



Shetland
Islands
Council

Future Hydrogen Production in Shetland



Agenda

- Shetland Statistics
- Main Wealth Creating Sectors and Employment
- Energy Resources
- Energy Use – Our Carbon Footprint
- The Opportunity for Change
- Our Ambition – the ORION Project
- Shetland Energy Futures Map
- Taking the First Steps into Commercial Hydrogen Production
- Our Action Plan

Shetland Statistics

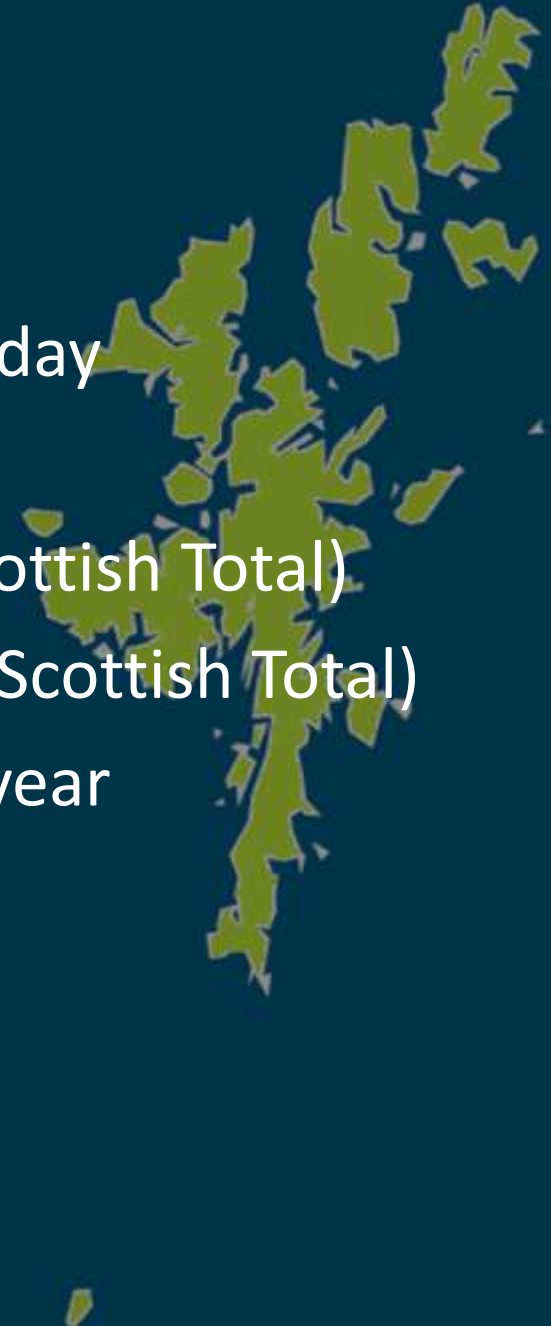
- 22,000 people living in 16 islands
- Lerwick, population 7,000, is the main centre and port
- Annual Economic Production - £1.1 Billion
- 1697 miles of coastline
- 225 miles from Bergen
- 211 miles from Aberdeen



Main Wealth Creating Sectors

- Oil and Gas – 200,000 barrels of oil equivalent per day
- Fishing – 123,000 tonnes of fish landed annually
- Salmon Farming – 40,000 tonnes a year (25% of Scottish Total)
- Mussel Farming – 6,500 tonnes a year (75% of the Scottish Total)
- Agriculture – 90,000 lambs/sheep exported every year

