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Clarke Energy – H_2 Reality Check

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2. H_2 Applications – Reality Check!
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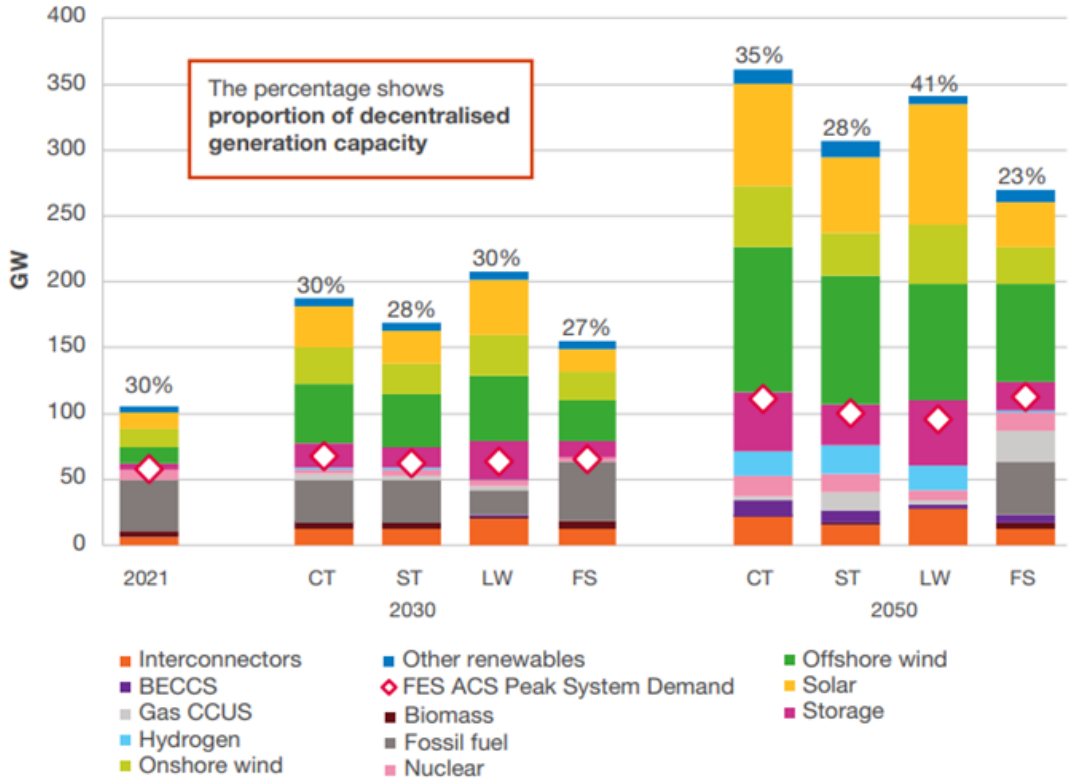
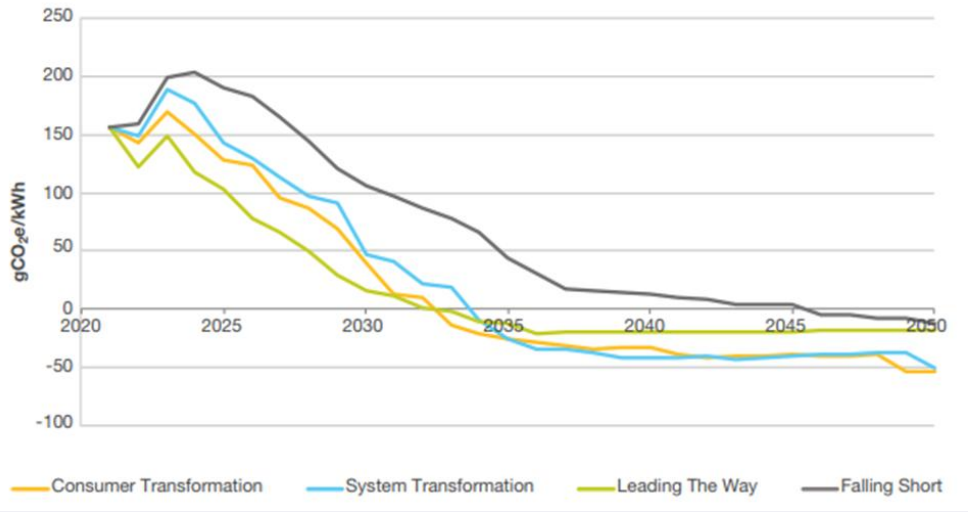
Decarbonising our Supply

Focus on an integrated system that offers maximum flexibility during operation

System Demand & Carbon Intensity in Net Zero Britain



Source: National Grid: Future Energy Scenarios



Net zero by 2050 is achievable with immediate action, but the window to act is closing.

Market evolution, providing incentive for investment in flexible, zero carbon, generation is key.

