Energy for generations

ESB | Hydrogen Ireland Webinar

Hydrogen in the power sector

26/08/2026

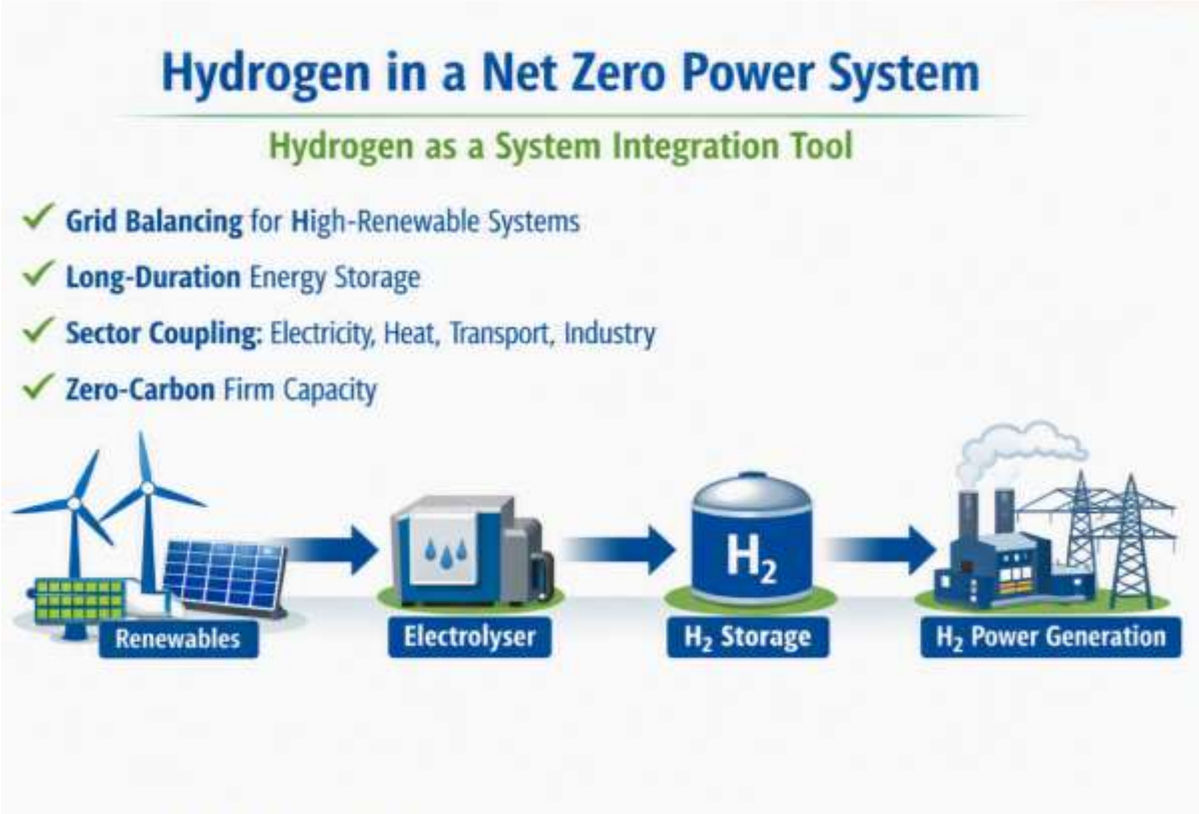
Hydrogen Ireland

Agenda

Time	Title	Speaker
11:00	Welcome	Philip Connolly
11:05	Setting the scene	Billy Kelleher MEP
11:15	The need for hydrogen in a net zero power system	Catherine Joyce O’Caollai
11:30	Hydrogen Storage options	Paul Cullen
11:50	Hydrogen Power Units trial at the Defence Forces	Paul Finnegan (Defence Forces) Enda Mitchell
12:20	From first H_2 molecules to system scale	Meadhbh Connolly
12:35	Carrington CCGT H_2 project	Catherine McHale
12:50	Q&A	All

Introduction from Billy Kelleher MEP

Introduction from Billy Kelleher MEP



Acts as a **grid-balancing asset** for high-renewable systems

Provides **long-duration energy storage** beyond batteries

Enables **sector coupling** across electricity, heat, transport, and industry

Strengthens resilience by supplying **zero-carbon firm capacity**

Creating Markets That Reward Flexibility & Zero-Carbon Firm Power

Markets must value **inertia, ramping, and long-duration storage**

Clear pathways for **hydrogen-ready generation** (CCGT conversion, peaking units)

For a clean, secure energy future

Ireland's pathway to a net zero energy system by 2050

Business Units & Brands

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Regulated Networks

ESB owns the electricity transmission networks and owns and operates the distribution networks in Ireland (ESB Networks) & Northern Ireland (NIE Networks).

Role: Enabling the connection of renewables to support national climate action plans and building infrastructure for all customers to enable the electrification of society

Generation & Trading

ESB operates competitive generation & trading businesses in Ireland's Single Electricity Market and in Great Britain

Role: Strategic focus on decarbonising electricity generation and supporting energy security

Partnering with leading energy companies to deliver projects of scale

Customer Solutions

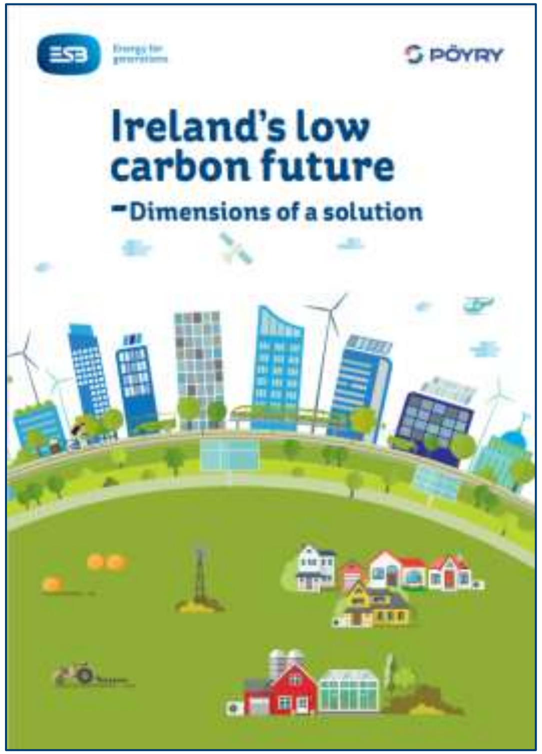
ESB Customer Solutions retails electricity and provides innovative products and services to support customers to achieve Net Zero

SIRO (a JV with Vodafone) is rolling out superfast broadband infrastructure to Irish towns and cities

NETWORKS · Northern Ireland Electricity Networks

Energy for generations · FuturEnergy Ireland

SO ENERGY · electric Ireland · electric Ireland Superhomes · ecars · SIRO · INTERNATIONAL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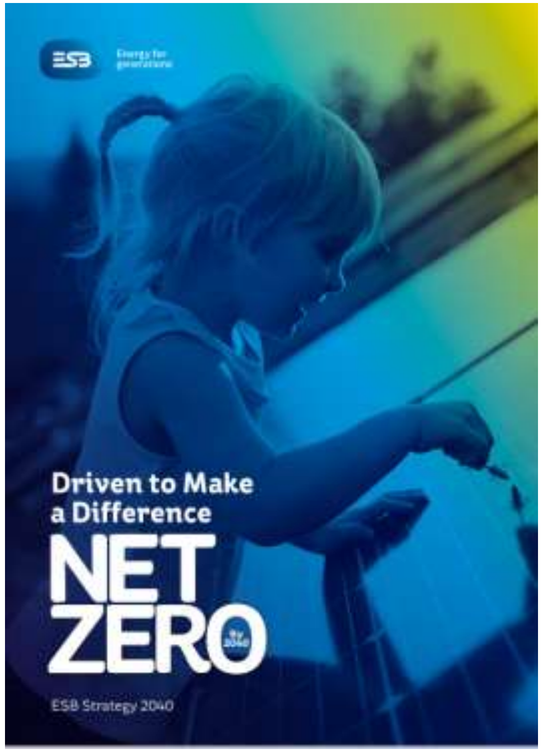
PÖYRY
Ireland's low carbon future
–Dimensions of a solution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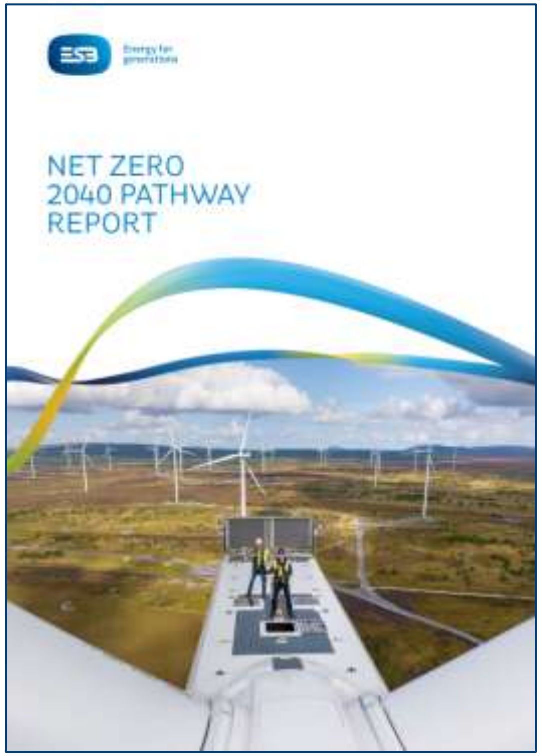
Driven to Make a Difference
NET ZERO
by 2040
ESB Strategy 2040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NET ZERO
2040 PATHWAY
REPORT


MOODY'S
RATINGS
ASSESSMENT
ESB
Net Zero Assessment - ESB assigned an NZ-3 score
Summary
NZ-3

Ireland's energy system in 2050: At a glance

Ireland's energy system encompasses all the infrastructure, processes and technologies involved in producing, delivering and consuming energy across the country. Our vision for the future energy system focuses on six interrelated areas:

- Whole energy system
- Industry
- Electricity system
- Transport
- Flexibility, resilience and security of supply
- Heating

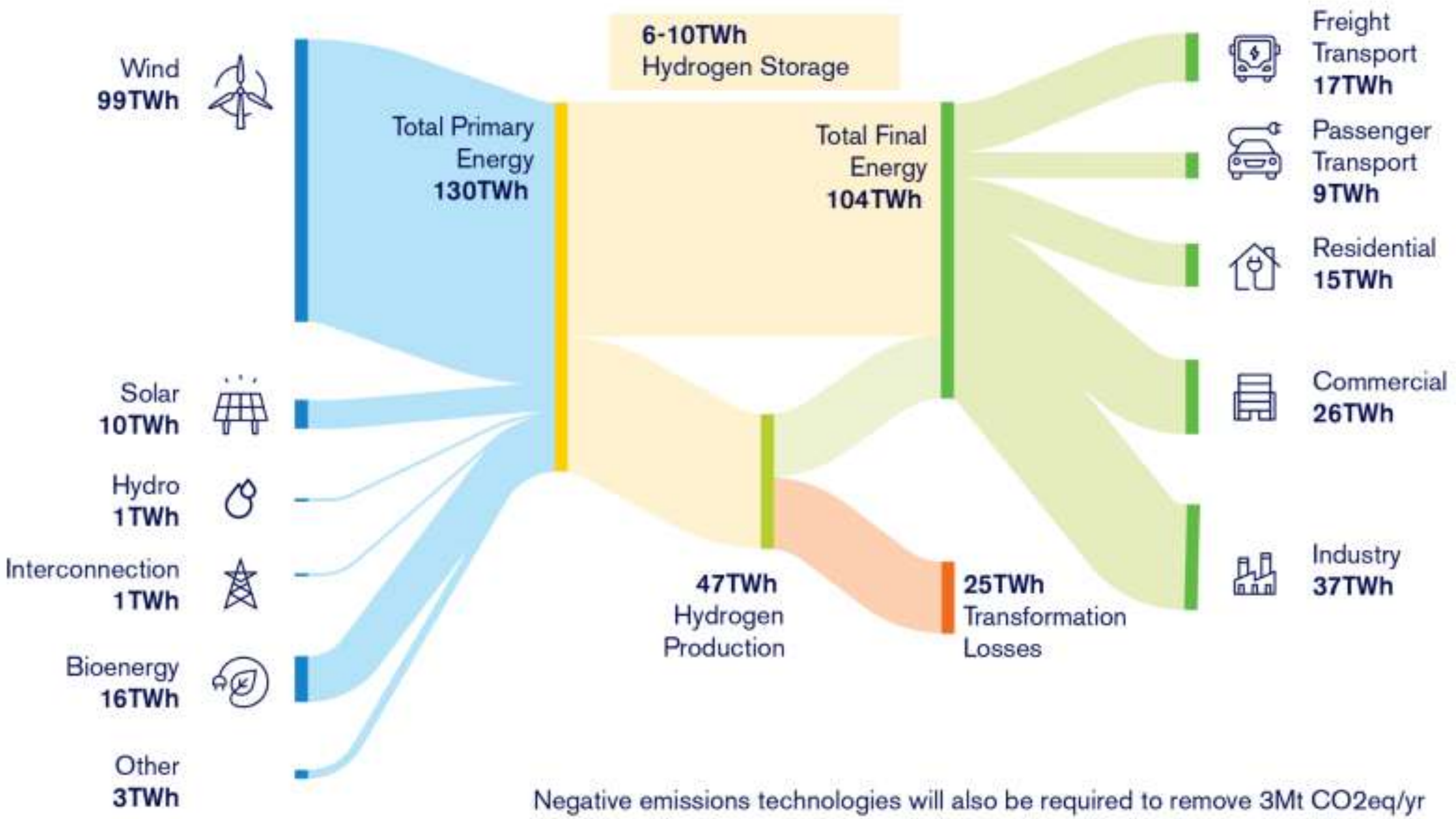
Whole energy system

What will Ireland's energy system look like in 2050?

~2.5x
increase in electricity demand in 2050 compared to 2019

>70%
proportion of final energy demand met by electricity

~80%
proportion of transport, residential and commercial energy demand met by electricity



Negative emissions technologies will also be required to remove 3Mt CO2eq/yr in 2050, arising from process emissions and fossil fuel emissions in niche applications, due in part to timing of investment decisions in the UCC model.

MaREI modelling was completed using the TIM Model. Hydrogen storage modelling was completed by ESB and complimented by MaREI modelling.