83% of the population are economically active

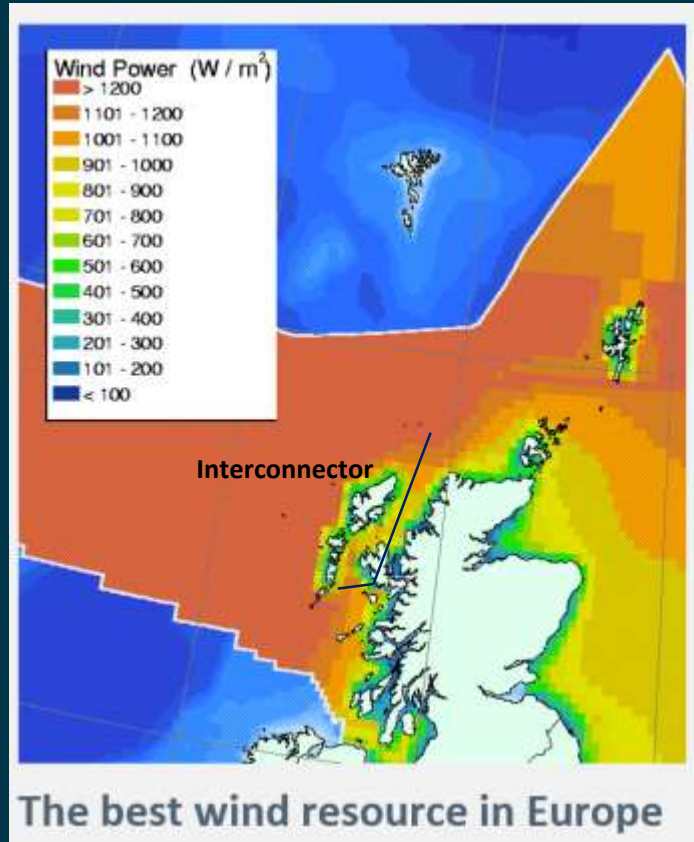


Wealth Creating Sector Employment

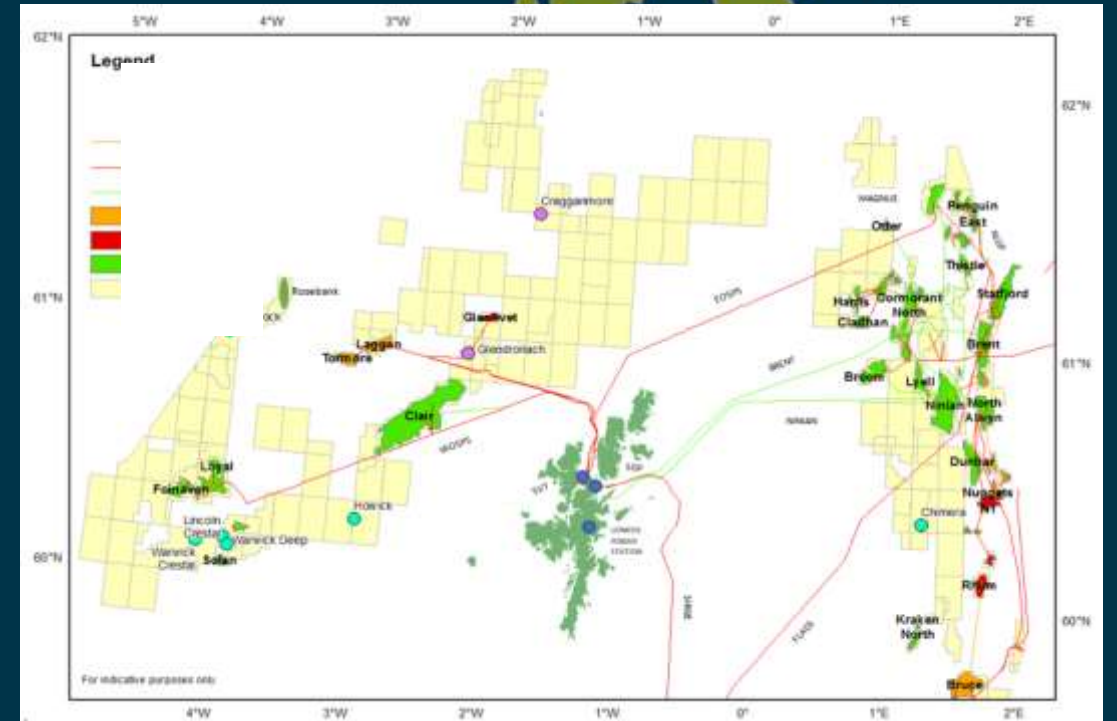
- Oil and Gas – 1000 FTE
- Fisheries and Aquaculture – 1200 FTE
- Agriculture – 500 FTE
- 30% of Shetland's 9000 FTE workforce