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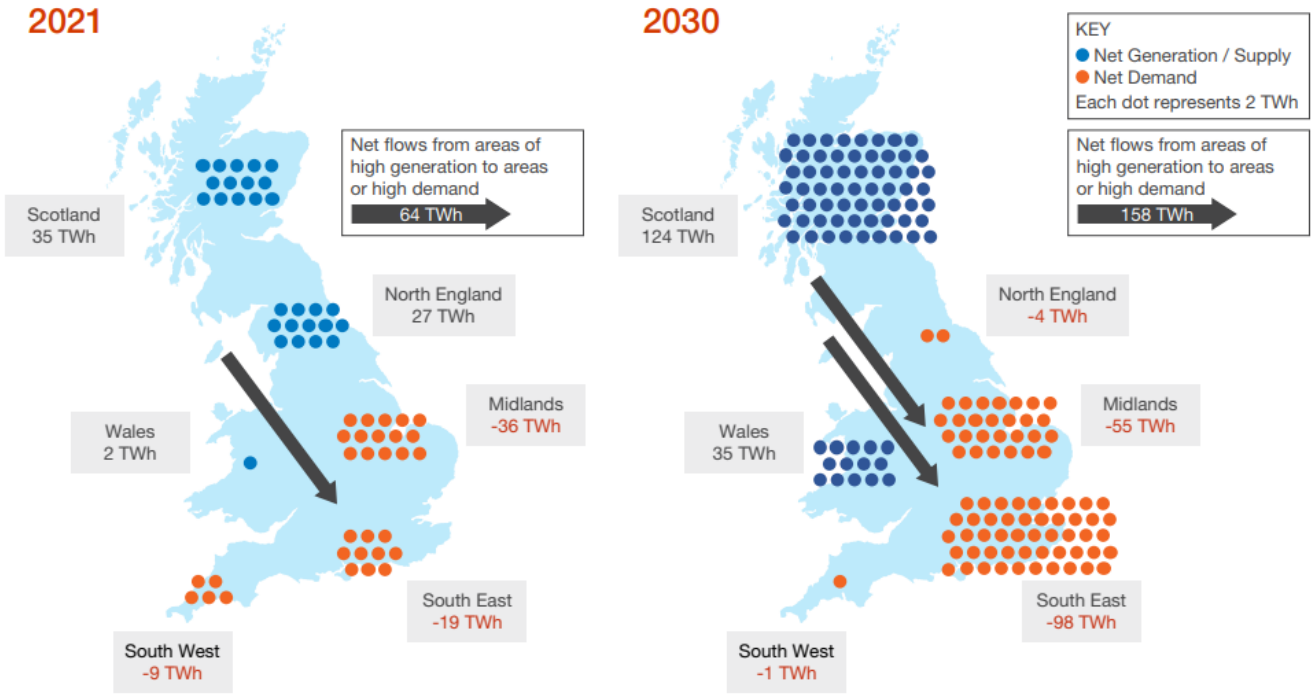
Transforming our Electricity Networks



Source: National Grid: Future Energy Scenarios 2022

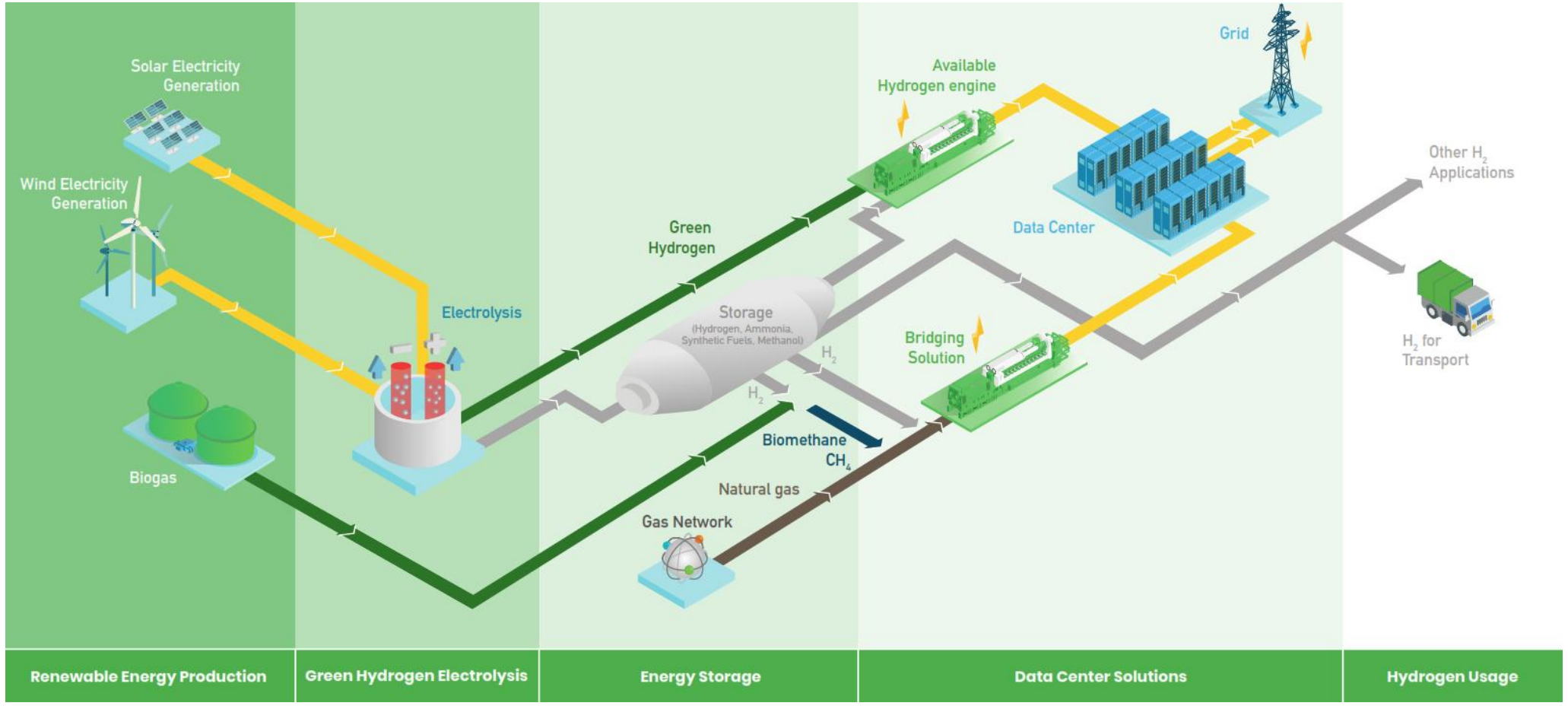
Balancing system demand with supplies, through a constrained system, will be critical to achieving Net Zero.

