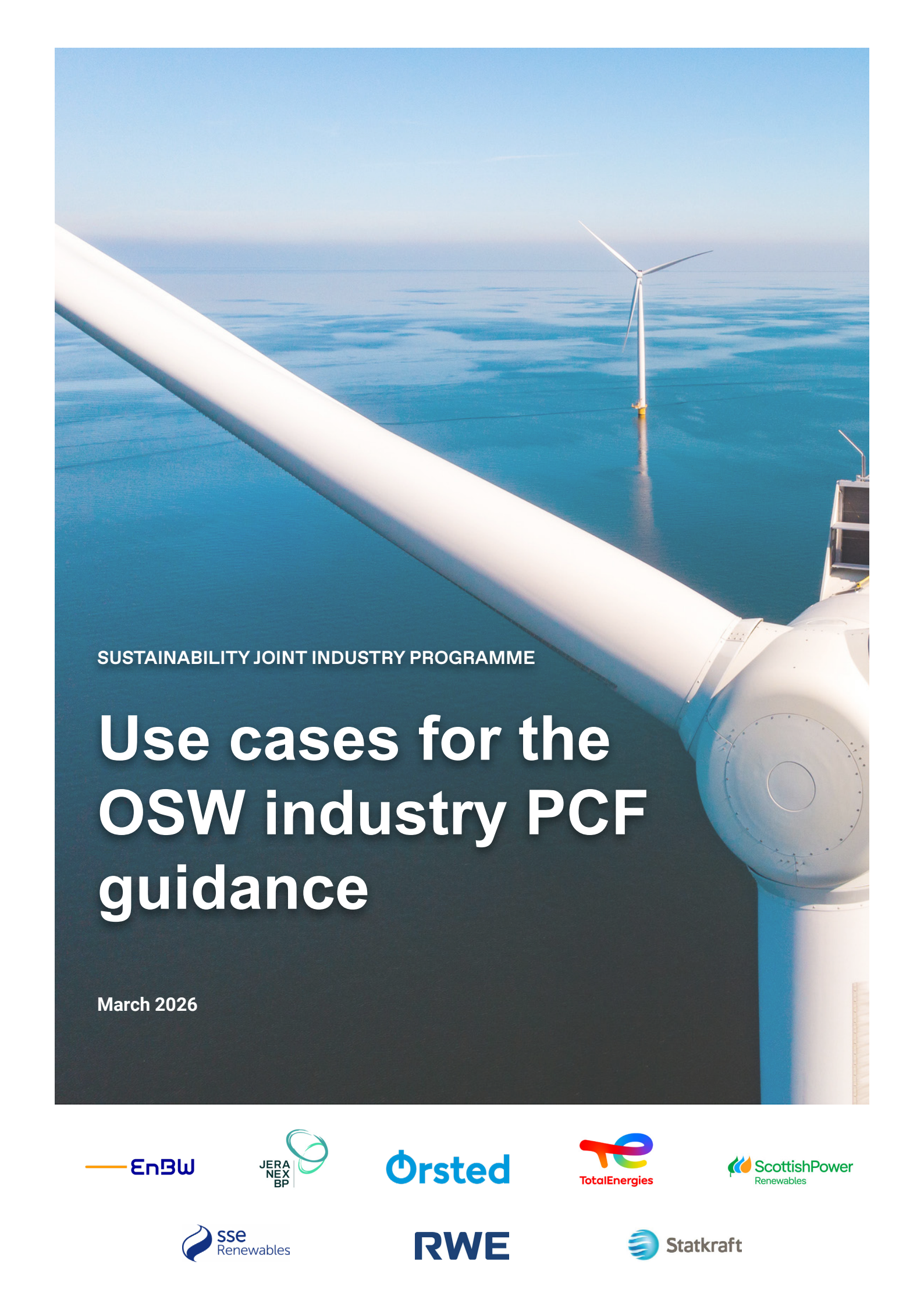




SUSTAINABILITY JOINT INDUSTRY PROGRAMME

Use cases for the OSW industry PCF guidance

March 2026



Use cases for the *OSW industry PCF guidance*

This document provides practical, worked examples demonstrating how the *OSW industry PCF guidance* can be applied to meet some of the specific business, technical and regulatory aims set out in section 2.1 of the guidance.

