# Hydrogen East

# Stakeholder Briefing

An update to stakeholders on the development and progress of the regional hydrogen cluster – Hydrogen East.

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# Contents

CONTENTS ..... 2
SUMMARY ..... 3
1. INTRODUCTION ..... 4
2. HYDROGEN EAST CLUSTER ..... 6
3. REGIONAL STRENGTHS AND DIFFERENTIATORS ..... 7
4. EAST OF ENGLAND FOCUS ..... 9
5. MOMENTUM ALREADY BUILDING ..... 12
6. APPENDIX 1 – SELECTION OF REPORTS & STUDIES ..... 14

# Summary

This paper summarises the background, progress and ambitions presented by the developing hydrogen economy and what this means for the East of England.

*Hydrogen East* cluster acts as a catalyst for regional development. Launched in May 2023, initial focus centred on research and awareness building. The cluster now via a joint industry programme is supported by **15 private sector organisations** forming an Industry Advisory Group. Over the next three to five years the cluster aims to attract investments **exceeding £5 million annually**, supporting project delivery, research, policy, export, and inward investment strategies.

**Figure 1.**

**Source: Hydrogen East**

This paper sets out:

- **Regional Strengths and Differentiators**

  The East of England is poised for early hydrogen deployment, with strong foundations. 5GW installed and 9.7GW in the pipeline of offshore wind, 1.3GW and a further 3.2GW of onshore solar, 3.2GW of new build nuclear, 2.8GW of battery storage in the pipeline and a **low carbon hydrogen production ambition well exceeding 2GW**.

- **East of England: A Leader in Low Carbon Energy**

The East of England, a key contributor to the UK's low carbon energy generation, is expanding its capacity. *Hydrogen East*'s evidence base supports the deployment of electrolysers in non-urban areas, aligning with regional priorities. **Transport decarbonisation, agriculture, aviation, and hydrogen infrastructure developments**.

- **Conclusion: Shaping a Sustainable Hydrogen Future**

*Hydrogen East*'s role as the East of England's hydrogen cluster is pivotal. The region's strengths, diverse opportunities, and strategic initiatives position it as a global leader in low carbon hydrogen. The ongoing evolution of policies, funding rounds, and industry engagement underscore the commitment to a sustainable hydrogen future. The East of England's journey towards net zero is marked by innovation, collaboration, alongside **place-based approaches to addressing unique regional challenges**. As a living document, this paper sets the stage for continuous updates, reflecting the dynamic landscape of the hydrogen sector and the **East of England's integral role in shaping a cleaner and more sustainable energy future**.

# 1. Introduction

Since the original publication of the UK *Hydrogen Strategy*, including all subsequent updates up to and including December 2023[1], and more recently with the new **Labour Governments commitment to "Make Britain a Clean Energy Superpower**[2]" that includes among others, investment in carbon capture and storage and hydrogen. Maintaining that hydrogen is seen by the Government as a key part of its policies to reach Net Zero and meet our carbon budgets.

The introduction and subsequent revision of the *Low Carbon Hydrogen Standard*[3] has provided welcome focus and clarity to ensure the various hydrogen production processes, occasionally referred to as the hydrogen colour spectrum, are in fact low carbon and will directly contribute to carbon reduction targets.

Blue hydrogen[4] and its deployment at industrial clusters continues to be an important policy focus, with several projects actively under development. Further positive progress was announced by the *North Sea Transition Authority* (NSTA) in September 2023, where a total of 14 companies have been awarded 21 carbon storage licences. The locations with the potential to store up to 30 million tonnes of CO2 per year by 2030, **Key operators at the Bacton Terminal were among those awarded**.

