MAHON, R., IYALLA, I. and MUNRO, G. 2024. Floating wind turbine standalone option: a viable approach for reducing North Sea emissions. Presented at the 2024 Topsides UK: energising the North Sea: focusing on energy security and emissions reduction, 5-6 November 2024, Aberdeen, UK.

Floating wind turbine standalone option: a viable approach for reducing North Sea emissions.

MAHON, R., IYALLA, I. and MUNRO, G.

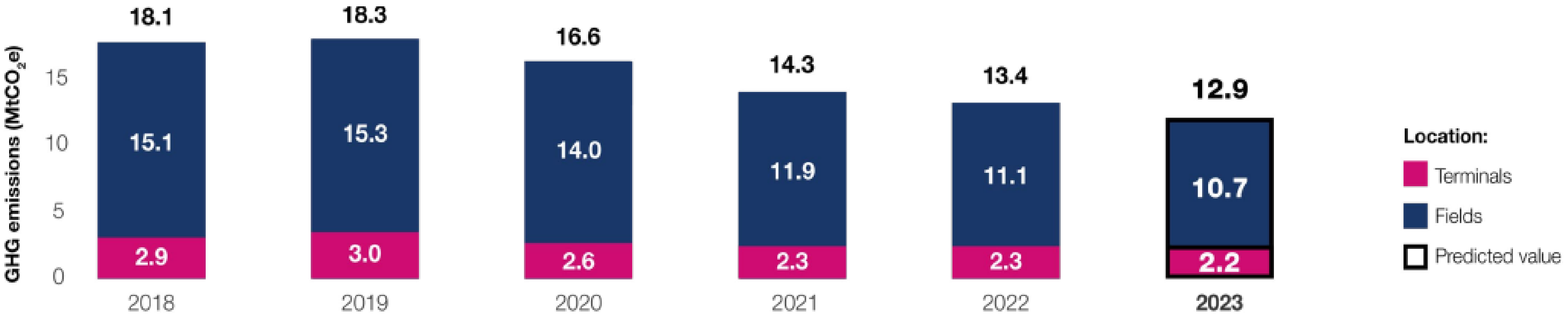
2024

Floating Wind Turbine Standalone Option: A Viable Approach for Reducing North Sea Emissions

Dr Ruissein Mahon, Dr Ibiye Iyalla, Grant Munro

13 CLIMATE ACTION

UK Upstream Oil & Gas Emissions Trend



GHG Emissions Trend in the Oil & Gas Industry (NAEI, EEMS, ETS, NSTA)

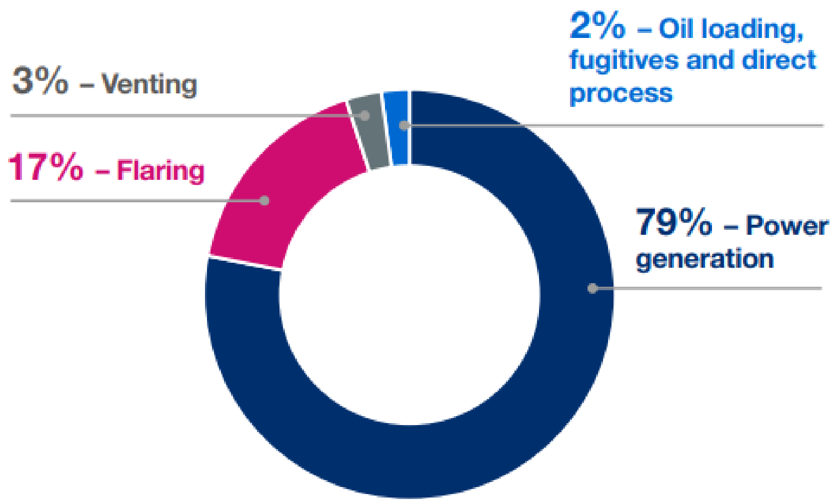
EEMS – Environmental Emissions Monitoring System
ETS – Emissions Trading Scheme
NSTA – North Sea Transition Authority
NAEI – National Atmospherics and Emissions Inventory

UK Upstream Oil & Gas GHG Emissions Reductions to 2022 (NAEI)

Gas type	Emissions reduction 2018 – 2023*	Emissions reduction 2022 – 2023**
CH_4	26%	4%
CO_2	52%	4%
N_2O	26%	4%
Total GHGs	**28%**	**4%**

*2018 – 2022 calculation uses NAEI data which includes terminals and fields
** 2022 – 2023 calculation uses NSTA projection data

UKCS Production Challenge



2023 Offshore Field Emissions by Source (EEMS, 2023)

2023 Emissions Intensity Breakdown by Installation Type and Age (EEMS)

Installation age	Floating	Large platform	Small platform
0 – 10 years	20	12	6
11 – 25 years	36	20	18
> 25 years	34	52	33

Asset Age	Small Platform	Floating	Large Platform
> 25 Years	32	34	51
0-10 Years	6	20	12
11-25 Years	17	36	20

GHG Intensity ($kgCO_2e/boe$) by Installation Age and Platform Type (EEMS)

Older, large assets have the highest GHG intensity on average and new, small assets have the lowest.

