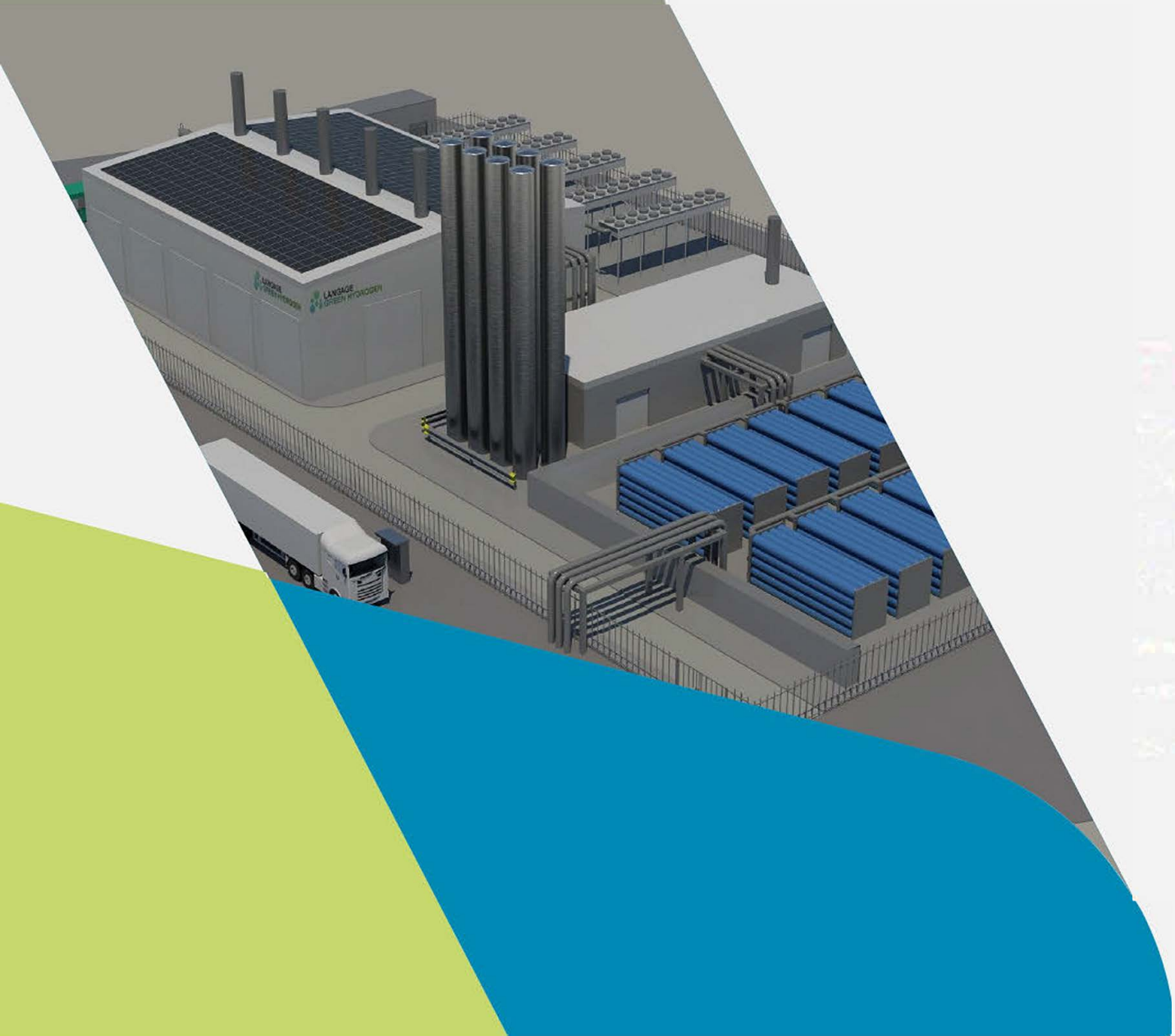

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PASD Freeport: Hydrogen Demand Assessment Introduction and Executive Summary

Note: company names have been redacted and the Demand Assessment itself is commercially confidential which was a condition of businesses agreeing to be interviewed.