Approaching 2030, we see an increase in renewable generation in the North and significant increases in demand further South through electrification of heat and migration to electrified transport.

The risk is that existing System Constraints might limit our Net Zero future.

Scotland will become the UK's energy hub as we continue toward 2050 but system-wide transformation is required to ensure supply can be moved!

Gas as a Path to Net Zero



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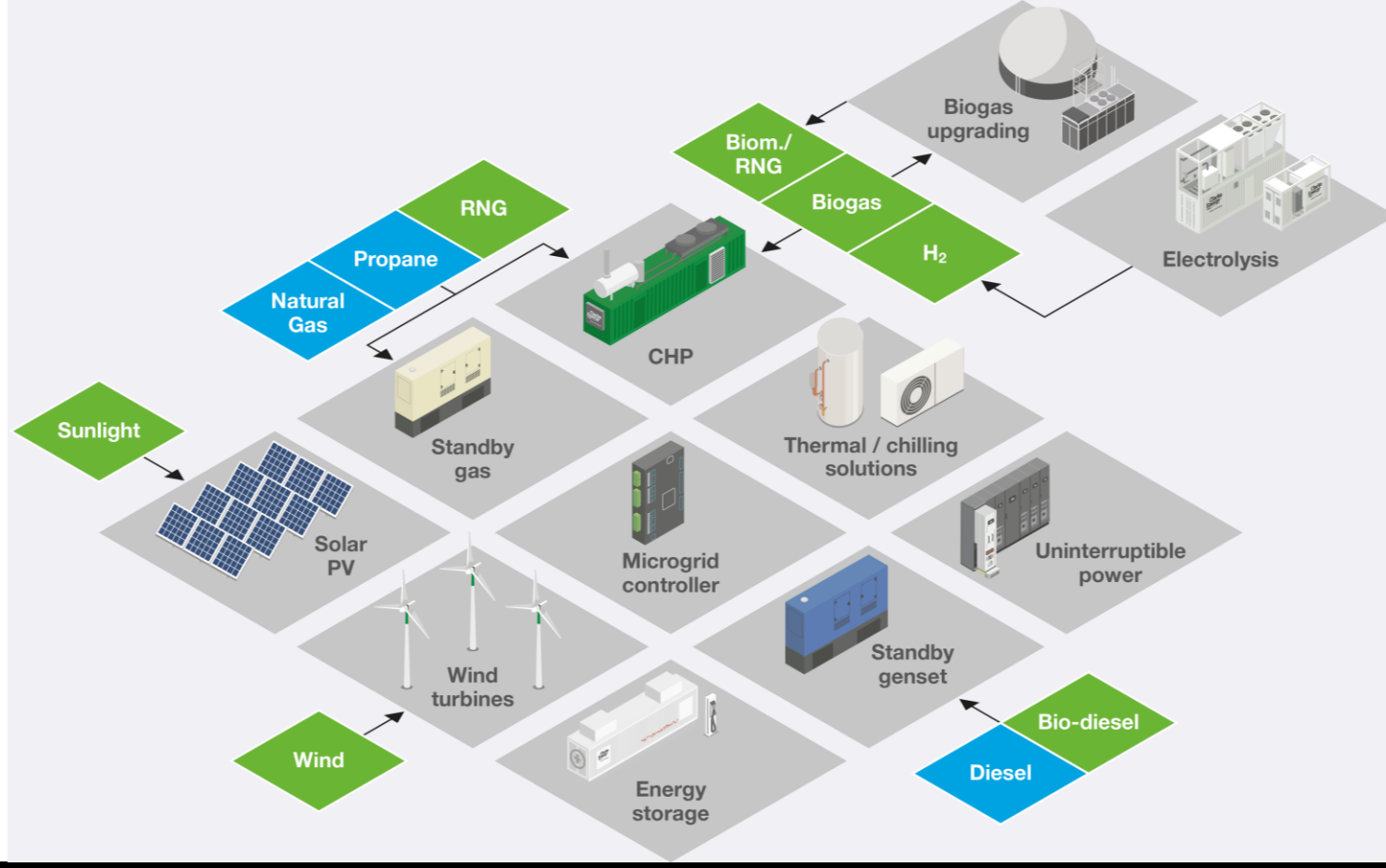
Clarke Energy Products and Applications



Gas engines, battery energy storage systems, biogas upgrading and electrolyser technologies for an integrated energy system

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Flexible Delivery Model

Innio Jenbacher Gas Engines

A Jenbacher gas engine module configured for electricity generation and/or recovery of both electricity and heat, utilising a range of renewable and non-renewable gaseous fuels