OGA Plan: Emissions Reduction

Long-term plan to support progress and take serious action on emissions reductions. Four action areas:

1. **Investment & Efficiency:** Operators must make investments to cut their operational emissions, e.g., existing power generation and process operations.
2. **Platform Electrification & Low Carbon Power:** Plays a significant role in reducing the bulk of production emissions.
3. **Inventory:** Increased scrutiny of assets with high emissions intensity and their CoP dates. Closing some low-producing, high polluting installations earlier could allow higher producing and cleaner new assets to come online while still reducing overall emissions.
4. **Flaring & Venting:** Reduce to the lowest possible levels. All new developments should be developed with zero routine flaring and venting.

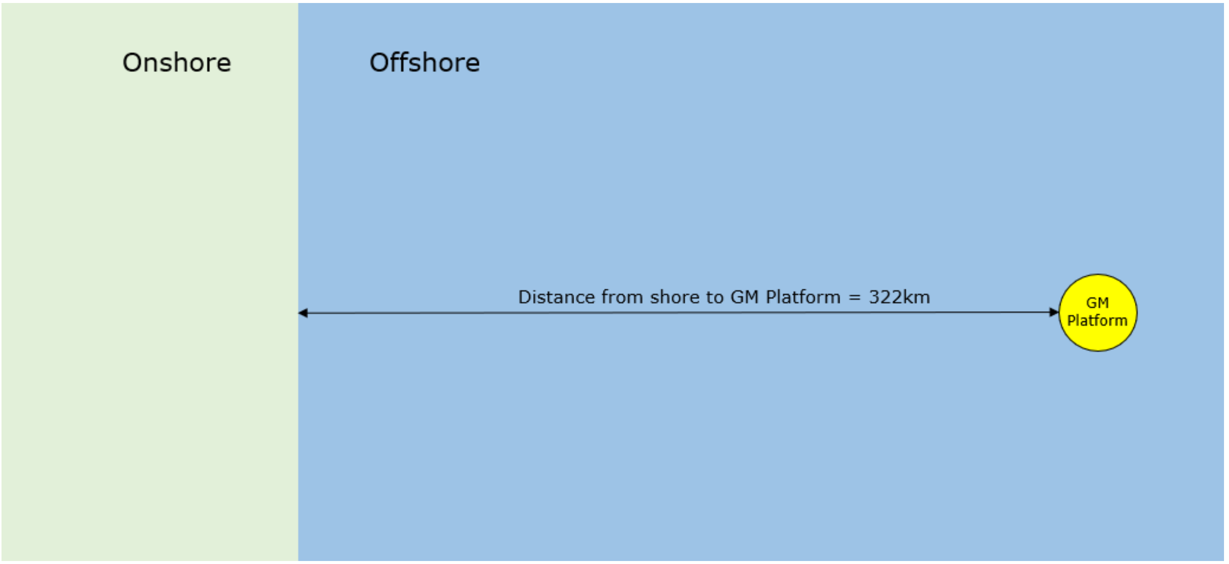
Maintain Social Licence to Operate

North Sea Case Study: Overview

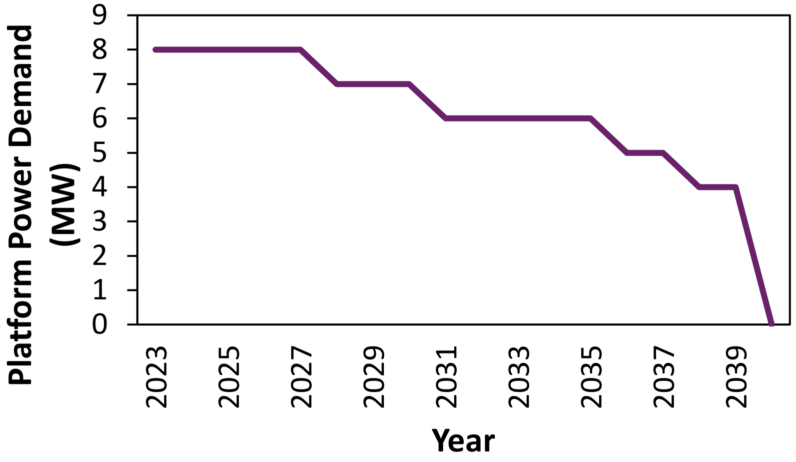
Case study data:

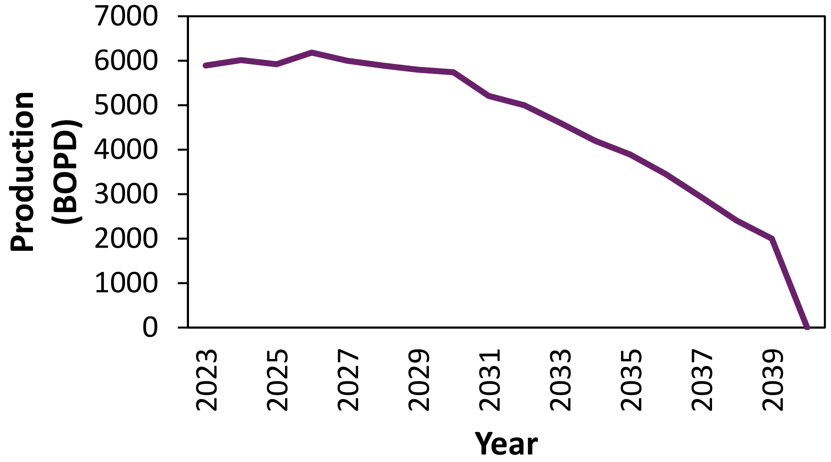
- Water depth 117 m, ~ 322 km from shore in the North Sea.
- GM platform consists of a self-contained production and processing unit.
- Platform linked via a 33 kV power sharing ring main:
  - 2 gas turbine driven compressors.
  - 9 packages contain equipment and machinery.
  - 1 package is the Accommodation Module and Central Control Room.