23 August 2024

GLOSSARY

BEV	Battery Electric Vehicle
CCUS	Carbon Capture Usage and Storage
CMDC	Clean Maritime Demonstration Competition
CTV	Crew Transfer Vessel (e.g. for offshore wind farm servicing)
DESNZ	Department for Energy Security and Net Zero
DfT	Department for Transport
EPL	Energy Profits Levy
EV	Electric Vehicle
ESAF	Sustainable Aviation Fuel (from renewable electricity, i.e. Power-to-liquids)
ETS	Emissions Trading Scheme
FCEV	(Hydrogen) Fuel Cell Electric Vehicle
FES	Future Energy Scenario (from National Grid)
FMCG	Fast Moving Consumer Goods
FOCs	Freight Rail Operating Companies
H2	Hydrogen
HGV	Heavy Goods Vehicle
HRS	Hydrogen Refuelling Station
HVO	Hydrotreated Vegetable Oil
ICE	Internal Combustion Engine
LCOH / LCOE	Levelised Cost of Hydrogen / Electricity
LCV	Light Commercial Vehicle
NZHF	Net Zero Hydrogen Fund
OEM	Original Equipment Manufacturer
PASD	Plymouth and South Devon Freeport
RCVs	Refuse Collection Vehicles
SAF	Sustainable Aviation Fuel
SMR	Steam Methane Reforming (when combined with CCUS produces blue hydrogen)
TOCs	Passenger Rail Operating Companies
TPD	Tonnes per day

01

INTRODUCTION

Project background and overview

PROJECT BACKGROUND

PASD FREEPORT CONSISTS OF SEVERAL TAX SITES IN THE PLYMOUTH AREA

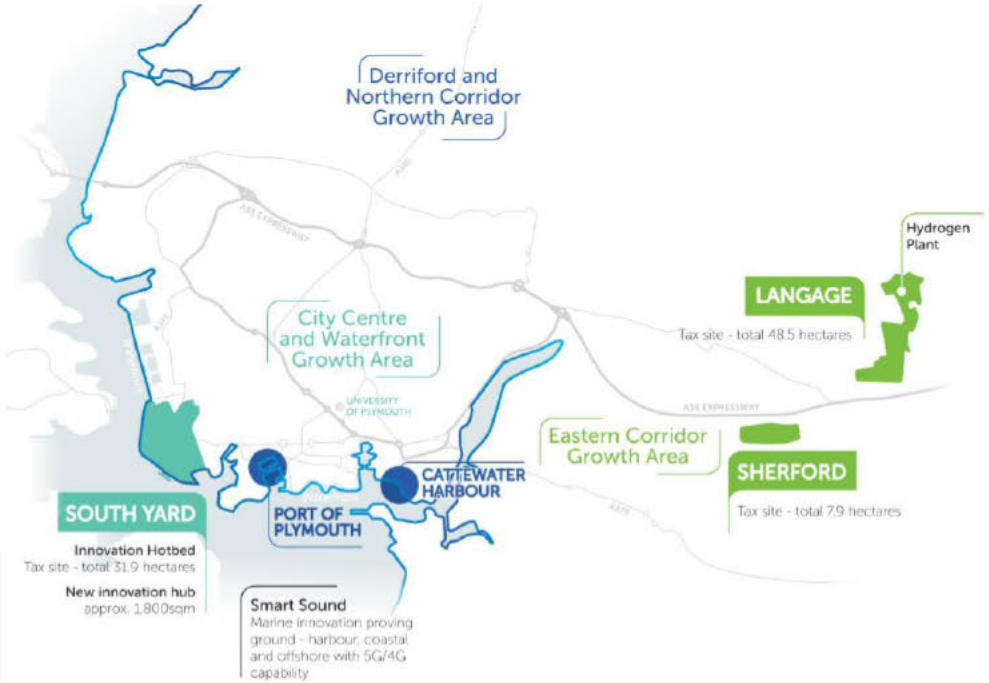
The subject of this study is the Langage site, to the east of Plymouth

PASD Freeport are supporting Carlton Power with their Green Hydrogen Project at Langage. Carlton's green hydrogen project (10MW) was one of the 11 projects to win funding from DESNZ as part of the Hydrogen Allocation Round 1 funding in December 2023.

Both PASD Freeport and Carlton Power are keen to carry out a hydrogen demand assessment within 100km radius of the Langage Freeport site, approximately covering Cornwall, Devon and parts of Somerset.

