Oil & Gas Authority

TOPSIDES® UK 2021

Technologies for the Energy Transition

TopsidesUK 2021

Carlo Procaccini, OGA Head of Technology

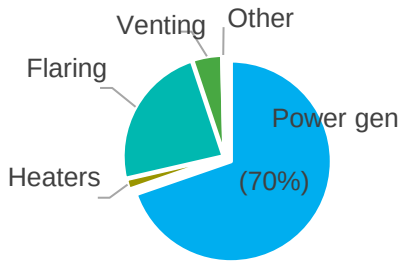
30 November 2021

Roadmap to ‘UK net zero’

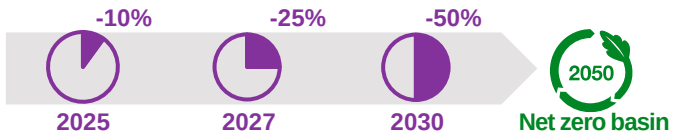
Oil & Gas Authority

O&G offshore emissions reduction

14 $MtCO_2e$ in 2018



NSTD emission reduction targets



OGA Stewardship Expectation 11

OGA Flaring & Venting guidance

2030 zero routine flaring

Offshore Windpower

OW Sector Deal (2019)
- 30 GW by 2030

Prime Minister 10-point plan (2020)
- 40 GW by 2030
- Of which 1GW *floating*

Scottish Government targets (2020)
- 11GW by 2030
- Of which 4GW expected *floating*
- Scotwind Leasing
- INTOG round

Carbon Capture and Storage

UK Government targets raised

- 2020’s: 2 ‘*track-1*’ clusters approved
- 2030: 4 CCS clusters, 20-30 Mtpa CO2
- 2035: ~ 50 Mtpa CO2

Low-carbon Hydrogen

UK Low-carbon H2 Strategy released (2021)

- Blue- and Green-Hydrogen

H2 production targets

- 2025 1 GW
- 2030 5 GW
- 2035 10-17 GW
- Equiv. to 7–10% of UK natural gas demand, or 20–30% of offshore windpower capacity exp. 2035

