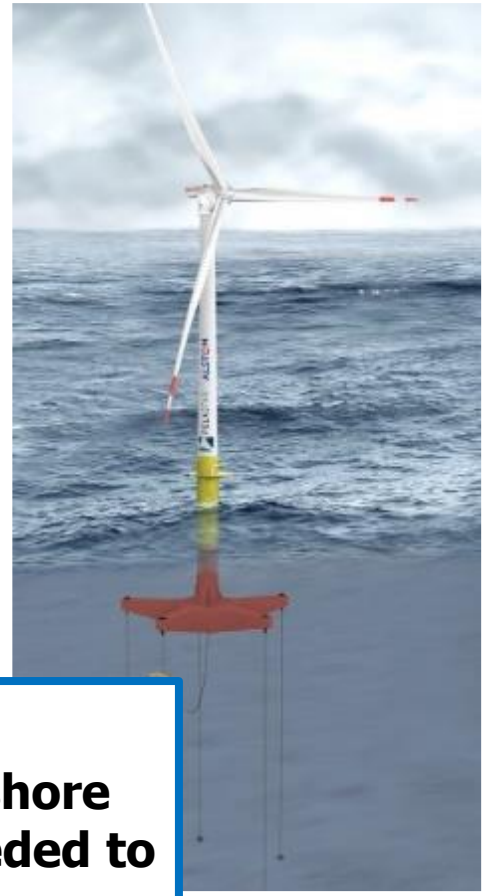
Crondall energy

Future Offshore Wind Concept Selection (FOWCOS)

Nov 2021

Offshore Wind Concept Selection

- In March 2019, the UK Government targeted 30GW installed offshore wind capacity by 2030.
- To reach this level of installed capacity the industry will be moving from fixed foundation wind turbines near shore to more remote locations (probably floating facilities in deeper water).
- Energy transmission distances to the onshore grid will increase and as the overall UK installed capacity grows exponentially the ability and flexibility of the grid to accept electrical power from offshore energy will become increasingly constrained.
- For this reason, the conversion, storage, and transportation of energy in alternative forms (P2X or Power (electrical) to other ("X") forms) is likely to become increasingly attractive to offshore renewable developments.



This introduces a wider range of feasible concepts for a given offshore wind development and consequently a selection process will be needed to identify the best value concept for each location.

JIP Future of Offshore Wind – Fresh look at what may now be possible.

Crondall energy

Emerging Opportunities:

Low cost, high reliability, low OPEX wind turbines

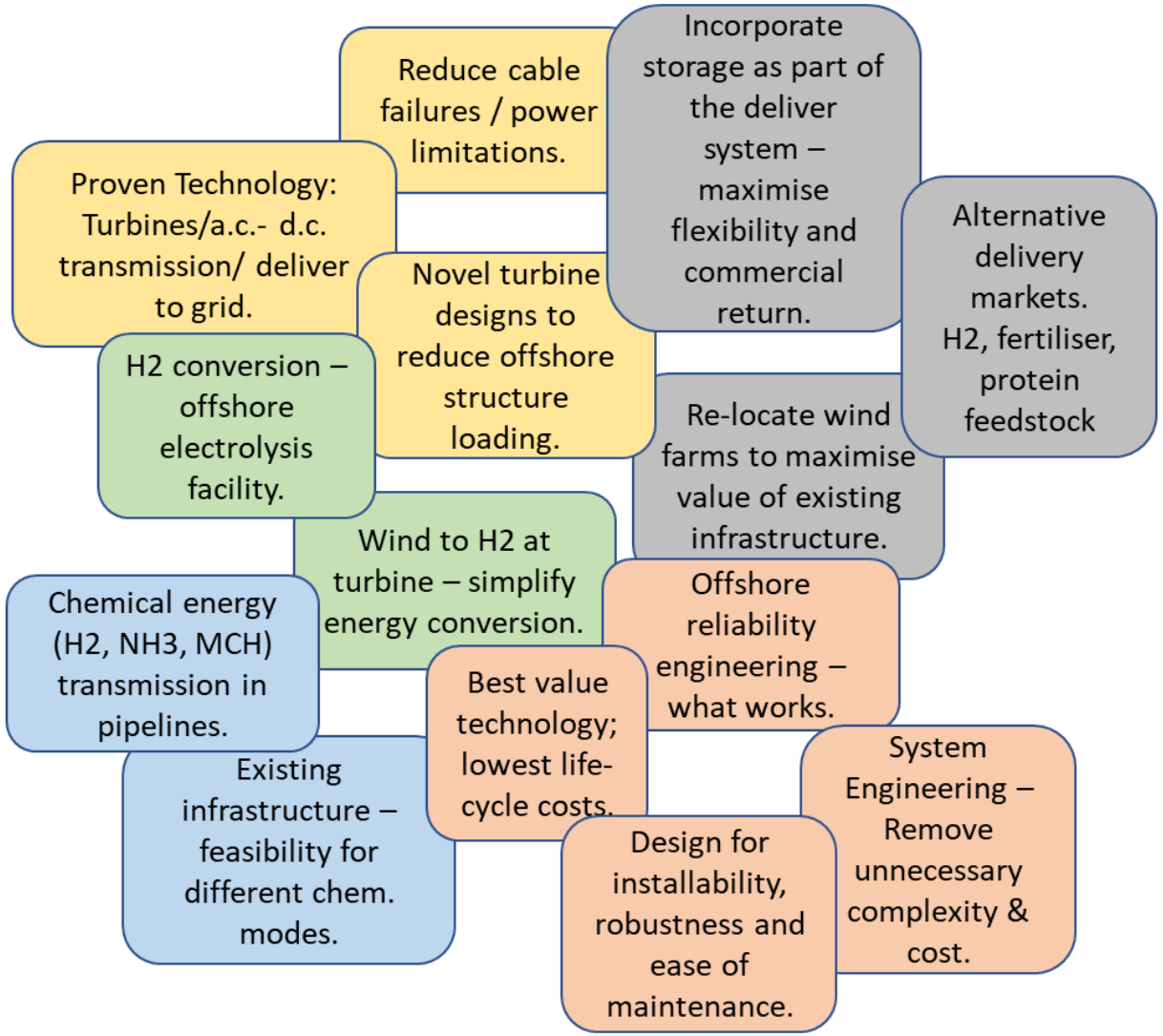
H_2 electrolyser technologies at different scales