1 https://www.gov.uk/government/publications/uk-hydrogen-strategy#full-publication-update-history

2 https://labour.org.uk/change/make-britain-a-clean-energy-superpower

3 https://www.gov.uk/government/publications/uk-low-carbon-hydrogen-standard-emissions-reporting-and-sustainability-criteria

4 Methane from which carbon has been sequestered and stored.

Hydrogen from other sources, including green[5] which initially received less attention are now gathering pace, building confidence with original equipment manufacturers (OEMs), technology developers and innovators but more importantly with end users. The *Net Zero Hydrogen Fund* (NZHF) Strands One and Two saw successful Round One applicants announced in March 2023. 15 projects supported, with ***Conrad Energy*, Lowestoft and *Scottish Power*, Felixstowe of particular interest in the East of England.**

Pink/red[6] hydrogen is also poised and may provide additional valuable contributions to wider decarbonisation efforts, alternative fuels, versatility, and energy security. The new build nuclear site at ***Sizewell C* announced in September 2023 a pilot scheme that will see the introduction of hydrogen powered buses** to be used during the construction phase. If successful, this scheme could extend to introduce up to 150 buses[7].

Policy, guidance and industry consultation and alignment continues to be an important mechanism to ensure the most appropriate projects, technologies and applications are introduced in the areas where they will have the most impact. Focus on industrial cluster locations will continue to represent utility scale size projects whereas more rural areas with dispersed industrial loads will require **alternative approaches alongside sub-utility scale projects that consider whole systems thinking and may include place-based solutions**.

The introduction of the *Hydrogen Production Business Model* (HPBM) and the continued development of the *Hydrogen Transport & Storage Business Model* as outlined with *Hydrogen Production Delivery Roadmap*[8] sets out 10-year delivery roadmap for scaling up hydrogen production.

The *Hydrogen Allocation Round* (HAR) announced the 11 successful green hydrogen production projects under round one on the 14th December 2023[9]. These 11 projects total 125MW capacity unfortunately, on this occasion did not include any projects specifically within the designated East of England area. However, **HAR1 does include projects in the wider representative area *Hydrogen East* are engaging and are actively supporting**.

HAR2 closed for full applications in April 2024 with an aim to support up to 875MW capacity, that will contribute to the ambition of 1GW of electrolytic hydrogen in construction or operation by 2025. HAR2 broadened the eligibility criteria to include other production technologies such as, biomass or waste gasification and pyrolysis to hydrogen, and gas splitting producing solid carbon. ***Hydrogen East* believe this addition to technologies is very positive for the region, we are aware of numerous applications being submitted and will await the announcement of successful projects.**

Hydrogen East are hopefully there will be additional HAR's and are strongly encouraging organisations and stakeholders to engage now in developing projects as the application process is both challenging and lengthy.

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5 Clean hydrogen derived from renewable electricity through an electrolysis.

6 Clean hydrogen derived from nuclear electricity and/or heat, also through an electrolyser.

7 https://www.sizewellc.com/news-views/first-buses-using-clean-hydrogen-fuel-to-be-ordered-by-sizewell-c/

8 https://assets.publishing.service.gov.uk/media/6579e4a9095987000d95e069/hydrogen-production-delivery-roadmap.pdf

9 Hydrogen Production Business Model / Net Zero Hydrogen Fund: HAR1 successful projects (published December 2023) - GOV.UK (www.gov.uk)

This paper provides an update, the background, and the role of *Hydrogen East* as the regional Hydrogen Cluster.

This paper, which is a living document, sets out:

- Hydrogen East cluster
- Regional strengths and differentiators
- East of England as a global leader
- Examples of relevant projects

The aim is to ensure the East of England is recognised and acknowledged for its continued contributions to the clean energy agenda, local, regional and national decarbonisation efforts alongside continued efforts to delivering and ensuring water, food and energy security.

# 2. Hydrogen East cluster

*Hydrogen East* was launched in July 2020 originally to carry out research and raise awareness and take up of hydrogen opportunities in the East of England.

***Hydrogen East* has already delivered various studies and project related works** including but not limited to, hydrogen blending assessments for a network operator, hydrogen site assessments and pre-screening analysis and alternative fuels and refuelling infrastructure studies for major developers and local authorities, additionally, hydrogen capability assessments supporting the supply chain to access the hydrogen value chain and two major research pieces on regional hydrogen opportunities:

- A ***Bacton Energy Hub*** study that considered potential local hydrogen markets and how they might be tied to sector developments for both offshore and onshore and the production of green and blue hydrogen.[10] The study was sponsored by the *New Anglia LEP, North Norfolk District Council, OGTC* and the *Offshore renewable Energy Catapult*, and our report was delivered in May 2021.
- A pre-feasibility study for electrolyser development centred at ***Lowestoft PowerPark*** with some initial thinking on how this might scale into a wider regional green hydrogen cluster. This study was undertaken supported by a group of eight companies and councils as a multi-client study. The funders included *East Suffolk District Council* as well as energy industry players such as *Scottish Power, Cadent* and *Conrad Energy*.[11] *Conrad Energy* subsequently amended their local FlexGen application to include an electrolyser and are now hoping for first hydrogen production in 2025[12].