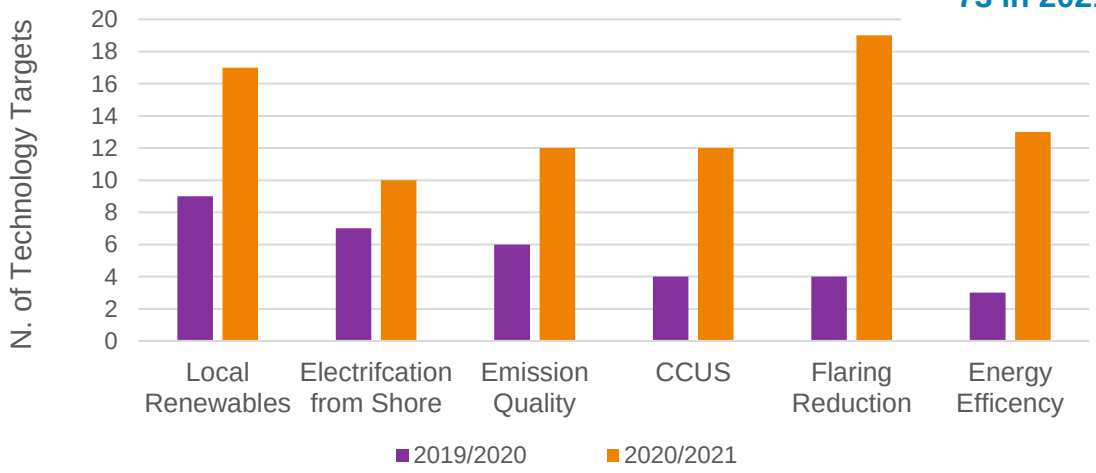
Role of Technology

Oil & Gas Authority

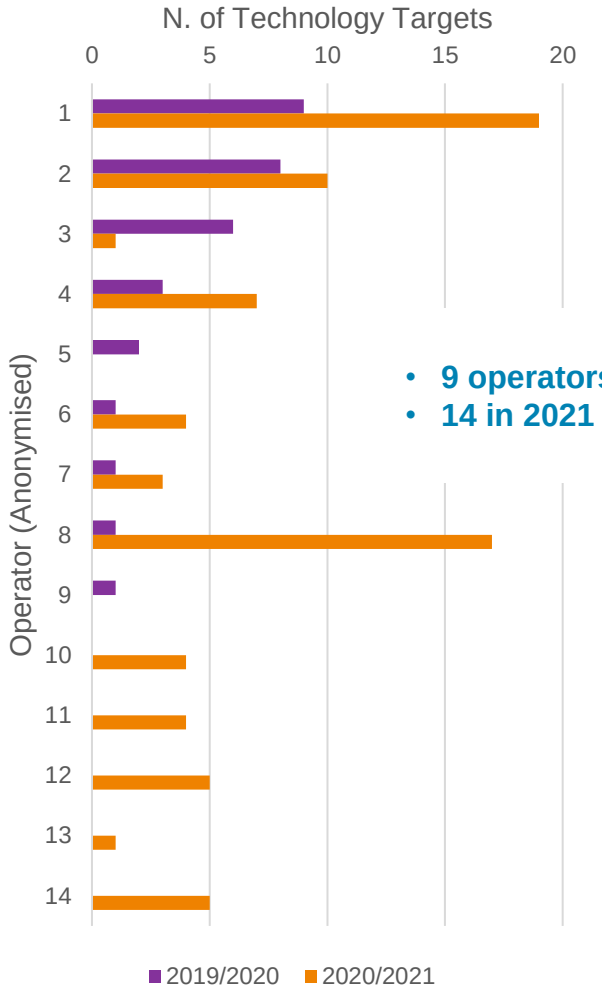
Operators' technology plan survey 2020 vs 2021

Reported 'net zero technologies' by Category

- 33 net zero technologies in 2020
- 73 in 2021



Reported 'net zero technologies' by Operator



- 9 operators in 2020
- 14 in 2021

Near-term: F&V reduction and energy efficiency

Oil & Gas Authority

Venting & Fugitive Emissions

Sources
- Process design (vessel blanketing)
- Fugitive leakage
- Venting / purging for maintenance

Metering of vent flows is not routine

Improvements include…
- Installation-wide HC emission monitoring and atmospheric sampling
- Nitrogen replacing fuel gas for purging/blanketing - Shell SNS
- NII techniques to avoid vessel entry

Beyond visual reach drones for atmospheric sampling

Net Zero Technology Centre – Technology Driving Transition; FLYLOGIX; bp

Flaring

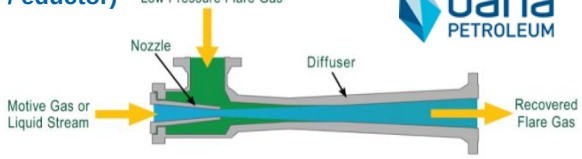
Issues
- Lack of export route for associated gas
- Passing valves releasing into flare systems
- Low combustion efficiency of flares (methane emissions)

Monitoring flare efficiency is not routine

Improvements include…
- Flare gas recovery systems
- Flash gas compressors, ejectors / eductors
- Monitor and optimise flare combustion efficiency

Flare gas recovery system (ejector / eductor)

dana PETROLEUM



Flare efficiency monitoring and optimisation

Baker Hughes; Panametrics – a Baker Hughes business

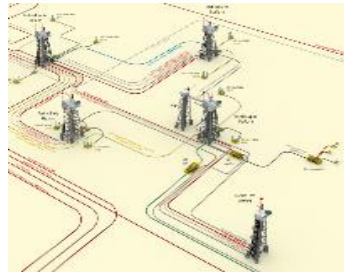
Energy efficiency

Issues
- Redundant power generation / compression capacity

Improvements include…
- Power ring mains
- Power storage – reducing spinning reserve
- Compressor and pump right sizing / rewheeling
- Optimised equipment controls