H_2 Electrolysis of seawater

Available NS O&G Infrastructure

Chemical conversion of H_2 into lower risk, more readily transported fluids (NH3 MCH (Spera H_2)

Deepwater, remote offshore engineering experience



Potential Outcomes:

UK plc. Best Value Strategy for North Sea future.

Best Value Offshore Wind Industrial Concepts for Various Scenarios

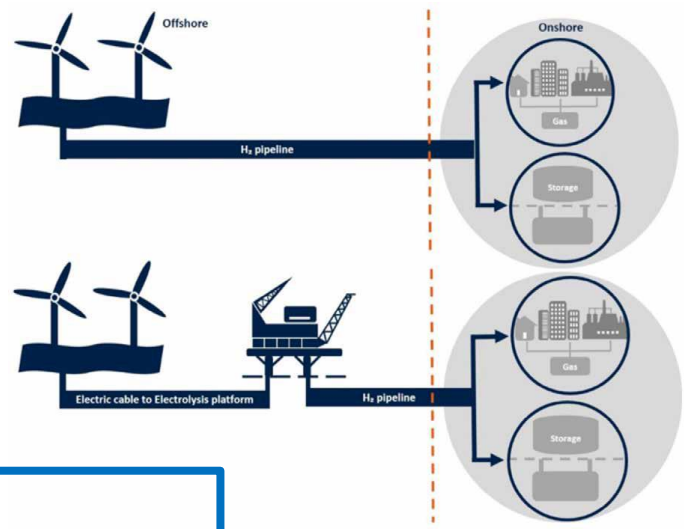
Highly Reliable, Low OPEX Wind Energy Capture from Offshore Resources.

Range of High Value Products to UK and International Markets.

Built in Energy Storage for Maximum Flexibility and Commercial return.

Crondall Energy believe there is value in running a JIP to explore these issues and develop guidelines to support developers in concept selection for offshore wind developments.

The JIP will cover the entire energy delivery chain across the key P2X systems i.e., electrical power generation, power delivery from a renewable source to a conversion point, energy conversion (electron or molecular form, gas or liquid), storage, and energy export (chemical or/and electrical).