Whole energy system: Carbon removal options

Even with significant renewable power, energy efficiency and electrification by 2050, Ireland will still have some residual greenhouse gas emissions from its energy system in niche areas where fossil-fuel use cannot be avoided, and in process emissions from cement production and emissions from waste.

Bioenergy carbon capture and storage (BECCS)

Direct air carbon capture (DACC)

Nature-based solutions

Electricity system: Backup generation and storage

With renewables as the main power source, backup solutions are essential for times of low wind and solar output. Several net-zero compatible backup options are possible:

Zero-/low-carbon fuelled dispatchable generation

Open or combined-cycle gas turbines powered by low- or zero-carbon fuel

Large-scale interconnection

Large capacities are envisaged, however, periods of low wind in Ireland may coincide with similar weather across interconnected regions in Northern Europe. Local dispatchable capacity needed.

Large-scale electricity storage

Technologies are emerging for longer-term battery storage (4 hours plus), but unlikely to be feasible at volumes needed to store 10 plus days of electricity demand

Natural gas/coal/biomass with carbon capture and storage (CCS)

Nuclear electricity

Zero-/low-carbon dispatchable generation will be particularly important for a net zero system in Ireland, along with interconnection and storage.

Electricity system:
Net zero versus near zero

The core net zero model

- **9 GW** Onshore wind
- **11 GW** Hydrogen gas turbines
- **17 GW** Offshore wind
- **10 GW** Solar
- **3 GW** Interconnection
- **2.7 GW** Batteries (12-hour)

Alternative scenarios

Base case with no hydrogen **1.4Mt**

1. Extra battery storage (5GW of 24h) **0.9Mt**
2. Extra interconnection (5GW) **1.3Mt**
3. 1GW zero-carbon peakers (1,000h per annum) **1.4Mt**
4. Combination of (1), (2) and (3) **1.0Mt**

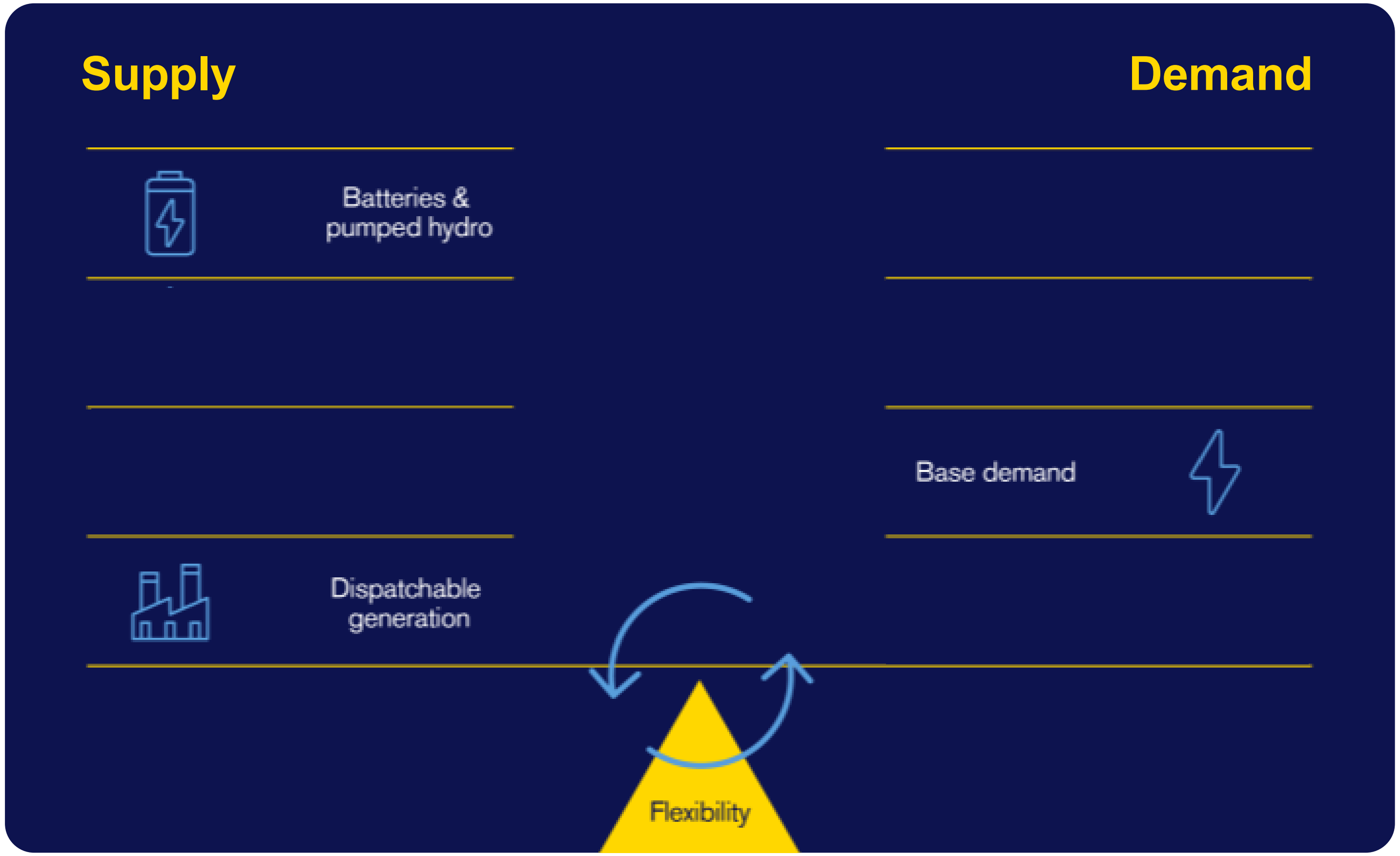
*Emissions above refer to an average renewables year; in a year of very low wind output, all but the core scenario would see emissions approaching 4Mt.

Without hydrogen, a zero-carbon system resilient to prolonged periods of low wind/solar is unlikely to be possible.

Flexibility, resilience and security of supply

Flexibility

In a net-zero system, variable renewables will sometimes generate less electricity than needed to meet demand; at other times, they will generate far more power than can currently be absorbed. For this reason, flexibility and flexible demand in particular will play a crucial role in the future.



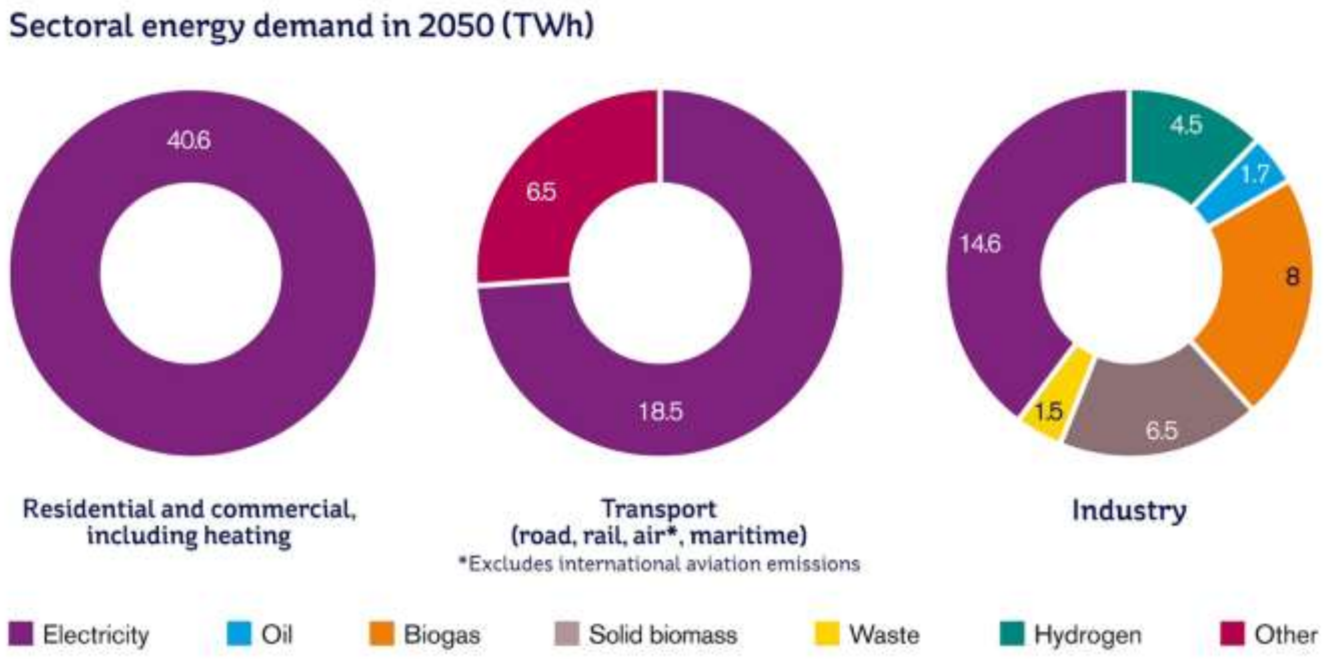
Flexibility, resilience and security of supply

Security of supply

By 2050 most people will be entirely reliant on electricity for their energy needs. This means that the electricity system must be highly secure, with disruptions of supply kept to an absolute minimum. A range of measures will be needed:

- **Complementary mix of renewables**
- **Dispatchable generation capacity**
- **Demand-side flexibility**
- **Supply-side flexibility services**
- **Large-scale seasonal storage**

Accelerating electrification in heating, transport and industry will be key to maximising clean electricity. By 2050, electricity can meet all residential and commercial energy needs, and most vehicles can be electrified. Advances in technology will also enable a large share of industrial demand to be powered by electricity.



A clean, secure energy future: How we get there

A zero-carbon energy system by 2050 in Ireland is possible – but sustained rapid progress is needed on all fronts to make it happen:

Whole energy system

- Empower customers
- Energy System Masterplan
- Robust planning system
- Workforce and skills

Electricity system

- Renewables at scale and new system practices/services
- Electricity grid investment
- Electricity market design

Flexibility, resilience and security of supply

- Support for demand-side flexibility
- Energy storage: short and long-term
- Resilient networks

Heating

- Energy efficiency measures
- Retroftting
- Support adoption of low-carbon heating

Transport

- Support transition to low-carbon transport alternatives (EVs, public transport, active travel)
- EV charging network development

Industry

- Support schemes, policies and regulation to encourage use of low-carbon technologies

Utility Scale Hydrogen Storage

Paul Cullen, Hydrogen Manager, ESB

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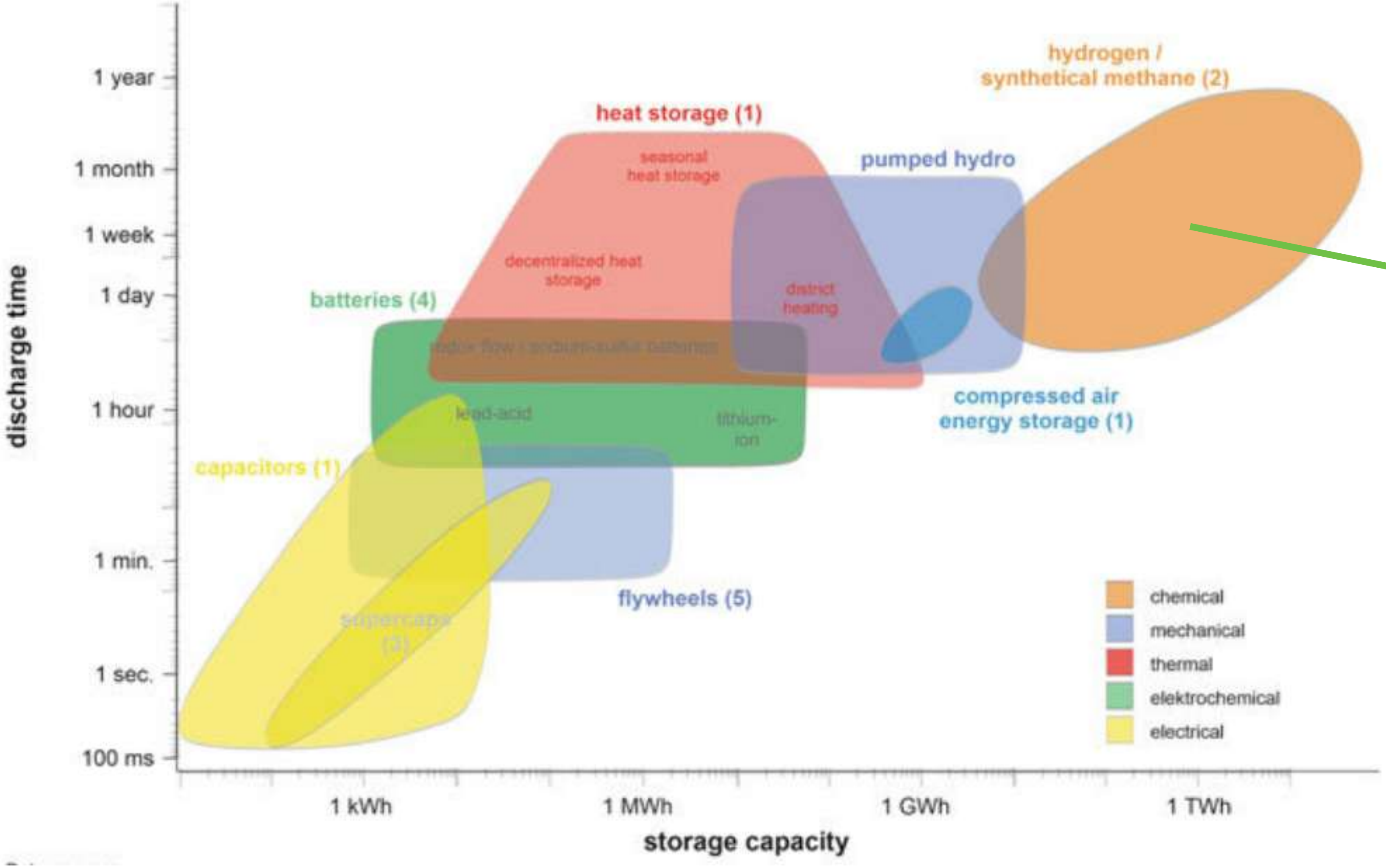
Energy Storage Technology Options



- Compressed
- Liquified
- H2 derivatives

Overview of Energy Storage Technologies Besides Batteries

Eva Schischke, Anna Grevé, Ulrike Ehrenstein, and Christian Doetsch

Small scale hydrogen storage

Multi Element Gas Container (MEGC)