PASD Freeport have held discussions with the Freeport Hub regarding undertaking a study to map potential offtakers and estimate demand potential across the applicable end-use segments in the region, where hydrogen offers a credible decarbonisation pathway.

This report covers the points above and aims to provide clarity of the overall Hydrogen opportunity relevant to the area. It also serves to inform the forward-looking plans for a policy paper of interventions to support offtaker transition that could be presented to UK Government



Map of tax sites at the PASD Freeport [57]

OVERVIEW OF STUDY

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Inputs

- Undertaking desk-based research and reviewing industry reports & technical literature to collate data
- Utilising internal PA database and modelling tools
- Conducting interviews with potential regional offtakers/ stakeholders (through PASD Freeport and Carlton Power facilitated introductions)

Objective: Understand the local area and shortlist offtake segments in region with use case for Hydrogen

TASK 1

- Prepare offtake segmentation chart
- Prepare qualitative demand assessment framework for segments covering key decision drivers
- Perform a time-to-market assessment for hydrogen use cases to reach maturity.
- Finalise segments to focus for Task 2 demand mapping aligned to opportunities in the region.

Objective: Estimate addressable volumes for offtakers by segment and infrastructure needs

TASK 2

- Prepare demand mapping dataset of potential off takers
- Interviews of potential Offtakers
- Estimating potential hydrogen volumes (e.g. tonnes/day) for the segments
- Infrastructure needs assessment

Objective: Conclusions and identify next steps

TASK 3

- Use the data and insights from the previous tasks to make recommendations
- Identify areas to cover in the policy paper

02

EXECUTIVE SUMMARY

ELEVEN HYDROGEN USE CASES IDENTIFIED IN THE REGION, EACH WITH VARYING LEVELS OF APPLICABILITY AND MATURITY

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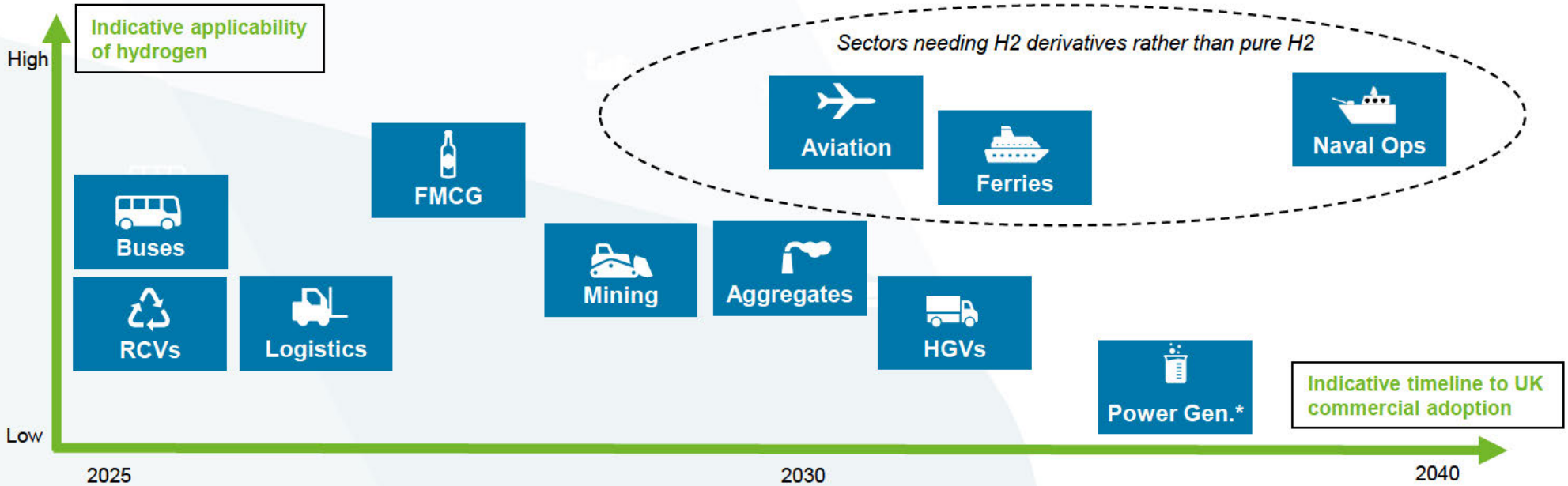
1. Segmentation, Demand Assessment Framework & Maturity