While the guidance document defines the *methodology* (the "rules" of the assessment), these use cases illustrate the *application* (how to use the rules to understand the carbon footprint of an offshore wind farm and make decisions). They cover a range of common scenarios faced by developers, from early-stage design optimisation and supply chain engagement to corporate reporting and auction compliance.

1. **Scenario:** A typical real-world challenge.
2. **Assessment steps:** How to apply the PCF guidance to solve the challenge.
3. **Outcome:** The resulting value, insight or compliance achievement.

It is important to note that all numerical values presented in the use cases are illustrative examples only and do not reflect real data from the industry or SUSJIP partners. They must not be used as industry benchmarks, reference values, or proxies for actual project data.

The material quantities, emission factors, carbon intensity results, and analytical findings from these scenarios are fictitious and have been made up by the authors of the *OSW industry PCF guidance* solely for the purpose of demonstrating with numerical examples how practitioners can apply the calculation methods and reporting formats. Assessors should always source primary data or verified secondary data relevant to their specific assessment context as defined in Section 3.3 of the guidance (Data collection).

Acronyms

The following acronyms and abbreviations are used throughout the use cases.

Acronym	Definition
CO ₂ e	Carbon Dioxide Equivalent (unit of measurement for GWP)
EPD	Environmental Product Declaration
GHG	Greenhouse Gas
OSW	Offshore Wind
PCF	Product Carbon Footprint
WTG	Wind Turbine Generator

Use case 1: Informing design decisions

Relevant aims: *Identify carbon emissions hotspots; compare different design options.*

Scenario: During the Concept design phase (design-stage PCF), a developer is selecting the foundation technology for a 1 GW offshore wind farm (70 turbines) in water depths of 50 metres. The engineering team is deciding between an XL Steel monopile and a Suction bucket jacket. The assessor uses the guidance to compare the potential carbon impact of both designs to inform the final decision.

Step 1, Define the reference flow: The assessor ensures both options are compared based on the same functional unit: *1 kWh of electricity delivered to the grid.*

- **Installed capacity:** 1,000 MW (70 turbines x ~14.3 MW)
- **Capacity factor:** 50% (default value)
- **Service life:** 25 years (default value)
- **Electrical losses:** 5% (assumed for calculation)

Using the formula in Table 14: Reference flow = 104,025,000,000 kWh

Step 2, Compare production stage emissions (A1-A3): The assessor calculates emissions for the 'Fixed foundation' asset category (Table 15, asset 2).

Option A: XL Steel monopile

- **Material:** 2,200 tonnes of steel per foundation x 70 turbines = 154,000 tonnes.
- **Emission factor:** Global average heavy plate steel (2.5 tCO₂e/t).
- **Calculation:** 154,000 x 2.5 = 385,000 tCO₂e.

Option B: Suction bucket jacket

- **Material:** 1,200 tonnes of steel per foundation x 70 turbines = 84,000 tonnes (note: Jackets for this depth typically require ~45% less steel mass than monopiles).
- **Emission factor:** 3.0 tCO₂e/t. (note: A higher emission factor is applied to account for the increased manufacturing complexity, such as welding and nodes, of the lattice structure).
- **Calculation:** 84,000 x 3.0 = 252,000 tCO₂e.

Step 3, Compare construction and installation stage emissions (A5): The monopile requires a heavy-lift vessel with high fuel consumption, while the suction bucket can be installed by a smaller vessel, though installation time may be longer.