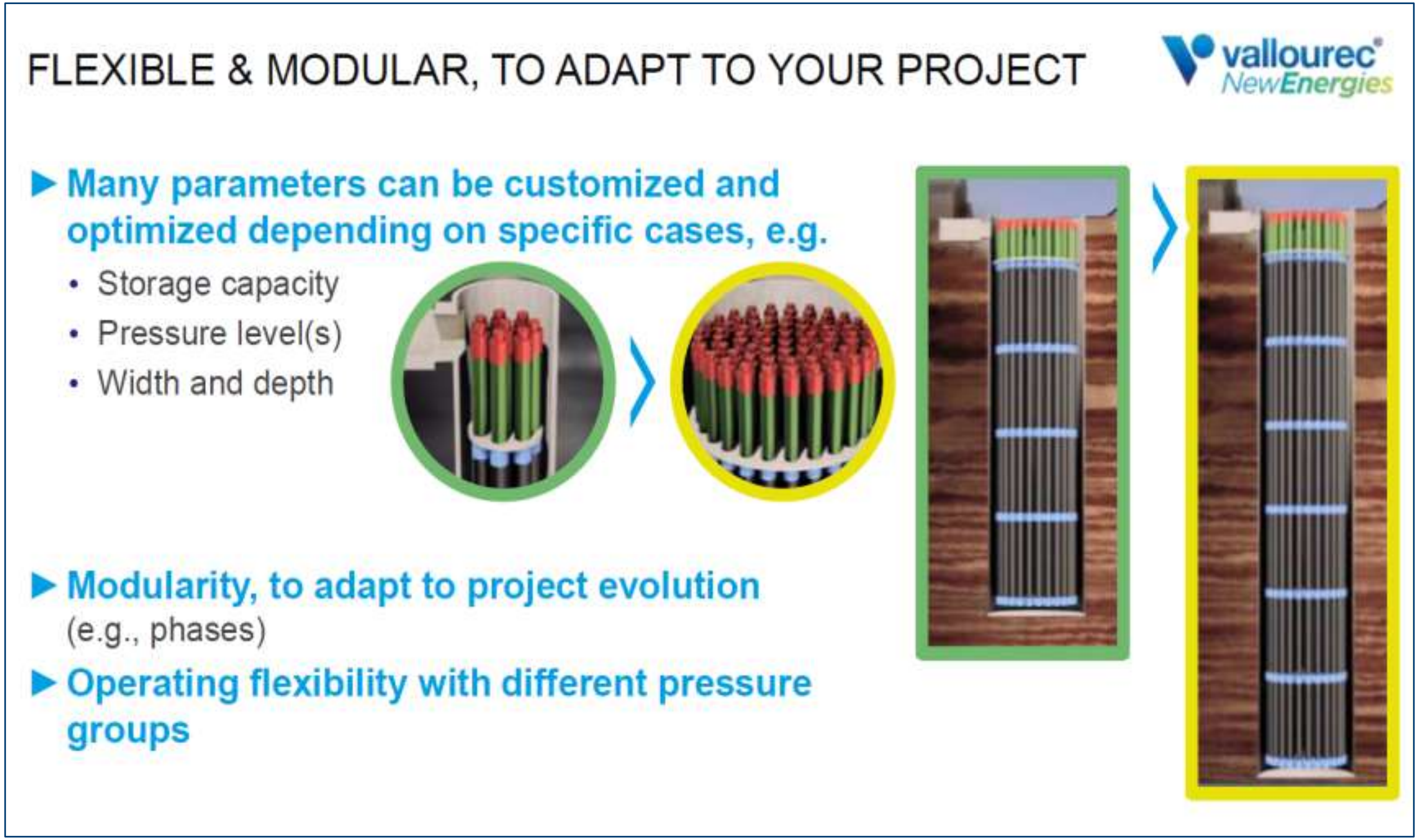
- A modular transport assembly linking multiple high-pressure gas cylinders, tubes, or bundles inside an ISO framework lattice
- Usually “20foot” or “40 foot” container size
- Normally Trailer mounted
- Typically < 1 ton each unit

Ground-mounted composite tube banks

- Configurations consisting of multiple composite pipes arranged in parallel rows, secured to a ground-based foundation.

Capex circa. €1.6 million per Ton

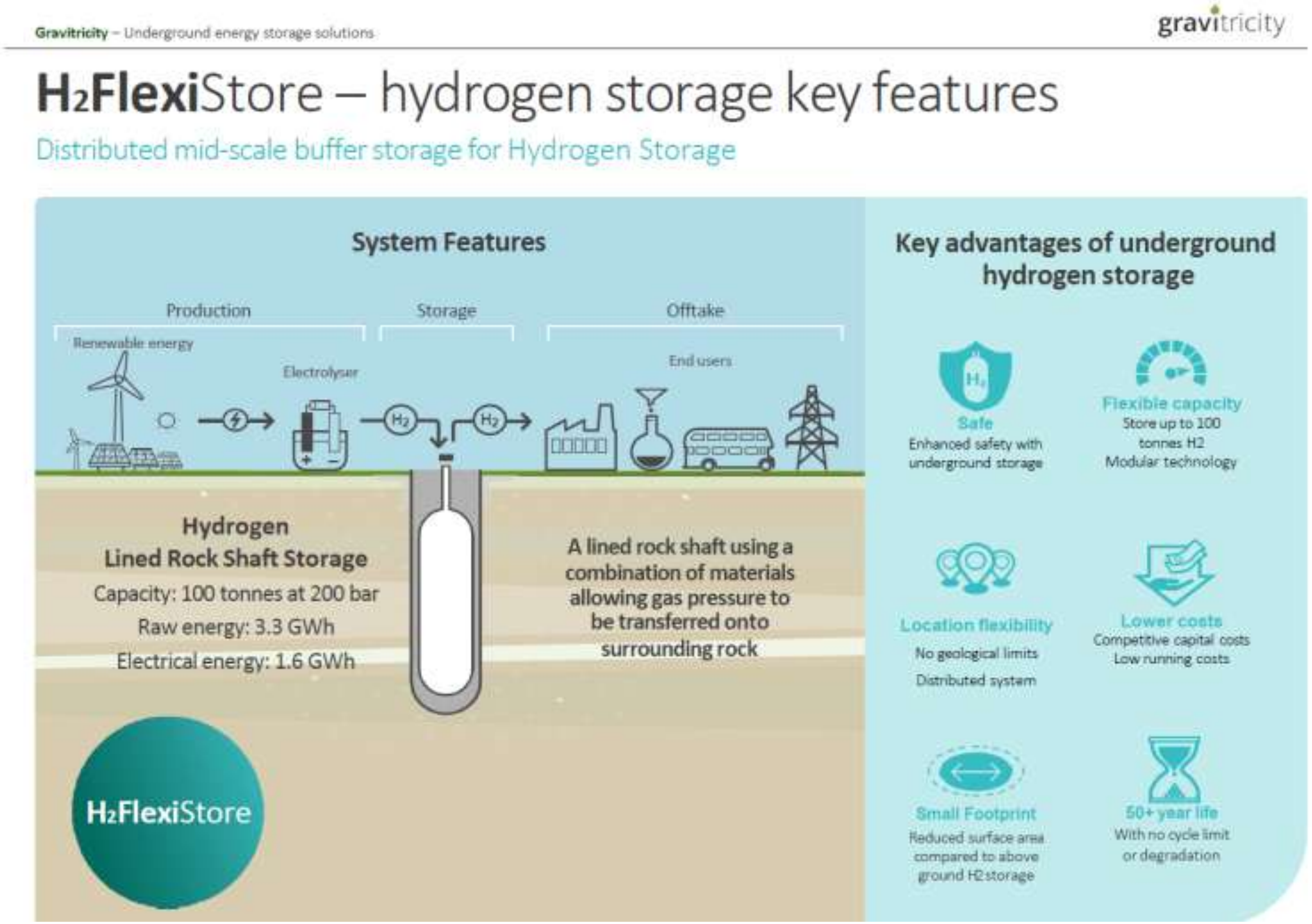
Underground vertical tubes



- 10m dia x 100m deep
- Up to 300 bar in tubes
- 200kg per tube
- Scalable 10-100T per instance
- Can have multiple instances
- 100T equiv ~ 1,600MWh elec
- Proven technology
- Pilot in operation >12 months
- DNV Certification June 2025

- Capex c. €1m per Ton

Underground vertical shaft



- 10m dia x 100m deep
- Scalable to 100T per instance
- Can have multiple instances
- Un-proven technology
- No pilot in operation
- £500k for feasibility studies
- No costings available

Underground vertical shaft

Shaft Storage Advantages

Safety

- → Below ground away from interference
- → No oxidant or ignition source
- → Fewer connections, valves, maintenance

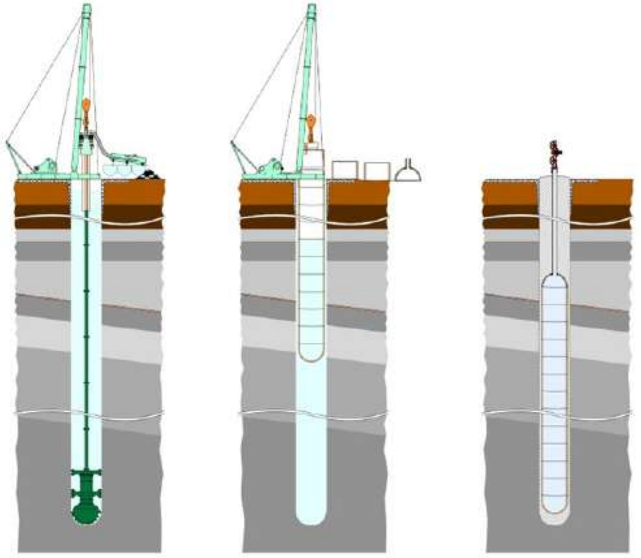
Large capacity - decouple production and demand

Liner Design

- → Lowest specific cost ($/kg)
- → High purity product returned

Small footprint

Low environmental and visual impact



Ardent Underground Solution

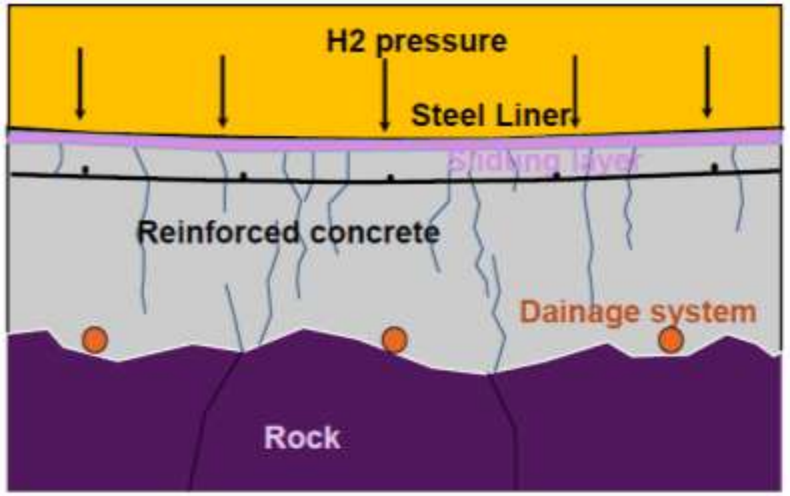
- Similar to Gravìticity
- Un-proven technology
- No pilot in operation

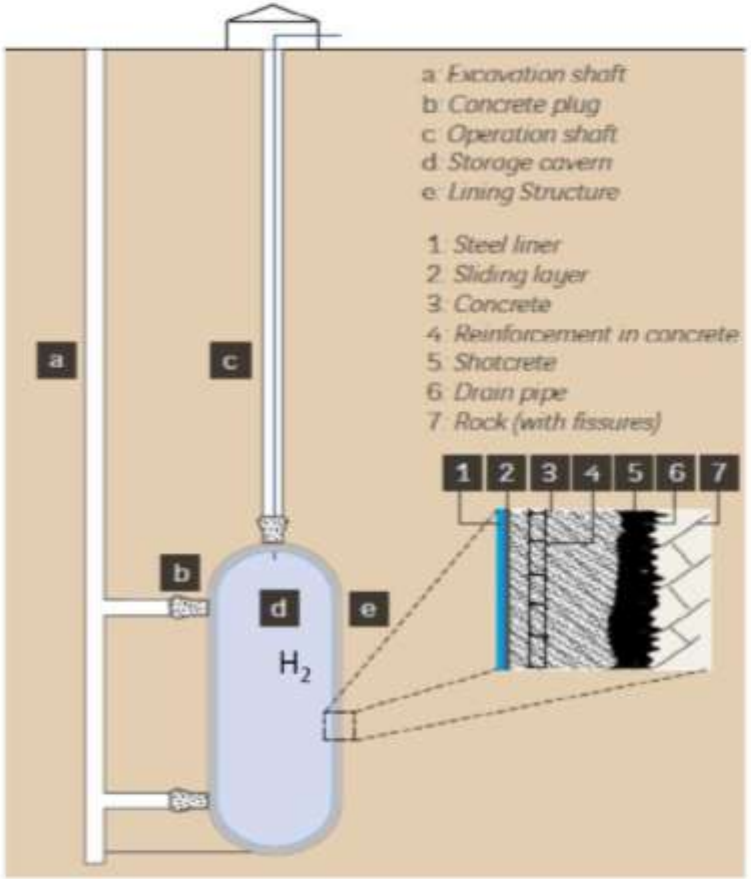
- No Costings

Lined Rock Cavern

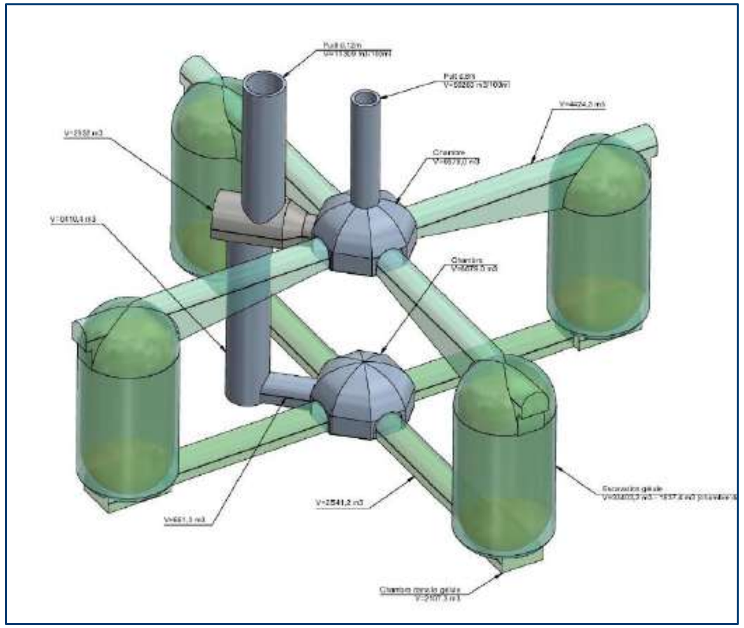
Lined Rock Cavern for gaseous product - Concept