The study identified 11 use cases with applicability of hydrogen based within 100km of Langage: HGVs, Buses, RCVs, Naval Operations, Ferries, Forklifts, Mining & Quarrying, Aviation, FMCG, Aggregates, and Power Generation. There will be competition from alternative decarbonisation pathways across all the use cases (e.g. EVs for land-based mobility, biofuels for aviation) in addition to the policy/regulation incentives, lack of infrastructure and willingness to pay challenges highlighted in the report. Hydrogen use cases in Buses and Logistics are already in operation in parts of UK whereas others such as FMCG, Mining, HGVs and Aviation, are likely to mature in the late 2020s / early 2030s.

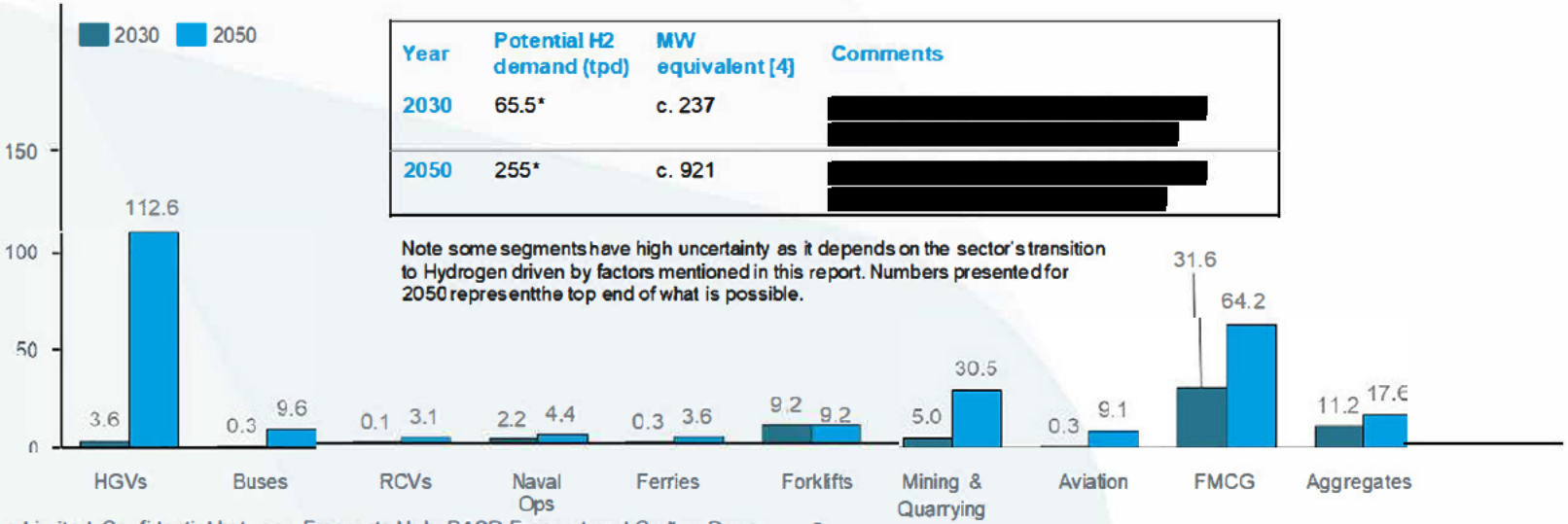


MODELLING INDICATES REGIONAL HYDROGEN DEMAND POTENTIAL OF UP TO 65TPD BY 2030, GROWING TO 255 TPD BY 2050

2. Demand Volume Modelling

By 2030, c. 65tpd (237MW) of potential regional demand could be realised, but this will be mostly dispersed geographically, led by various FMCG sites in Cornwall. [redacted]. There is currently no supportive policy/incentives in place for Hydrogen use in the power sector, with CCUS being the preferred solution the industry is moving towards as evident from the UK CCUS track 1 and 2 cluster projects.

By 2050, potential demand could grow to 255tpd (921MW). Of this, there will be c.30 offtakers large enough to consider pipeline connections – it is crucial infrastructure (connecting supply and demand hubs) is developed as production expansion and associated challenges are considered to meet the demand potential across the various end use segments.