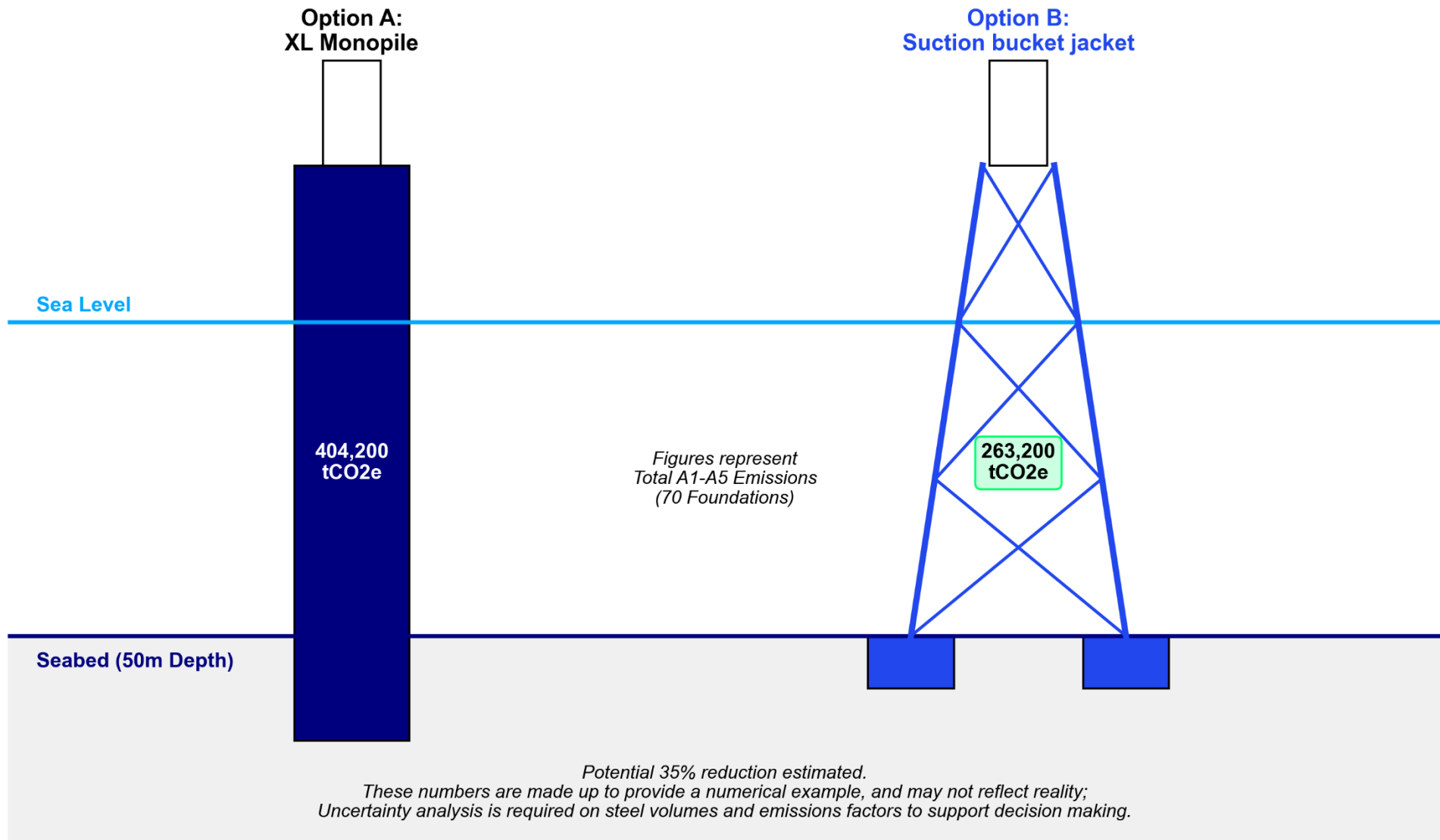
- **Option A (heavy lift):** 100 days x 60 tonnes fuel/day x 3.2 tCO₂e/t fuel = 19,200 tCO₂e.
- **Option B (light vessel):** 140 days x 25 tonnes fuel/day x 3.2 tCO₂e/t fuel = 11,200 tCO₂e.

Outcome: The PCF assessment indicates a potential reduction in carbon (A1-A3 + A5) of approximately 35% for Option B (263,200 tCO₂e) compared to Option A (404,200 tCO₂e). This reduction is primarily driven by the lower material mass of the jacket design. However, as this is a prospective assessment, further analysis should be undertaken during the technical design phase to verify manufacturing emission factors and material quantities.