$0.25MW_e$ – $10.50MW_e$

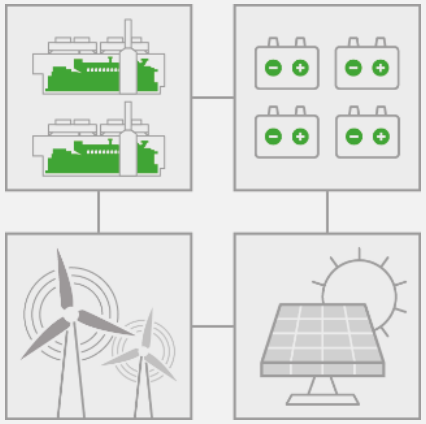
Battery Energy Storage Systems

Clarke Energy can offer either fully-wrapped or Balance of Plant style contracts for a range of BESS suppliers and integrators

10MW – 400MW

Hybrid Energy Solutions

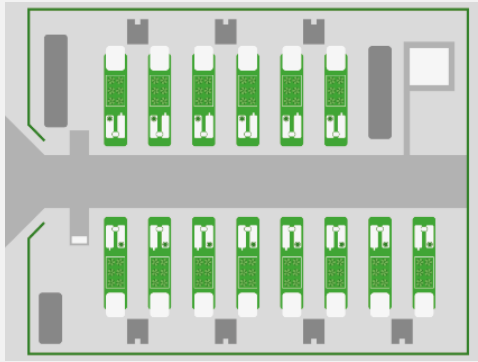
Clarke Energy can incorporate different power generation and storage technologies, alongside renewables and control software to optimise generation within a turn-key microgrid



Biomethane Upgrading / Electrolysis Plants

Clarke Energy can supply turn-key installation of renewable gas production facilities.

Electrolyser plants up to 10MW range and biomethane upgrading up to 5,000Nm^3/h



H_2 Applications – Reality Check

Clarke Energy can support a range of hydrogen applications, from production of to power generation, working with global equipment suppliers to deliver exactly what our customer’s require

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Jenbacher H_2 Gas Engine Categorisation

JENBACHER
INNIO
Distributor New Units & Services

A

H_2 in natural gas pipeline

A-1: Low H_2 blending
Optimised for natural gas
<5% H_2 (v/v)

A-2: Medium H_2 blending
Broad product
5-25% H_2 (v/v)

B

H_2 local admixing

B-1: Special gas engine
Operational optimised
up to ~60% H_2 (v/v)

B-2: Natural gas / H_2 engine
Dual gas engine to 100% (v/v)
Natural gas / H_2

C

Pure H_2

C: H_2 engine
Hydrogen engine (H_2)
100% H_2 (v/v)

Conventional natural gas + H_2 fuel mixture boosted system

H_2 fuel injection system

Available for existing versions

Available for existing versions

Available for existing versions

Special release engines available

Special release engines available

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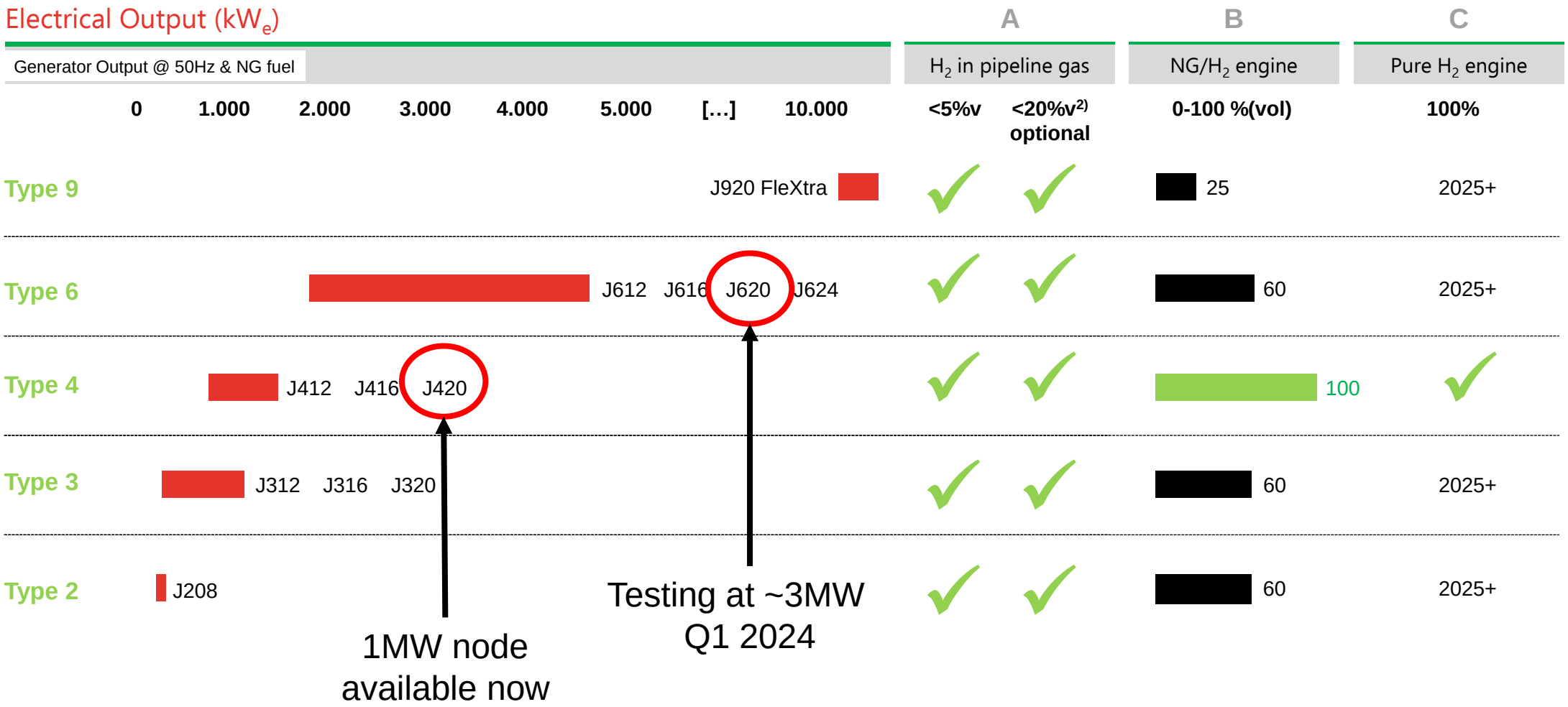
Jenbacher Product Portfolio