Cavern Diameter	~ 20 - 40 m
Cavern Height	~ 50 - 100 m
Volume	~ 20 000 – 100 000 m^3
Masse H2	~ 200 t – 1000 t
Operating Pressure	~ 2 MPa to 20 MPa Weekly to monthly turnover (Pmax-Pmin)
H2 Temperature	~ 0 °C to 70 °C
Design life	30 to 50 years





- Up to 1000T per cavern / 33 GWh
- HYBRIT 100m3 demo in Sweeden (2 Ton / 66 MWh)
- Feasibility study carried out for ESB for the Cork Region in 2025 - 500T solution

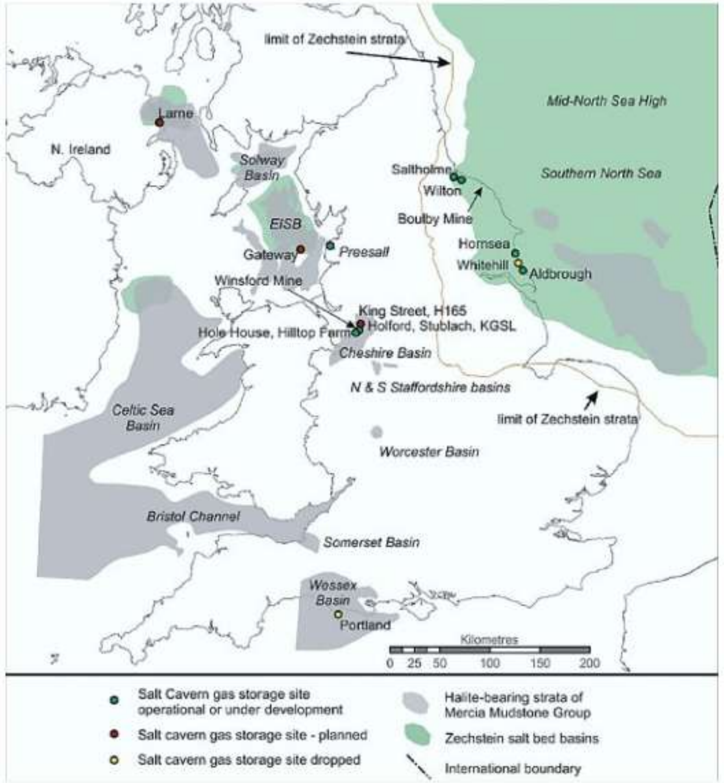


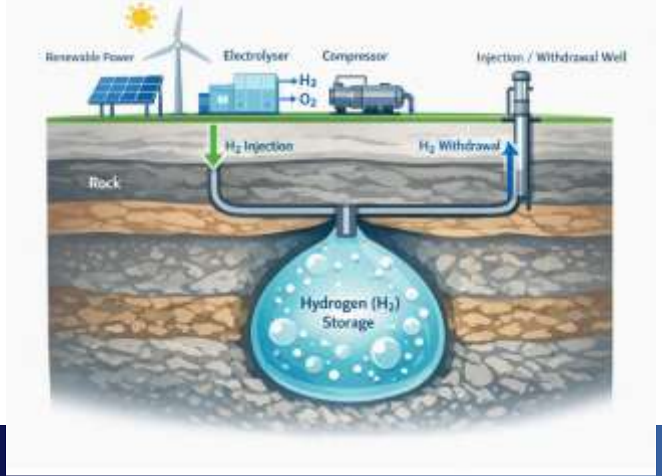
Salt Cavern

Salt caverns offer a proven route to high-capacity, long-duration hydrogen storage where suitable geology exists.

- Created by solution mining underground salt formations.
- Compressed hydrogen is injected, stored, and withdrawn through wells.
- Low permeability and self-sealing salt help contain hydrogen safely.
- Supports repeated cycling to balance renewable generation and demand.

Key considerations for Ireland: **geology, cavern integrity,** well materials, monitoring, regulation, and brine management.





Indicative Capex costs;

Large Offshore; €0.021 m per Ton stored *

* https://repository.tudelft.nl/record/uuid:8eb96cf8-2c91-4553-b0cb-a41458f61b5d

Depleted Gas Field

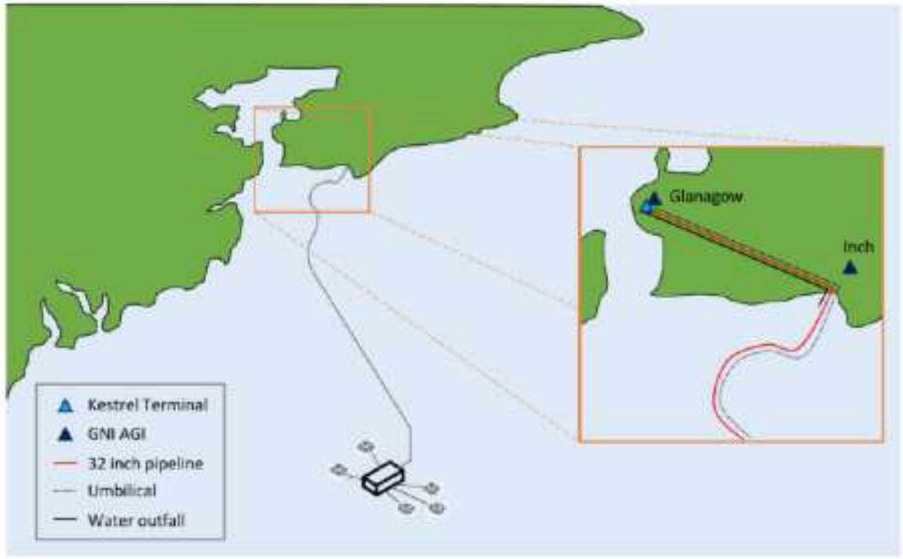


Figure 1 – Kestrel Offshore and Onshore Location

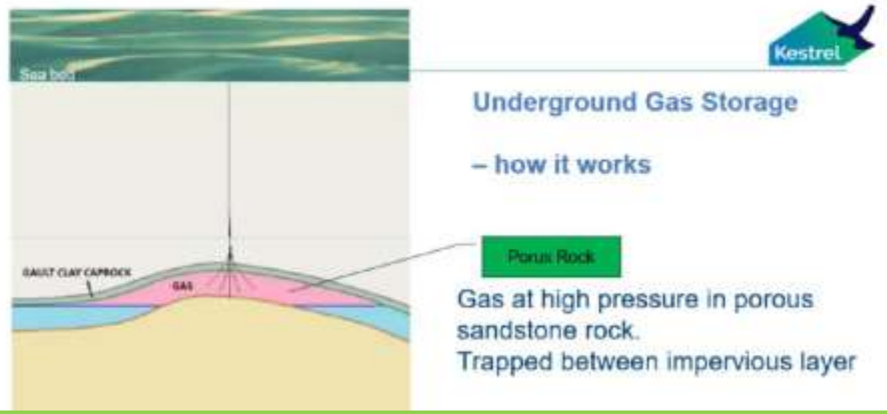


Figure 2 – Indicative sub-sea cross section

At Ballycotton the reservoir is 1000m below the sea bed, below a layer of imperviable caprock. Originally at 85 bar the field is now depleted.

14TWh Natural Gas Storage

transitioning to

3+ TWh of H_2 storage
100,000 Tons of H_2

Cost per Ton of H_2 €0.011 m

TRL level 7 demonstrated by RAG Austria https://www.sciencedirect.com/science/article/pii/S0360319926034221?dgcid=coauthor

Hydrogen Energy Table – Cost comparison

Quantity Stored	Stored Energy Content	Electricity Output (@ 45% eff)	Solution Type options	Capex Cost (indicative)
1 Ton	33.3 MWh	200 kW for 3 days	Overground e.g. MEGC 10MWh / 300Kg each	**€1.67 m per Ton stored**
1 -10 T	333 MWh	2 MW for 3 days	Ground-mounted composite tube banks	**€1.0 m per Ton stored**
10 -100 T	3.33 GWh	20 MW for 3 days	Vertical Tubes (up to 3.3 GWh / 100T each)	**€1.0 m per Ton stored**
100 -1000 T	33.3 GWh	200 MW for 3 days	Lined Rock Cavern 16.6GWh / 500T	**Range €0.5m to €1.8m per Ton stored**
1,000 - 10,000 T	333 GWh	1 GW for 6 days	Salt Cavern typical 150GW / 7500T per cavern	**Large Offshore €0.021 m per Ton stored**
10,000 - 100,000 T	3.33 TWh	1 GW for 60 days	Depleted Gas Field (Kestrel 3-4 TWh / 100,000 T)	**€0.011 m per Ton stored**

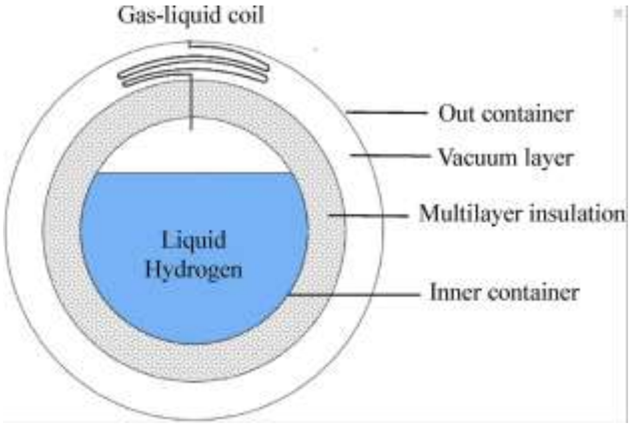
Liquification Example from USA actual plant

(H2 for transportation)

- The process of “freezing and compressing” hydrogen into a liquid form at -253 degC
- Inefficient process – current technology 25-30% energy losses
- Energy density of liquid hydrogen is 5 times higher than compressed h2 @ 200 bar hence good for transportation
- “boil off” @ 0.2% per day impacts long term operating costs

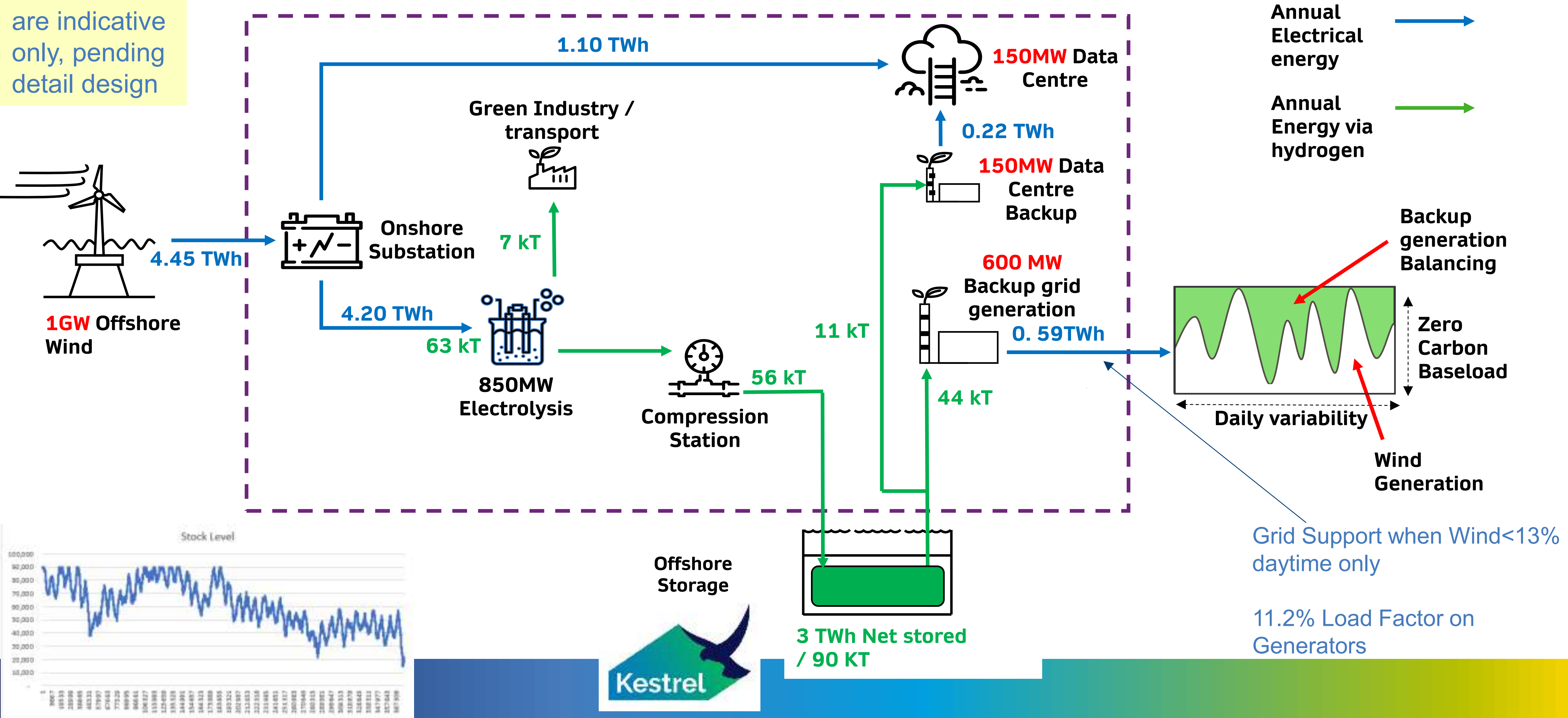
- Case Study USA
  - 15 Tonnes per day liquified → ~ 40MW electrolyser output
  - $37 million for the liquefier → similar price range as the electrolyser
  - Storage 24 Tonnes , 340m3, cost $3 million

- Worth considering if high utilisation of the liquification plant and if H2 being transported not in long term storage.