Power ring main to optimise generation and spinning reserve

Apache – Forties



Power storage (batteries) as back-up source

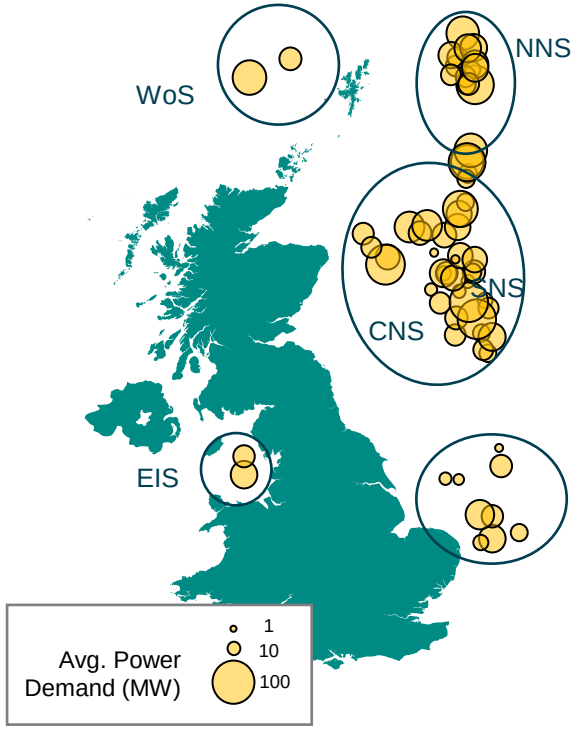
Woodside; HITACHI ABB

10% (sustainable) emission reductions by 2025 achievable

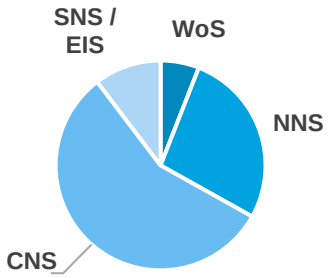
Mid 2020s: electrification of O&G facilities

Oil & Gas Authority

Oil & gas offshore power usage



2.5 GW (total in 2018)



Sources: OGA

Decarbonisation targets and electrification timeline

2050
Net Zero

2030
-50% Emissions Reduction
Zero Routine Flaring

2027: -25% Emissions Reduction

2025-2027 "First power"