Year	Potential H2 demand (tpd)	MW equivalent [4]	Comments
2030	65.5*	c. 237	[redacted]
2050	255*	c. 921	[redacted]

Note some segments have high uncertainty as it depends on the sector's transition to Hydrogen driven by factors mentioned in this report. Numbers presented for 2050 represent the top end of what is possible.

FMCG SECTOR IS A POTENTIAL LEADING DEMAND DRIVER, BUT THEY ARE DISPERSED GEOGRAPHICALLY IN REMOTE LOCATIONS PROVIDING DELIVERY CHALLENGES

2. Demand Volume Mapping

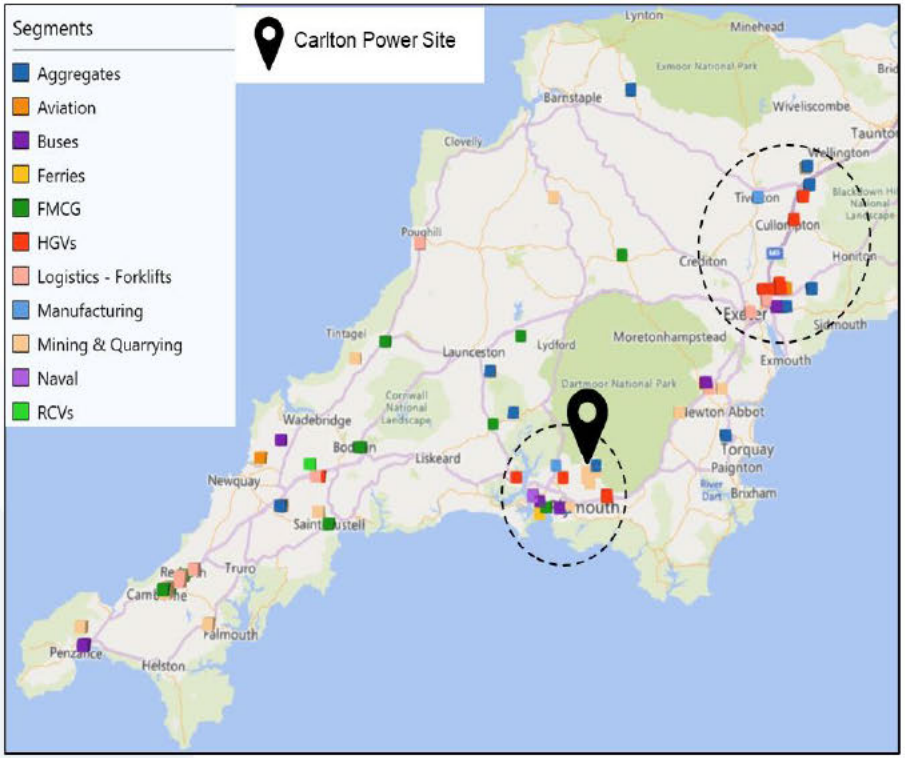
FMCG segment dominates potential demand, but they are dispersed geographically providing delivery/logistics challenges due to lack of infrastructure: The largest individual offtakers by 2030 could be [redacted] (9.7tpd), [redacted] (6.5tpd) with [redacted], [redacted] and [redacted] all needing >2tpd as well.

Beyond 2030, demand from large HGV operators depending on Hydrogen FCEV uptake for larger tonnage HGVs (e.g 44 tonnes) could come online [redacted] being the largest) who will begin to require volumes > 7tpd each, potentially requiring large private depot-based HRS, with many of these near Exeter.

Outside of FMCG and HGV segments, other potential large offtakers beyond 2030 are [redacted] (use of Hydrogen derivatives), [redacted] works– all requiring at least 5tpd in the long term as they start transitioning to greener sustainable fuels .

A full list of potential offtakers and demand is captured in Appendix II.

There are two potential demand clusters in the region: near Plymouth and Exeter, joined by the A30. These users are from the HGVs, logistics, mining and aggregates segments. Interviewees noted the importance of proximity to Hydrogen production to facilitate tube trailer deliveries due to lacking infrastructure e.g. pipelines The offtakers in clusters closest to Langage Green Hydrogen production site will be crucial ones to engage.