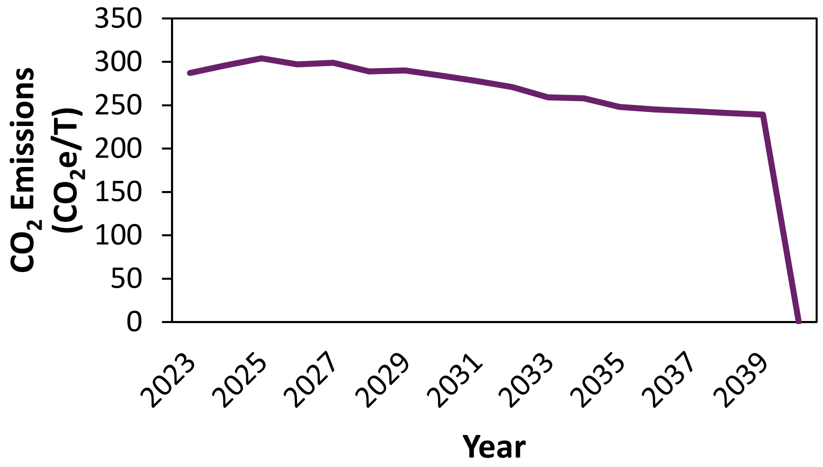
Existing Field Layout

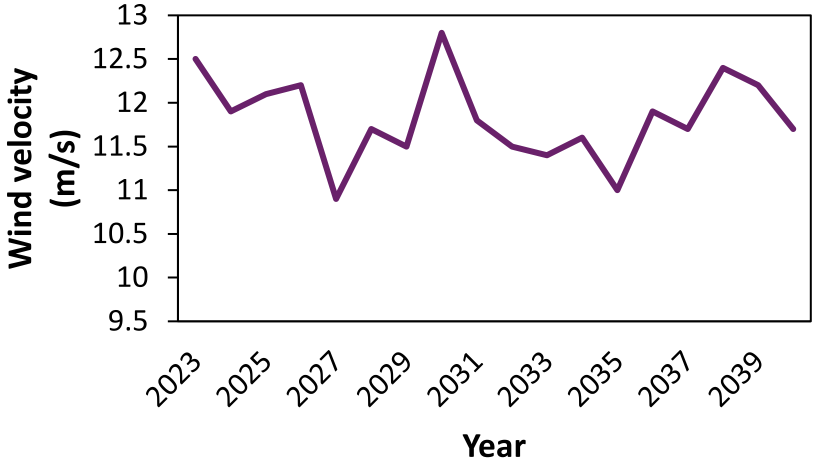


North Sea Case Study: Operational Limits





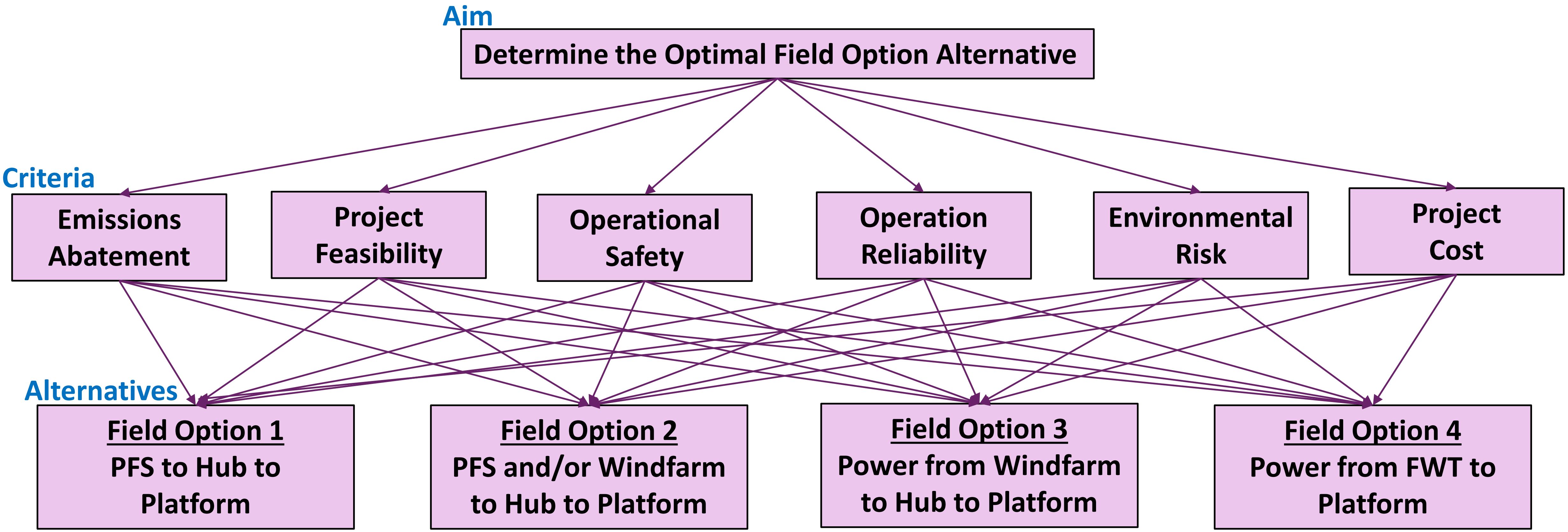




Case study data:

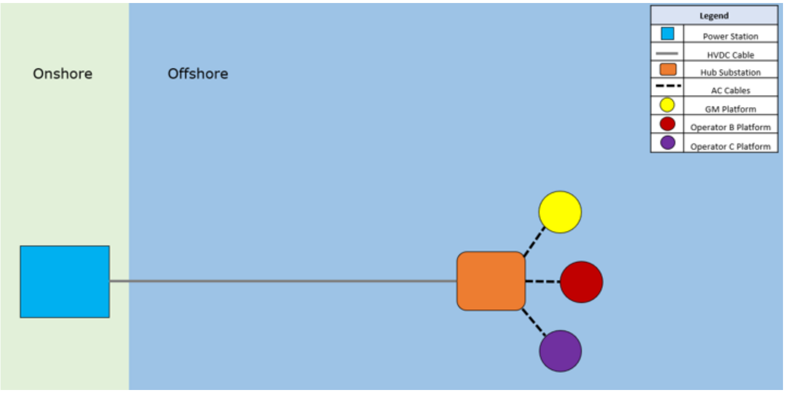
- Power demand average on platform is 8 MW.
- Production remains steady at around 6,000 BOPD until 2030, then begins to sharply decline until CoP in 2040.
- Emissions average on platform is 287 CO_2e/T.
- Wind velocity average at field is 12.5 m/s.
- CoP is expected in 2040.

Analytical Hierarchy Process (AHP)

