Capital Hydrogen

5th Consortium Meeting
17th September 2025

Working in partnership to deliver hydrogen for
London, the East of England and the South East

Cadent
Your Gas Network

national gas

SGN

capital H_2

Welcome and Introductions

Kelly Manders
Regional Development Manager (East and London)
Cadent

Housekeeping

Please mute microphones to limit disruption

Please turn off webcams if you are not speaking. This will improve general call quality.

Please ask questions using the chat or Q&A functionality.

This meeting will be recorded, and a newsletter summarising the content will be distributed afterwards.

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Agenda

Time	Agenda Item	Speaker
14:00- 14:10	Welcome, Introductions & New Members	Kelly Manders *Cadent* Amy Taylor *Talan*
14:10-14:25	**Breakout Session**	
14:25-14:30	Breakout Session Discussion	Kelly Manders *Cadent*
14:30-14:40	An update on the East London Hydrogen Pipeline from Cadent	Kelly Manders & Siobhan Grant *Cadent*
14:40-14:55	National Gas Blending Programme	Alan Stephen *National Gas*
14:55 -15:10	**Autoflame**	Duncan Cairnie *Autoflame*
15:10-15:25	**Rux Energy**	Marius Bosch *Rux Energy*
15:25-15:30	Closing remarks	

capital **hydrogen**

Thank you to our speakers

Kelly Manders
Regional Development Manager
(East and London)
Cadent

Siobhan Grant
Hydrogen Project Delivery Engineer
Cadent

Alan Stephen
Business Development Manager
National Gas

Duncan Cairnie
Market Solutions and Strategy Director
Autoflame Engineering

Marius Bosch
Head of Strategy & Commercial
Rux Energy

Consortium Members

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Hydrogen Demand Users

B&DENERGY
British Sugar
CONWAY
CEMEX
DP WORLD
EUROVIA UK
evolum
FORTH PORTS
ft gas control
FREEPORT EAST Felixstowe Gateway 14 Harwich
A GLOBAL FREEPORT FOR A GLOBAL BRITAIN
Heidelberg Materials
Haltermann Carless
HUTCHISON PORTS HUTCHISON LOGISTICS
InterGen
icl
H+H PARTNERS IN WALL BUILDING
IMERYS
MAG London Stansted Airport
marine2o
Limpsfield
national highways
Navigator
NHS
PORT OF LONDON AUTHORITY
PORT OF TILBURY LONDON
LON CITY AIRPORT
T·C·P ECO
RUX energy
SEEL SUMMIT ENERGY EVOLUTION
TARMAC A CRH COMPANY
TATE & LYLE SUGARS
THAMES ENTERPRISE PARK
THAMES FREEPORT GLOBAL OPPORTUNITY. SHARED FUTURE.
Dunphy
HOLCIM
AUTOFLAME
Tilda
CMB.TECH
URBANENERGY
XODUS
Wienerberger

Hydrogen Transportation Stakeholders

Cadent
national gas
SGN Your gas. Our network.

Hydrogen Production Stakeholders

HYGEN
H2TERMINALS
InterGen
Chinook Sciences
Carlton POWER
eni
PROGRESSIVE ENERGY
Fuse
FOUR ZEROS ENERGY
sse
STATERA BALANCING THE GRID
uniper
RWE

Government, Regional, Third Sector and Local Authority Stakeholders

CITY OF LONDON
Essex County Council
East of England Local Government Association
North Sea Transition Authority
Hydrogen East
IKIGAI CAPITAL
Net Zero East
NORTH NORFOLK DISTRICT COUNCIL
Supported by SURREY COUNTY COUNCIL
Jacobs
Thames Estuary
TOWER HAMLETS
Suffolk County Council
XODUS

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Welcome to our latest members

Limpsfield

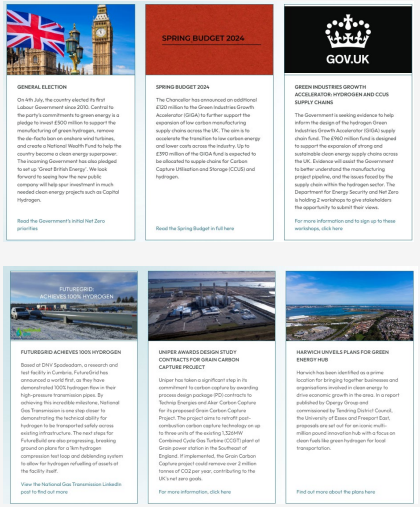
Fuse

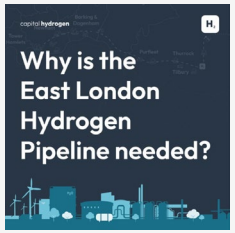
AUTOFLAME®

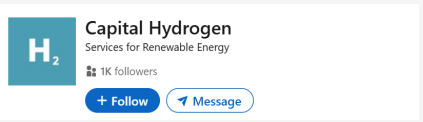
Dunphy

capital **hydrogen**

Capital Hydrogen communications update







HIGHLIGHTS FROM THE EAST LONDON HYDROGEN PIPELINE LAUNCH

On Thursday 19th June, we hosted the Capital Hydrogen East London Hydrogen Pipeline (ELHP) Launch at ExCeL London. The event saw project partners, policymakers, and ELHP stakeholders come together with a shared mission of accelerating East London's transition to a hydrogen-powered future.

REACHING NET ZERO: THE ROLE OF HYDROGEN

Hydrogen is increasingly being brought to the table as a serious contender for decarbonisation. This was especially apparent at this year's Futurebuild conference, where hydrogen's potential consistently featured in key discussions surrounding decarbonisation.

Growing Member Base

News
Please continue to share your news and updates with us.

LinkedIn page
1,155 followers
11,825 total impressions
Please follow and engage

Content
Brochures, blogs, case studies

capital H₂

Breakout Session

Prompt Questions

Small group discussion for 15 minutes

Suggested conversation prompts

1) What opportunities does hydrogen present for your company?

2) How can the Capital Hydrogen programme best support you to achieve these?

Discussion

East London Hydrogen Pipeline: Project Summary

Siobhan Grant
Hydrogen Project Delivery Engineer
Cadent

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Major Project Lifecycle

Initiation / Feasibility

The initial set-up of the project; development of the Solution Concept; and feasibility assessment.

Pre-FEED

Preliminary Front End Engineering Design

The appraisal of the Solution Options and the selection of the concept.

FEED

Front End Engineering Design

The project definition is developed through further engineering processes to inform key decisions such as routing.

Detailed Design

FEED focuses on developing the concept to a preliminary design, this Stage focusses on the detail.

Construction and Commissioning

This stage encompasses all physical construction and commissioning works.

Operation

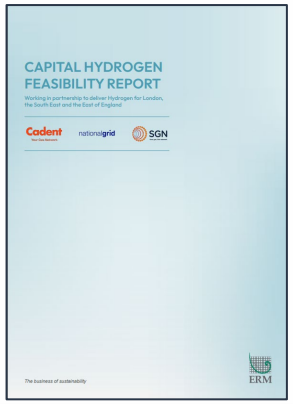
The Operations team will take ownership of operating and maintaining the asset.

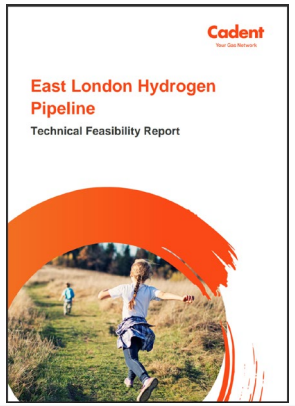
2022 — Capital Hydrogen Feasibility Report published

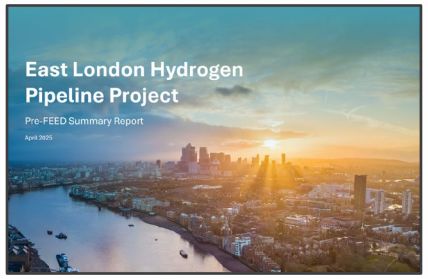
2023 — Technical Feasibility completed

2023 — Customer and Producer Data collected

2025 — Pre-FEED completed







Pre-FEED Scope

What

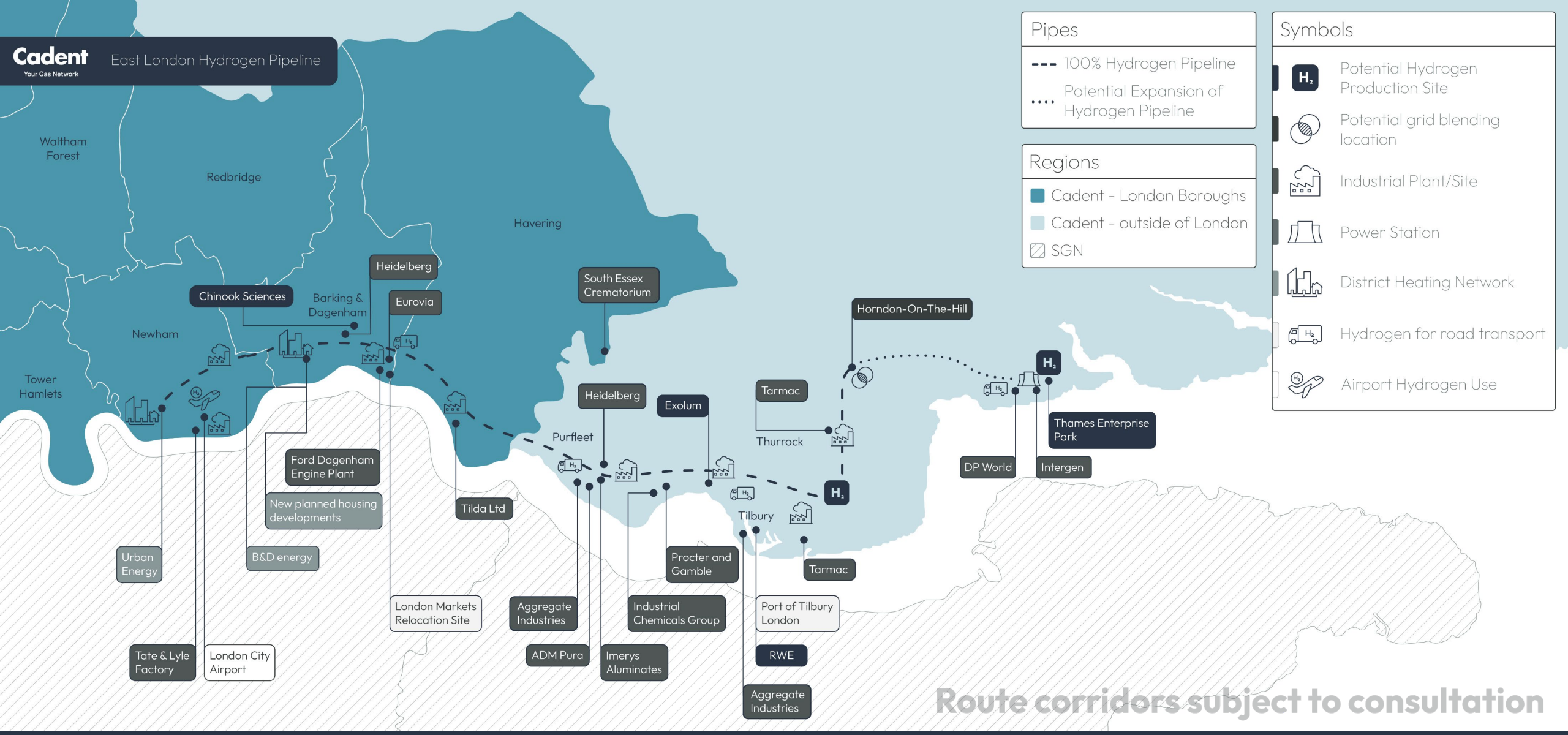
Design a pipeline to supply Hydrogen to industrial, power generation, transport and heat network customers within the Cadent North London network who require a supply