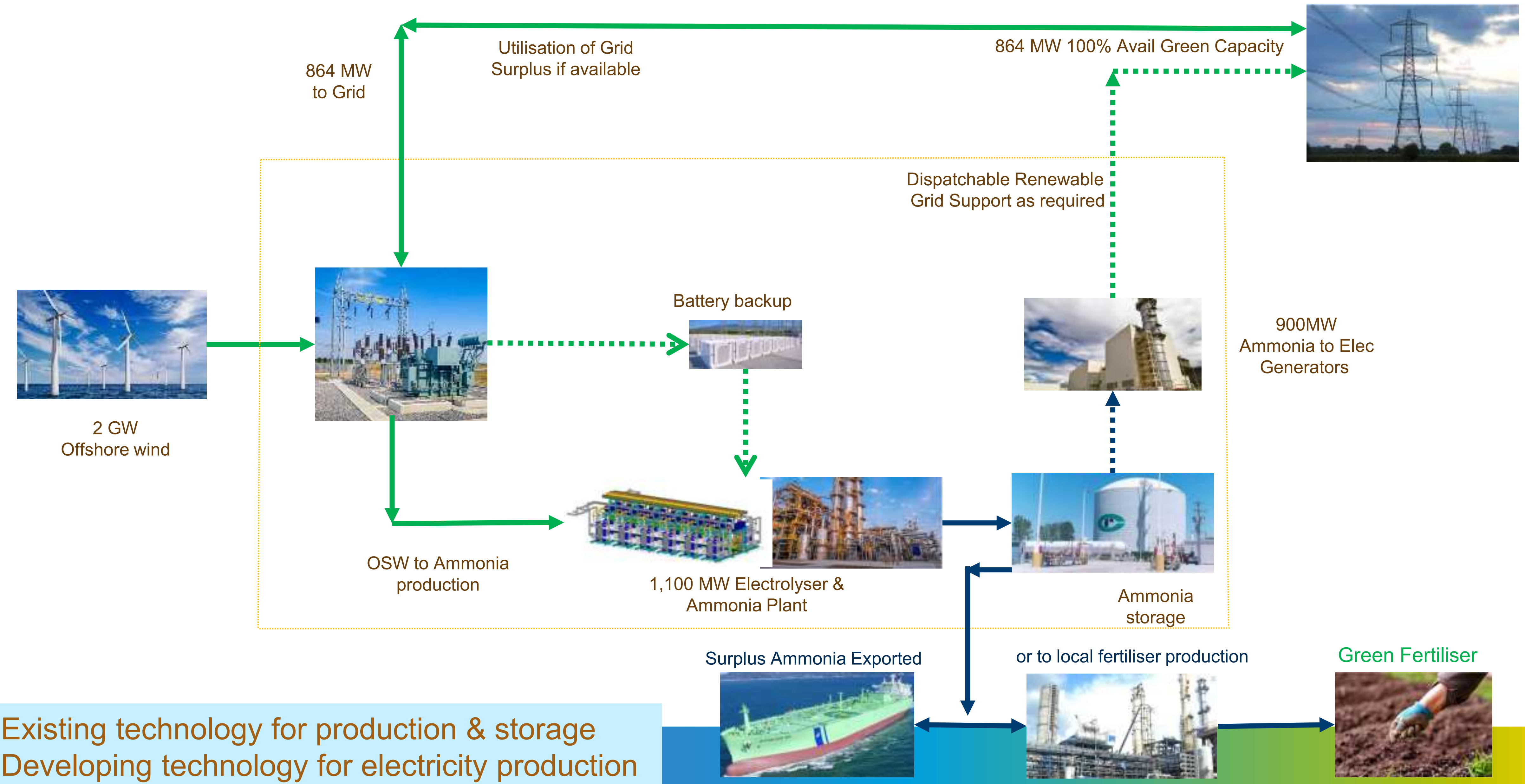


Cork Energy Hub – Reference Case – energy balanced

All numbers are indicative only, pending detail design



Derivatives – Green Ammonia



- Existing technology for production & storage
- Developing technology for electricity production

Hydrogen in a Net Zero Power System

Case Study - HPU Collaboration with the Irish Defence Forces

Enda Mitchell – ESB Generation and Trading

Paul Finnegan – Irish Defence Forces

ESB's Hydrogen Lighthouse Project: **Learn by Doing**

Óglaigh na hÉireann
DEFENCE FORCES IRELAND

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Rialtas na hÉireann
Government of Ireland

National Hydrogen Strategy

Standing Start

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Small-scale H_2 Demonstrator Projects

- Better understanding of commercial business models
- Help alleviate regulatory, consenting and supply chain barriers
- Chance for end-users and public to see and experience hydrogen production, storage and power generation technology

Start small; build competence and confidence

Overview

- Defence Forces Objectives
- Lynch Camp
- Operational Philosophy
- Deployment Overview
- Site Setup & Safety
- Technical Uncertainties
- Commissioning
- Key Learnings and Future Opportunities
- Further Advancement of Hydrogen Field

Defence Forces - Objectives

- Evaluate **hybrid energy systems** for **fully resilient** islanded military camp using 100% renewable energy supply
- Understand **application of H2 Fuel Cell technology** into an existing operational site
- **Carbon offsetting** by replacing fossil fuel generation sources
- **Interconnection of a renewable source of energy** to take the camp off-grid for the duration of the project

Lynch Camp – Kilworth, Co. Cork

- **Training Installation** for Defence Forces Ireland
- **24/7/365** Operational Facility
- Varying loads with **surge occupancy of exercising troops**
- Recent energy upgrades to facility including; ground mounted **100kWp Solar PV, A2W HP** to accommodation buildings and **EV charging**

Operational Philosophy

- **ATS switched** from **mains to generator** supply taking the Camp off-grid
- **PV system** to supply the Camp, and the **HPUs** treated as a load on the camp
- **HPUs** take a charge (when available) from the **Solar PV**
- **Excess demand** from site (above PV production) supplemented by the **HPU's battery storage and fuel cell**
- Site will be supplied by **solar energy or low carbon hydrogen gas** for the duration of the project
- **Two HPUs** are provided to ensure that there is **resilience** on the project

HPU (Hydrogen Power Unit) **Demonstrations**

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Type	Emissions for typical 250kVa Diesel Generator	Emissions for Green H2 HPU
CO2	960g / kWh of operation	0g
NOX + HC	932.5g per hour of operation	0g
CO	327.5g per hour of operation	0g
PM	45g per hour of operation	0g

A **Hydrogen Power Unit** is a transportable, zero-emission power generator that uses green hydrogen and Proton Exchange Membrane fuel-cell technology to provide clean, silent, emission-free electricity (400v 3Φ AC) for off-grid, backup, or temporary power needs

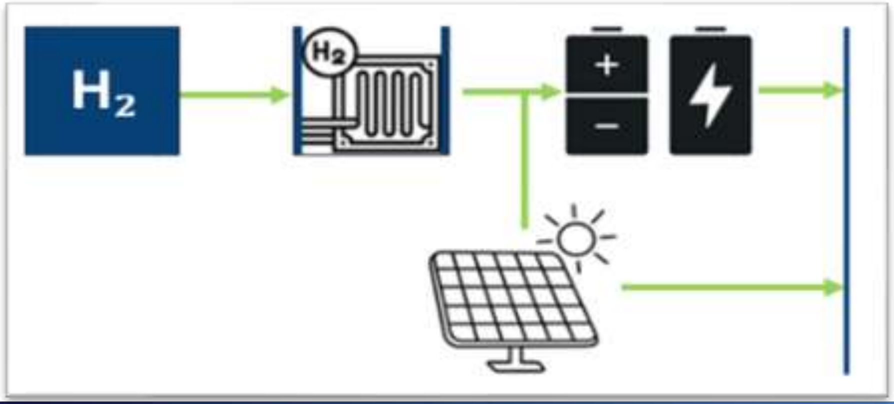
Deployment Overview

The **Kilworth Camp HPU Deployment** was a **6-week** demonstration project at the Defence Forces Camp in Kilworth, Cork. It aimed to **prove the concept** of integrating **HPUs** (Hydrogen Power Units) with **solar PV** for **off-grid**, **mission-critical power supply**.

- **Objective:** Demonstrate **hybrid hydrogen** and **solar** power generation with battery backup.
- **Configuration:** **Two HPUs** (250kWe each) + **100kW solar PV** system.
- **Duration:** September–October 2025 **(6 weeks)**.
- **Outcome:** Delivered **23,132kWh** of **low carbon** energy off-grid and provided necessary resilience whilst proving benefits of the integration of renewable energy systems with HPU technology

Site Configuration

- **Two-HPUs** positioned within a fenced compound with **two-MEGC** (Multi Element Gas Containers) hydrogen gas storage trailers.
- Each HPU utilised onboard **integrated battery** storage (216kWh per HPU) for dynamic load response and store of electrical energy.
- **Dual feed** from **Solar PV** and **HPU** to busbar with supply cable from busbar to HPUs.



Set-Up to Live Optimisation

At Lynch Camp, two 250 kWe HPUs, 100 kW solar PV and 432 kWh of onboard batteries were integrated behind a shared busbar.

SET UP

01

Two HPUs and two MEGCs connected to the camp LV switchroom.

ASSURE

02

ATEX/HAC controls, bonded fencing and emergency procedures established.

COMMISSION

03

Voltage monitoring, cabling fixes and inverter tuning stabilised the system.

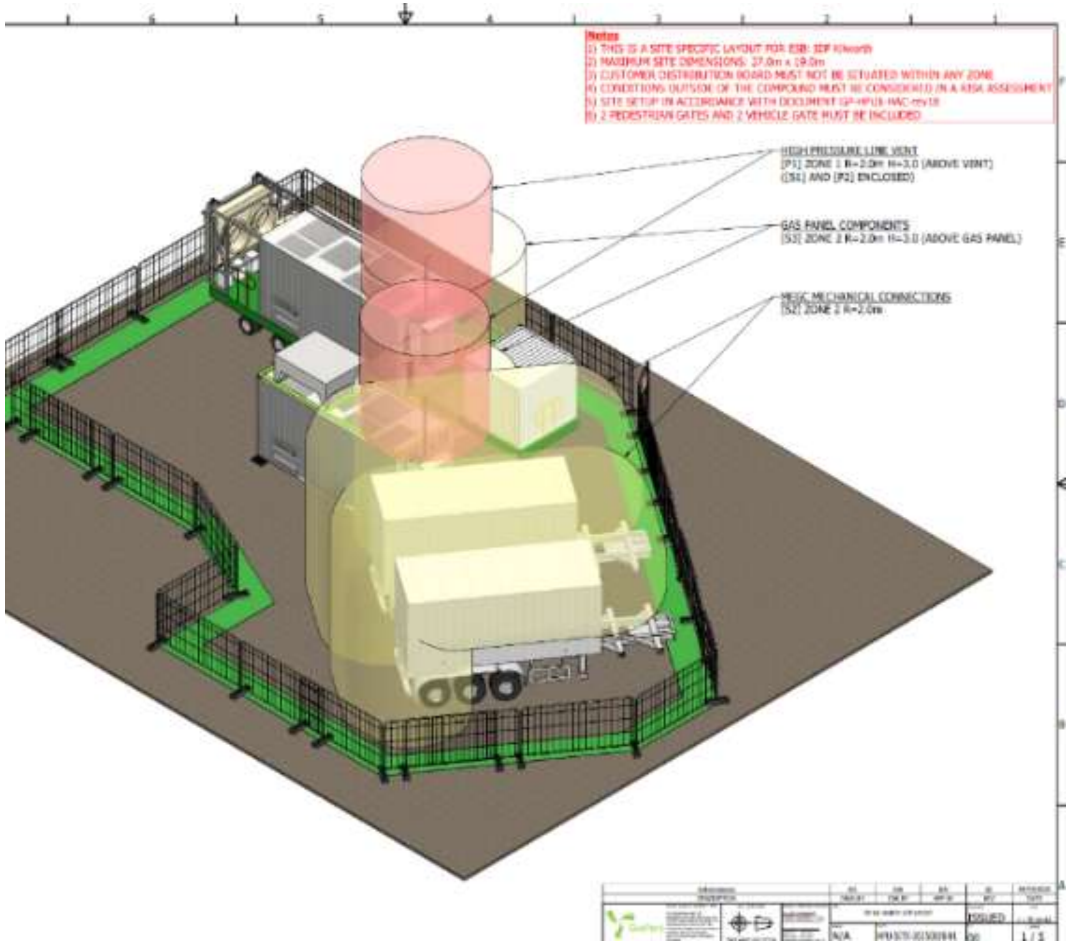
OPERATE & LEARN

04

Live loads tested solar charging, battery response and hydrogen optimisation.

Result: 23,132 kWh delivered off-grid. Solar reduced hydrogen use by 222.9 kg; hybrid carbon intensity was 40.5 gCO_2/kWh — 72% below the grid benchmark over same period.

Hydrogen Site Safety



- **Safety controls** designed and implemented as a response to creation of an **explosive atmosphere** (compressed gaseous fuel) at site.
- Compliance with **ATEX Regulations** and **Health Safety and Welfare at Work Act 2005**.
- **Hazardous Area Classification** (HAC) drawings developed for site and compound installed to comply with requirements.
- **Risk Assessment Method Statement** (RAMS), **Emergency Response Plan** (ERP), and **Explosion Protection Document** (EPD) developed and implemented.
- Separation distances as per **BCGA CP33** guidelines (5m and 8m zones).
- **Safety signage** and **bonded fencing** to prevent risk of ignition due to static charge.