Our Energy Resources



Onshore and Offshore Wind Resource

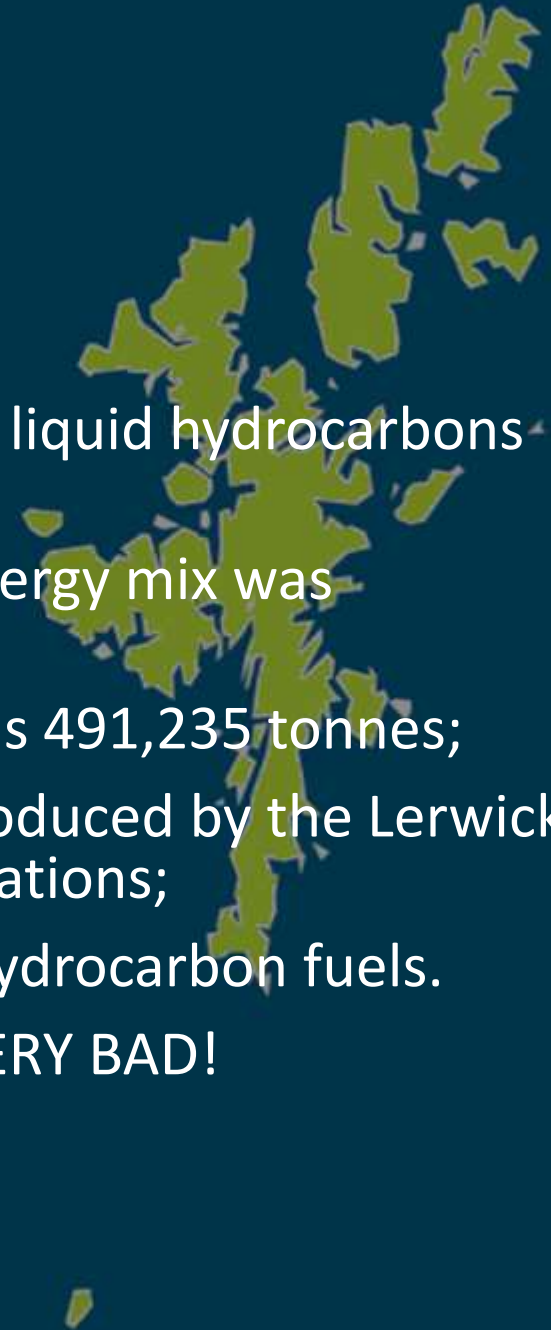


Oil & Gas Infrastructure Hub

Key components available to supply both local and regional clean energy

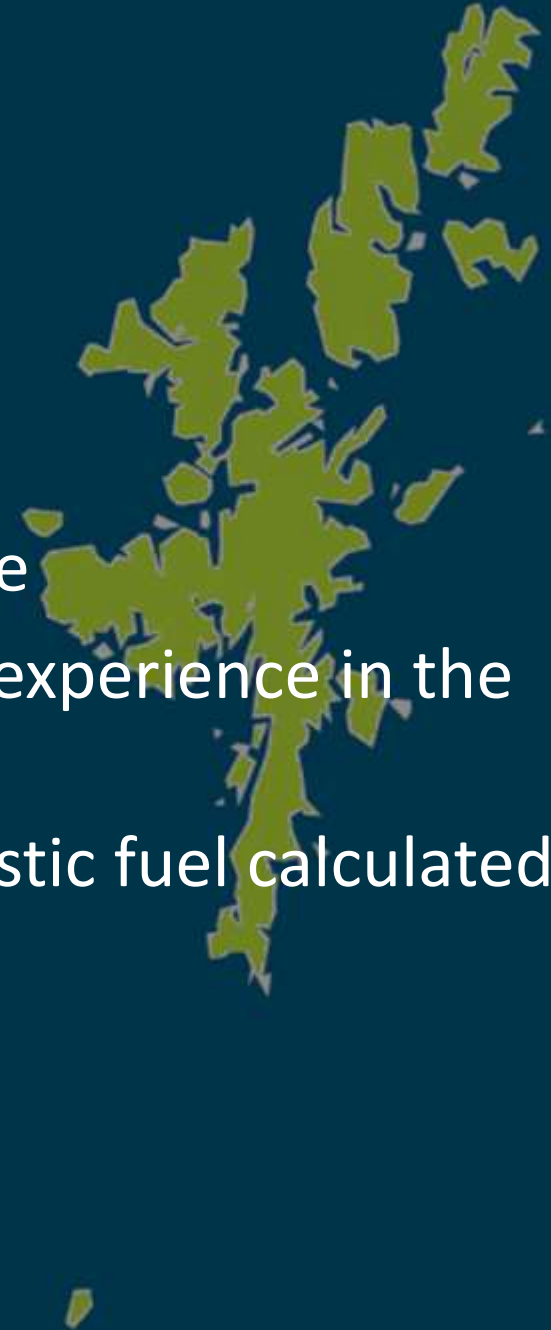
Our Energy Use

- On-island energy use in 2018 was 1,222 GWh;
- 78% of the total energy supplied was in the form of refined liquid hydrocarbons (Marine Gas Oil, Diesel and Petrol);
- The total renewable heat and power contribution to the energy mix was 95.19GWh, 8% of the total energy supplied in Shetland;
- The total CO₂ emissions from Shetland's energy sources was 491,235 tonnes;
- 13% of the energy consumed in Shetland was electricity produced by the Lerwick (oil fuelled) and Sullom Voe Terminal (gas fuelled) Power Stations;
- Shetland consumers spend £58M a year on refined liquid hydrocarbon fuels.
- Carbon Emissions - 17 tonnes of CO₂ per capita annually, VERY BAD!
- Scottish annual per capita carbon emissions – 5.3 tonnes



The Opportunity for Change

- World-class wind resource for base energy
- Commercial experience in renewable energy
- PURE Energy Centre Hydrogen Production expertise
- An engineering supply chain with over 40 years of experience in the oil and gas industry
- An annual local market for road, marine and domestic fuel calculated at around £50M in 2018