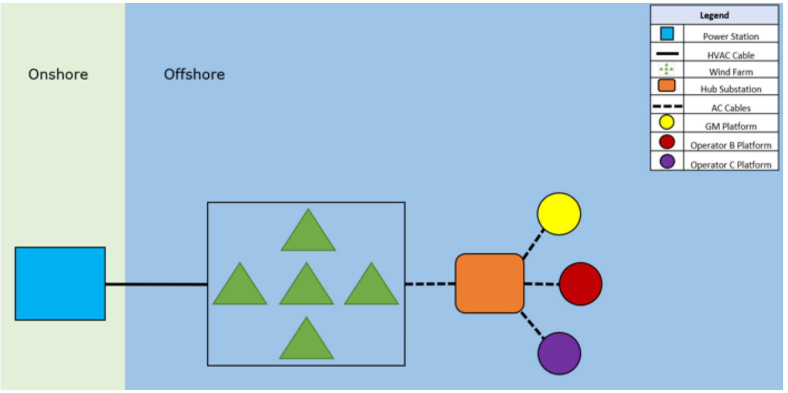


North Sea Case Study: Field Options

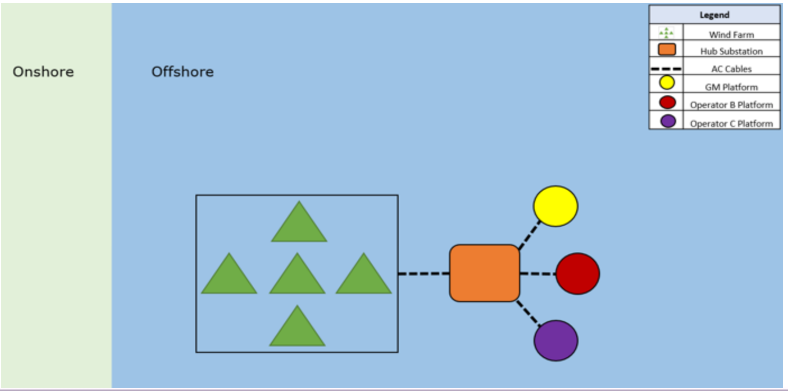
Field Option 1: PFS to Hub to Platform



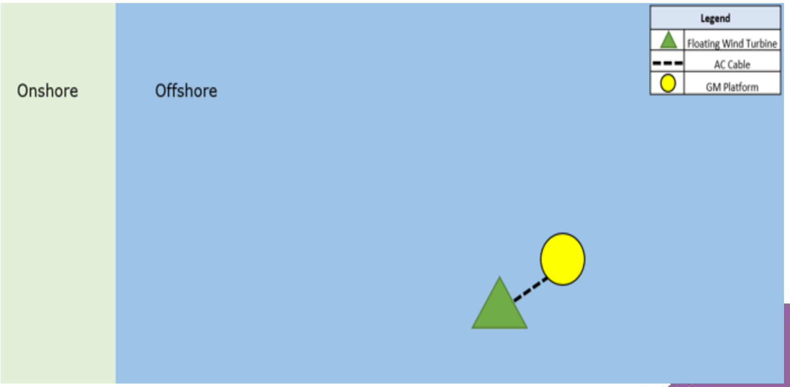
Field Option 2: PFS and/or Windfarm to Hub to Platform



Field Option 3: Power from windfarm to Hub to Platform



Field Option 4: Power from FWT to Platform



Significant potential to reduce GHG emissions by sourcing power either from the shore or from offshore renewables.

AHP Methodological Approach

Criteria Weighting

Criteria	Level 1 Weights	Level 2 Weights
Technical Analysis	**0.5**	
Emissions Abatement		0.2
Project Feasibility		0.2
Operational Safety		0.2
Operational Reliability		0.2
Environmental Risk		0.2
Economic Analysis	**0.5**	
Project Costs		1

Criteria Categories

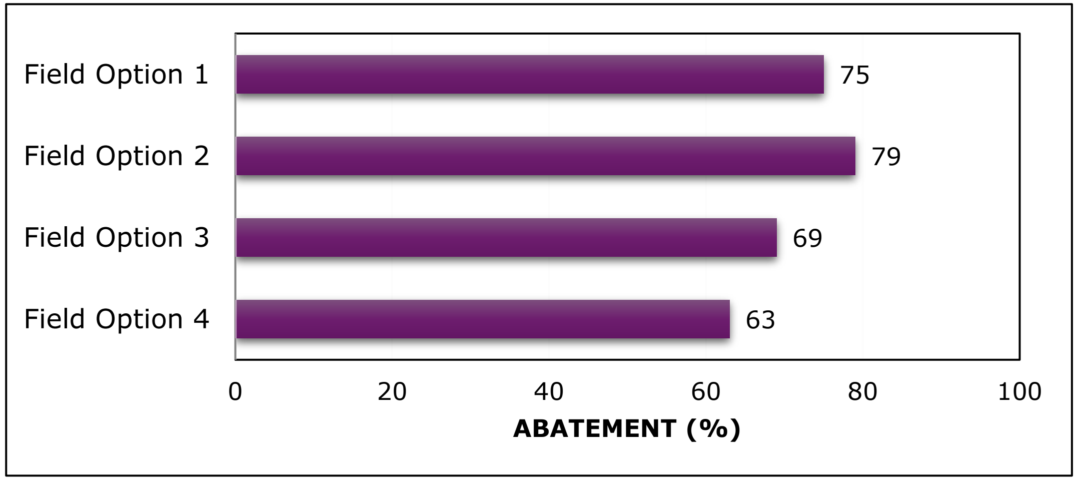
Score	Category
100	Best
80	Excellent
60	Good
40	Fair
20	Poor
0	Worst

Criteria Scoring:

- Technical Score = (0.2 x Score) + (0.2 x Score) + (0.2 x Score) + (0.2 x Score) + (0.2 x Score) x 0.5
- Economic Score = (1 x Score) x 0.5
- Combined Score = Technical Score + Economic Score