In **hydrogen-to-power**, **safety** extends beyond any single project: one incident could undermine **confidence** across the industry, so every deployment must set the **highest standard**

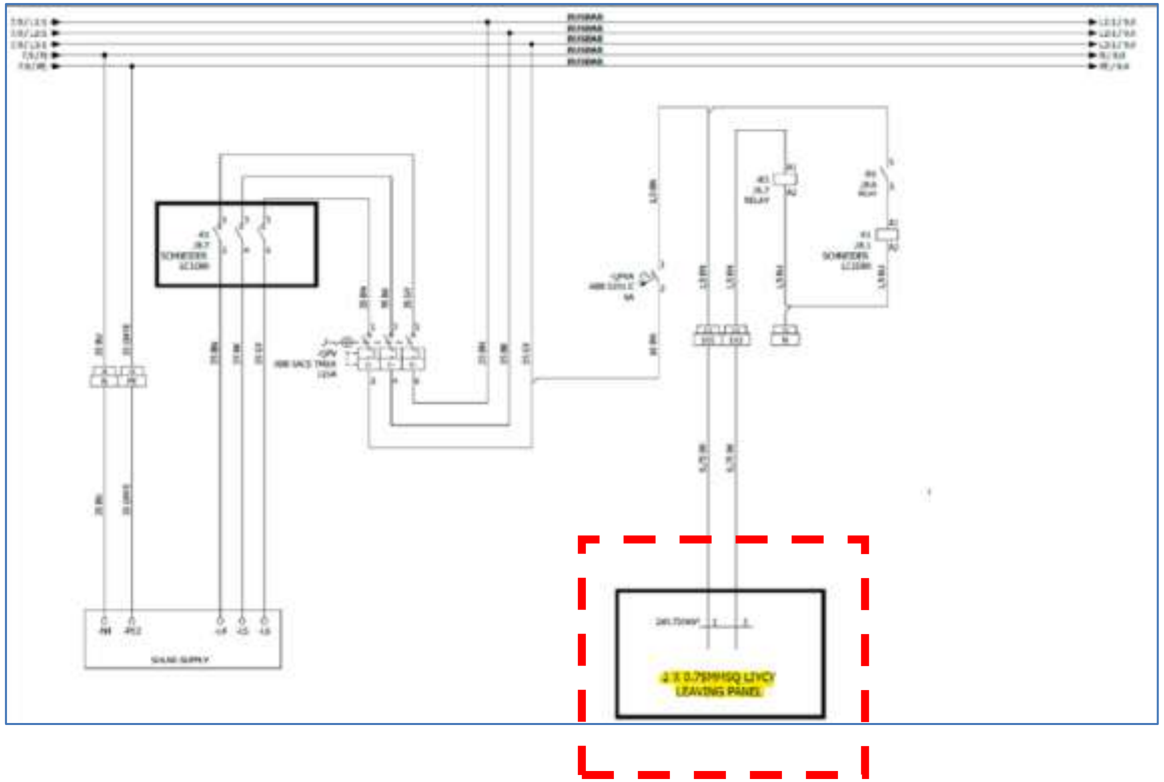
Technical Uncertainties

Integration of HPUs with solar PV introduced several unknowns.

- **LV network design** and **inductive loads** caused voltage fluctuations = challenge to stable integration.
- **Reactive power** and “charging budgets” impacted system behaviour. Injection of **“reactive”** power to facilitate charging resulted in unexpected energy consumption
- **Solar integration** required “zero-export” control and inverter tunning.
- Monitoring of **voltage** to ensure batteries didn’t **overcharge**
- **Predictive modelling** for load and solar variability was not available pre-commissioning so a period of **configuration** required.
- Achieving **steady state** electrical supply whilst **optimising** performance of HPUs
- Assessing **load fluctuations** and requirements for **duty-standby** configuration of HPUs
- **Solar performance** and **seasonal variations**

Installation & Commissioning

- Modified switchroom **drawings** required to reflect design integration requirements
- Inclusion of **voltage monitors** to prevent battery overcharging in HPUs.
- Cable terminations and hose length limitations were identified, and **workarounds** provided.
- **Safety** signage and compound fence bonding applied to align with **ATEX** requirements

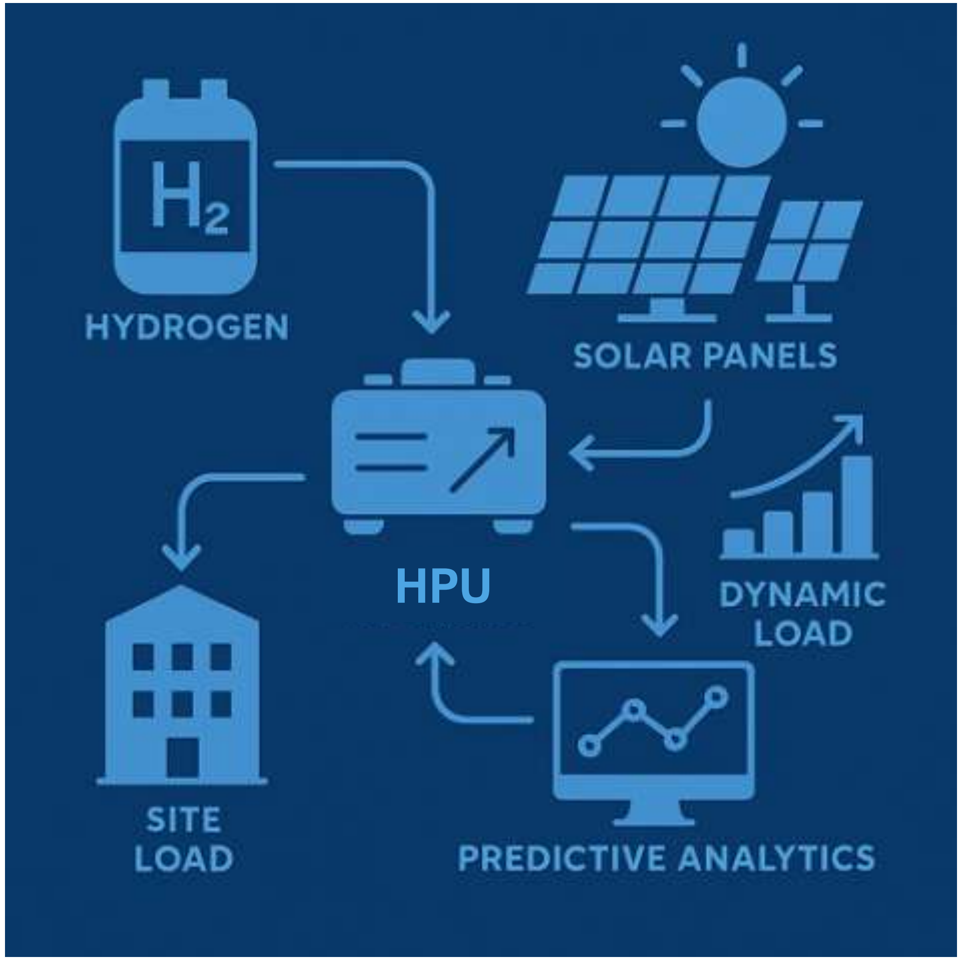


Control wiring design amendment

Continued learnings from previous deployments indicates the team's focus on developing and improving processes from safety and operational perspectives

Key Learnings

- HPU's **battery storage** smoothed the solar **variability** and reduced hydrogen use required for Balance of Plant in HPUs.
- HPU's **dynamic load handling** demonstrated resilience under varying demand – batteries offer **fast response** to fluctuating loads.
- **Seasonal solar variability** highlighted benefits of predictive modelling.
- **System tuning** was required to optimise operation for site specifics (load profile and solar resource availability)
- **Carbon Intensity** significantly lower than grid supplied electricity
- Opportunities identified to **expand scope** for larger solar PV sites or site with small scale wind and higher capacity factors
- Project **proved concept** for off-grid energy systems, integrating **solar and wind with green hydrogen and battery storage**



The HPU Trial Validated Flexible Operation across Changing Demand

HOW ENERGY MOVED THROUGH THE SITE

INPUTS
solar + hydrogen

HYBRID SYSTEM
battery + HPU

SITE LOAD
operating demand

TUNING
adaptive response

WHAT THE TEAM LEARNED

Variability was manageable

Battery storage smoothed renewable intermittency / variation and supported rapid response to changing loads.

Operating profiles mattered

Weekday and weekend demand patterns called for different operating strategies.

Renewables reduced fuel reliance

On-site solar supported auxiliary demand and reduced dependence on delivered hydrogen.

Hybrid Operation Showed a Credible Path to Lower-Carbon Power

WHAT THE TRIAL DEMONSTRATED

ON-SITE SOLAR

BATTERY STORAGE

HYDROGEN POWER

HYBRID
orchestration

FLEXIBLE OPERATION

Resources worked together to strengthen system response and reduce dependence on any single source.

LOWER-CARBON PATHWAY

On-site renewable power reduced grid reliance and operational carbon intensity.

OUTCOMES TO CARRY FORWARD

Integrated performance

The hybrid resources operated as one coordinated system rather than separate assets.

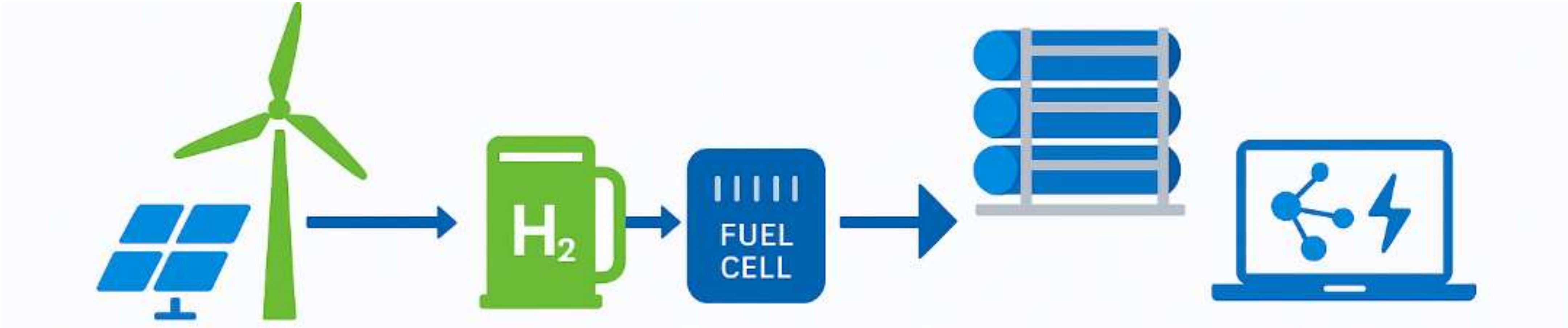
Directional carbon benefit

Renewable integration supported a lower-carbon operating model.

Clear optimisation pathway

Control tuning, storage strategy and renewable mix offer further potential at scale.

Further Advancement of the Hydrogen to Power Field



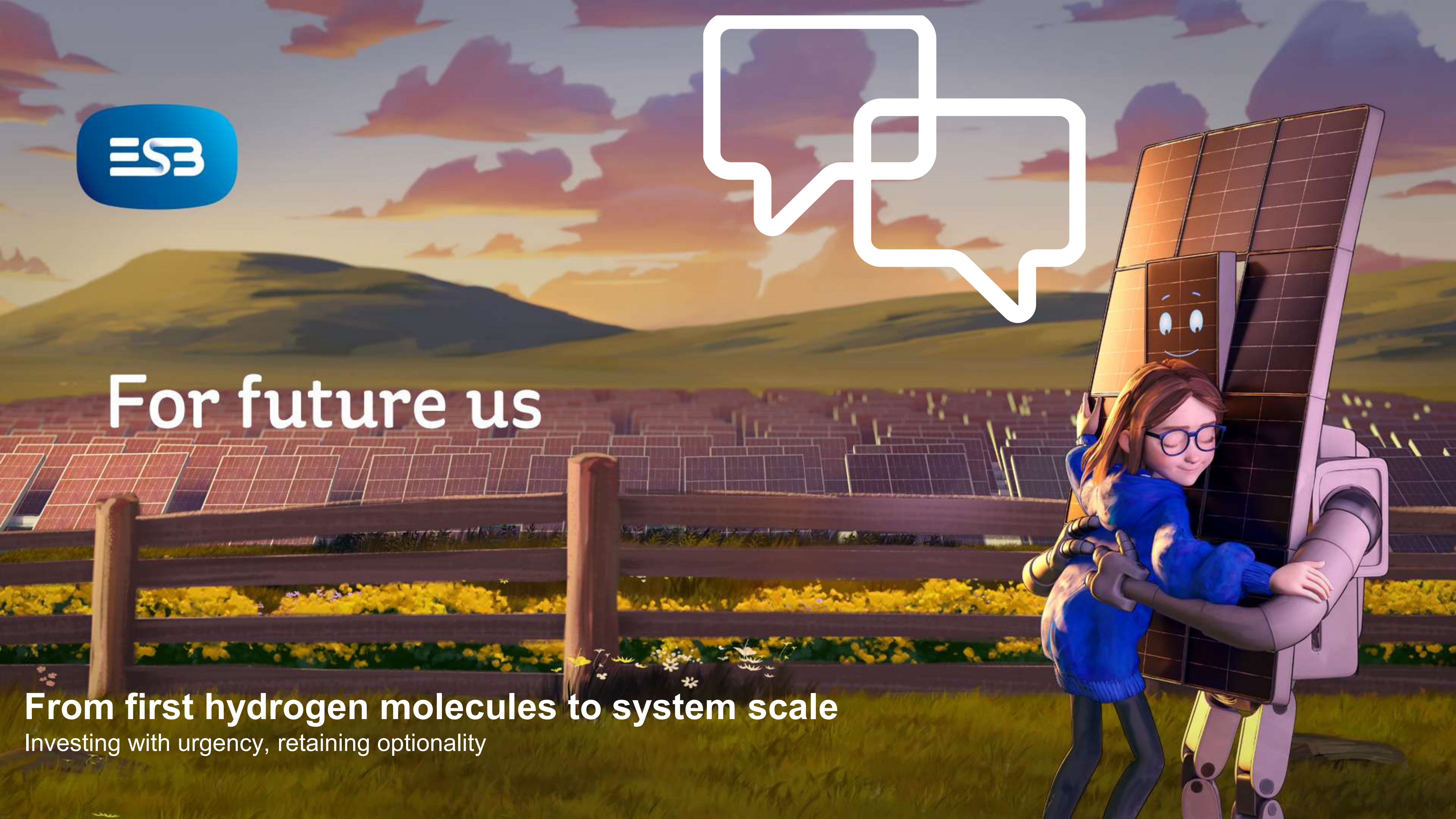
Hybrid systems outperform standalone HPUs in efficiency and flexibility.

Future designs: integrate wind (higher capacity factor), predictive control, and automated solar tuning.

Opportunities for onsite hydrogen production and onsite storage

Utilisation of larger MEGC storage to reduce transport emissions, O&M associated with refuelling activities.