Our Ambition – The ORION Project

Onshore Green Hydrogen



ORION funding LOHC study

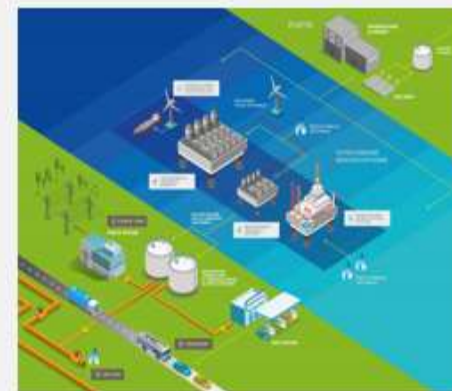


Marine fuel bunkering
H2/Ammonia

Offshore Green Hydrogen



Repurpose EOS
offshore infrastructure



HOP Phase 1 Project



Potential up to 1GW
Onshore wind potential



Sullom Voe Port jetties used for
H2 export



ScotWind License Round
East of Shetland 2GW potential

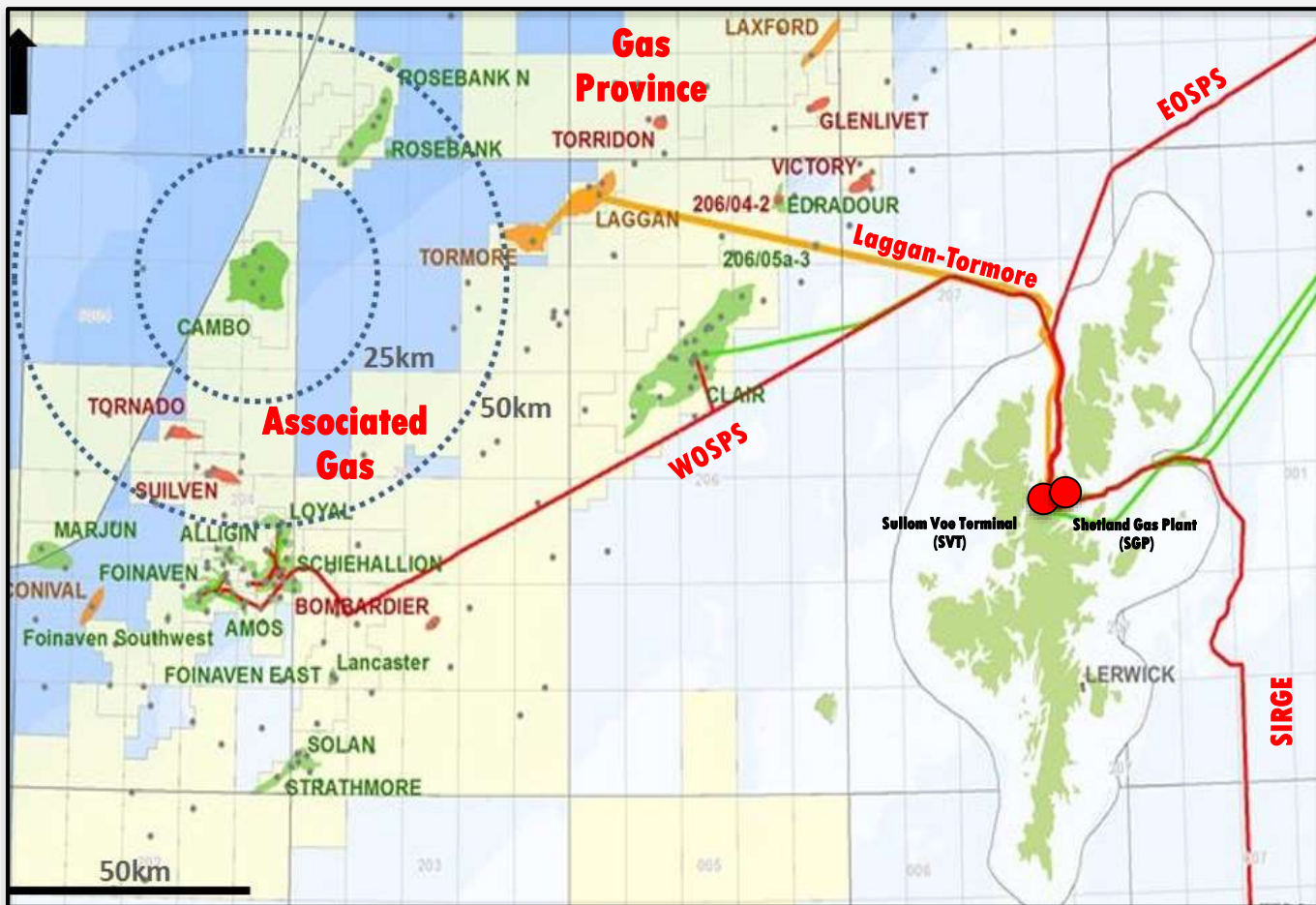


Dales Voe support offshore
Wind industry

Objectives

Hydrogen	Supply 32TWh of low carbon hydrogen annually, 12% of the expected UK total requirement, by 2050
Transform	Produce green hydrogen, utilizing wind and tidal energy, to fuel domestic heating, road, and marine transportation in Shetland
Electrification	Provide more than 3GW of wind generated electrical power to Shetland, the UK grid, generating green hydrogen and electrification of the offshore oil and gas sector
Net Zero	Enable all West of Shetland hydrocarbon assets to be net zero by 2030 and abate 8Mt/year CO2 by 2050
Revenue	Generate £5bn in annual revenue by 2050 and contribute significantly to the UK Exchequer
Employment	Provide sustainable employment for 1,750 people, both regionally and locally, whilst maintaining a pristine environment

Transformational objectives both locally and regionally



West of Shetland (WOS) Gas Reserves & Resources

Reserves	1.0 TCF
Discoveries	2.0 TCF
Prospects & Leads*	2.5 TCF
Plays*	10.0 TCF

**unrisked*

Based on OGA Reserves & Resources Report 2018

- **Significant gas reserves and resource in region**
- **Most active exploration area in the UKCS**
- **Available gas pipeline infrastructure in place**
- **Onshore terminals at Sullom Voe in Shetland**

Blue hydrogen



Natural Gas

Gas supply from Laggan Tormore gas condensate fields and associated gas from West Shetland current oil production e.g. Clair and future developments providing about 10% of UK current gas supply exported to St Fergus



Industrial Site

Sullom Voe Oil & Gas Terminal (1000 acres) with 50% site currently not used, Shetland Gas Plant Site with (133 acres), Sullom Voe port with loading and construction jetties and Scatsta airport for both helicopter and fixed wing operation