2025: -10% Emissions Reduction

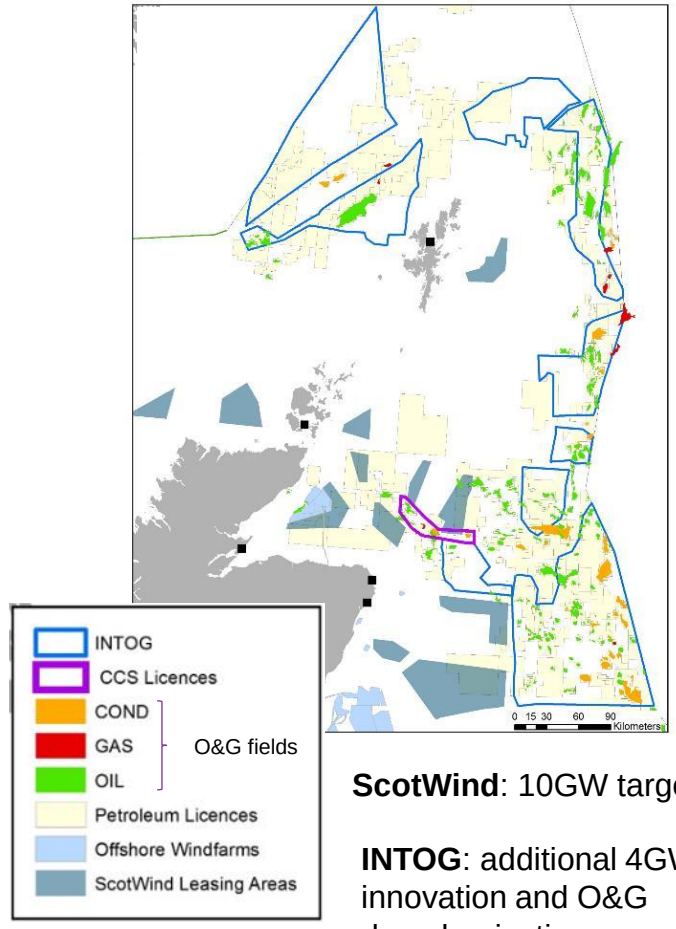
2024 Projects sanction

2022 Concept select

2021 O&G / Suppliers engagement – concept work

2020 Feasibilty

Synergies with Windpower



ScotWind: 10GW target

INTOG: additional 4GW for innovation and O&G decarbonisation

Sources: OGA, Crown Estate Scotland, Marine Scotland

Technologies for electrification

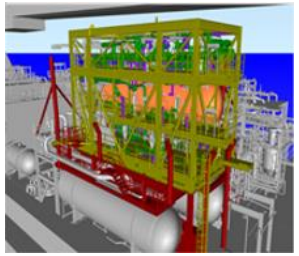
Oil & Gas Authority

Platform design & modifications

Green field – design for electrification
- Renewable power via cable (substations, risers, FPSO swivels / turrets)
- Local renewables / power storage for continuity (batteries; hydrogen/fuel cells; gas turbine/CCS)
- Renewable energy for process heating – geothermal/well heat recovery/sea source

Brown field – equipment retrofitting
- Footprint & weight – subsea vs topsides
- Integration with existing systems
- 50 vs 60 Hz frequency conversion
- Shutdown impact
- NZTC competition on cost-effective brownfield modifications

dana PETROLEUM



SBM OFFSHORE

Offshore transmission/distribution

Transmission cables HVAC vs HVDC
- Longer distance (~>150km) AC now possible
- Technology gaps: DC dynamic cables and swivels

Transmission equipment
- Voltage step up/down, converters, regulators
- Potential for subsea transformers, distribution and switch gear

Transmission installations and power hubs
- Fixed vs floating
- Integrated power hubs (built in continuity vs power from shore)

ABB

Floating HVDC converter

Hitachi Energy

Subsea transformer

Floating Wind Power

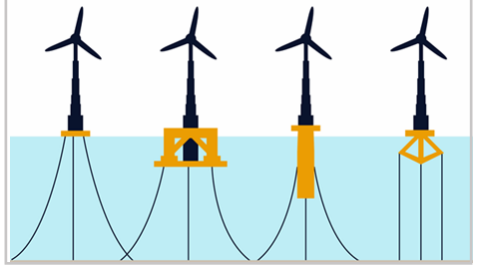
Floating structures
- Incl. TLP, SPAR, Semi-Subs, barge
- Substructures and mooring design
- No single or dominant solution (yet)

Cost pressures: from £175/MWh in 2020 to £50/MWh (near fixed wind parity) by 2030

Other technology gaps
- Dynamic cables for floating wind structure and FPSO connection
- Simpler, lower cost swivel changeouts/retrofits for voltage and power requirements
- Compact electrical equipment to fit available topsides space

NZTC / OREC planning studies and field pilots

Alternative concepts of floating wind structures



Integrated renewables (Source: FPP)