JENBACHER
INNIO
Distributor New Units & Services



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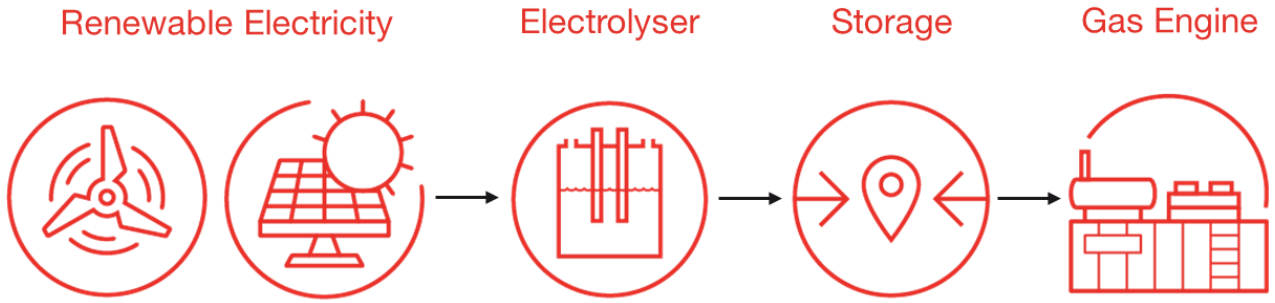
Hydrogen Operation



H_2 blend (%)	Renewable Electricity (MW_e)	Electrolyser (kg H_2 / hr)	Gas engine (/MW_e)	CO_2 saving vs 100% natural gas (%)
20%	0.25	5	1	7
50%	0.80	16	1	22
100%	3.75	75	1	100

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Fuel Cells and Electrolysers

Initial overview of fuel cell and electrolyser opportunity in the UK market

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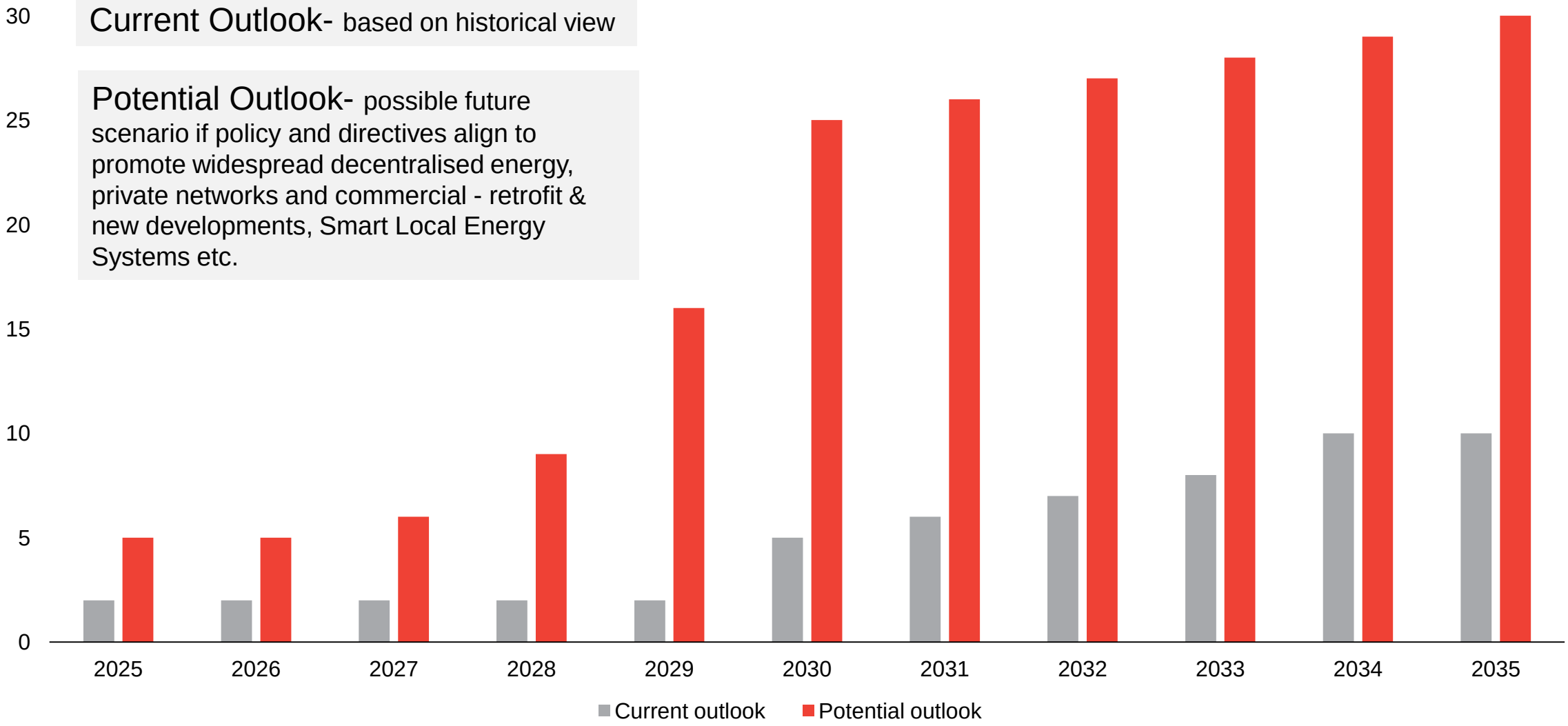
Fuel Cell Market Estimates UK (No. projects)

Current Outlook- based on historical view

Potential Outlook- possible future scenario if policy and directives align to promote widespread decentralised energy, private networks and commercial - retrofit & new developments, Smart Local Energy Systems etc.