Export

There are two options for hydrogen export namely by pipeline mixing with natural gas in SIRGE and FUKA, via EOSPS pipeline system, or export by tanker via Sullom Voe port using LOHC, ammonia or methanol



CO2 Transport

CO2 transportation is primarily a bi-product from blue hydrogen production utilizing current pipeline infrastructure such as EOSPS or redundant oil lines or liquified tanker export



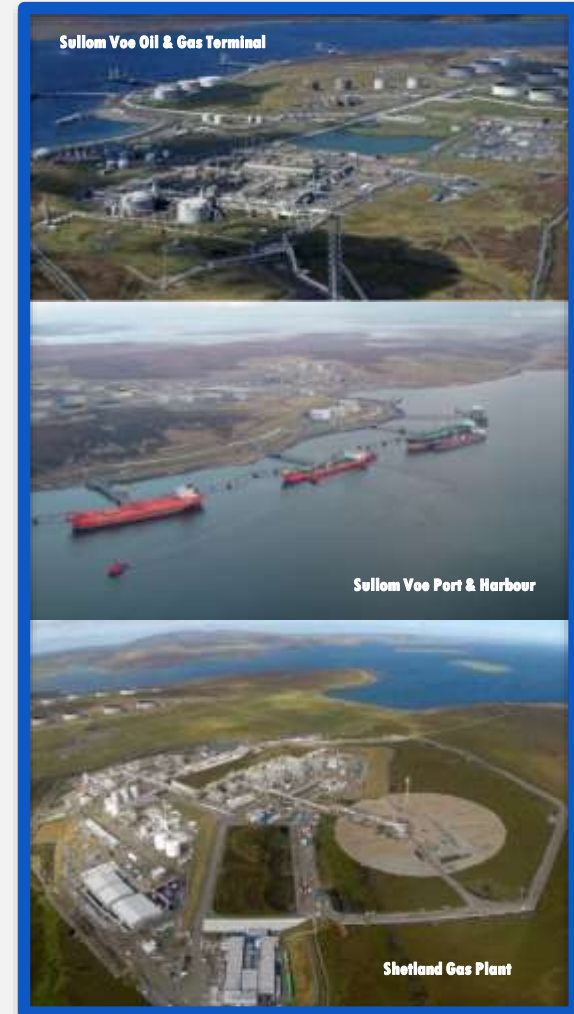
CO2 Storage

CO2 flood for EOR at Magnus or stored in East of Shetland depleted oil and gas fields such as Frigg and Brent







Workforce

Skilled workforce and supply chain with more than 40 years experience in the Oil & Gas sector & associated industries



All key ingredients available for production of blue hydrogen

Green hydrogen

- **Offshore Wind** **Offshore wind energy source (2GW+) converted to electricity and exported to shore utilizing an offshore gathering station to produce hydrogen onshore**
- **Repurposing** **Removal of topsides during decommissioning of mature East of Shetland (EOS) oil fields and repurposing for hydrogen production utilizing offshore wind**
- **Onshore Industrial** **Onshore wind and tidal power electrifying SVT, SGP and port facilities with surplus output (200MW+) to produce H2 for conversion into marine fuel or H2 derivatives**
- **Onshore Local** **Onshore wind power to create hydrogen, utilizing curtailed wind, for use in fueling heavy duty vehicles, home heating & power and aquaculture**