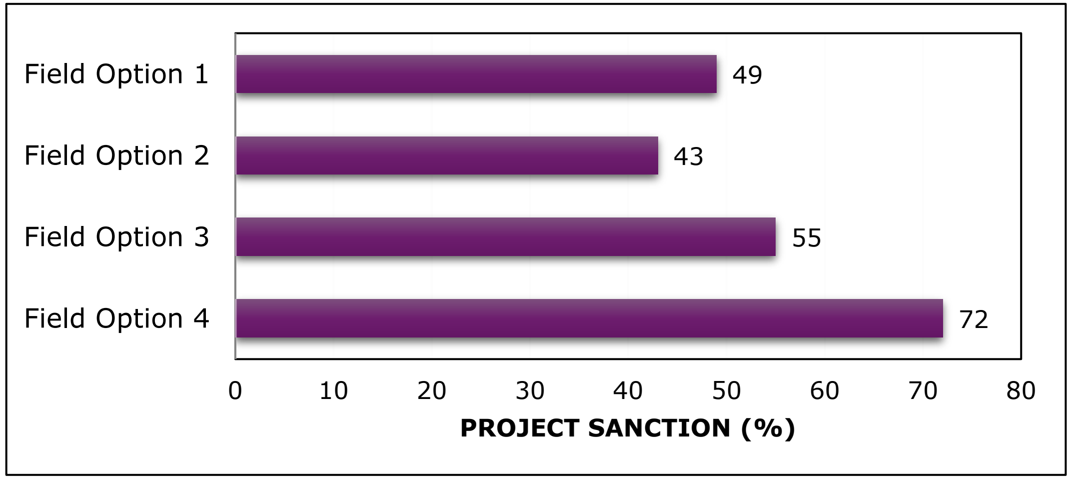
Field Options Analysis

Emissions Abatement Result



Field Option 2 scores Best because it can draw power from shore when wind output is insufficient.

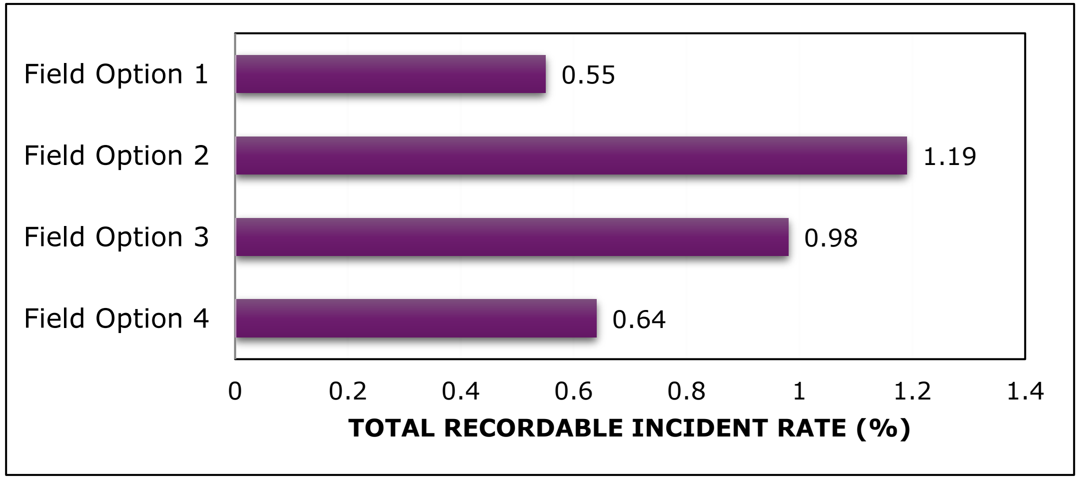
Project Feasibility Result



Field Option 4 scores Best because there is no reliance on a JV partnership with only one FWT to manufacture, the lead time and subsequent start-up is operationally faster.

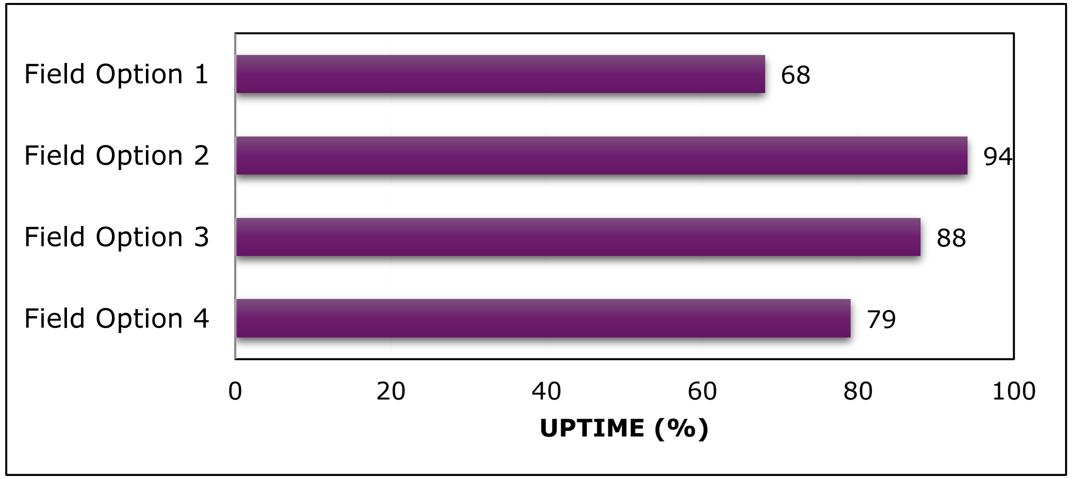
Field Options Analysis

Operational Safety Result



Field Option 1 scores Best since it avoids the risks involved in commissioning, maintaining and decommissioning FWTs.