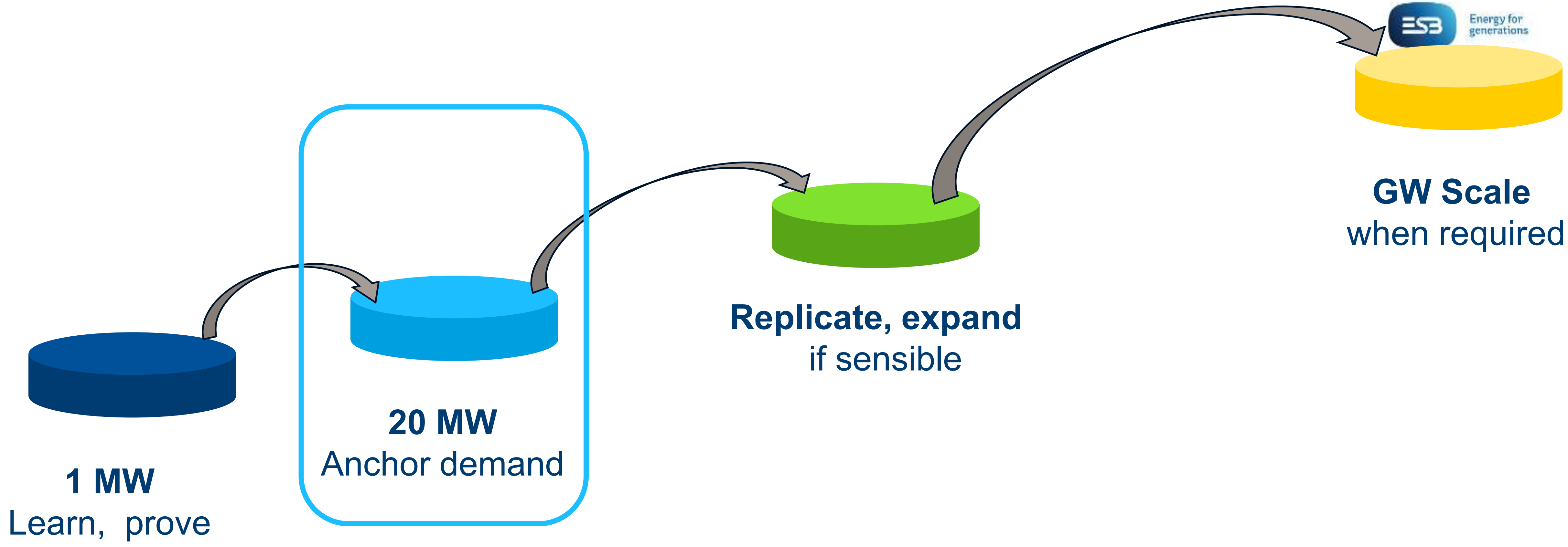
Digital twins for real-time optimisation and molecule-to-watt tracking.



From first hydrogen molecules to system scale

Investing with urgency, retaining optionality

A decision-gated pathway from 1 MW towards GW scale H2



4 tests at every gate: Customer demand • Economics • Policy clarity • Transferable learning

Each step must earn the next.

Existing H2 demand. Existing infrastructure. Existing Route-to-market

Don't invent a customer — decarbonise one that already exists

Renewable inputs
Electricity + water

20 MW Electrolyser
Certified RFNBO H_2

Hydrogen logistics
Storage + transport

REFINERY USE

Renewable hydrogen replacing **fossil** hydrogen in an existing molecular process.

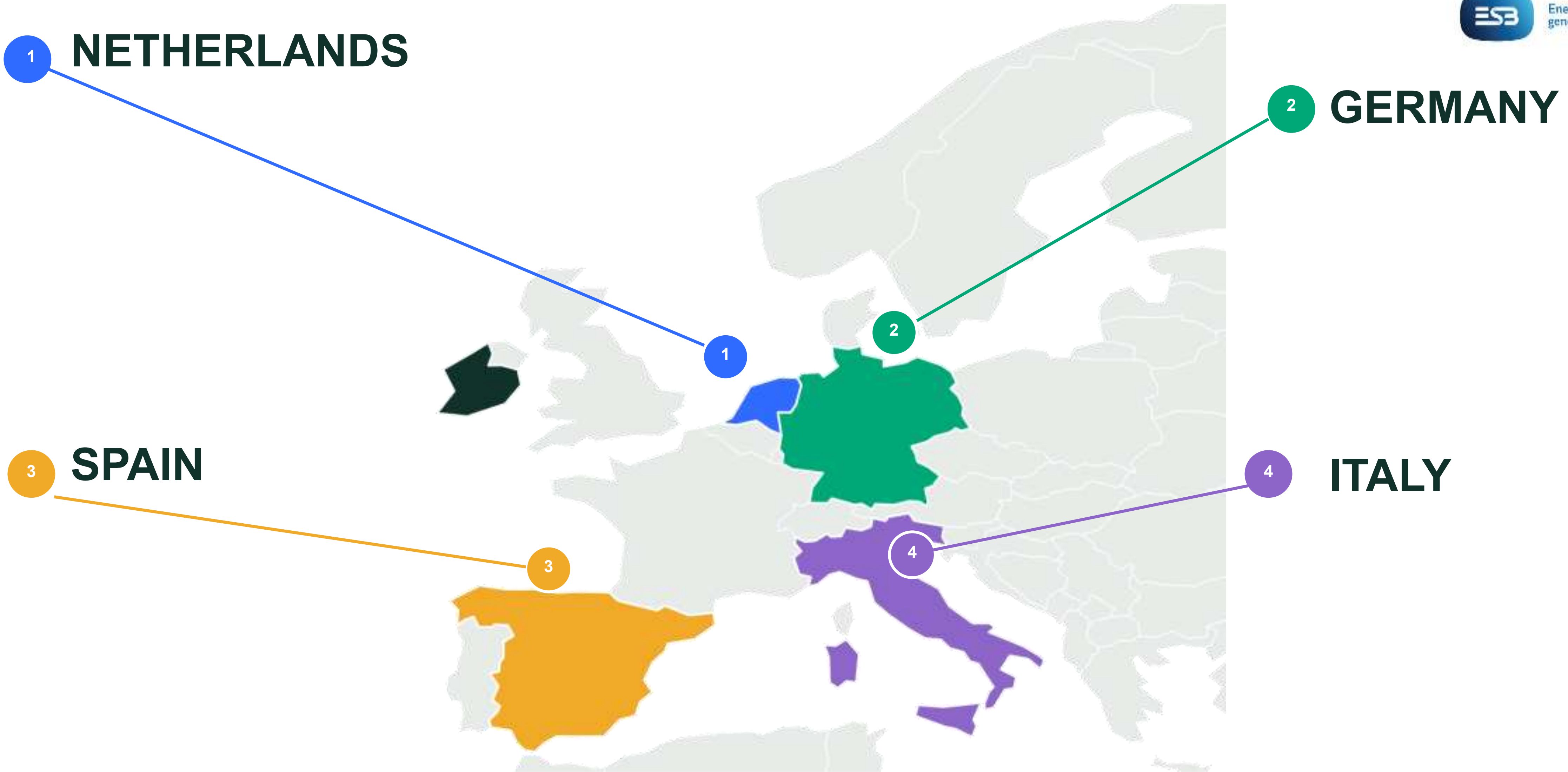
Transport fuels
Conventional products

RFNBO recognition
Operational clarity required

Compliance value
Allocation to be defined

East Cork Hydrogen Cluster

Other EU Member States are enabling the RFNBO refinery route

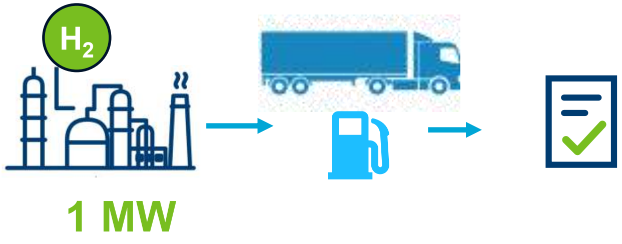


Lesson: clear qualification, certification and compliance value turn a <u>target</u> into an <u>investable market</u>

Use 1 MW to prove. Fund 20 MW to scale. Retain options.

Focus support on complete value chains with credible, scalable, enduring demand.

PROVE



1 MW supply

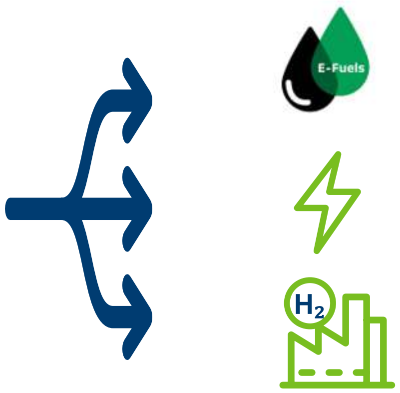
- End-to-end refinery trial
- Certification and compliance evidence

SCALE

20 MW refinery project

- Credible anchor demand
- Economics, connection and governance

RETAIN OPTIONS



Future uses

- Future fuels
- Storage
- Clean power

Policy should provide certainty. Projects should provide evidence.

Project Arrington

Catherine McHale – Project Director

UK Update
August 2026

Department for Energy Security & Net Zero

Hydrogen update

- Hydrogen remains a central pillar of the cleaner, more secure energy system this Government is building.
- Our understanding of where hydrogen delivers greatest value has evolved over the last year.
- It is a key tool for decarbonising industry and the power system, and it can be a driver of regional renewal, investment and long-term growth.
- The industrial strategy recognised hydrogen as a frontier industry — catalysing investment, creating and retaining high-productivity jobs, and anchoring supply chains in the UK.

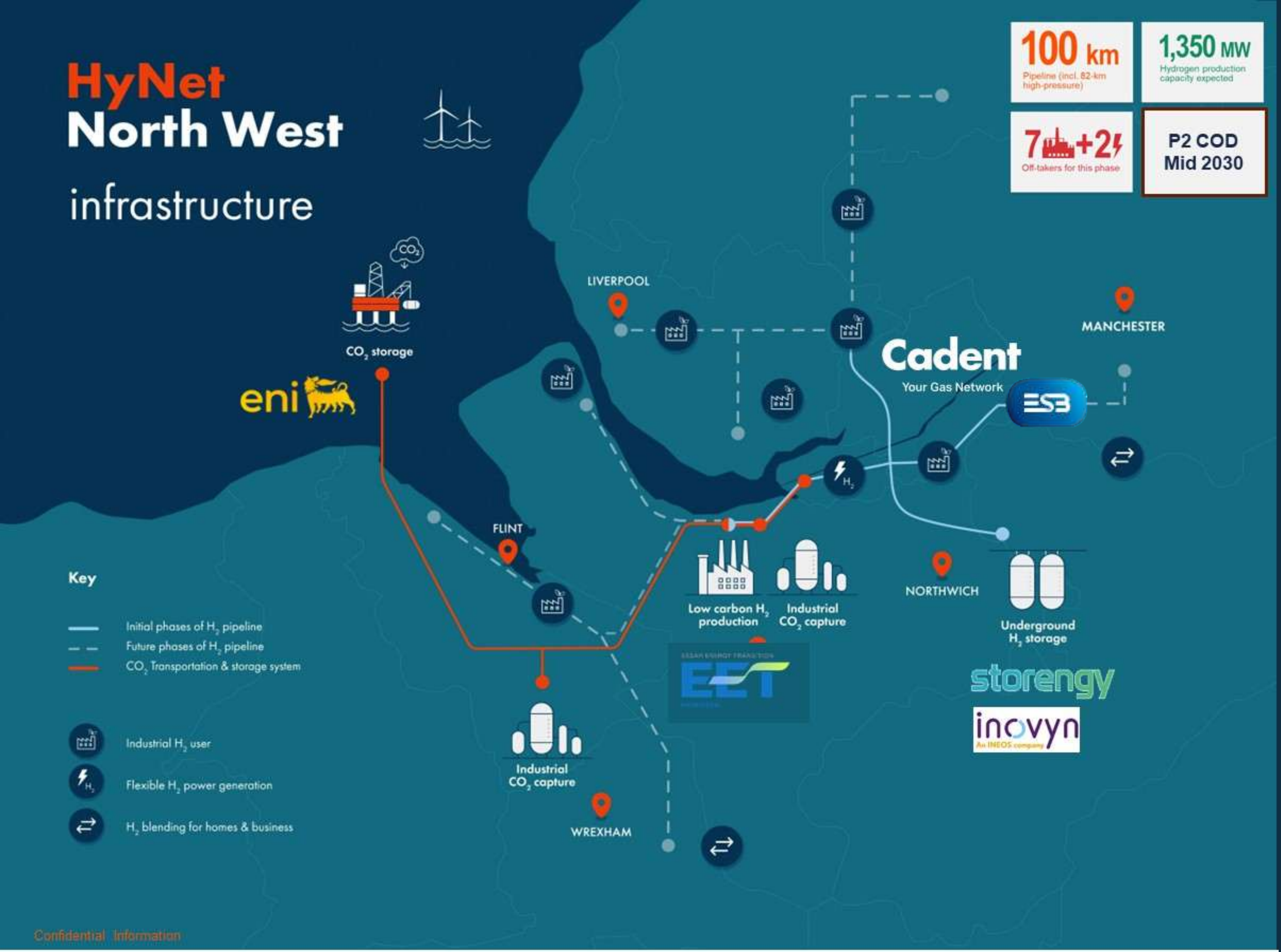
Carrington Power Station - Site Journey

Carrington Power Station (1956 to 1991)

Carrington Power Station 2016 onwards

Gas Fired 884MW

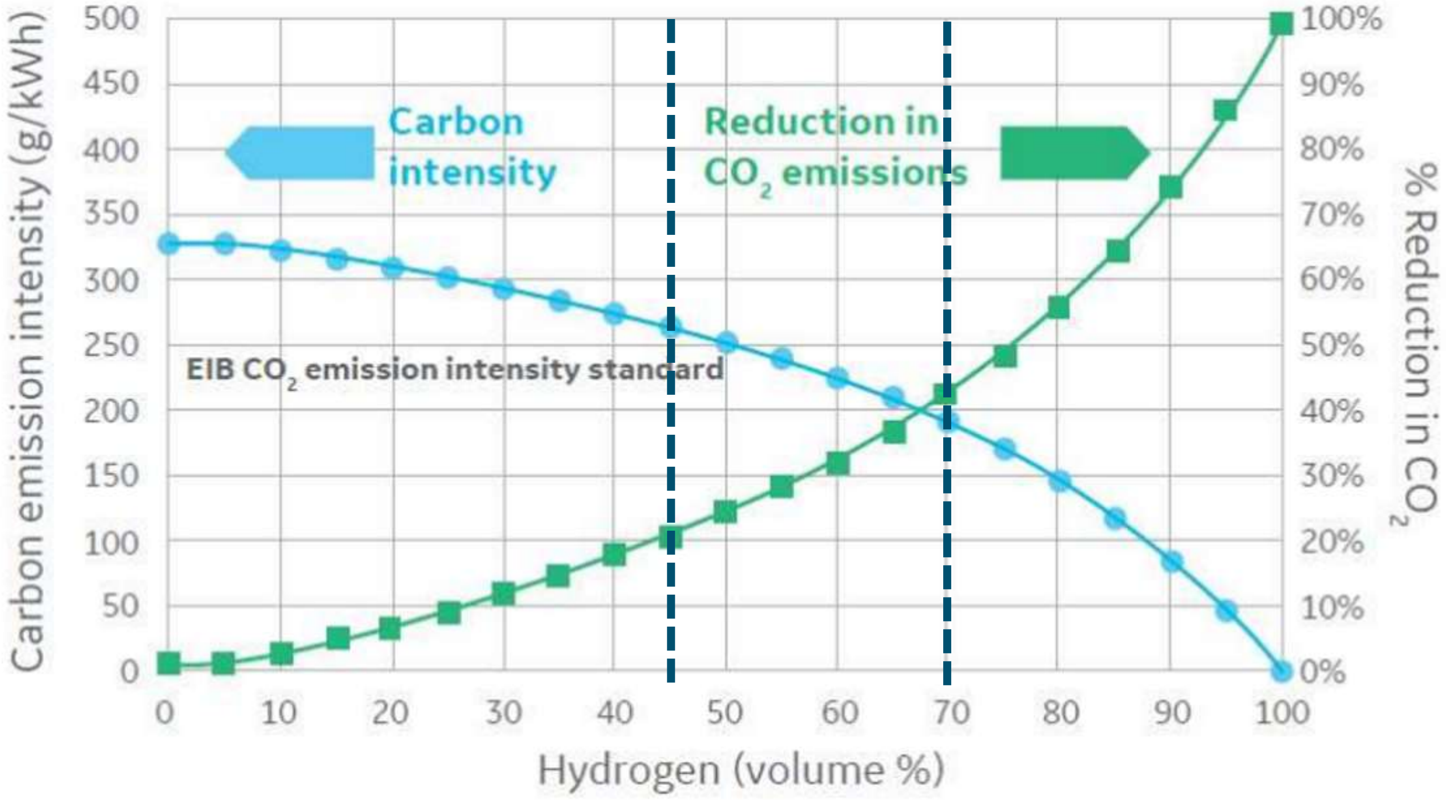
Carbon Reduction Pathway



HyNet Infrastructure

- CO_2 transport and storage facilities
- Low-carbon hydrogen production, storage, network
- Blue Hydrogen 20% of subsidy cost of green hydrogen
- FID taken on CO_2 storage