In May 2023, *Hydrogen East* via a Joint Industry Programme formally launched and became the *East of England Hydrogen Cluster*[13]. An industry led initiative that builds on the body of knowledge, insights and relationship, to further stimulate and accelerate through

10 https://hydrogeneast.uk/bacton-energy-hub/

11Executive summary: https://hydrogeneast.uk/lowestoft-powerpark/

12 Lowestoft Power Park – Conrad Energy

13 East of England Hydrogen Cluster launches, while IAG takes shape - Opergy Group

targeted action the development of the hydrogen economy in the East of England. The cluster is currently formed of **15 organisations that contribute and make up the *Industry Advisory Group***, has four sub-cluster working groups covering agriculture, aviation, transportation and mobility and infrastructure[14].

*Hydrogen East* cluster committed in year one (23/24) to successfully launching the cluster, establishing a committed and comprehensive industry backed advisory group that is representative of the hydrogen value chain, and gaining endorsement and support from local government representatives and regional industry bodies and sector groups. **Final deliverable of the year one objectives, a Regional Hydrogen & Next Generation Fuels Economic Roadmap delivered by the *Institute for Manufacturing* (IfM), due to be published Q3 2024.**

*Hydrogen East* activities for year two and years three to five are to help the region bring to reality a portfolio of project opportunities targeted on bringing a **minimum of £2mn of investment** into the region and to support development of research, policy, export, and inward investment strategies that maximise opportunities for investment and leadership across the region's hydrogen economy, with a **target of >£5m p.a. project investment and funding** respectively.

*Hydrogen East* believe that the *Government* should create opportunity and growth across a variety of different and disparate regions of the UK, including the East of England, allowing **low carbon hydrogen and next generation fuels to be a significant and important contributor to a Net Zero Britain**. This could, should, and can happen in the short to medium term, not in a decade or two as some industry narratives have previously suggested, and the prospects for the deployment of low carbon hydrogen are not contingent on proven deployment of blue hydrogen technologies but **deployed concurrently and in a way that is complimentary to the many other technologies** that support and deliver against our decarbonisation obligations.

# 3. Regional strengths and differentiators

*Hydrogen East* believes low carbon hydrogen development will be strongly influenced by local conditions and lead to the **formation of clusters and sub-clusters** with distinct regional characteristics. **This in many cases will reflect place-based opportunities and solutions** (including site availability, existing infrastructure, renewable surpluses, network constraints, district emissions profiles and local use cases) alongside other decarbonisation measures being adopted locally to achieve net zero. These factors and cross-sector collaborations will be essential.

Many projects are being scoped or delivered around industrial clusters in "hard to reach" sectors currently heavily weighted towards blue hydrogen. This approach may make sense for those locations. However, this focus does not reflect the diversity of thinking that is now building up around **local opportunities enabled by the early deployment of sub-**

14 East of England's Hydrogen Ambitions Soar as Regional Cluster Strengthens Leadership Team with Key Appointments - Opergy Group

**utility scale low carbon hydrogen projects**, and the fast-shifting economics between the different production techniques of hydrogen, hydrogen derivatives and synthetic fuels. At a high level the *Energy Security Strategy* acknowledges **the need for a more diverse approach**, especially regarding electrolytic hydrogen.

These opportunities include developments that should arise from the need to decarbonise transport, especially larger vehicles in dispersed regions, which is a particular challenge in the East of England. They are also likely to embrace agriculture, aviation and shipping given the absence of viable alternatives at scale. Local flexibility markets (in which electrolysers could play a key role as sources of turn up/turn down energy demand when local electricity supply is in surplus), are also likely to **deliver value to local networks by relieving energy supply bottlenecks and constraints**. Most industry analysis fail to consider the wide range of potential use cases in agriculture and food processing, and which differ from region to region, and which require urgent consideration if carbon budgets are to be achieved.