Who

Cadent – Your Gas Network
Jacobs
apollo
united living – infrastructure services
ERM

How

- Flow Assurance
- Routing Methodology
- Constructability
- Environmental Strategy
- Corrosion Control
- Carbon Abatement
- Hazard and Risk
- Materials
- Process and Operations
- Consenting Strategy
- Value Propositions
- Reuse Opportunities
- Procurement



948 GWh

342 GWh

180 GWh

1828 GWh

2668 GWh

1158 GWh

Route Optioneering and Selection

Define Route Options	Develop Evaluation Method	Scoring and Initial Route Shortlist	Technical Review	Route Refinement and Selection
Define & produce metrics for comparison	Agree evaluation criteria and weighting, methodology and boundaries	Score metrics against weighted criteria	Flow Assurance Vantage Surveys Constructability Review HAZID Reviews	Refine the options and produce recommendation

Cadent
Your Gas Network
capital H_2

Technical Review

- Define Route Options
- Develop Evaluation Method
- Scoring and Initial Route Shortlist
- **Technical Review**
- Route Refinement and Selection

UP TO 75KM OF PIPELINE

OPTION FOR ASSET REUSE

DIAMETER OF PIPE

2-7 BAR OPERATING PRESSURE

18 CONSUMERS 20 SITES

3 PRODUCERS

DEMAND: 5966 GWh BY 2035+

SUPPLY: 1158 GWh BY 2035+

CARBON SAVINGS

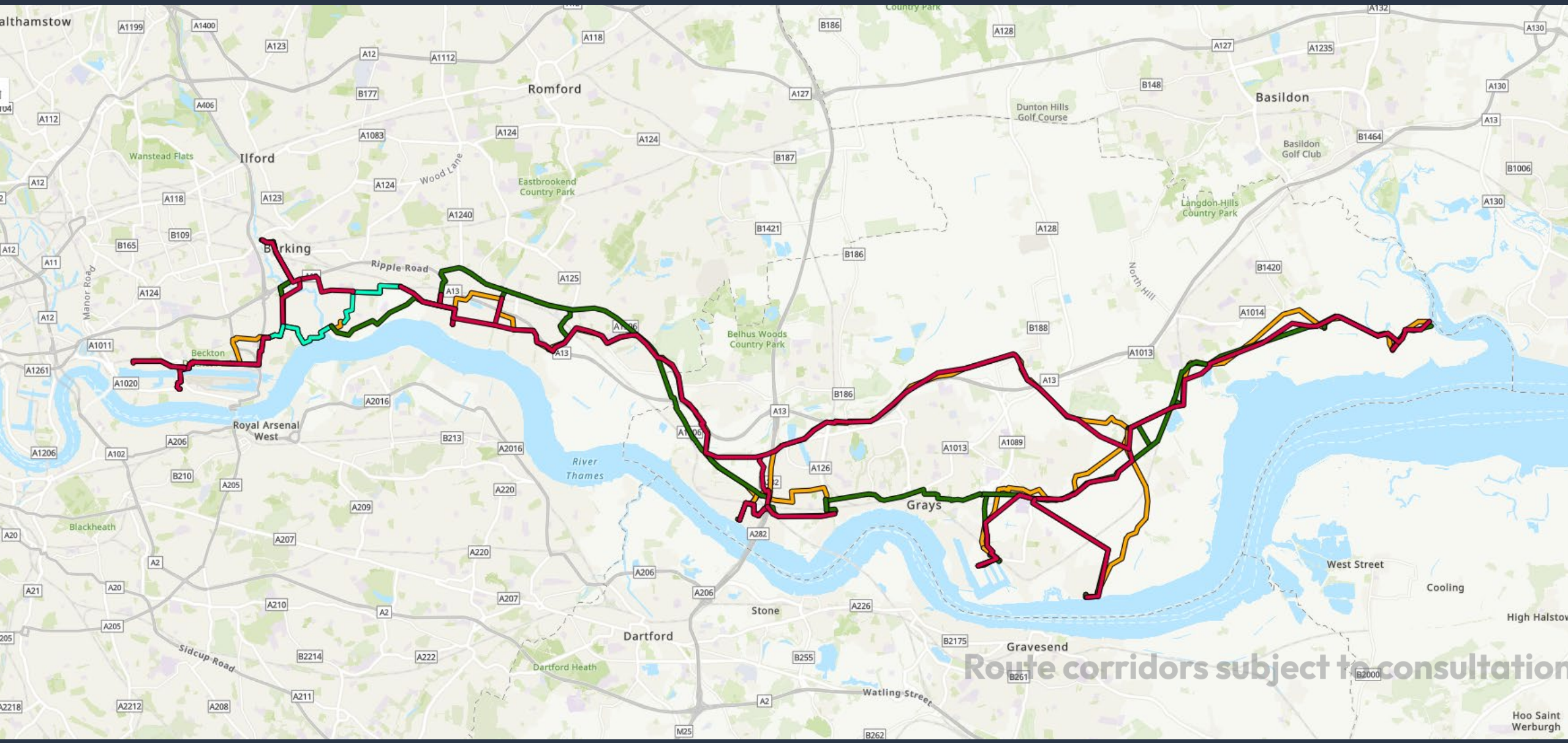
Carbon emissions equivalent to...

9,449
one-way flights from London to New York per year

which is also equivalent to approximately

49.5 million
trees worth of carbon absorption per year

Route Options



Outcomes of the Pre-FEED

- A strong design foundation produced for the entire project lifecycle
- Project design informed by key technical, environmental, consenting and constructability constraints
- 11 routes generated initially and shortlisted to 3 refined options
- Option for asset reuse
- Phasing strategy developed to enable connection and supply to customers between 2032-2035
- Consenting strategy developed
- Requirements and objectives of the next stage of the project (FEED) identified

- **Confirmation that ELHP can successfully transport hydrogen from 3 producers to 20 industrial customers with no connection to large scale storage**

- **Flow assurance analysis has validated that a 7 barg, 500mm diameter, PE network is suitable for a fully developed ELHP distribution system**

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***2026-29** — FEED

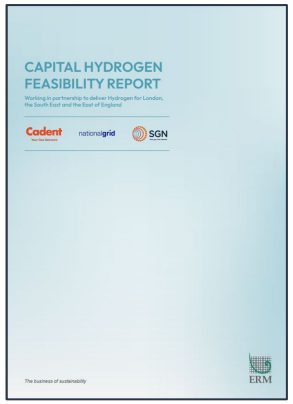
***2030** — Consents and Delivery Planning

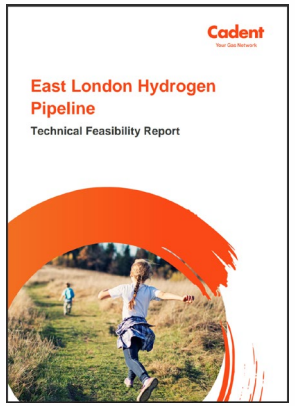
***2031-32** — ELHP Detailed Design

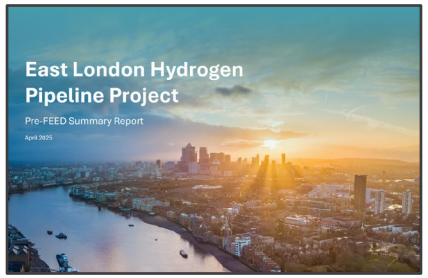
***2032** — Construction and Commissioning begins

***2035** — Construction and Commissioning complete

***2035+** — Operation and Maintenance







- Completion of Pre-FEED Cost Benefit Analysis (CBA)
- Engagement with DESNZ
- HTBM update early next year
- Competition late next year

**Future stage commencement dates tbc*

National Gas Blending Programme

Alan Stephen
Business Development Manager
National Gas

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Hydrogen blending into the GB gas transmission network

Blending a Primer

What is a Hydrogen Blend?

Through hydrogen blending producers can **inject hydrogen** into the NTS to a **set percentage**. This enables operation at **optimum levels** depending on local hydrogen demand. It **diversifies** the demand base and **de-risks** projects in the early stages of their production.