Hydrogen by volume -vs- carbon reduction



45% by volume = 20% CO_2 ↓

70% by volume = 41% CO_2 ↓

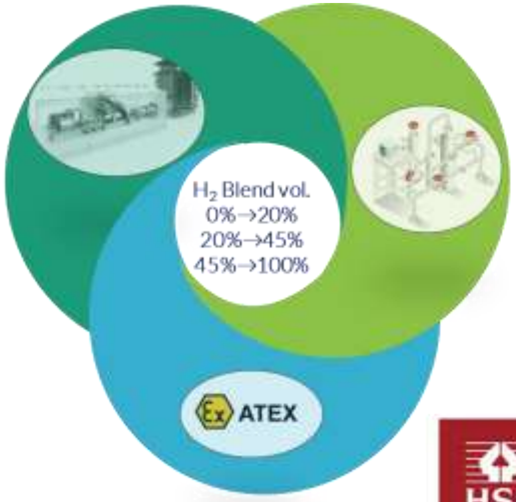
Need to get high % blends for large CO_2 reduction

Project Arrington – Feasibility Studies

Energy for generations

Gas Turbine Systems

ansaldo energia

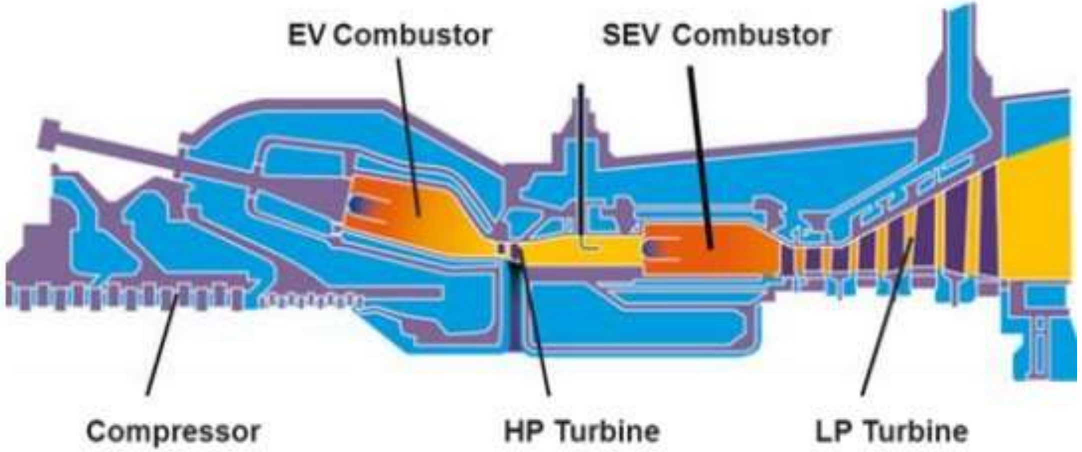


Pipeline Systems

ROSEN

ATEX

HSE Health and Safety Executive



Blending Station → Pipeline + PTFs → GT/ HRSG

Blending Station

- **Integration Study**
- Pre-FEED design
- On-site blending option
- Compression strategy

Pipeline + PTFs

- Gap analysis of existing work
- Scoping of 2nd phase of feasibility
- Pipeline routing options
- AGI modifications at Partington PTF

GT/ HRSG

- BoP development
- Transient/non-routine operation
- Commissioning volumes

GT26 100% H2 roadmap

Project start

Current capability:
45% H_2

MXL3 2nd stage burners

Ready for engine test
@ 60% H_2

NEW 1st stage burners

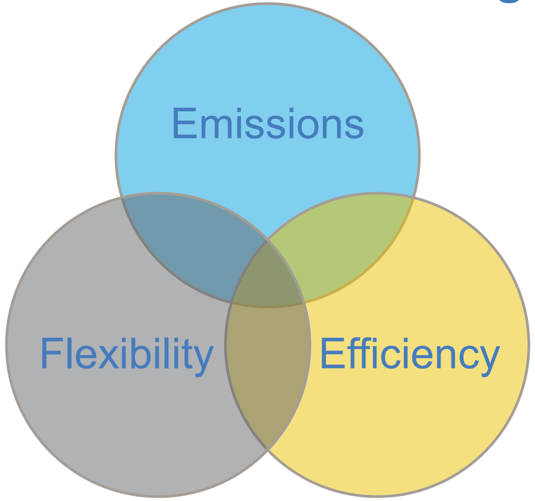
1st stage burner

2nd stage burner

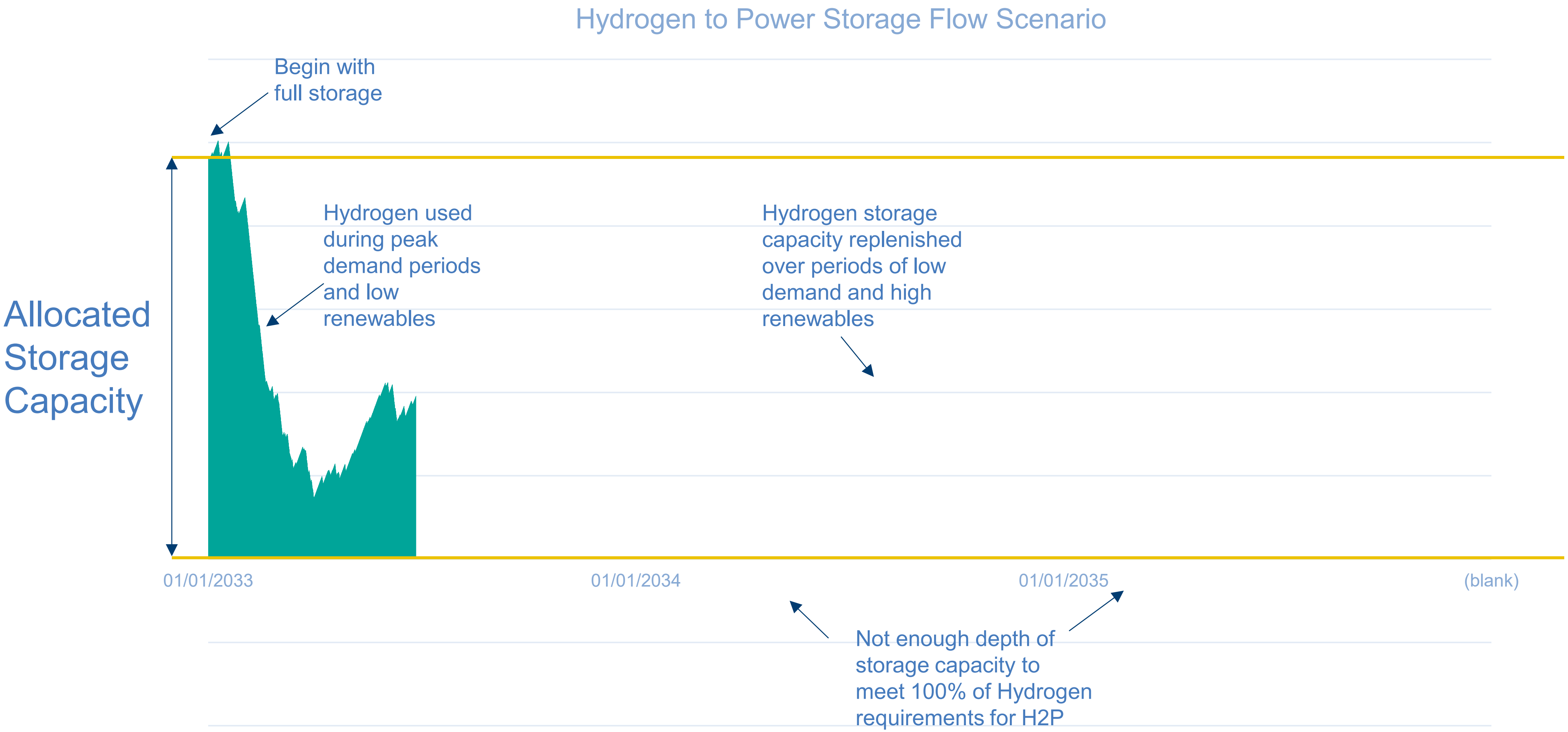
Ready for engine test
@ 100% H_2

NEW 2nd stage burners

H2 Combustion Challenges

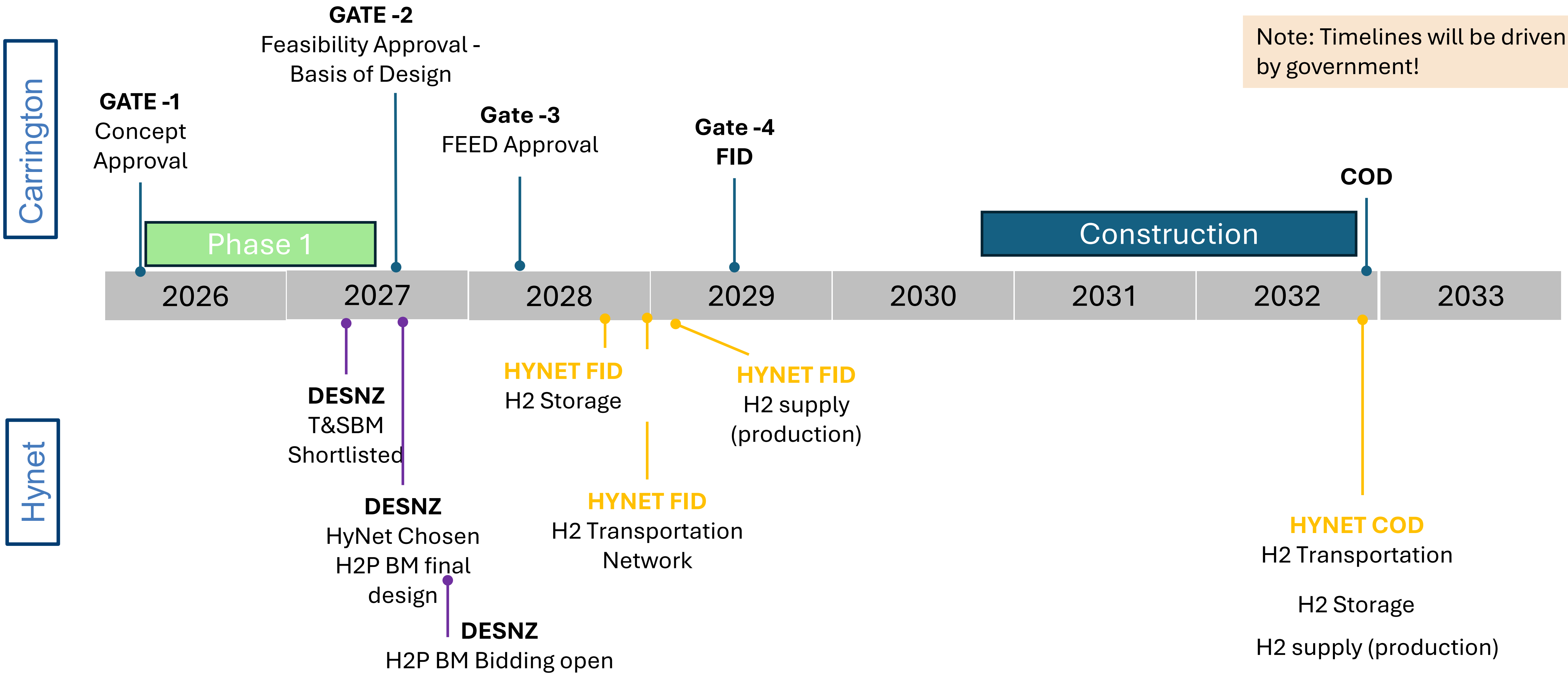


Importance of Hydrogen Storage for Dispatchable Power



HyNet Delivery Timelines – Cluster Sequencing

Note: Timelines will be driven by government!



*Updated Feb 2026 based on the latest information.

Hydrogen Ireland Calendar of Events 2026

Energy for generations

- 2nd July Webinar ***Clean hydrogen not at all costs, not at any cost but at the right cost* -** Host Pinsent Mason

- 26th August Webinar ***Hydrogen in a net Zero Power System***- Host ESB

- 10th September Webinar ***Beyond the Grid: Clean Hydrogen Pathways for Data Centres* -** Host Bord Gáis

- 14th October Workshop **Hydrogen Ireland 2026: *Delivering Demand, Security and EU-Aligned Deployment*** Host GNI

- 18th -19th November International Conference **H_2 SUMMIT Securing Europe's Energy Future - *Hydrogen for Energy, Industry and Data Resilience in a Connected Europe***

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Data Resilience in a Connected Europe
18-19 November 2026 | Fota Island Resort, Cork