We believe the East of England region already has strong foundations to support early deployment of a variety of low carbon hydrogen projects. This is in addition to continuing developments at the ***Bacton Terminal*** **complete with supporting infrastructure, import and export potential** and the **ambitions at *Freeport East*** and the work being undertaken by *Scottish Power* at Felixstowe.

Indeed, a growing number of regional stakeholders believe that **other forms of hydrogen production could be developed concurrently** of any blue hydrogen and carbon capture & storage (CCS) initiatives. For instance, the *Bacton Hydrogen Hub* concept is centred around transmission scale activity and strongly wedded to the *Capital Hydrogen* initiative and therefore not presently expected ahead of 2030 and possibly later.

In addition, we are aware of a growing number of **offshore wind developers considering production of green hydrogen** either directly linked to onshore assets or potentially developing or repurposing assets offshore to diversify the use of renewable energy.

*Hydrogen East* supported by ***Opergy Net Zero*****'s geospatial mapping work (NZ E-Map)** and demand estimation work has shown that there is a much more nuanced and diversified picture across the East of England, **reflecting a range of different hydrogen development opportunities** in turn supporting and stimulating the transition and uptake of hydrogen and hydrogen derivatives.

We also expect a nascent onshore low carbon hydrogen market to grow strongly combined with the availability of **increasing volumes of onshore solar, battery and other low carbon generators, including the recent announcements surrounding onshore wind** being considered, in planning and being built.

*Hydrogen East* can also **focus planning, coordination, policy and investment** regionally to bring the **required solutions at the appropriate scales** across diverse beneficial regional use cases. Further **discussions with Hydrogen Innovation Initiative (Hii) would be welcomed** to consider how empowered regional delivery could leverage funding and investment and accelerate national delivery and growth.

# 4. East of England Focus

The East of England, as represented in **Figure 2** is already delivering a substantial contribution towards the UK's low carbon energy generation and decarbonisation efforts with further **significant increases to installed capacity across many technologies** out to 2035 and beyond.

**Figure 2.**[15]

| Source | Installed Capacity (MW) | 2022 homes | % | Installed Capacity (MW) | 2030-35 | % |
|---|---|---|---|---|---|---|
| **Offshore Wind** | 5,059 | 4,021,226 | 16% | 15,059 | 11,969,884 | 45% |
| **Onshore Wind** | 416 | 330,664 | 1% | 504 | 400,612 | 2% |
| **Solar** | 1,294 | 323,039 | 1% | 4,514 | 1,126,892 | 4% |
| **Nuclear** | 1,200 | 2,696,153 | 11% | 4,400 | 9,885,893 | 37% |
| **BioEnergy & Waste** | 349 | 592,455 | 2% | 439 | 745,237 | 3% |
| **TOTAL** | **8,318** | **7,963,537** | **32.1%** | **24,916** | **24,128,518** | **90.9%** |

**Source: Opergy Group**

*Hydrogen East* has built a strong evidence base and supporting narrative for the deployment of electrolysers in predominantly non-urban areas with specific local characteristics. In this context, transport decarbonisation is a key priority but also a major challenge.[16] **Agriculture, aviation, the broader mobility agenda and importantly the proactive consideration and development of associated hydrogen infrastructure,** also prioritised. These priority areas form the initial *Hydrogen East Sub-Cluster* working groups.

The area represented by *Hydrogen East* spans the A1 border from the Humber, the East and Southeast to the South coast, all with priorities on emerging hydrogen opportunities.

The *Norfolk and Suffolk Economic Strategy* issued in January 2022[17] builds on the *Local Industrial Strategy* and reaffirms this approach. Both documents signal the strategic importance of hydrogen development to the region's economy. Notably **recognising the importance of *Hydrogen East*** in supporting the GW scale ambitions at both Bacton and Freeport East.

[15] Cambs, Essex, Norfolk & Suffolk, calculated using 2023 BEIS datasets, avg. domestic household consumption.

16 Transport emissions typically account for around 35% of $CO_2$ emissions across Norfolk and Suffolk. In some districts they are close to 50%.