Proposals to Blend Hydrogen

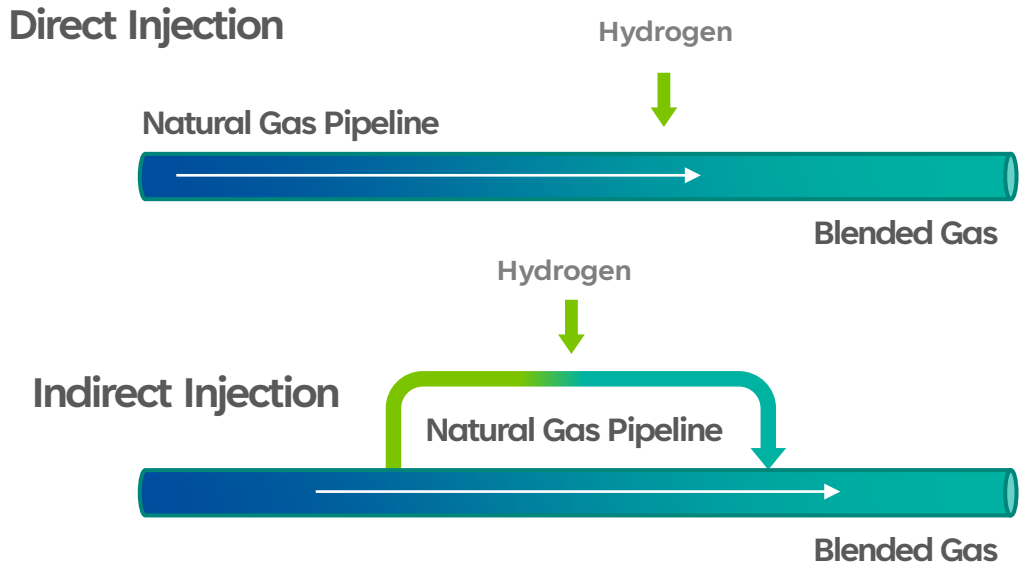
2 main blending methods that are dependant on scale of Hydrogen production, and connection location etc.

Direct Injection

- Injects Hydrogen into pipeline using a branch connection. Blending of gasses then happens within the pipeline.

Indirect Injection

- Draws gas from the NTS and blending with Hydrogen via a separate blending loop. The homogenously blended gas is re-injected the network.



National Gas – Key player in Hydrogen Transport Infrastructure

Blend and grow hydrogen economy

Project Union

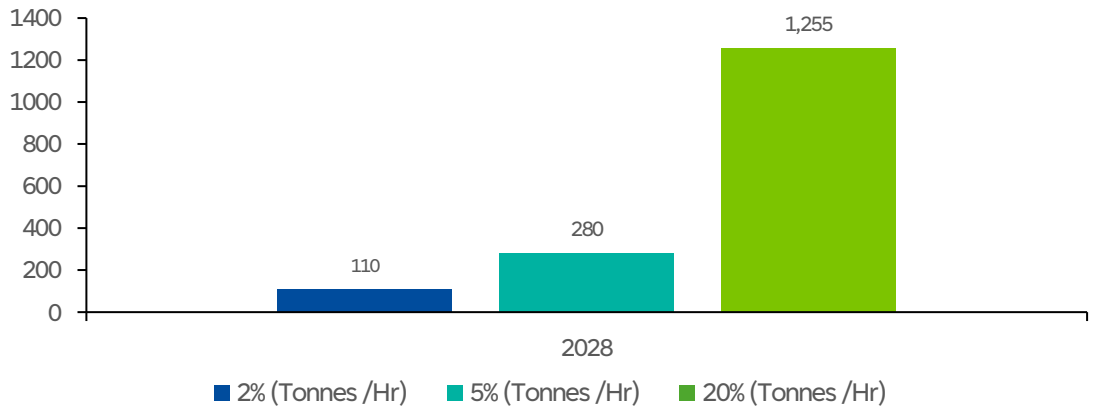
Deliver on UK's decarbonisation goals by **2050**

Hydrogen Blending

Enabling Hydrogen Blending on the NTS is crucial to building a Hydrogen market

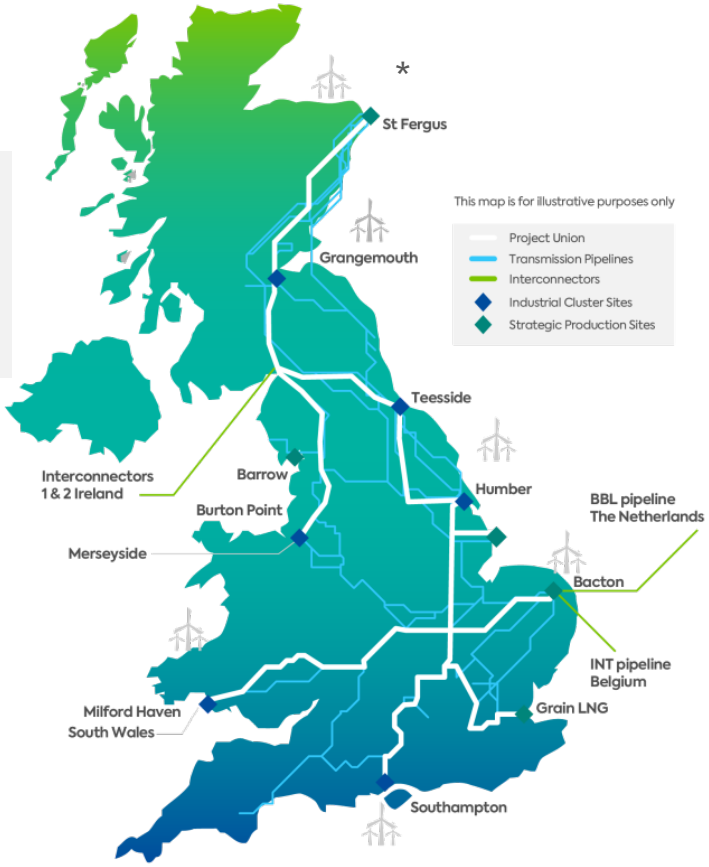
Through blending, Hydrogen producers can access a wider demand market and de-risk projects

Blend Volumes available in 2028
Tonnes/Hr



ProjectUnion

National Gas plans to repurpose NTS assets and build a GB central hydrogen backbone



* For illustration

DESNZ Consultation

Hydrogen blending into the GB gas transmission network

DESNZ Consultation

Questions

Q1a. Do you agree with the assessment of the impacts of blending up to 2%, 5% and 20% hydrogen by volume on NTS connected end users? Please provide evidence to support your response.

Q1b. Are there any further operational and/or financial impacts on end users we should consider? Please provide evidence to support your response

Q2. Do you agree that if transmission blending is enabled and intended to be commercially supported by government, the most appropriate mechanism would be via the Hydrogen Production Business Model? Please provide evidence to support your response.

Q3. Do you agree with our minded to position, if blending were enabled, to allow both the gas transmission network operator and gas shippers to purchase hydrogen produced for blending? Please provide evidence to support your response.

Q4. Do you agree that working within the current gas billing arrangements will not result in an increase in billable usage and gas bills for end users connected to the NTS, should transmission level blending be enabled by government? Please provide evidence to support your response.

Q5a. Do you agree with our minded to position, if blending were enabled, to consider further whether to support and enable transmission blending of up to 2% hydrogen by volume? Please provide evidence to support your response

Q5b. Do you have any further concerns on enabling blending up to 2% hydrogen by volume into the NTS? Please provide evidence to support your response.

Q5c. Is there a maximum level of blend that would be feasible with minimum modifications for sites connected to the NTS? Please provide evidence to support your response.

Q6a. We welcome feedback on the economic assessment presented and any further analysis on the costs and benefits of transmission blending

Q6b. Please provide any additional information on the costs of any required modifications or mitigations required for NTS connected sites to be able to accommodate a blend of up to 2% hydrogen by volume. If you do not currently have this information, how long do you expect it take to assess what mitigations might be needed and what the costs of these could be?

Consultation Details

Department for Energy Security & Net Zero

Hydrogen blending into the GB gas transmission network

Published 23 July 2025
Closes 11:59pm on 16 September 2025

How to respond
Respond online or
email hydrogentransportandstorage@energysecurity.gov.uk

Summary Technical ask: End-User acceptability and modifications required at different blend percentages? (2, 5, 20%)

Summary Commercial ask: What are the costs involved for end users and the market? How much does it de-risk Hydrogen producers?

National Gas Response

Key Response

National Gas is calling for **DESNZ to take a strategic policy decision of up to 5% blend** on the Transmission system. We believe that **5% maximises de-risking for Hydrogen producers** while still managing impacts for end-users. Our current understanding is that **modifications required for 2% and 5% will be broadly similar,** however **further work is required**. A strategic policy decision is required to enable a thorough investigation into <5% blend.

End-User Acceptability

- National Gas response looks at blend acceptability at the following archetypes:

  Power Stations
  Storage sites
  Industrial sites
  Interconnectors

- We believe that modifications required for **2% and 5% will be broadly similar** but accept further work will be needed. We have suggested routes to funding this work.

- In order to remain in line with current EU policies, we are investigating our approach to **managing blends at interconnectors**

De-Risking Producers

- National Gas agrees that blending at 5% will enable hydrogen producers to **fully de-risk projects** and allow them to access lower cost debt to fund their projects

- This in in turn will enable them to **reach FID earlier** and **decrease** their hydrogen **strike price**

- Overall subsidy requirements will be lower, and the resulting savings should be redeployed to end-users for any required modifications

Commercial Frameworks

- National Gas agrees that blending **should be managed through the HPBM.** This should include considerations to ensure direct offtake of hydrogen is incentivised over blending.

- National Gas agrees that current billing arrangements should be sufficient. Shippers and networks should be allowed to buy blends, although highlights that a certification scheme should be enabled to unlock additional value of blends and decarbonise key end-users

- Enabling blend connections will need **improved strategic thinking** to maximise the utility of blending for the whole system. It will optimise production while mitigating impacts to end-users.