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SUS-JIP use case 1: Informing design decisions

Comparing prospective carbon footprints of foundation concepts



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Use case 2: Meeting auction requirements (prequalification or award criteria)

Relevant aims: *Meeting regulatory reporting requirements; benchmarking against industry average.*

Scenario: A developer is preparing a bid for an upcoming seabed lease auction. The auction includes a sustainability related prequalification criterion: the proposed project should demonstrate an expected life cycle carbon intensity of less than 18 gCO₂e/kWh.

To satisfy this pre-qualification criterion, the developer calculates the carbon footprint using two scenarios:

- **Calculation A (optimistic):** Using project specific values for the reference flow parameters (service life, capacity factor, electrical losses, Section 2.5)
- **Calculation B (conservative):** Using the guidance default values, to do a sensitivity analysis to test the result against the threshold (Section 3.8.3).

Step 1, Identify the tender requirements: The assessor reviews the tender documentation.

- **Metric:** Levelised carbon Intensity (gCO₂e/kWh) threshold: < 18 gCO₂e/kWh (A1-C5).
- **Uncertainty requirement:** The regulator requires an uncertainty assessment of +/- 50% to be applied to early-stage estimates.

Step 2, Calculate using both practitioner parameters, and guidance default for sensitivity analysis:

The assessor calculates the footprint for the reference flow (1 kWh delivered to grid).

- **Calculation A (practitioner values):**
 - **Assumption:** 30-year life, 55% capacity factor (based on specific site wind analysis).
 - **Reference flow:** $500 \times 1,000 \times 0.55 \times (30 \times 8,760) \times 0.95 = 68,661,450,000$ kWh.
 - **Calculated emissions (A1-C5):** 500,000 tCO₂e
 - **Intensity:** $500,000 \times 10^6$ (gCO₂e, estimated A1-C5 emissions) / 68,661,450,000 (kWh, reference flow) = 7.28 gCO₂e/kWh.
 - **Result:** 7.28 gCO₂e/kWh. With +/- 50% Uncertainty: Range 3.64 – 10.92 gCO₂e/kWh.
- **Calculation B (sensitivity analysis):**
 - **Requirement:** 25-year life, 50% capacity factor.
 - **Reference flow:** $500 \times 1,000 \times 0.50 \times (25 \times 8,760) \times 0.95 = 52,012,500,000$ kWh.
 - **Calculated emissions (A1-C5):** 500,000 tCO₂e
 - **Intensity:** $500,000 \times 10^6$ (gCO₂e, estimated A1-C5 emissions) / 52,012,500,000 (kWh, reference flow) = 9.62 gCO₂e/kWh.
 - **Result:** 9.62 gCO₂e/kWh (higher due to conservative default assumptions). With +/- 50% Uncertainty: Range 4.81 – 14.43 gCO₂e/kWh.