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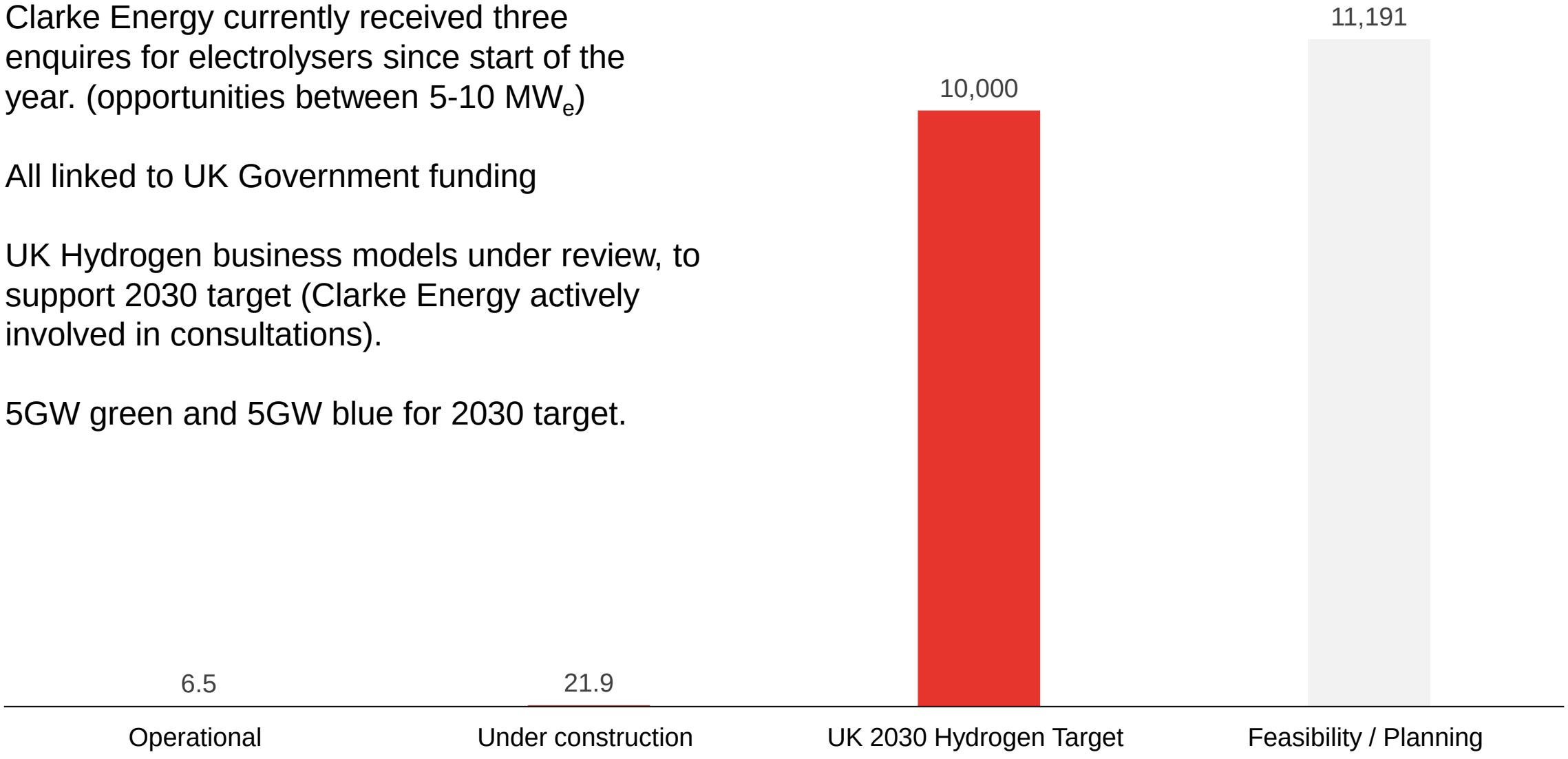
Electrolyser Market UK (MW_e)

Clarke Energy currently received three enquires for electrolysers since start of the year. (opportunities between 5-10 MW_e)

All linked to UK Government funding

UK Hydrogen business models under review, to support 2030 target (Clarke Energy actively involved in consultations).

5GW green and 5GW blue for 2030 target.