For more information or further conversations contact:

Hydrogen Blend

Alan Stephen
alan.stephen@nationalgas.com

John Stevens
john.stevens@nationalgas.com

Harriet Guiry
harriet.guiry@nationalgas.com

Update from Autoflame

Duncan Cairnie
Market Solutions and Strategy Director
Autoflame Engineering Ltd

DECARBONISATION STRATEGIES

GAS SOLUTIONS

CAPITAL HYDROGEN CONSORTIUM MEETING

WEDNESDAY 17TH SEPTEMBER 2025

DUNCAN CAIRNIE

MARKET SOLUTIONS AND STRATEGY DIRECTOR

AUTOFLAME ENGINEERING LTD

AUTOFLAME

CUSTOMER OBJECTIVES

- **Customer engagement**
  - Site analysis and identifying opportunities
  - What are the customer aims?
  - Gas efficiency expertise
  - Optimisation techniques
  - Full-service boiler room opportunities
  - Gas savings opportunities (dry side *and wet side*)
  - Global leading product lines
- **Energy Performance Calculator**
  - Savings / CO_2 reduction calculations
  - Engineering and drawing works
  - Installation and commissioning
  - Project and contractor management
  - Measurement & Verification (M&V)
  - Government grants and rebates (when applicable)
  - Maintenance testing and 24/7 service support
- **Future-proof investment with H_2 approved equipment**

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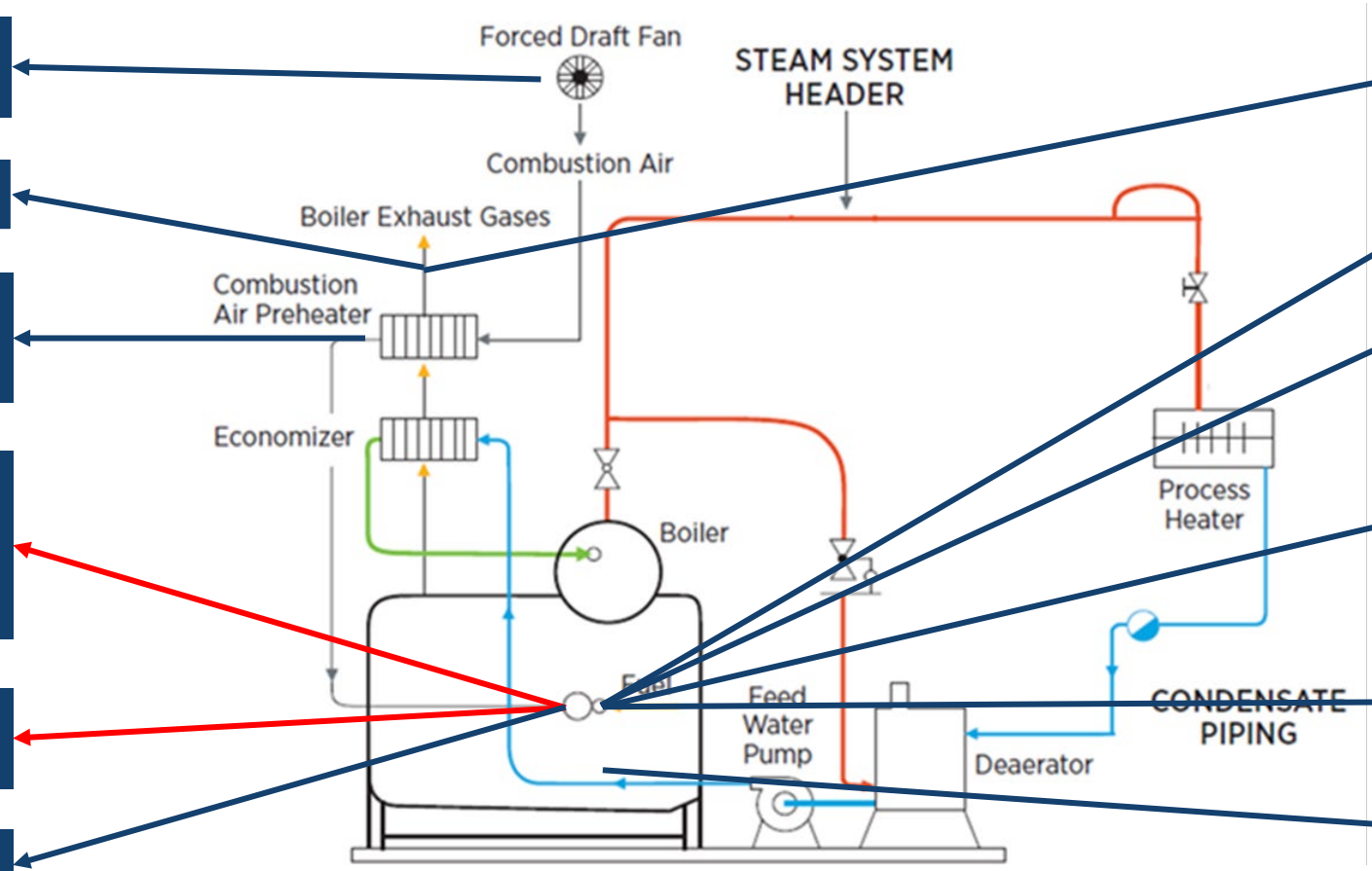
GAS SAVINGS – DRY SIDE



Variable Speed Drive
10 – 40% (kWh)

Draft Control
0.5 – 1.5%

Pre-heat Combustion Air
(20ºC≈1%)
1 – 8%

Automatic Combustion Management System & Electronic Control
4 – 7%

High Efficiency Burner
3 – 8%

Increase Turndown
2 – 6%

Combustion Trim
1 – 2%

UV Trim
1 – 3%

Fuel Switching
5 – 100%

Control Strategies
Setpoint Variation
Timeclock
Plant Schedule
Lead / Lag & Sequencing
Continuous Pilot
No pre-purge
Outdoor Reset

Burner De-rating
1 – 5%

Fully Metered Combustion Control
1 – 3%

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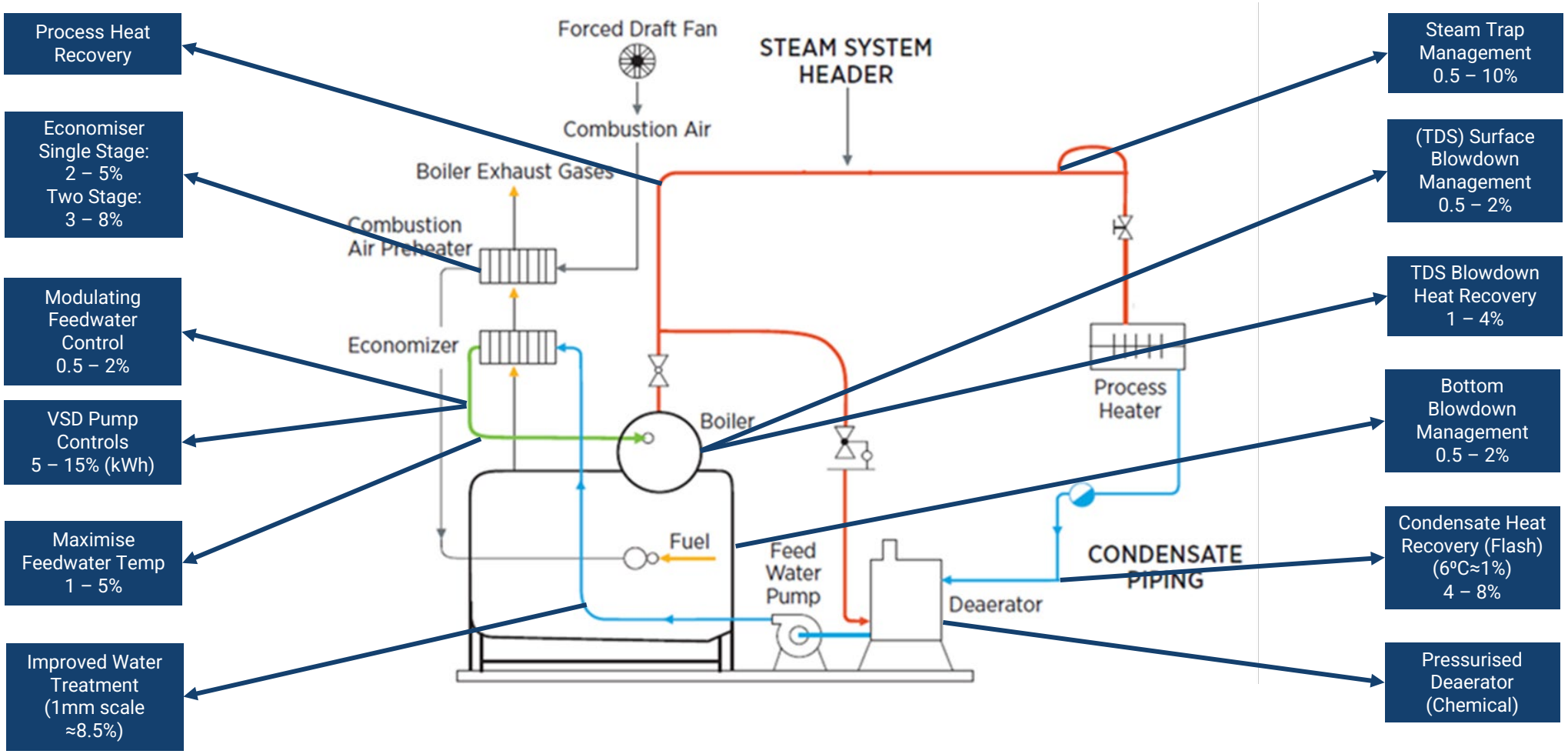
GAS SAVINGS – WET SIDE



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OPPORTUNITIES – MULTIPLE PROCESSES

Opportunity	Cost	Payback	Readiness
Plant scheduling	$	<1	A
Combustion analysis and tuning	$	<1	A
Flue gas shut off dampers	$$	<2	B
Optimized fuel / air ratio control	$$	<2	A
Burner upgrade	$$	<2	A
Variable Speed Drive (VSD) oncombustion air fan	$$	<2	A
Pipe and valve insulation / Boiler insulation	*$$*	*<2*	*A*
Combustion air pre-heat	$$$	<5	B
Condensing and non-condensing economisers	*$$$*	*<5*	*B*
Waste heat recovery	*$$$*	*<5*	*B*
Sub metering systems	$$$	<5	B
Boiler sizing and low load boiler	$$$$	<10	A

