SCOTTISH Hydrogen & Fuel Cell ASSOCIATION

www.shfca.org.uk

Scaling up Hydrogen across Scotland now for Net Zero by 2045

> Dr Nigel Holmes CEO, SHFCA

Scaling up Hydrogen across Scotland



Scotland has a target for Net Zero by 2045, and annual electricity demand is now almost all met by renewables. Hydrogen Valleys are developing in Orkney, Aberdeen, Levenmouth in Fife, and the port of Cromarty region:

- Mobility & Logistics: Aberdeen H₂ fleets with Aberdeen H₂ Hub
- Industry: Cromarty Green Port, Aberdeen ETZ, Grangemouth/Fife
- Heat: key evidence to deploy 100% H₂ for heat with H100 Fife trials

Scotland is now scaling up hydrogen production and demand, with the ambitious target for 5GW low carbon hydrogen production by 2030.

Further scale-up will support Just Transition from fossil fuels to low carbon energy, with opportunities for partnerships and sharing experience.

Our Contribution to Stopping Global Warming

Scotland's target: Net Zero by 2045

Year	Scottish CO ₂ Reduction	
2030	75%	
2035	80%	
2040	90%	
2045	100%	

2009 Climate Change (Scotland) Act set an ambitious stretch target for 42% GHG reduction by 2020







Scotland's Transition to Low Carbon Electricity

AN INCLUSIVE ENERGY TRANSITION

Proportion of electricity generation by fuel type in 2018 (BEIS data)





Energy Statistics for Scotland: Q4 2020 Figures (March 2021)







Scapa Flow

SITE	DEVELOPER	CAPACITY	
Robin Rigg	RWE Renewables	174MW	
Hywind Scotland	Equinor	30MW	
Aberdeen Bay	Vattenfall	93MW	— 0.89 GW
Levenmouth	ORE Catapult	7MW	
Beatrice	SSE/Red Rock Power	588MW	
Kincardine	Cobra	50MW	
Moray East	Ocean Winds	950MW	
NNG	EDF Renewables/ESB	448MW	
Seagreen 1	SSE Renewables/Total	1075MW	
Inch Cape	Red Rock Power	1000MW	
Moray West	Ocean Winds	850MW	— 1.9 GW
ForthWind	Cierco	12MW	
Berwick Bank	SSE Renewables	2300MW	
Marr Bank	SSE Renewables	1850MW	4.15 GW

Current Wind Farms (total 9.4GW) By status







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The Hydrogen Office at Levenmouth



Levenmouth Smart Energy System at the Hydrogen Office & FRIC

The Hydrogen Office opened in 2011 and has provided education & outreach to over 30,000 pupils and students in Fife

2017: Levenmouth Smart Energy System TOSHIBA Leading Innovation W



Next steps: Consumer Acceptance with H100 Fife



Energy Park Fife









100% H₂ for household heating & cooking

- Demonstration of safety, technical R&D
- Households can make a positive choice to join the H100 trial
- Match supply/demand in representative and scalable network
- Quantified risk to inform household conversions
- Market creation and key learning of customer acceptance



Proving safe use of 100% H_2 for heat

The Fife 'Hydrogen Coast' and H100 Demonstration







The costal area of Fife just north of Edinburgh is an ideal location for testing and proving hydrogen production, storage, & use



Scottish Hydrogen Fuel Cell Train Development

Convert existing rolling stock from electric to H2 fuel cell Arcola Energy lead partner ARC, ARUP, & AEGIS partners Ballard fuel cell power Trials at Bo'ness railway in early 2022





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Here Clean Hydrogen for Fuel Cell Bus Fleet



Some of Aberdeen's 65+ Hydrogen Vehicle Fleet which includes fuel cell and H2 internal combustion power

€22m FCH-JU project

- Started March 2015
- 10 x Van Hool FC buses
- 2 million passengers
- 1.1 million kilometres
- 89% bus availability
- 200+ tonnes H2 used
- 10-12 mins refuel time
- >98% HRS availability





Herdeen Locally Produced Hydrogen for Bus Fleet



The Kittybrewster HRS in Aberdeen is one of the most intensively used in Europe, dispensing on average 35 tons of hydrogen per year for the past 5 years. Project supported by FCH JU & EU.