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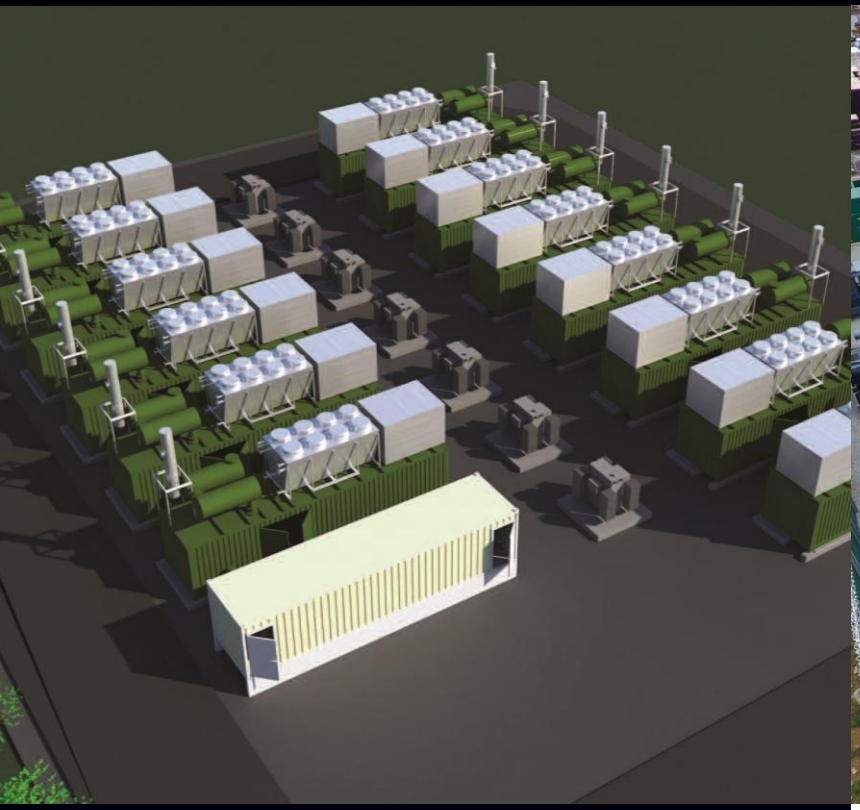
H_2 Projects – Some Progress



FACILITY ENGINEERING

PROCUREMENT AND CONSTRUCTION

RELIABLE AFTERSALES SUPPORT

Data Centre Power Solutions

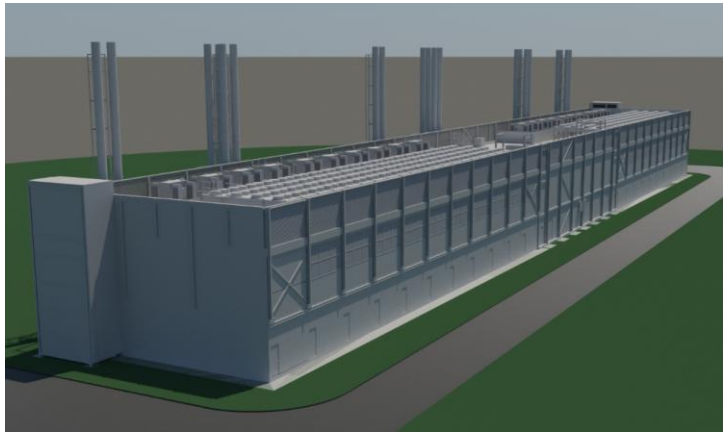
Ready for Hydrogen

Dublin 1 – Back-Up Power

Decarbonisation of back-up power

60MW gas-fired, high-transient back-up power solution, to a hyperscale data centre. Each 3MW node can achieve full load in 45s.

Entering commissioning phase

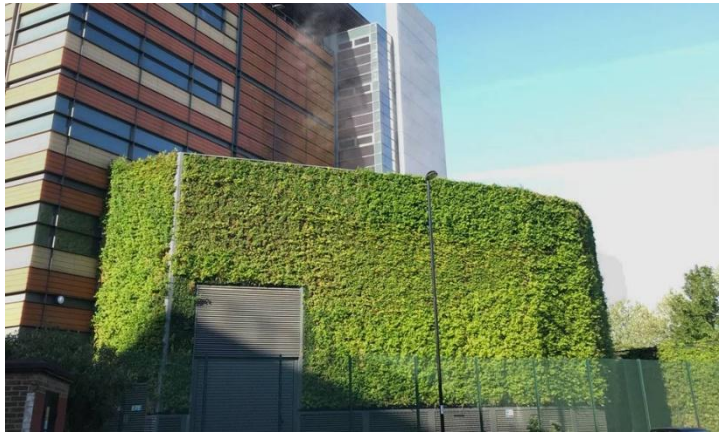


Dublin 2 – Baseload Gen

Grid constraints necessitating prime power

80MW gas-fired island mode energy centre providing base load generation to a hyperscale colocation provider. Scalability built around 4.5MW nodes.

In construction



London 1 - Trigeneration

Driving data centre efficiency, sustainably

3MW gas-fired trigeneration solution providing base load generation and chilled water to a global bank's data centre operations

In operation since 2015

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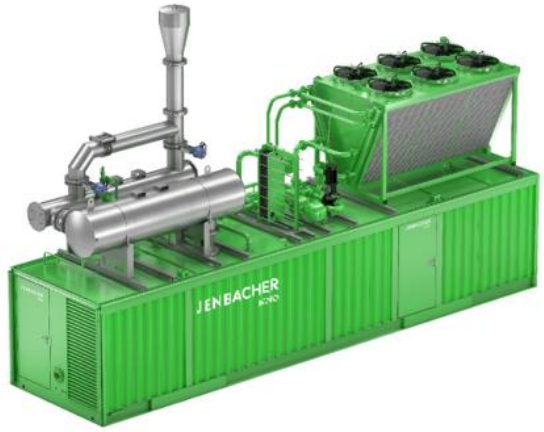
NorthC DATACENTERS, EINDHOVEN, NL