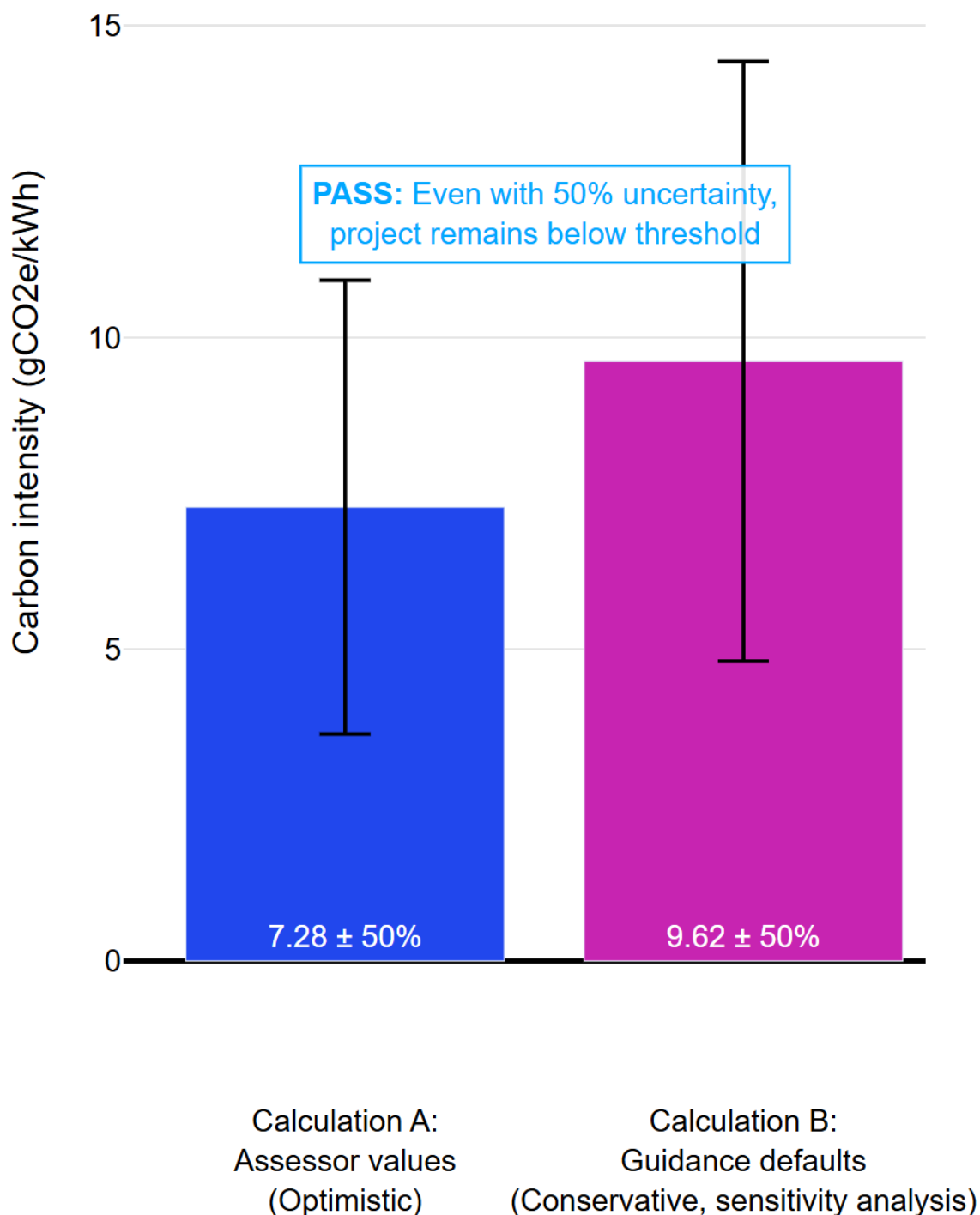
Outcome: The analysis demonstrates that even under the more conservative Calculation B scenario, and applying the maximum 50% uncertainty margin, the project's upper estimate (14.43 gCO₂e/kWh) remains below the prequalification criteria threshold. If each developer reports Calculation B (default values for reference flow parameters) in the OSW PER (Appendix 2, Table 2), the regulator can fairly compare these bids, despite different assumptions for service life, or capacity factor in Calculation A.

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SUS-JIP use case 2: Meeting tender requirements

Benchmarking project carbon intensity against regulatory threshold

Indicative auction pre-qualification threshold



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Use case 3: Improving data quality and uncertainty

Relevant aims: *Improve data quality; plan reduction interventions.*

Scenario: An Operational PCF is being conducted for a development moving into the construction phase. The initial assessment (prospective) used secondary data for 150km of 3-core inter-array cables (Asset Category 4a), resulting in a 'Fair' data quality score. The developer wants to improve the accuracy of the footprint.

Step 1, Baseline assessment (Secondary data):

- **Data source:** Industry database (secondary).
- **Data quality score:** 'Fair' (Score 0.5) based on Table 33.
- **Activity data:** 150 km of cable.
- **Emission factor:** 15,000 kgCO₂e/km.
- **Total emissions:** 2,250 tCO₂e.
- **Uncertainty:** High (parameter uncertainty calculated using Table 35 scaling factors).