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OPPORTUNITIES – HOT WATER

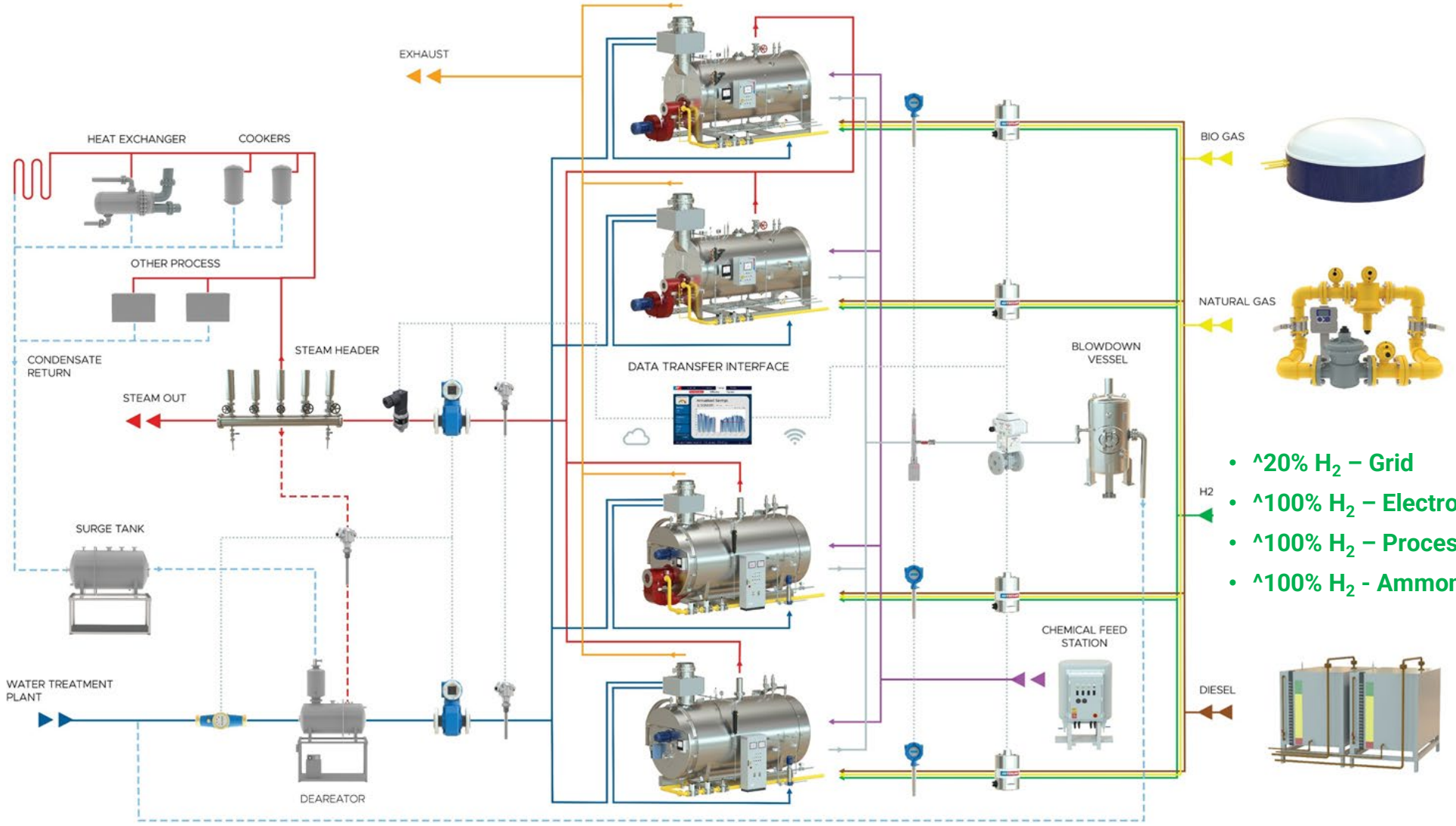
Opportunity	Cost	Payback	Readiness
Reduce hot water temperature	$	<1	A
Hot water use: efficient nozzles	*$*	*<1*	*B*
Hot water heater control	$$	<2	A
Condensing boiler (generator)	$$$$	<5	A

OPPORTUNITIES – STEAM

Opportunity	Cost	Payback	Readiness
Maximise condensate return	*$*	*<1*	*A*
Total Dissolved Solids (TDS) control of blowdown	$	<2	A
Maximise feedwater temperature	$	<2	B
Water treatment to reduce blow down losses	*$*	*<5*	*A*
Boiler sequencing and scheduling	$$	<2	A
Modulating water level control	$$	<2	A
Blowdown heat recovery	*$$*	*<5*	*B*
Failed steam traps and steam leaks	*$$*	*<2*	*A*
Flash steam recovery	*$$$*	*<2*	*B*
Steam accumulator	*$$$*	*<5*	*B*
Add / refurbish boiler refractory	*$$$*	*<5*	*A*
Pressurised de-aerator	*$$$*	*<5*	*A*
De-superheaters	*$$$*	*<5*	*B*

DATA ACQUISITION, REPORTING AND DIGITISATION

FULL BOILER HOUSE OPERATIONS



- ^20% H_2 – Grid
- ^100% H_2 – Electrolyser
- ^100% H_2 – Process
- ^100% H_2 - Ammonia

AUTOFLAME

INSTALLATION EXAMPLES

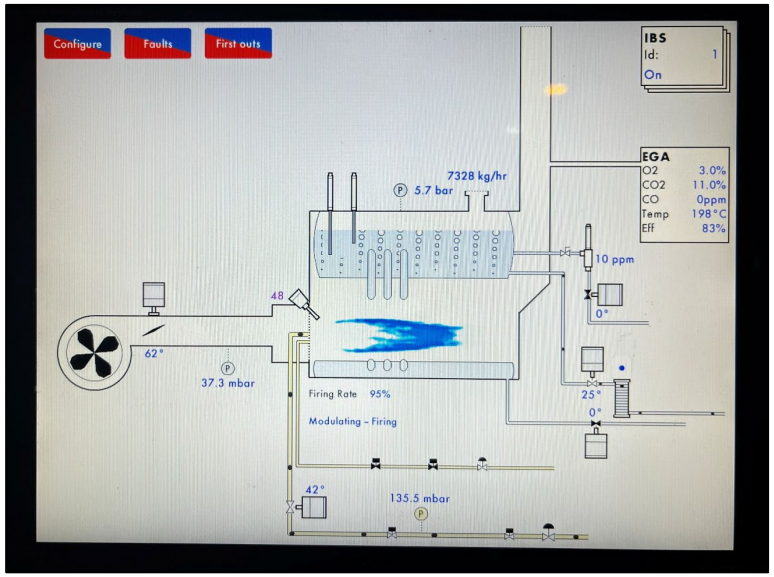
- **Brick Manufacturer –** world's first 100% Hydrogen-fired clay brick (industrial process)
- **BK Labtech – Training Facility –** all blends of natural gas / Hydrogen for testing (heating loop)
- **Decarbonising the Distillery Process –** awaiting electrolyser completion / 100% Hydrogen (steam system)

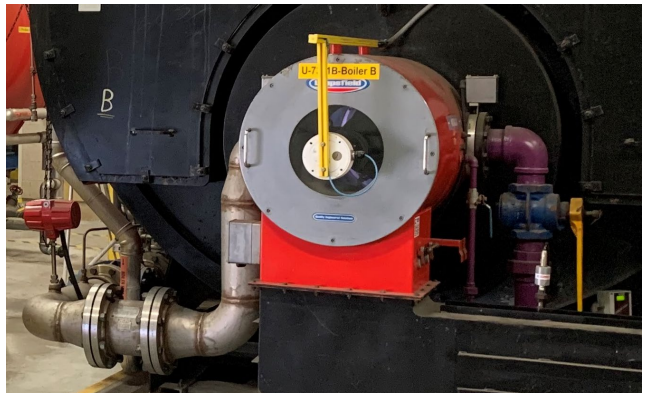
- **Large Consumer Goods Manufacturer –** up to 5% Hydrogen from small scale electrolyser blended into natural gas supply line (steam system)
- **Pharmaceutical Company –** 9.9% natural gas savings, increased to 13.3% utilizing Hydrogen from a small scale electrolser (steam system)
- **Hospital Facility –** 16% fuel savings / 100% Hydrogen approved (steam system)
- **Building Products Manufacturer –** 35.4% over 5 upgrade processes / Hydrogen ready (steam system)

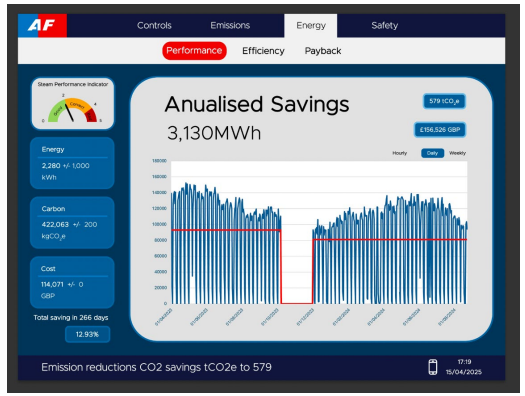
- **Football Stadium –** heating system with enhanced sequencing – 20% fuel reduction from system upgrade / further 32% fuel reduction from sequencing / 100% Hydrogen approved (heating system)
- **Wall Panel Manufacturer –** 25% fuel savings through condensing boiler, 100% Hydrogen approved burner (hot water process)

WHERE CAN WE HELP?

- **Optimization of the plant room and process**
  - Maximize boiler efficiency
  - Reduce wasted energy losses
  - Data integration and analysis
  - Improve boiler house operations
  - Process improvements
- **Minimize fuel usage**
  - Reduce fuel usage per ton of steam / product
  - Reduce GHG emissions / CO_2 emissions
- **Future proof the investment**
  - Equipment expansion (staged upgrades)
- **Limpsfield high efficiency burner**
  - Low NO_x for MCPD compliance
  - H_2 approved and ready (10% to 100%)