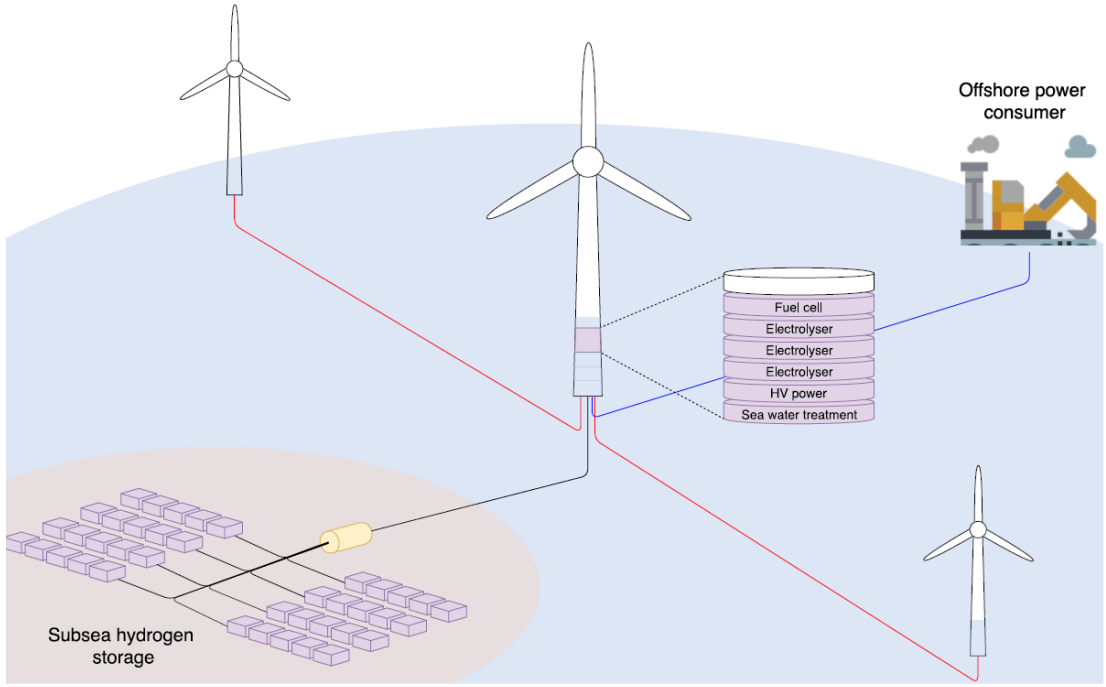
The purpose of the guidelines is to:

- Give supply chain and technology developers an understanding of selection criteria and drivers likely to be prioritised in P2X developments.
- Provide developers and investors with knowledge of P2X opportunities and risks as they look ahead to the practical realisation of larger scale offshore P2X renewable developments in the foreseeable future.

And as a consequence ensure all viable concepts are identified during early phase consent applications.

Potential drivers influencing concept selection are expected to include:

- Size of the wind farm (number and size of turbines)
- Distance from shore / market
- Available markets / distance to markets /flexibility in geographic delivery
- Grid constraints
- Bankability / return on investment
  (low risk/reward vs. high risk/reward)
- Technical feasibility
- Available technology / developing technology
- Safety and risk
- Cost (CAPEX/OPEX and future Decommissioning).
- Energy efficiency / CO2 emissions per kW delivered
- Operational Flexibility (e.g., P2X to monetise surplus power)
- Reliability, Availability & Maintainability
- Ease of storage / volume and cost of storage
- Potential for infrastructure re-use (transport or storage e.g., compressed air storage).
- Potential to provide alternative power to offshore oil and gas (or CCUS) installations and potentially use the current route to market e.g., via blended gas.



Phase 1 – Concept Selection Guidance

a) Research - Will cover two areas: the wind farm planning process and P2X technology. Technology assessment includes identification of TRL and estimated time/effort to full commercial operation.

b) Create a Concept Library

Identify the range of feasible options and document the pros, cons, benefits, risks, trade-offs and limitations of each. Undertake comparative cost analysis to identify tipping points between concept value as the distance from shore and the scale of the developments are varied.

c) Develop Draft Guidance

Create technical guidance that takes users through the feasible concepts and provides a comparative view on the concept selection factors identified above in relation to each concept.

Phase 2 – Case Study

A case study will be developed to road test the guidance. The case study will be written up as a worked example and appended to the final guidance document(s) for the benefit of users.

Phase 3 – Final Guidance

Updated to capture improvements suggested through the stakeholder review and feedback process and lessons learned in developing the case study.

The final deliverable is expected to comprise:

- **Written guidance on feasible P2X concepts**
- **Work example as an appendix to the guide**
- **Evaluation tool and data input sheet that can be adapted by users for their own projects.**

Crondall energy

OUR TRACK RECORD: KEY CLIENTS

Floating Production & Subsea Specialists

dana PETROLEUM

MCDERMOTT

Department for Business, Energy & Industrial Strategy

CLYDE&CO

North Sea Transition Authority

MUFG

F4OR Fit For Offshore Renewables

TOTAL

bp

CHRYSAOR

TAQA

ITHACA ENERGY

woodside

wood.

NewAge

subsea 7

INPEX

ORCADIAN ENERGY

ophir

FLUOR

Net Zero Technology Centre