Step 2, Supplier engagement: The developer requests an Environmental Product Declaration (EPD) from the cable supplier. The supplier provides a verified EPD based on their specific manufacturing plant in Europe, which uses 100% renewable energy for production.

Step 3: Updated assessment (primary data)

- **Data source:** Supplier EPD (primary).
- **Data quality score:** 'Very good' (Score 0.9).
- **Emission factor:** 11,000 kgCO₂e/km (lower due to renewable energy in manufacturing).
- **Total emissions:** 1,650 tCO₂e.
- **Uncertainty:** Low (high confidence in the specific dataset).

Outcome: By replacing secondary data with primary data, the developer achieves two key results:

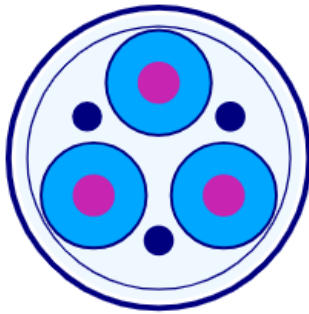
1. **Emissions reduction:** The reported emissions for the cable package decrease by 27% (600 tCO₂e), reflecting the actual lower-carbon manufacturing process using verified primary data from the supplier.
2. **Confidence:** The weighted average data quality score for the production stage (A1-A3) improves significantly due to the acquisition of primary data, reducing the overall uncertainty of the PCF.

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SUS-JIP use case 3: Improving data quality & accuracy

Reduction in uncertainty by gathering primary data (inter-array cable)

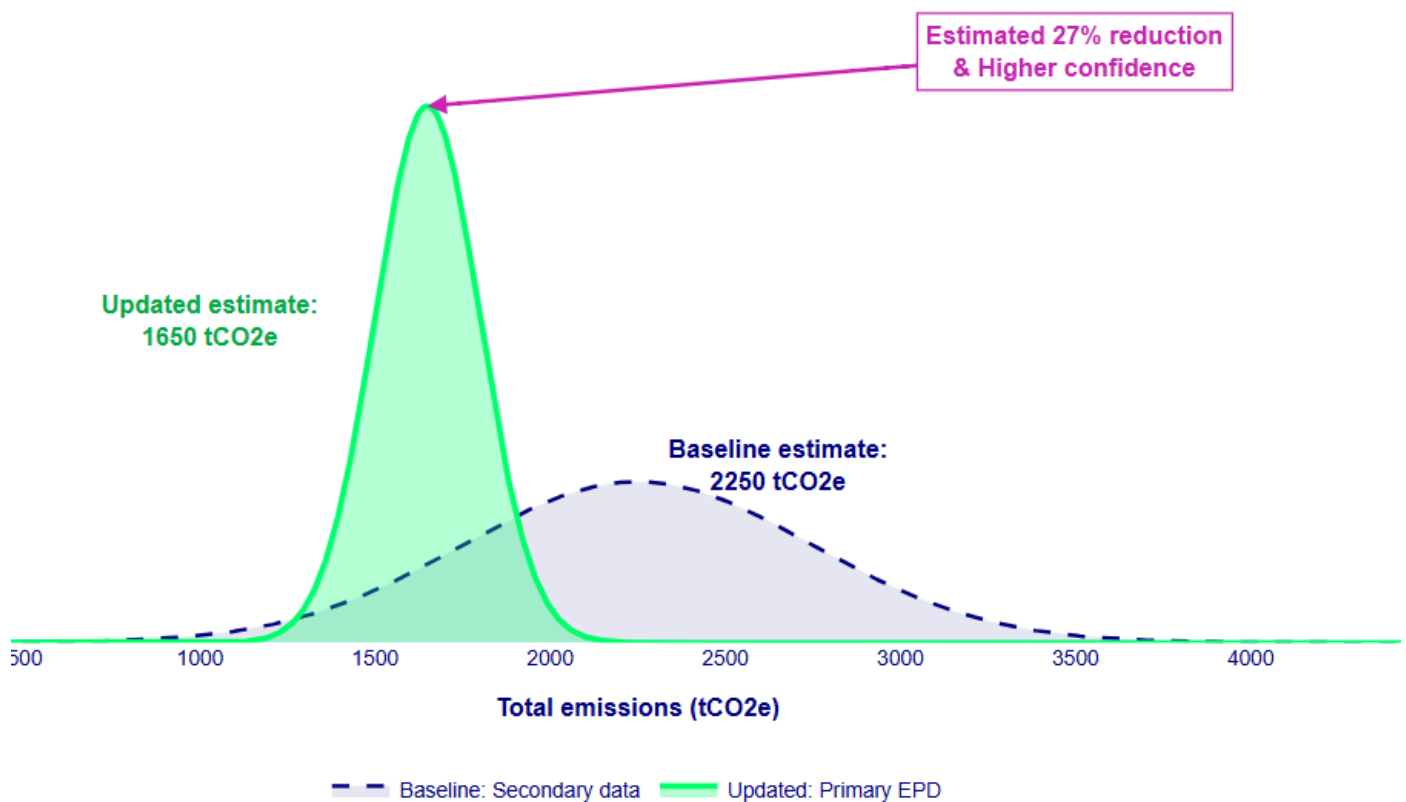
Inter-array cable (Asset category 4a)