Longer term – 2030-2050 UKCS ‘net zero’ potential

Oil & Gas Authority

Oil & Gas Authority

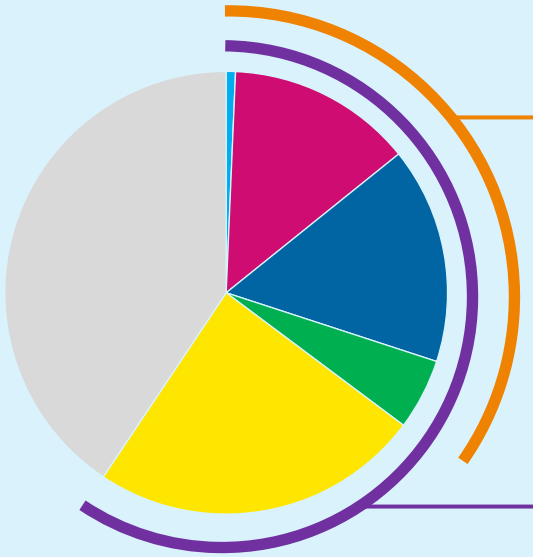
Department for Business, Energy & Industrial Strategy

Crown Estate Scotland
Oighreachd a' Chrùin Alba

ofgem

THE CROWN ESTATE

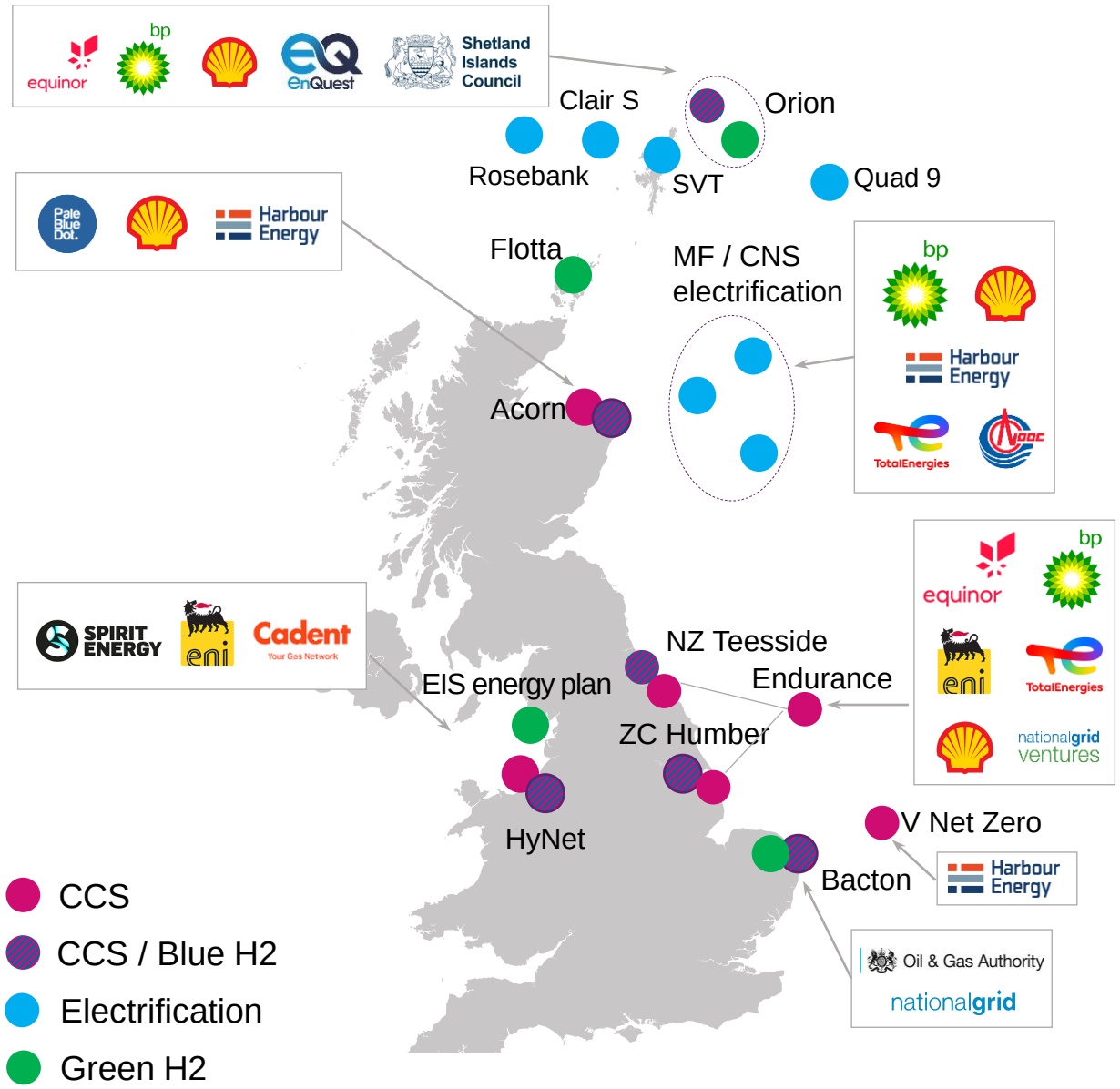
2050 UK net zero emission abatement required from 2018 baseline