17 https://newanglia.co.uk/economic-strategy/

The *Thames Estuary Growth Board* Vision, '*The Green Blue'* Action Plan[18] updated October 2022 and associated 'The Green Blue Workplan'[19] July 2021 provides clear objectives towards laying the foundations for the Estuary as one of the UK's leading hubs for hydrogen. With research demonstrating the potential to **create 9,000 jobs, generating £3.8bn in GVA and driving £2.2bn investment**[20].

*Freeport East* set out the ambition to develop a **1GW *Green Hydrogen Hub*** very early and has continued to make positive progress. The *Freeport East Hydrogen Offtake Assessment* February 2023 identified there could **140 tonnes per day (tpd)** of demand across the Freeport East representative area by 2030. The subsequent publication, The *Freeport East Green Hydrogen Hub*[21] report August 2023, further outlined the potential demand of 187tpd by 2035 with the potential to **increase to over 1000tpd by 2050**, requiring c. 2.3GW of electrolytic hydrogen.

Further supporting the local and regional activities are the national initiatives being led by *National Gas, Cadent and SGN* driving feasibility and pre-FEED studies for the ***East Coast Hydrogen, Capital Hydrogen*** **and** ***Hydrogen Valley*** projects, all part of the *Project Union*[22], *UK Hydrogen Backbone* developments. East Coast Hydrogen and Capital Hydrogen projects through early stakeholder engagement are **forecasting 33Twh of hydrogen production** by 2032 and **100-170Twh of potential production by 2050** respectively[23].

Other projects and stakeholders are now making good progress, such as, **RWE & Haltermann Carless, HyGreen Energy, Hynamics and Standard Gas**. But, are still dealing with the challenges of robust offtake agreements, appropriate infrastructure now or in consideration and an acknowledgment of appropriate support mechanisms to consider beyond direct uses of hydrogen and to explore additional processing facilities and associated assets and infrastructure that could support a range of applicable next generation fuels that add value to regional applications and sectors, such as biomethane and methanol.

The above referenced initiatives, ambitions and reports are a selection of what is developing across the region. There are further sub-utility scale concepts considering **placed-based solutions aligned to local characteristics**, maximising natural resources, supporting fuel switching and decarbonisation as part of the energy transition efforts across public and private sectors, **Figure 3** provides a visual representation.