Data quality improvement

Metric	Baseline (secondary)	Updated (primary)
Source	Industry DB	Supplier EPD
Factor	15,000 kgCO ₂ e/km	11,000 kgCO ₂ e/km
Total	2,250 tCO ₂ e	1,650 tCO ₂ e
Quality	Fair (0.5)	Very Good (0.9)
Uncertainty	High	Low

Probability distributions: Baseline vs. Updated



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Use case 4: Informing organisational carbon footprints (Scope 3)

Relevant aims: *Inform organisational carbon footprint.*

Scenario: A developer needs to report their corporate Scope 1, 2 and 3 emissions for the reporting year. They have completed the PCF for their development which has started construction during the year and is expected to continue in the next reporting year.

Step 1, Allocation of PCF to reporting year: The PCF covers the *entire* life cycle (25+ years). For corporate reporting, the developer must extract only the emissions related to activities that occurred *within the specific reporting year they are measuring*.

Step 2: Extraction by module

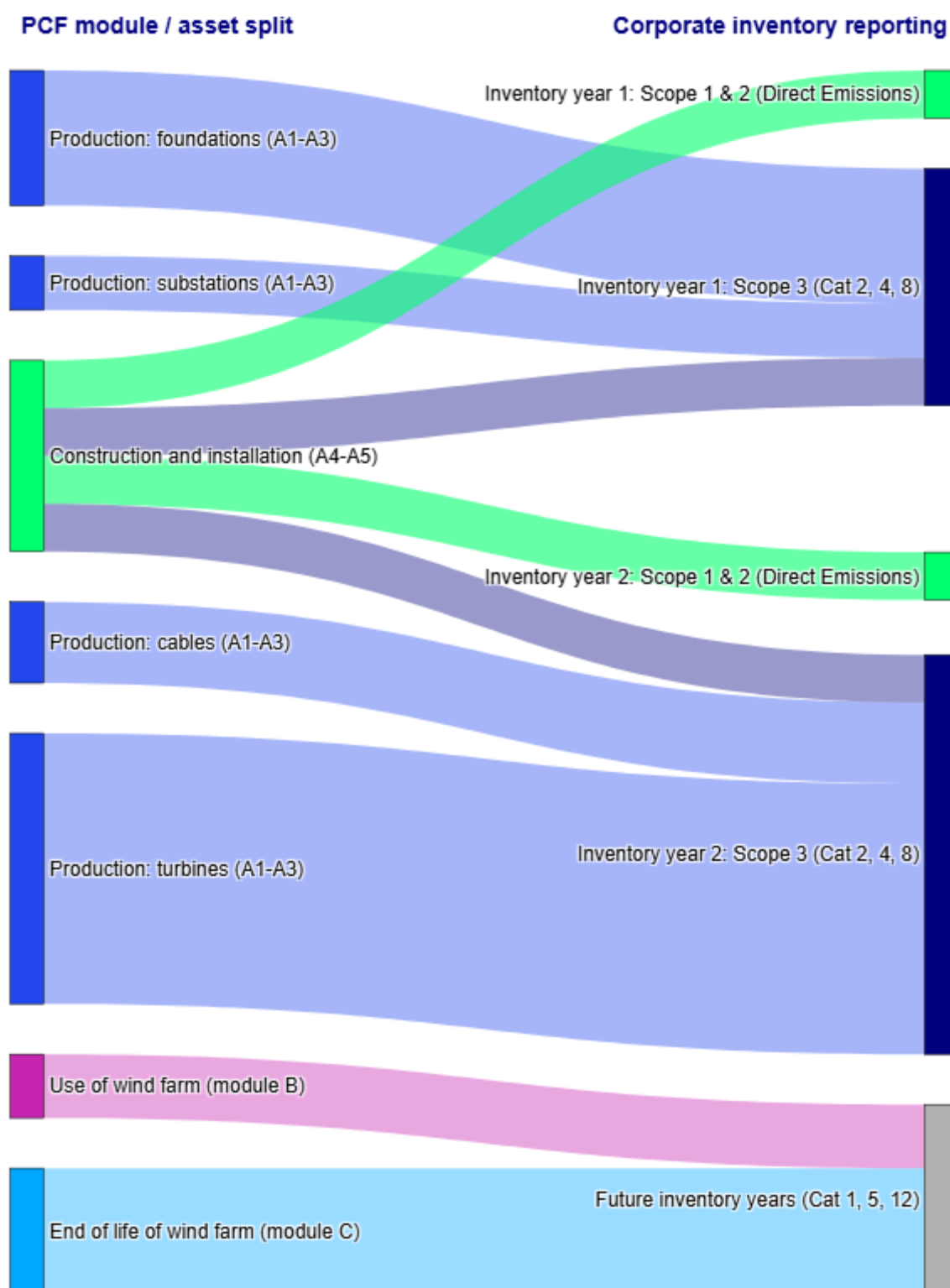
- **Module A1-A3 (production of major components):**
 - Inventory year 1: The foundations and substations were manufactured and purchased this year. The total 29,750 tCO₂e from these assets is included in the year 1 Scope 3 inventory (category 2: capital goods).
 - Inventory year 2: The wind turbines and inter-array cables were purchased this year. The total 55,250 tCO₂e from these assets is included in the year 2 Scope 3 inventory (category 2: capital goods).
- **Module A4-A5 (construction and installation):**
 - The developer manages construction activities across both year 1 and year 2. Allocation depends on the vessel contracting strategy:
 - **Scenario A (operational control):** The developer leases vessels on a bareboat charter or owns them. The fuel consumption (e.g. 7,500 tCO₂e/year) is included in the annual Scope 1 inventory.