~30%
Energy Integration – O&G, CCS, H2

~60%
UKCS incl. also windpower

- Offshore electrification
- Blue H2
- Offshore windpower
- CCS
- Green H2
- Onshore measures



Technologies for CCS

Oil & Gas Authority

CO_2 capture

Largest CCS cost component

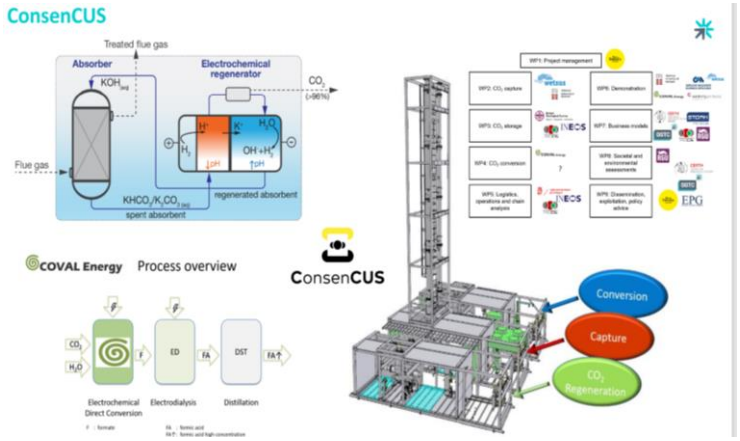
Leverage O&G industry strengths in gas separation and processing:

- Solvent based absorption techniques
- Membrane separation

Bolt-on, small-scale CO_2 capture that could be deployed offshore

Ion exchange CO_2 capture
CCUS collaboration: ConsenCUS

Net Zero Technology Centre
Technology Driving Transition



CO_2 transportation

New challenges

- CO_2 flow modelling and metering; impact of minor contaminants
- Phase control; colder temp. operation, energy addition
- CO_2 conditioning, H_2O removal
- Corrosion behaviour caused by CO_2
- O&G pipeline reuse - resistant coatings and materials
  - New-build only – no current tech for retrofit
- Integrity monitoring and predictive maintenance to detect and prevent crack propagation

Pipeline internal coating (for CO_2 and H_2)

SHAWCOR

Regional CO_2 infrastructure

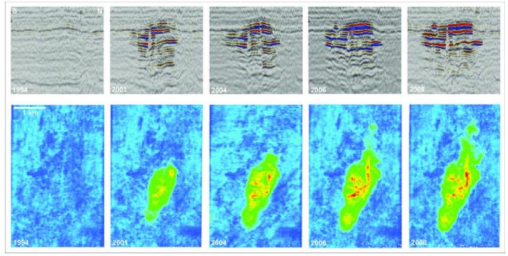
NECCUS
Scotland's industrial CO_2 emissions.