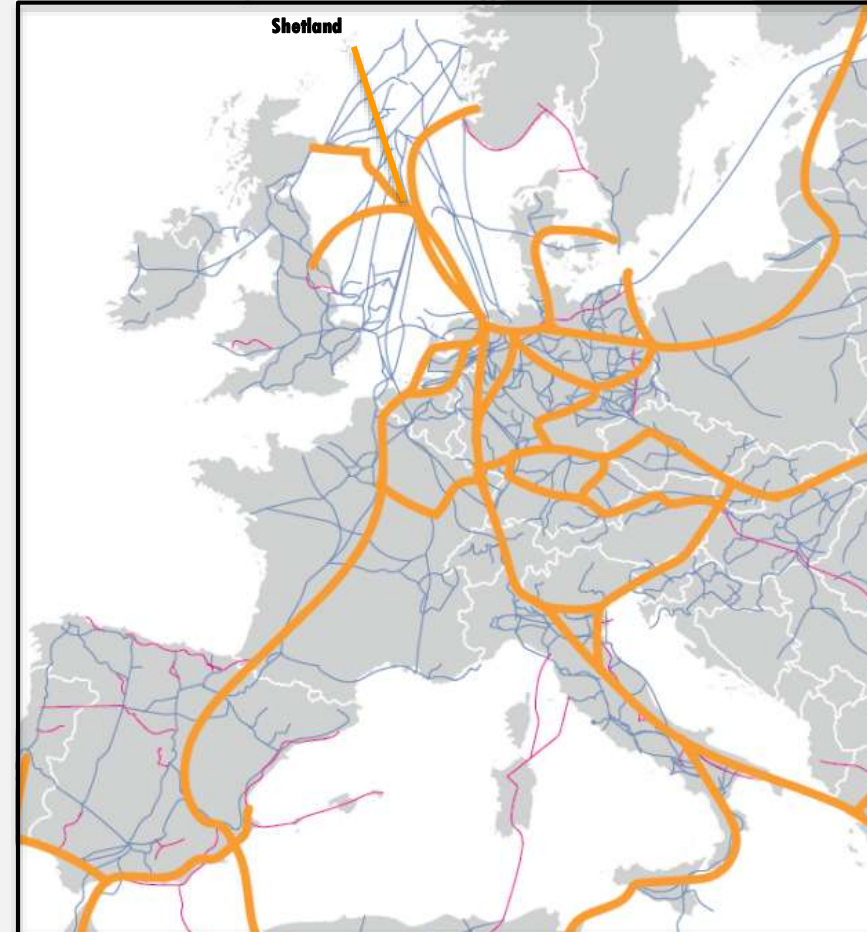


Green hydrogen options with onshore industrial & local opportunities pre-2025

Export & support



Shetland Main Ports



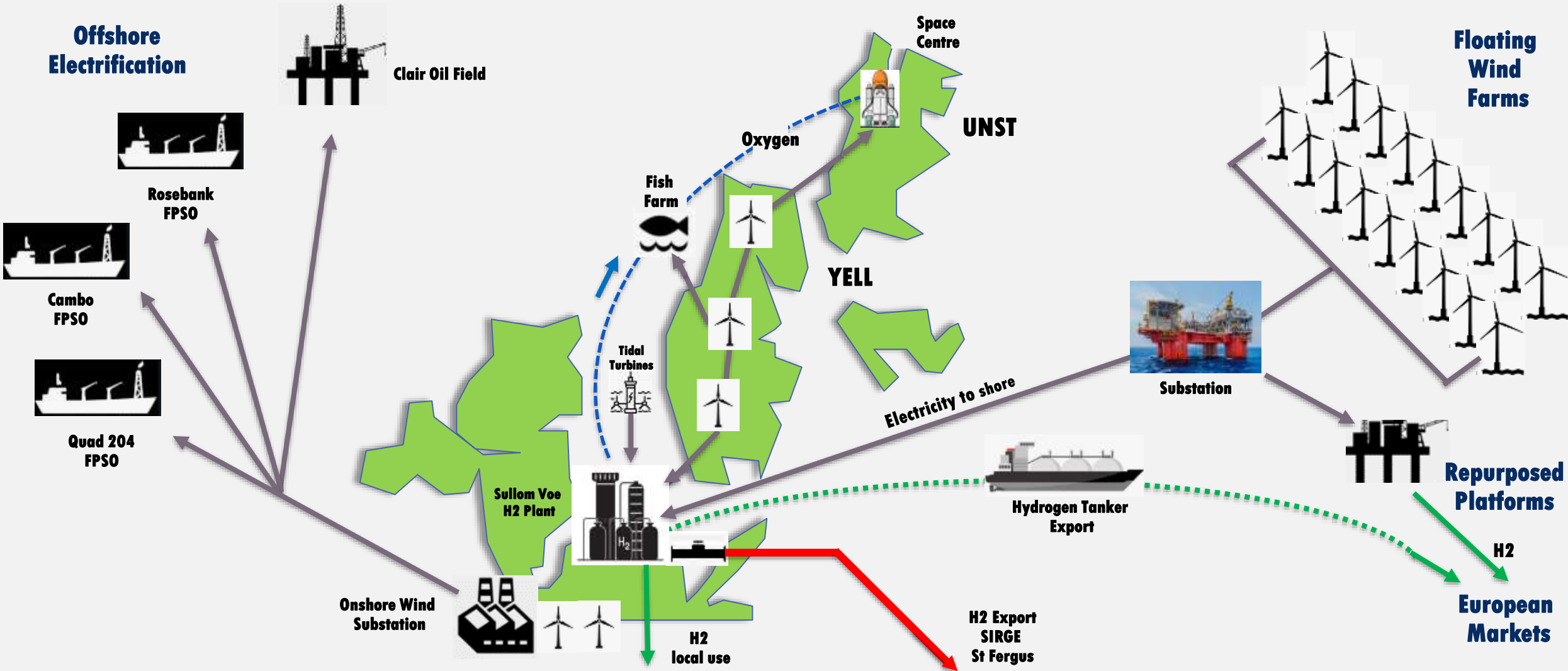
European Hydrogen Backbone



- **40 years tanker experience at Sullom Voe**
- **Sullom Voe berthing facilities 25m water depth**
- **Sullom Voe & Dales Voe support offshore wind**
- **ORION linked EU & UK government port initiatives**

Shetland ports have experience and capability to support H2 export and offshore wind sector

Electrification & hydrogen hub



Offshore & onshore wind and tidal energy used to electrify offshore & produce green H2

Shetland Clean Energy Generation



- Established Development
- Generation Capacity
- Export Capacity

1. Pure Energy Centre
- 2.
- 3.
- 4.
5. Burra Dale Wind Farm
- 6.
- 7.
- 8.
9. Luggies Knowe Wind Turbine
10. District Heating System
- 11.
12. Nova Tidal Array
- 13.
- 14.
- 15.
- 16.
- 17.
18. Off-grid Island (Foula)
19. Off-grid Island (Fair Isle)

Shetland Clean Energy Generation



-  Established Development
-  Consented Development
-  Planned Development
-  Generation Capacity
-  Export Capacity

1. Pure Energy Centre
2. Viking Energy Wind Farm
3. Energy Isles Windfarm
4. Peel Energy Wind Farms
5. Burra Dale Wind Farm
- 6.
- 7.
- 8.
9. Luggies Knowe Wind Turbine
10. District Heating System
- 11.
12. Nova Tidal Array
13. Tidal Opportunities
14. Mainland Interconnector
- 15.
- 16.
- 17.
18. Off-grid Island (Foula)