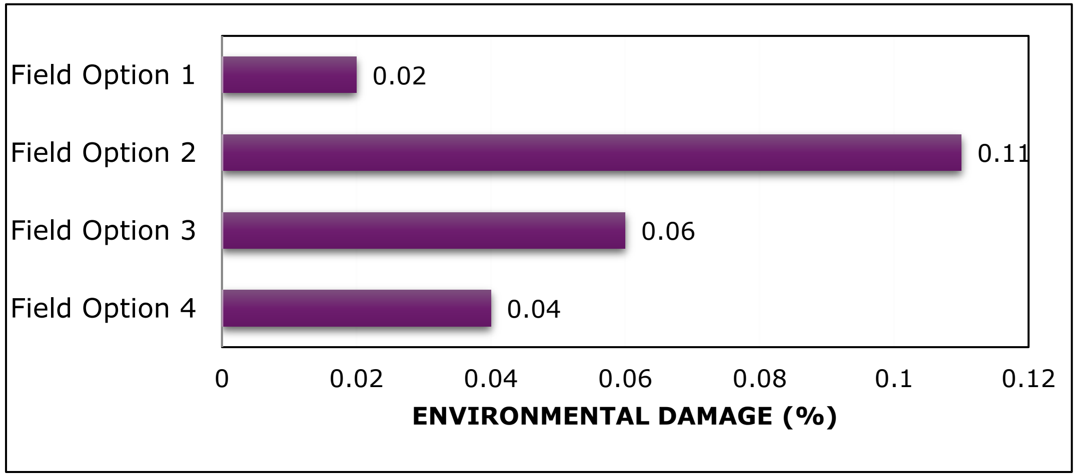
Operational Reliability Result



Field Option 2 scores Best since it can draw PFS when output from the windfarm is insufficient – no other Field Option has this combination.

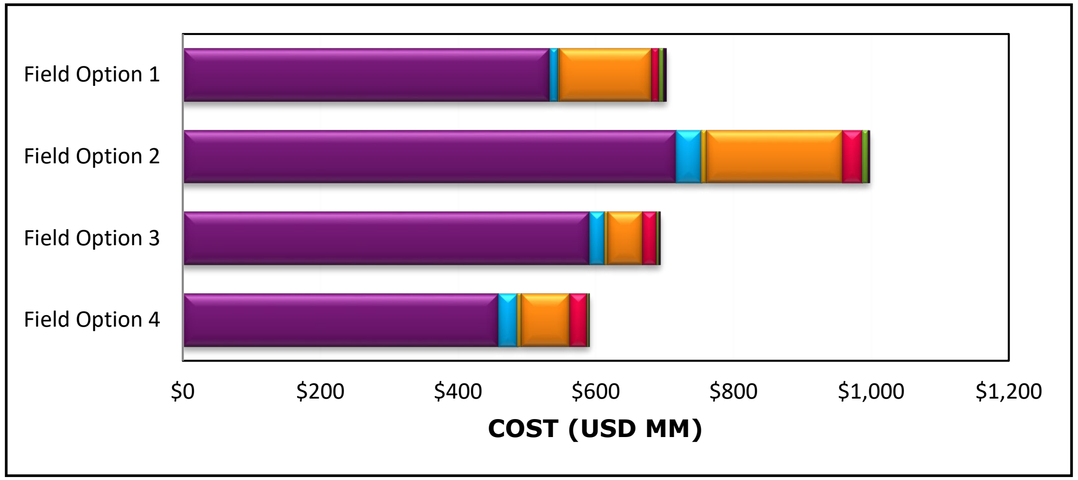
Field Options Analysis

Environmental Risk Result



Field Option 1 scores Best since it does not have a FWT, which can cause harm to birds.
The FWT's rotating blades can be harmful to birds whilst the mooring lines and anchors can be harmful to marine life for the other three Field Options.

Project Costs Result



Field Option 4 scores Best since it has the smallest amount of infrastructure to manufacture, commission and maintain through operational phase until CoP, including decommissioning.

Combined & Sensitivity Analysis

Final Combined Analysis

Criteria	Field Option 1	Field Option 2	Field Option 3	Field Option 4
Technical	30	20	26	28
Economic	30	0	40	50
Combined	**60**	**20**	**66**	**78**
Ranking	**3**	**4**	**2**	**1**

Field Option 4 ranks 1st

Sensitivity Analysis Results (60% / 40%)

Criteria	Field Option 1	Field Option 2	Field Option 3	Field Option 4
Technical	36	24	31.2	33.6
Economic	24	0	32	40
Combined	**60**	**24**	**63.2**	**73.6**
Ranking	**3**	**4**	**2**	**1**

Sensitivity Analysis Results (40% / 60%)

Criteria	Field Option 1	Field Option 2	Field Option 3	Field Option 4
Technical	24	16	20.8	22.4
Economic	36	0	48	60
Combined	**60**	**16**	**68.8**	**82.4**
Ranking	**3**	**4**	**2**	**1**