AUTOFLAME

Q&A

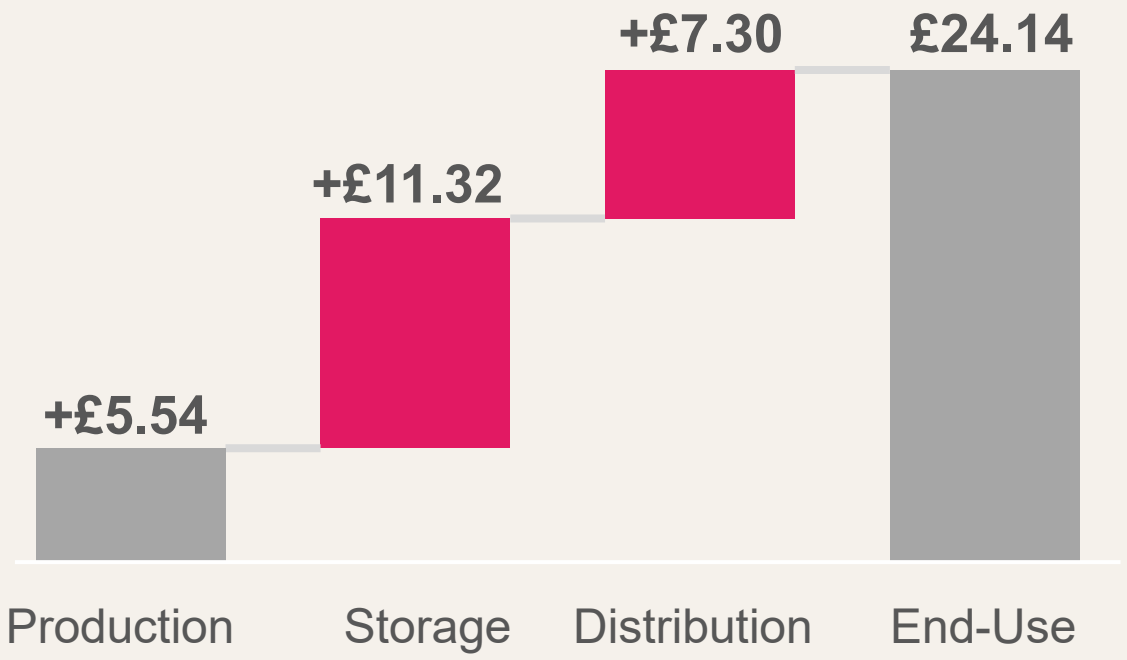
Update from Rux Energy

Marius Bosch
Head of Strategy & Commercial
Rux Energy

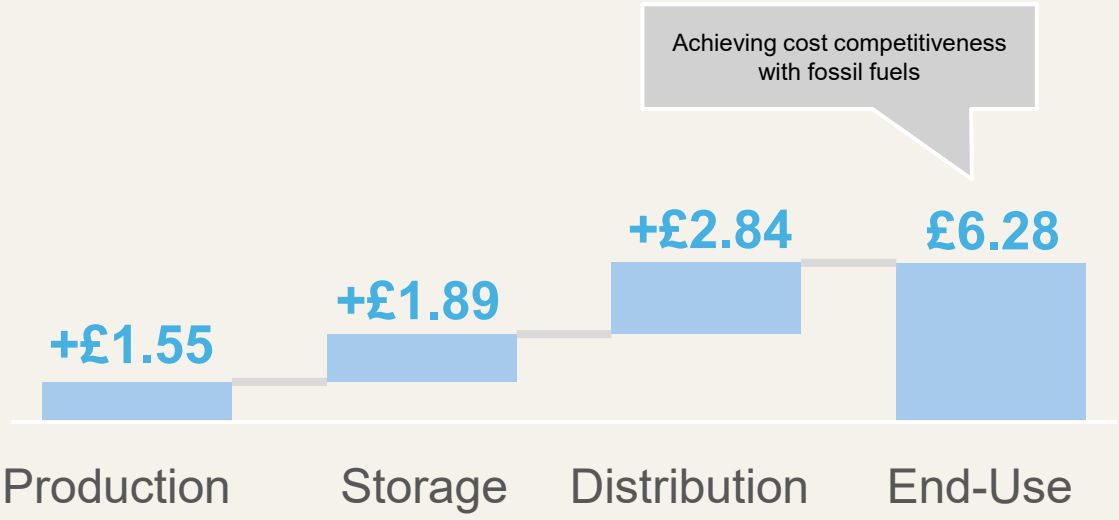
Unlocking a hydrogen future

Delivered Cost ≠ **Gate Price**

Today's Hydrogen Cost-Breakdown



This is how we can **beat diesel**



Source: Harvard University Center for Environment (October 2024)

Today’s Hydrogen storage technologies have **notorious downsides**

Physical Storage

Thermo-Pressurized

- 350 bar Compressed H2
- 700 bar Compressed H2
- 350 bar 77K Cryocompressed H2
- Liquid H2

Adsorption / Physisorption

- Rux Energy’s storage solution
  (Nano-porous materials adsorb hydrogen molecules on surface of material)

Chemical Storage

Molecules

- Ammonia
- Methanol

Chemical Carriers

- Liquid Organic H2 Carriers
- Metal Hydrides

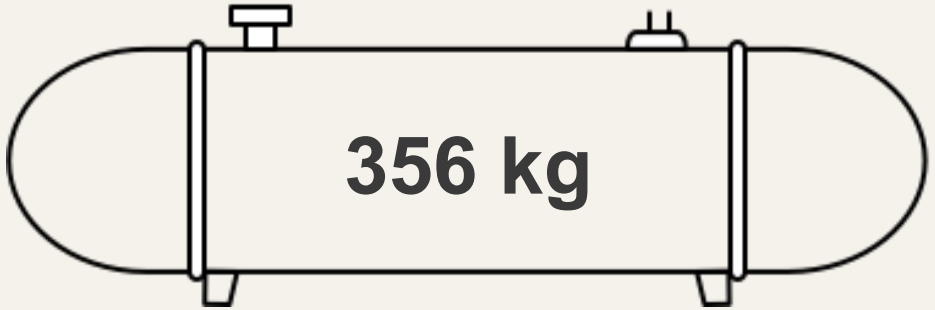
We **SOLVED** this problem

- Pathway to cost parity with diesel
- Interoperable, high-capacity packaged gas
- Breakthrough safety and efficiency

Rux HARMONY

We integrate **nano-porous materials** in ISO-certified, containerised storage systems

350bar Hydrogen tanks



Low pressure Rux-tech enabled H2 tank

World's FOAK Prototype delivered in Dec24

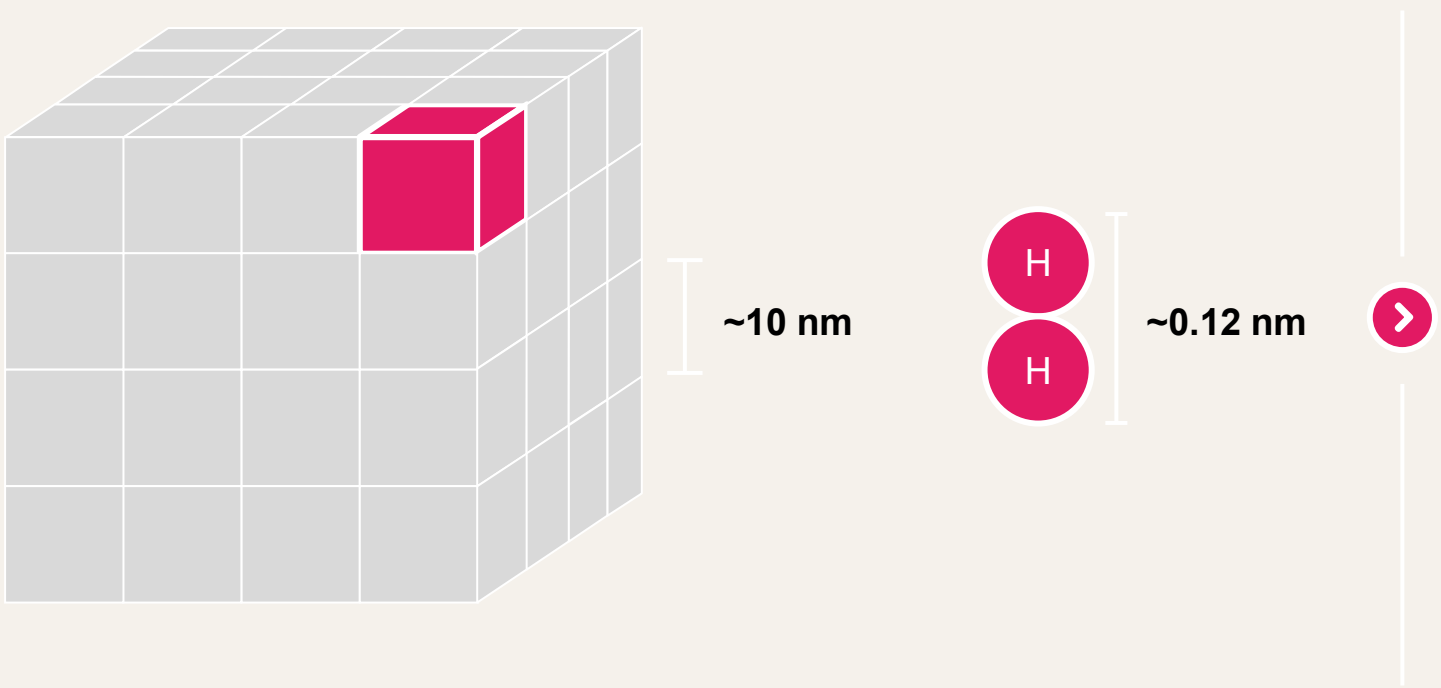
285% uplift

Patented nano-porous materials integrated in next-generation tanks

Exemplary Rux storage system operating at LNG-like temperatures and low pressures (~20ft container volume)

Our patented materials act like a **molecular sponge** for hydrogen

H_2 always remains gaseous, seamless adsorption, no energy required



Rux Metal-Organic Framework (MOF)

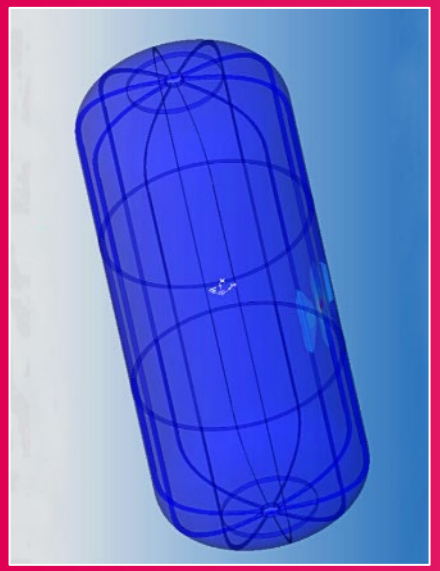
Gaseous Hydrogen molecule (H_2)