Hydrogen produced at the Kittybrewster site using three Hydrogenics (Cummins) electrolysers, with two BOC Linde ionic liquid compressors for ultimate reliabilty.





Herdeen Building the Ambition with Aberdeen H2 Hub

25 October 2021: Aberdeen City Council announces bp as its preferred bidder for a commercial partnership accelerate the city's ambitions to become a world-class hydrogen hub.

A key part of the programme will involve the creation of Scotland's first scalable green hydrogen production facility.

If the hydrogen hub enables the export of renewable hydrogen, then 700 skilled jobs could be created locally in the hydrogen industry by 2030.



Louise Kingham OBE of bp with Aberdeen City Council Leader Laing



OCOCO: Early H₂ production & use at the existing St Fergus gas terminal



Multiple pipelines, stores and a shipping option designed for maximum deliverability from day one, with built-in resilience.



DolpHyn 10MW Floating Offshore Wind & Hydrogen

10 MW Turbine (Floating Deepwater) 20 X 20 Array 4 GW (future layout)



Energy Transition Zone - Hydrogen Campus Concept Green Hydrogen Test & Demonstration Facilities

- Business incubation & Technology acceleration
- Electrolyser Manufacturing
- Clean Fuels Metrology Centre



SALAMANDER

200 MW pre-commercial 'stepping-stone' floating offshore wind project

Just east of St Fergus, Aberdeen

Exploring multiple potential routes to market including green hydrogen production

MoU with ERM, for ERM Dolphyn

Exploring options with SGN

Links into Aberdeen ETZ

https://salamanderfloatingwind.com/

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Orkney: >100% Green Electricity

Renewables generate > 100% of Orkney's electricity

Over 50MW of installed renewable capacity

>1000 renewable installations for 10,000 households



By 2014 Orkney was generating 120% of its annual electrical demand from Renewables



BIGHIT Green Hydrogen for heat, power, & transport

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Orkney: Growing the H₂ Portfolio



Next steps with H₂ for marine, aviation, and industry

Zero Emissions H2 Aviation Trials in Orkney

HyFlyer1 ZeroAvia 6-seater zero-emissions aircraft. Trials at Cranfield in July 2020.

Britten Islander 9-seaters already used in Orkney Islands. The project Fresson H2 version flight trials are planned for 2022.

Kirkwall Airport: Sustainable Aviation Test Hub

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H2-ICE genset for heat and power

Cromarty: Green Hydrogen Hub

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The UK's contribution to

stopping global warming

Net Zero

One of Scotland's largest natural harbours and connection point to offshore wind power

Building local industry demand for green H2

SCOTTISHPOWER

5 March 2021: Port of Cromarty Firth and ScottishPower launch the North of Scotland H2 Hub with 35MW electrolysis capacity

Next Steps: Green H₂ for Glasgow

Green Hydrogen for Glasgow: 20MW electrolysis at ScottishPower's Whitelee wind farm, the UK's largest onshore wind farm located near Glasgow. This facility will be able to produce up to 8 tonnes of green hydrogen per day, which will be used for decarbonising transport across Glasgow.

Clean Energy Project **Shetland** ORION Clean Energy Project Green H₂ from onshore & offshore wind Repurpose Sullom Voe oil & gas terminal

https://www.orioncleanenergy.com/

European Hydrogen Market Supply & Demand in 2050

Hydrogen will be crucial to ensure that Europe becomes a climate-neutral continent (EHB study, June 2021

Scaling up Hydrogen across Scotland

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Scaling up green hydrogen production and demand, with much of Scotland's 5GW low carbon hydrogen by 2030 likely to be from offshore wind.

Further scale-up will support Just Transition from fossil fuels to low carbon energy, with opportunities for partnerships and sharing experience.

Building a Hydrogen Economy Learning and Sharing Experience Scaling up Now for Net Zero

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Contact for further information

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