18 Thames-Estuary-Green-Blue-Action-Plan-UpdatedOct22.pdf (thamesestuary.org.uk)

19 The Thames estuary Growth Board

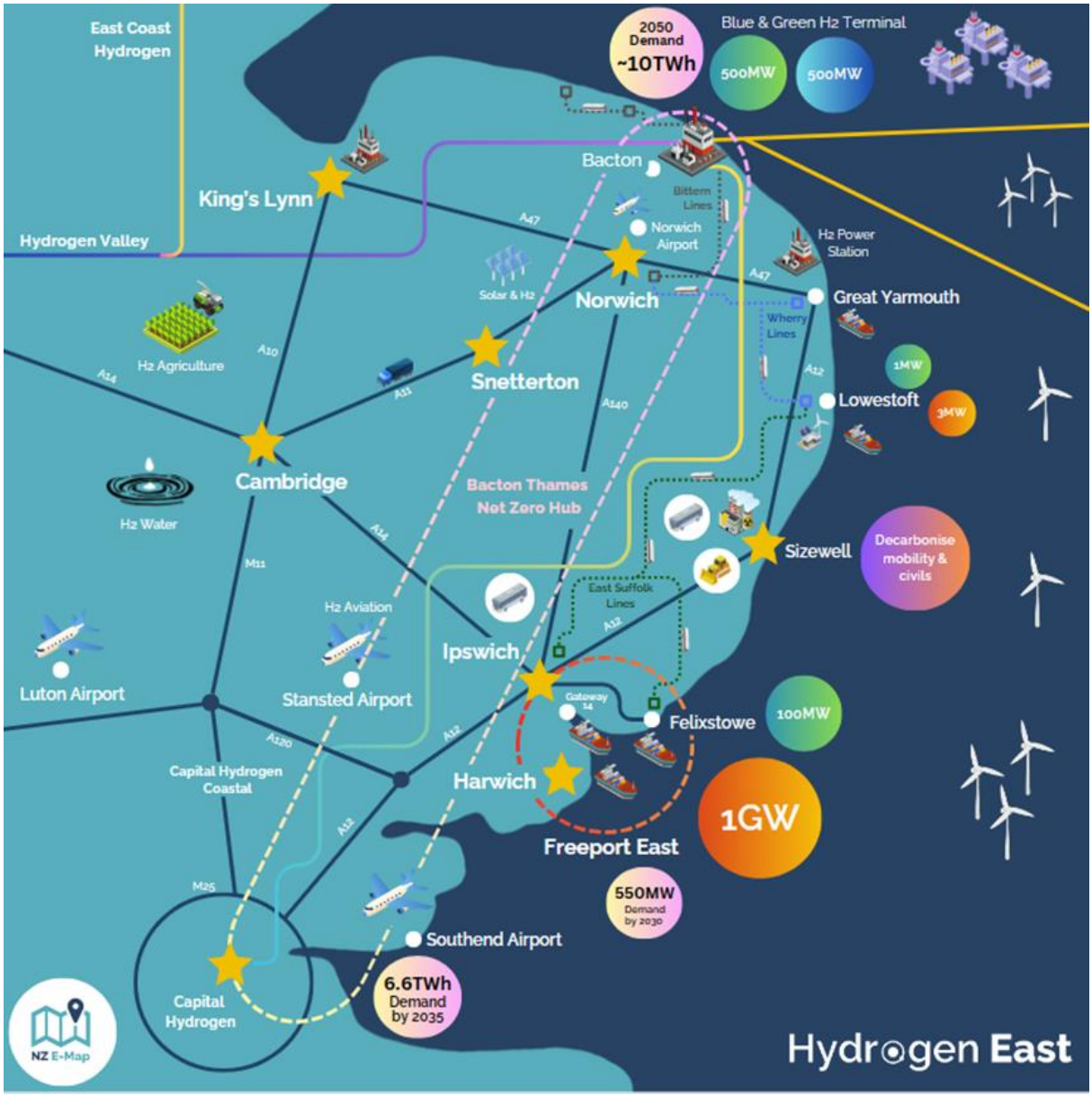
20 Thames-Estuary-Hydrogen-Route-Map-V1-Final.pdf (thamesestuary.org.uk)

21 PowerPoint Presentation (freeporteast.com)

22 National Gas deal paves the way towards no-regrets hydrogen network | National Gas

23 East London Hydrogen Pipeline (eua.org.uk)

## Figure 3.




**Source: Opergy Net Zero**

Hydrogen clustering is also being considered across the region, and these areas could **become important catalysts providing integration** with continuing aggressive build out of onshore renewables, nuclear and wind off the East of England coast.[24]

24 Several offshore wind development, such as the Sheringham Shoal and Dudgeon Ext's, and other new projects such as Boreas, Vanguard and Sizewell C.

# 5. Momentum already building

Several research-based assessments and projects connected to hydrogen development are already underway in the region, many of which delivered by Hydrogen East and partners.

These include:

- **Sizewell C** is committed to supporting the decarbonisation activities throughout the civils and construction phases of the project. Recently launched a pilot project to assess the suitability and viability of **introducing hydrogen buses** for the workforce.
- The **Freeports East** project centred on **Felixstowe and Harwich**, which could see early adoption of hydrogen production being pursued by **Scottish Power** to supply port-side operations and alternative fuels for shipping.
- Development of flexible generation "flexgen", where **Conrad Energy** has obtained **planning approval for an electrolyser at Lowestoft** to produce hydrogen, site presently under construction[25]
- Another, larger operational "flexgen" project at Stowmarket, potential to **transition to an alternative low carbon fuel** in conjunction with blending or in combination with replacement of some assets fuelled by locally produced hydrogen
- The SHIfT study – **Sustainable Hydrogen Infrastructure for Transport** – under the Community Renewal Fund programme, which examined co-location of solar with electrolysers to produce hydrogen for heavy transport.
- SHIfT could be combined with phased integration of hydrogen-fuelled/dual-fuelled **refuse collection vehicles** and other vehicles operated by a local district council(s)
- Transition to alternative fuels for **agricultural, construction and other off-road vehicles,** especially in remote rural areas
- The **opportunities for large estates** and the significant role the likes of **Holkham, Dennington Hall Farms, Sandringham** and others can play on behalf of their specific and wider contributions.
- **Sustainable aviation fuel and e-fuels.** Collaboration with the airports and operators to introduce alternative fuels and initiatives to further decarbonise aviation. Building on exemplary examples and commitment from **Saxon Air** and others
- The potential conversion of the **Bittern, Wherry and East Suffolk** branch railway lines, with the potential to transition away from diesel to hydrogen as outlined by