INFRASTRUCTURE INVESTMENTS ARE CRITICAL TO CONNECT SUPPLY WITH DEMAND AND FOR FUTURE SCALE UP : KEY INTERVENTIONS NECESSARY TO SECURE OFFTAKER COMMITMENT

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2. Key challenges faced by local stakeholders

Many offtakers are remote with infrastructure challenges

The region suffers from lack of infrastructure e.g. pipeline to service high demand centres. Grid capacity challenges exist and needs substantial improvement to support growth of green hydrogen production. Pipeline and fuel storage assets exist in proximity to Plymouth, but connections to offtakers in hinterlands is very lacking. Road infrastructure could support tube trailer deliveries along A38 towards the M5 with a view to developing potential multi-modal hub in the future serviced through refuelling stations/depots.

- Many potential offtakers are off-grid with access to little infrastructure connecting them to the wider region due to limited industry presence. High demand offtakers within FMCG [redacted]) and mining [redacted] and [redacted]) are dispersed and remote from Langage.
- Early supply will need to be mostly tube trailer based, until the business case for dedicated pipelines for an offtaker or for a cluster of offtakers (e.g. multi-modal transport hubs) can be justified based on volumes, offering attractive ROIs.

Key challenges must be overcome for offtakers to commit to long term offtake contracts

Offtakers are not averse to long term contractual commitments but need key criteria to be met i.e. cost parity with counterfactuals, continuity and scale of supply, HSE considerations for storage and handling of Hydrogen, CAPEX & OPEX government support for asset switching & infrastructure development and supportive policy incentives for demand end-users [73]

- Many interviewed stakeholders highlighted areas that must addressed allowing them to justify the business case and to commit to the 15-year offtake agreements in line with UK Government LCHA period.

ETS makes switching to hydrogen significantly more attractive

Majority of the stakeholders interviewed were of the view that the ETS makes switching to hydrogen attractive. Many of them were just under the threshold but speculate the policy could change in future. [73]

- Stakeholders were concerned any potential future changes to ETS or even minimal reductions in the limits would bring them inside ETS, changing their business model significantly.
- In that scenario, Hydrogen switching becomes significantly more attractive: Aggregate Industries specifically called out ETS as a driver to decarbonise in-scope sites. [73]

NEXT STEPS & INITIAL CONSIDERATIONS FOR POLICY PAPER

RECOMMENDED NEXT STEPS

1. **Engage with offtakers who are likely to be ready to switch to Hydrogen in the short to mid term, but with potential to expand.**
   - Before 2030, potential offtakers are limited; Carlton's 10MW green hydrogen project supply could service demand primarily in the FMCG sectors which has 3 of the biggest offtakers i.e. [redacted] and [redacted] and others including [redacted]. Demand modelling suggests there are potentially 21 offtakers locally who could take the entire 10MW output in the long-term (beyond 2030). These have been called out in this report, and a full list provided in Appendix (Section 7.2).
   - Priortise sites that are located closer to Carlton's Langage site and able to handle hydrogen tube trailer deliveries potentially replacing existing tankered liquid fuels e.g. kerosene.
   - Engage with Offtakers to better understand their existing and future infrastructure requirements to support delivery logistics

2. **Develop a high-level regional hydrogen policy paper:**
   - Develop a policy paper highlighting the challenges and opportunities including key government interventions required to facilitate Hydrogen adoption in the region and development of an ecosystem with supporting infrastructure. See details below on key points to consider.

POLICY PAPER CONSIDERATIONS

Following engagement with key stakeholders across the region, the policy paper should consider the following key points, but not limited to :

1. **Access to renewable power & feedstock utilities:** Grid capacity constraints and lack of renewable power. Aspects such water abstraction licenses and sources should also looked into.
2. **Offtaker transition incentives:** The important role of policy/regulation incentives in supporting offtaker transition should be looked into including key criteria's to be addressed to support their Hydrogen investment business cases: e.g. continuity and scale of supply, cost parity with counterfactual fuels, HSE considerations; additional government support (CAPEX & OPEX) for investment into Hydrogen infrastructure on the demand side.
3. **Lack of infrastructure:** Absence of industrial clusters and the dispersed nature of the offtakers resulting in lack of infrastructure e.g. pipelines limiting the Offtaker ability to transition to low carbon fuels at scale.