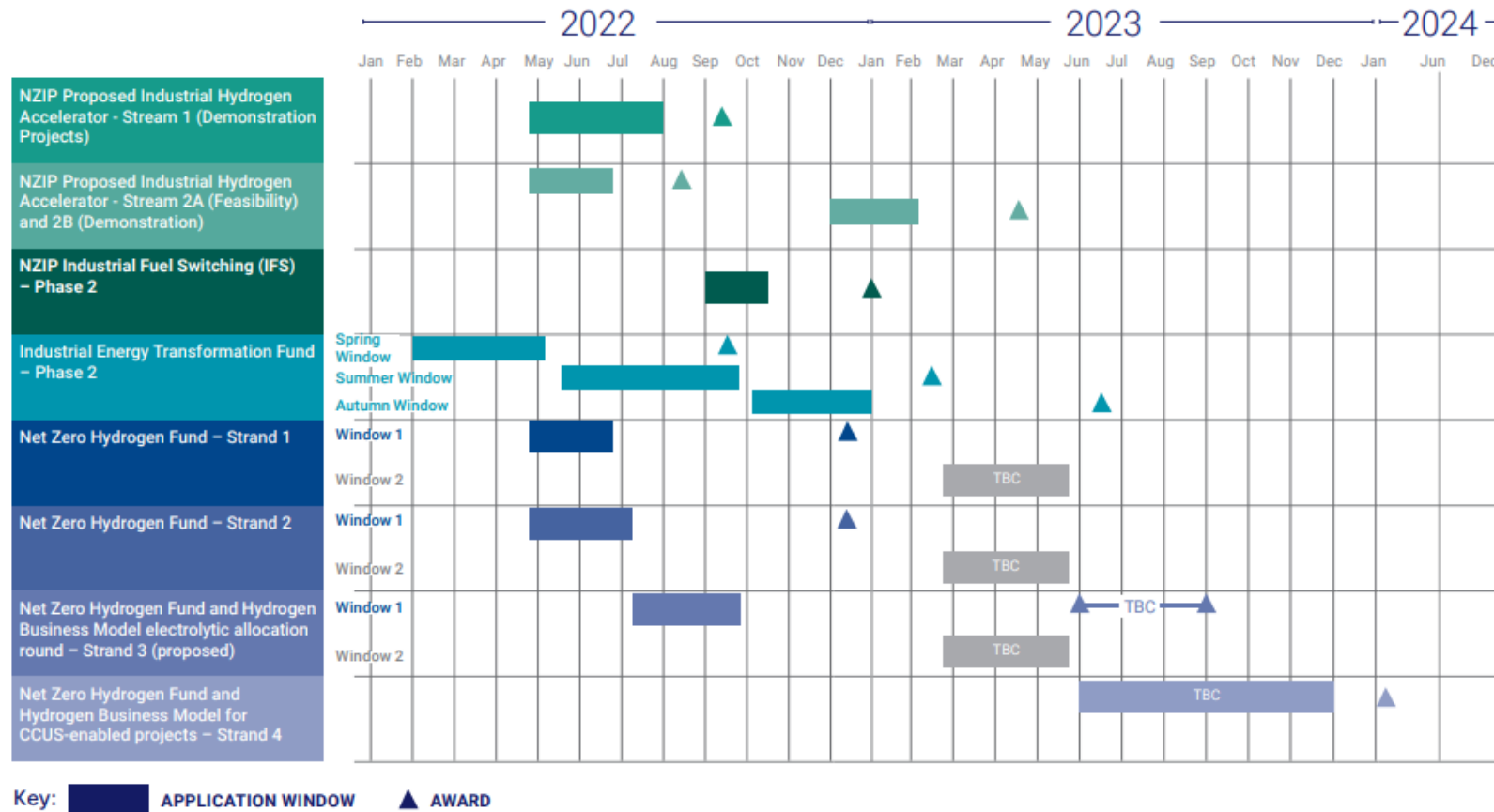
² The Hydrogen Business Model is funded by the Industrial Decarbonisation and Hydrogen Revenue Support Scheme (IDHRS).

³ project may receive revenue support via the Department for Transport’s Renewable Transport Fuel Obligation (RTFO) scheme.