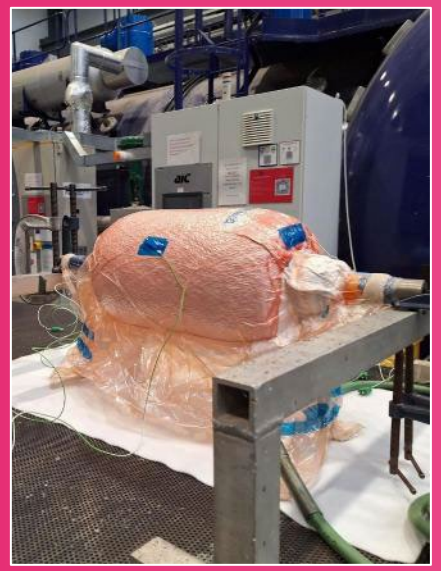
Standard H_2 storage tank

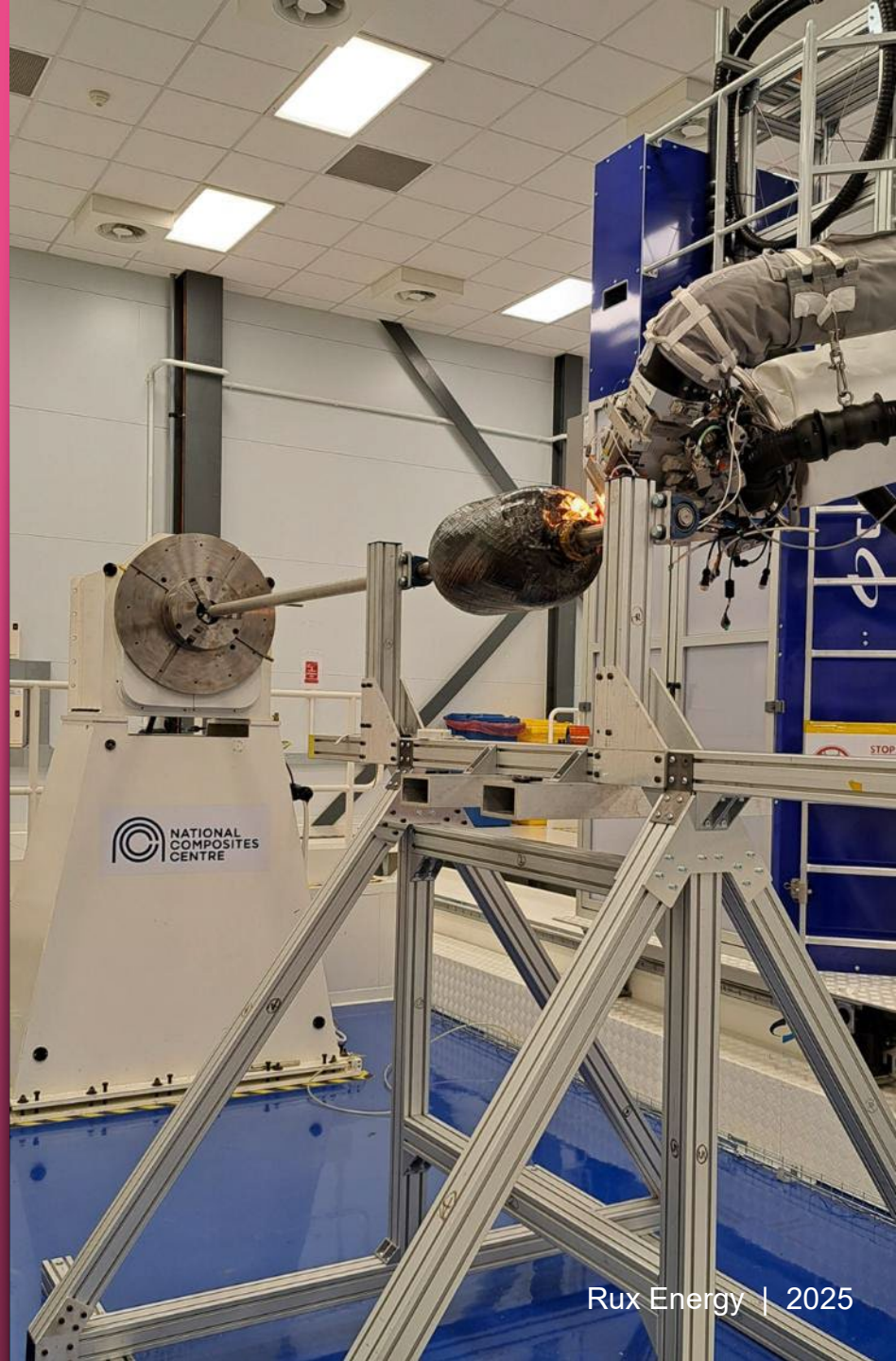
MOF-enabled storage system

Innovation in cryo-compressed composite storage tanks

- World’s first-of-a-kind nanoporous materials-enabled carbon composite storage tank delivered in late 2024
- Developed in collaboration with the National Composites Centre (NCC) UK

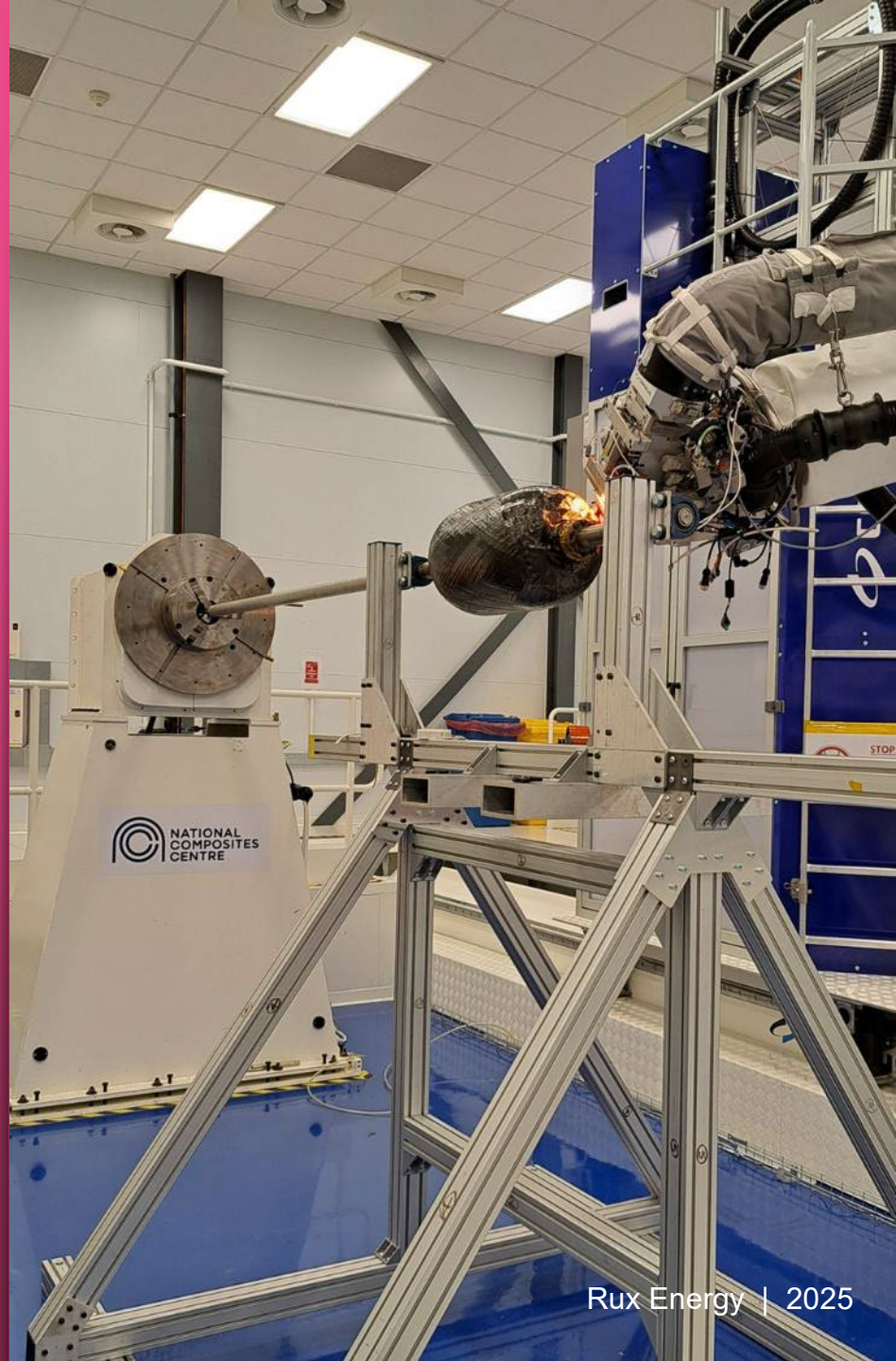






Successful Proof-of-Concept testing & validation

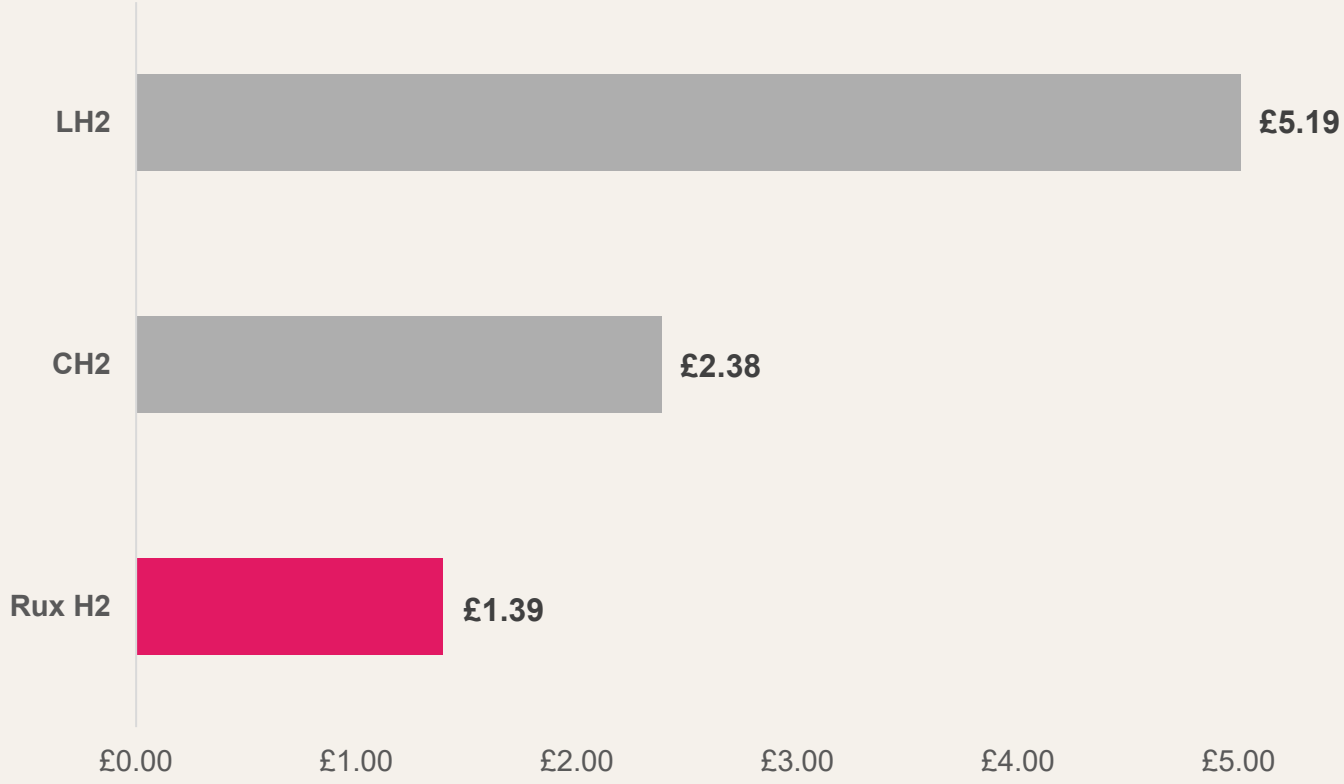
- Prototype validates Rux's storage technology, delivering 3x the capacity of 350bar (Type III/IV) hydrogen storage tanks
- Prototype filled with ~25kg of nanoporous material from Rux's experimental manufacturing facility in Sydney
- Results confirmed strong alignment with uptake modelling