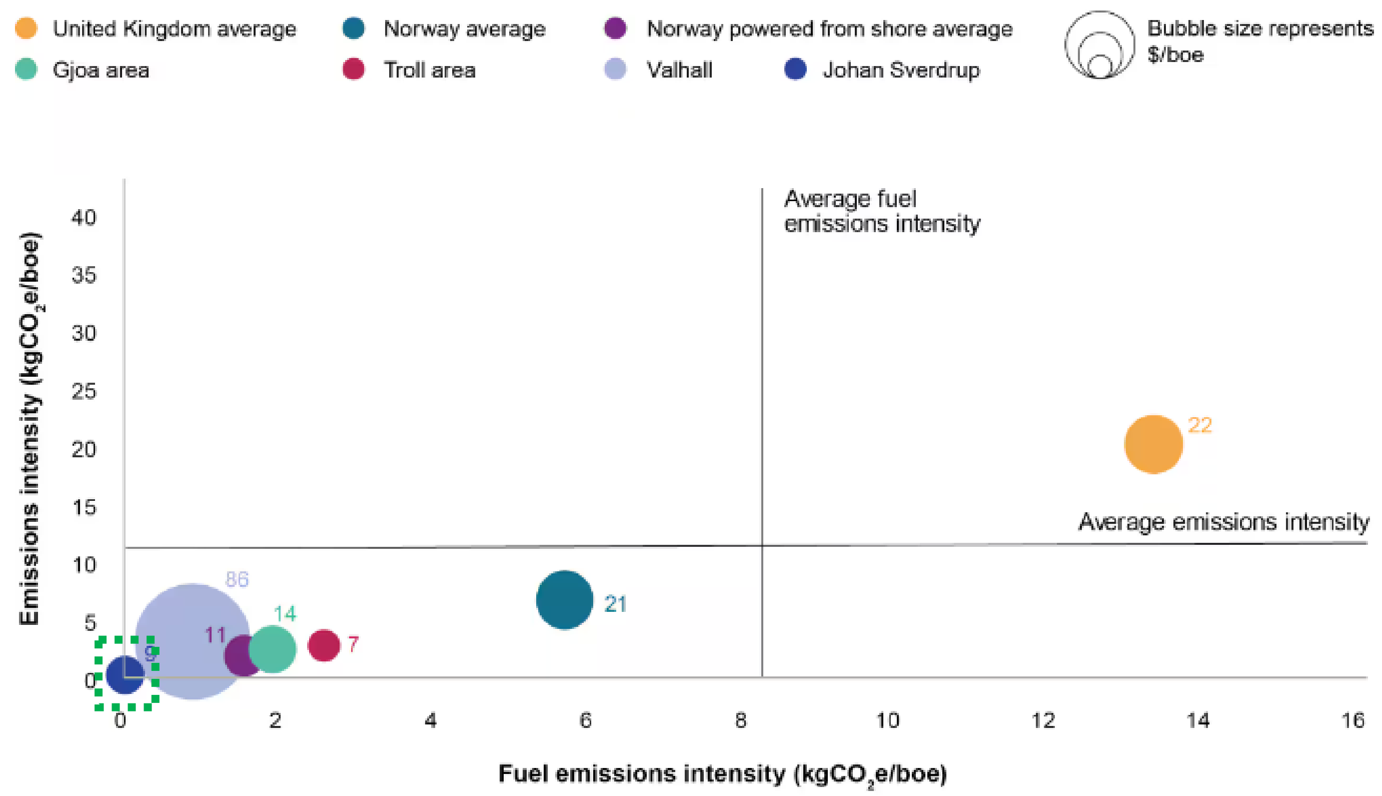
UKCS Pathway Forward

- Platform electrification Field Option 4 (Power from FWT to Platform) is the optimal emissions reduction strategy for the “GM” North Sea Case Study.
- Commercial opportunity for renewable power developers – allowing for co-investment in transmission infrastructure, while leveraging oil and gas deep-water technologies could support growth.

“Performing while Transforming: Decarbonising UKCS Production”

- **Integration:** Synergies from smartly combining uses and technologies across and within classical and new energy sectors, to boost efficiency and economic viability.
- **Partnerships:** Collaboration and strategic planning is crucial in addressing climate change and developing sustainable oil and gas production assets while securing a sustainable future.

UKCS Pathway Forward



North Sea Absolute Emissions Intensity and Fuel Emissions Intensity, 2022 (S&P Global, 2023)

Electrification deployment scenario	Assumption
Low case	**Seven assets** are **partially electrified** in 2032 and does not include projected new fields/projects with major infrastructure.
Mid case	**Eight assets** are **fully electrified** in 2030 and includes projected new fields/projects with major infrastructure.
High case	**Nine assets** are **fully electrified**, and **eight assets** are **partially electrified** in 2029 projected new fields/ projects with major infrastructure.

Summary of Scenario Criteria (NSTA, 2024)

Thank you for listening!