19. Off-grid Island (Fair Isle)

Shetland Clean Energy Generation



1. Pure Energy Centre
2. Viking Energy Wind Farm
3. Energy Isles Windfarm
4. Peel Energy Wind Farms
5. Burra Dale Wind Farm
6. Offshore Wind Area DPO NE1
7. Potential Offshore Wind Site
8. Potential Offshore Wind Site
9. Luggies Knowe Wind Turbine
10. District Heating System
11. Wethersta Hill Wind Turbine
12. Nova Tidal Array
13. Tidal Opportunities
14. Mainland Interconnector
15. Offshore Electrification
16. International Interconnector
17. Offshore Wind utilisation
18. Off-grid Island (Foula)
19. Off-grid Island (Fair Isle)

Taking the First Steps into Commercial Hydrogen Production

Produce hydrogen at 3 wind farm sites with spare wind capacity
Shetland Islands Council to be initial base customer:

- Vehicle fleet
- Ferries (50% of Council CO2 emissions)
- Port Operations
- Replace heating boilers in rural schools, care homes etc
- Oxygen by-product sold for use in aquaculture
- Annual sales estimated at £5.5 M
- Annual CO2 abatement of 4.9M kg
- 8-12 skilled jobs
- £10M investment (Islands Deal, Industry, Shetland Islands Council)



Our Action Plan at Community Scale

- Engagement and Research
- Confirm baseline customer requirements
- Assess availability of future constrained wind for scaling up to 20MW production
- Prepare full cost/benefit analysis and due diligence
- Prepare Skills and Capacity Building Plan
- Complete the Business Case
- Apply for Support Funding from Islands Deal etc