25 https://www.linkedin.com/feed/update/urn:li:activity:6895293318868414464/

Network Rail. There is also the potential to **link the East Midlands with the Freeport East zone**.

- Repowering and/or repurposing of **RWE's Scroby Sands** first generation wind turbines off the coast of Great Yarmouth and potential pairing with off/onshore electrolysers.
- Investigation of **Snetterton** and potentially **Hethel** and **Lotus** as the focus for development of hydrogen refuelling in conjunction with EV fast charging supporting the **Cambridge-Norwich Tech Corridor** along the A11, and potentially involving repurposing of other landfill gas sites (operating and closed) in the region.
- Longer term considerations regarding the injection of hydrogen to local gas networks at step-down sites such as Yelverton and development of other **Hydrogen Networks** at private sites such as that at **Scottow Enterprise Park.**
- **Hydrogen market awareness and capability assessments** to support the supply chain to prepare for the evolving hydrogen market and gain insights into early entrant or transition opportunities.
- **Demand side assessments.** Considering the needs and infrastructure requirements to **enable early, appropriate, and scalable distributed hydrogen**. Proactively developing and complimenting the transmission scale initiatives.
- '***Connectrolyser***' a ***Strategic Innovation Fund*** project aims to scale hydrogen electrolyser hub development to expedite new connections while minimising impact of the network.
- **Offshore green hydrogen,** the offshore environment provides the much-needed space for electrolyser and storage capacity to be built at speed and scale to meet demands.
- **Water Scarcity,** an ever-increasing challenge, especially considering the impacts of climate change. Innovative approaches to water when considered alongside hydrogen production becomes a real and exciting opportunity**. Strategic Cross-Sector Multi-Use Shared Desalination Assets including Brine Electrolysis** has the potential to support the food, water and energy sustainability agenda, enabling inward investment and economic growth.
- The **Bacton Energy Hub**, which is primarily focused on blue hydrogen. This might expand over time into a wider **sub-regional hub combining both blue and green hydrogen** and integration with solar and other renewable technologies locally.

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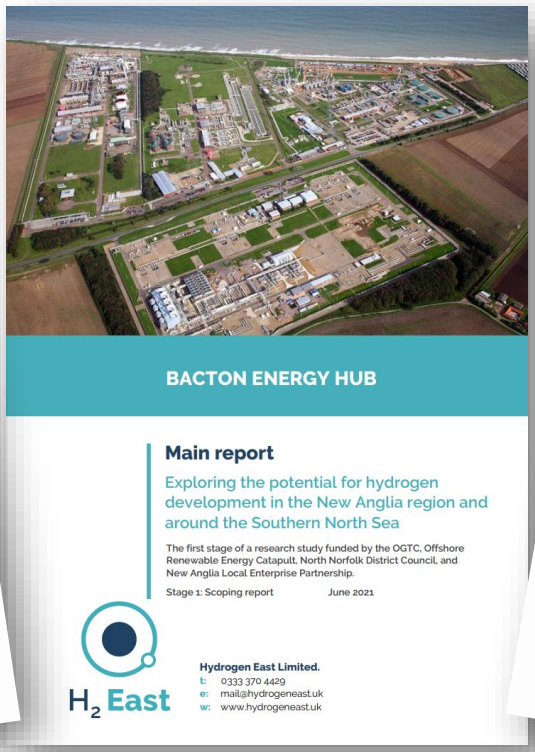
# 6. Appendix 1 – Selection of Reports & Studies