Rux's **FOAK systems** cut H2 storage & distribution costs by **40–70%**

Levelised Cost of Hydrogen Delivery (LCOHD) (£/kg)

based on exemplary 1tpd H2 demand across 20 years project



Low-cost H2 for e-Methanol production: **US$600/tonne-eMeOH within reach**

Geologic Hydrogen Project via Rail – North America

- Annual demand target: **100,000 tonnes** of stimulated H_2
- No pipeline → dedicated rail line, 2 trips/day, 270 t/day
- Offtake**: e-Methanol production** (~120km through existing rail corridor)
- Total cost: **US$1.75/kg H2 delivered** (LCOH: ~US$1/kg H_2+ Rux logistics: US$0.75/kg H_2)

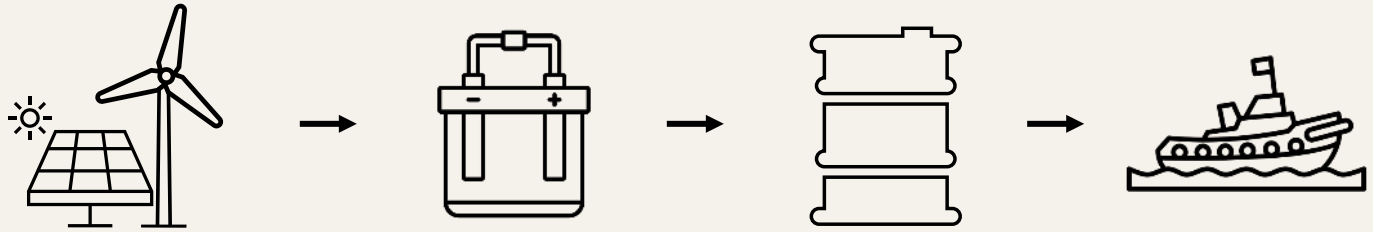
Why this matters?

Intra-regional bulk H_2 transport via rail is already feasible

Low-cost H_2 = Low-cost e-fuels

Industrial-scale use cases stimulate H2-derivatives demand

Domestic Renewables Powering Cost-Efficient Workboat Operations – **Outperforming Fossil Fuels Under Carbon Pricing**

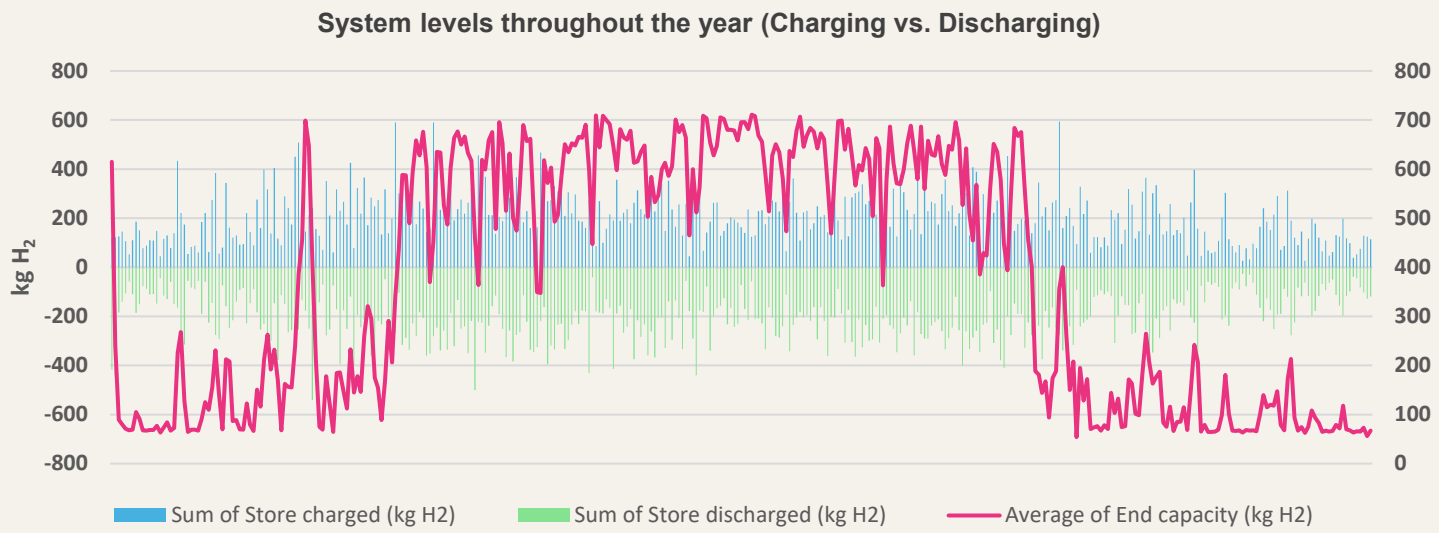


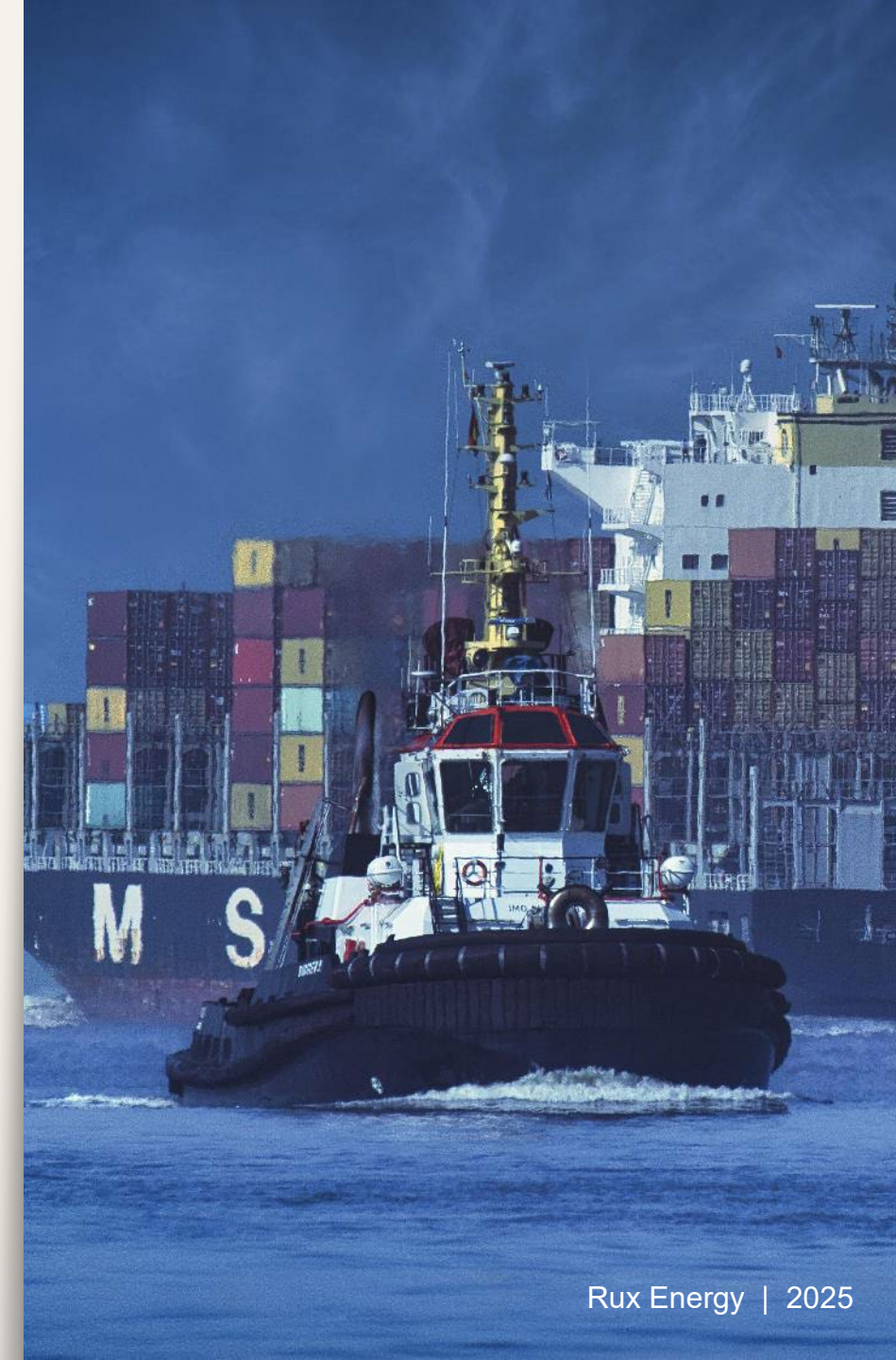
Electricity Production
(RE/Grid-connected)

Hydrogen Production
(e.g. Electrolyser)

Storage & Distribution
Rux systems

Deployment H2 ICE
or dual Fuel ICE



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Any Questions?

Thank you for joining!

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