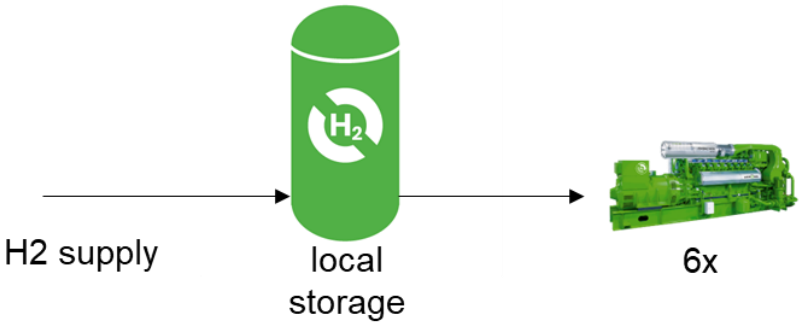
First data centre with H_2-Engines for emergency back-up

NorthC Datacenters

- Small scale regional DC in Netherlands, Germany & Switzerland
- 6 MWe … standby power based on **6 x 1 MWe H_2-Engines** (JGC420)
- Dual fuel H_2-Engines (pipeline gas as back-up fuel)
- H_2 as main fuel from local H_2 storage until H_2 pipeline is available
- Pipeline gas as back-up fuel in case of longer grid failures

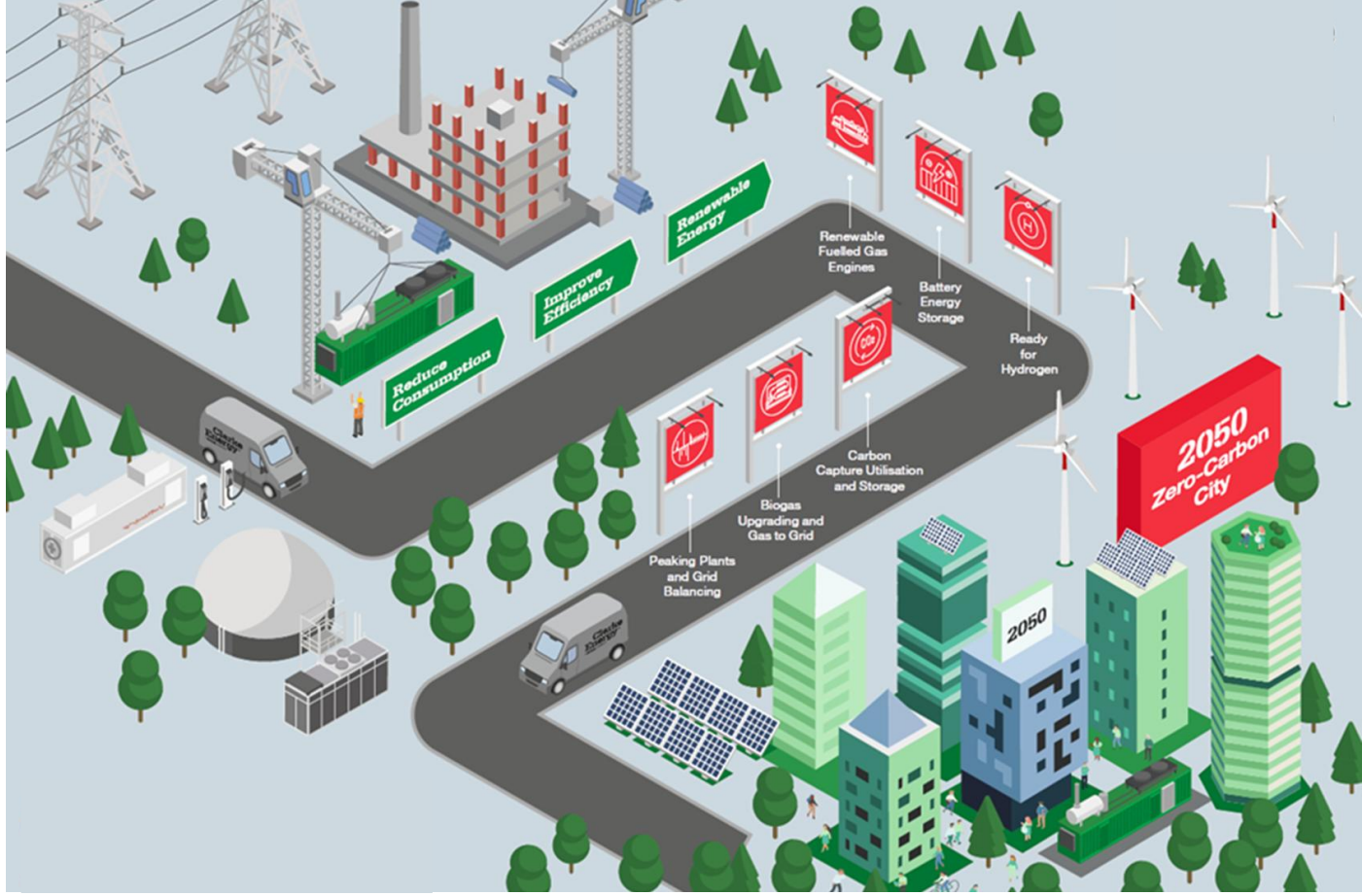
NorthC Eindhoven





ready for HYDROGEN

Clarke Energy - Supporting Net Zero



Engineering sustainable, resilient and energy efficient installations, then servicing those assets through life – all whilst supporting the transition to net zero carbon

Supporting Net-Zero

Renewable Electricity Enablement

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