CO_2 storage

New subsurface applications

- CO2 migration monitoring
- Detection of leaks
- Wells technology for CO_2 operating conditions and corrosion
- CO2 resistant P&A of legacy wells

CO2 plume 4D seismic (Sleipner, Norway)



CO2 injector completions

Welltec®

Geochemical water column sampling

BlueOcean MONITORING

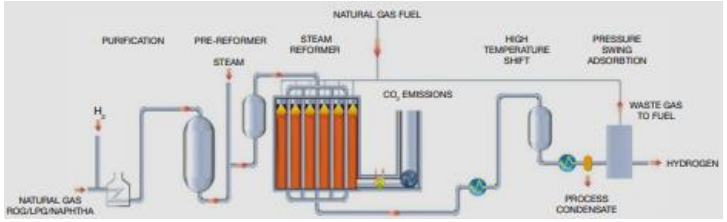
Technologies for Hydrogen

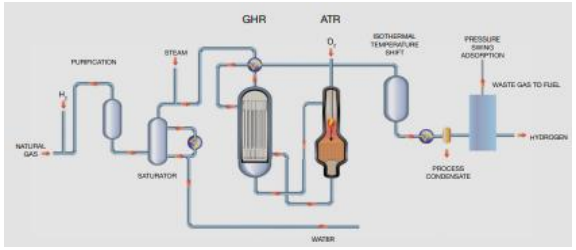
Oil & Gas Authority

Blue Hydrogen

- Methane reforming
- Blue hydrogen production essential to meet CCS and UK emission targets
- Existing technologies: SMR, ATR, POM
- Technology enhancements incl. hybrid processes: GHR, Dry Reformation and Sorption Enhanced Reformation
- New disruptive methods; methane pyrolysis (produces solid carbon instead of CO_2)

Steam methane reforming vs. hybrid process (ATR/GHR)



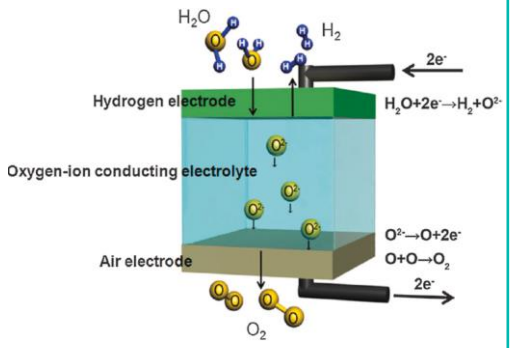


Green Hydrogen

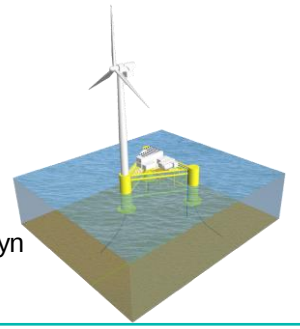
Existing technologies based on AEM, PEM and SOEC (solid oxide electrolyser cell)

New disruptive methods
- Reversible SOEC/Fuel cell
- Direct seawater electrolysis
- Desalination improvements
- Electrolysis equipment marinization
- Equipment integration into floating wind structures

Solid oxide electrolyser cell



H2 integration into floating wind structures



ERM Dolphyn

Hydrogen Infrastructure

Large hubs

Scale in production, transportation and storage

Flotta, Orkney

Bacton

Shetland

Transportation / distribution
- Repurposing of hydrocarbon pipelines
- H_2 blending with natural gas
- Users fuel switching
- Compression, risers, metering
- Ammonia, LOHC and Liquid H_2

Storage
- Renewables intermittency strategy
- Existing pipelines - line pack not feasible?
- Inter seasonal storage - geological

The opportunity

Oil & Gas Authority

- Develop the UKCS into a key ‘net zero’ energy asset for the UK

- Leverage existing O&G technologies, competencies and skills
  - O&G / Windpower synergies (esp. in *floating wind*)
  - Carbon Capture and Storage - *subsurface and facilities*
  - Hydrogen – *production and transportation*

- Continue technology development to address key gaps
  - Reduce Capex and Opex of ‘net zero’ energy projects
  - Scale up Wind, CCS and Hydrogen to meet net zero by 2050 ambitions

Thank you