Competition timings for BEIS Hydrogen funds

The timeline shows the key dates for BEIS competitions that will support hydrogen projects. Dates of some competitions are subject to change and updates will be published on gov.uk



BEIS Competitions and funding for hydrogen and industry - summary

BEIS [Net Zero innovation Portfolio](#) Innovation Competitions (SICE):

- £60m [Low Carbon Hydrogen Supply 2](#) competition – closed
- [Hydrogen BECCS](#) Innovation - closed
- £55m [Industrial Fuel Switching 2](#) (IFS) – phase 2 opens Autumn 2022.
- £10m [Industrial Energy Efficiency Accelerator](#) (IEEA)
- [Industry of Future](#) (IFP)
- £40m [Red Diesel Replacement](#) (RDR) – phase 2 opens spring 2023
- £10m [Green Distilleries Competition](#) - closed
- [£19.5m CCUS Innovation 2.0 competition](#). The £6.5m Call 2 aims to open w/c 23rd May.
- £67m [Longer Duration Energy Storage](#) competition (LODES) - closed
- [Energy Entrepreneurs Fund](#)

Generally aimed at mid-TRL technologies which need support for development and demonstration.

Wider BEIS support:

- £240m [Net Zero Hydrogen Fund](#) (NZHF)
- [Hydrogen business model](#)
- [Joint NZHF HBM](#) electrolytic allocation
- [Industrial Energy Transformation Fund](#) (IETF) and [Scottish Industrial Energy Transformation Fund](#) (SIETF)
- Industrial Strategy Challenge fund (ISCF) and £170m [Industrial decarbonisation challenge](#) (UKRI led)
- Support for world-leading trials of hydrogen for heating, including a hydrogen neighbourhood trial by 2023
- [CCS Infrastructure Fund](#)
- [Industrial CCUS business model](#)

Generally aimed at supporting the deployment of higher TRL technologies.

Scheme	Industrial Hydrogen Accelerator (IHA)	Net Zero Hydrogen Fund (NZHF)	Industrial Energy Transformation Fund (IETF)
Aim	Demonstrate end-to-end industrial fuel switching to hydrogen to provide evidence on feasibility, cost and performance.	Fund development & deployment of new low carbon hydrogen production to de-risk investment and reduce lifetime costs.	Support the development and deployment of technologies that enable businesses to transition to a low carbon future.
Funding	£26m innovation funding for feasibility studies and demonstration	Up to £240m grant funding - for DEVEX (development expenditure) and CAPEX (capital expenditure)	£289m in grants, up to £30m/project CAPEX co-funding for feasibility, engineering studies & deployment
Technology maturity	Innovation projects	TRL 7 + Permanent deployment	TRL 7 + Permanent deployment
Timeline	Opened April 2022 First award summer 2022 Projects complete by March 2025	Spring 2022 – March 2025 Strand 1 & Strand 2 opened in April 22 Strand 3 (NZHF+HBM) – summer 22	Competition windows in Spring, Summer and Autumn 22. Successful applicants must complete by March 2025.
Scope & Eligibility	<ul style="list-style-type: none"> - Innovation focussed - End-to-end project, from low carbon H₂ generation to industrial end-use - Operational by February 2025 - UK wide 	<ul style="list-style-type: none"> - Low carbon hydrogen production projects - Based in the UK - Commercial projects TRL 7+ 	<ul style="list-style-type: none"> - Onsite low carbon H₂ end-use projects, TRL 7+ (H₂ generation out of scope) - Must demonstrate ability to switch to H₂ within 5 years of project completion - Within England, Wales or N. Ireland¹
Email and web	nzip.hydrogen@beis.gov.uk Industrial Hydrogen Accelerator	HydrogenProduction@beis.gov.uk Net Zero Hydrogen Fund Electrolytic Market Engagement	ietf@beis.gov.uk Industrial Energy Transformation Fund

Hydrogen investor roadmap and funding infographic available [here](#).

17 Industrial Hydrogen Accelerator Launch and Networking Event
1 Sites in Scotland see Scottish IETF <https://www.gov.scot/policies/energy-efficiency/scottish-industrial-energy-transformation-fund/>

Appendix 2 – Hydrogen Investor Roadmap

The following page contains a timeline published by BEIS which may be helpful to anyone seeking to understand the Hydrogen Funding Landscape

○ Key events for Bacton Energy
 ...

Our 2035 Delivery Plan

Critical activities and milestones on a path to developing the UK hydrogen economy