 - **Scenario B (no operational control):** The developer leases vessels on a time charter (with crew). The fuel consumption is included in the annual Scope 3 inventory (category 8: upstream leased assets).
- **Module B (use phase and operations):**
 - These emissions will occur in future years. They are excluded from the current corporate inventory but remain in the PCF report. They will be captured in future corporate inventories (e.g. as Scope 1 for direct maintenance or Scope 3 category 1 for outsourced maintenance).
- **Module C (end of life):**
 - These are excluded from the current corporate inventory. They will be captured in future corporate inventories in the year the decommissioning activities occur (typically Scope 3 category 5: waste generated in operations).

Outcome: The PCF serves as a source of data for the corporate inventory. The detailed granularity of the Asset taxonomy (Table 15) allows the developer to map specific PCF components (e.g. steel foundations) to specific corporate procurement categories.

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SUS-JIP use case 4: Informing corporate carbon footprints

Allocation of PCF lifecycle module emissions to corporate inventory years and scopes



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Use case 5: Research, innovation and analytics

Relevant aims: *Support academic research; compare different design options; benchmarking against peers.*

Scenario: A university research group is assessing the potential decarbonisation impact of a novel recyclable blade technology for a theoretical 500 MW offshore wind farm. The study aims to quantify the life cycle benefits of the new material compared to a standard fibreglass-epoxy blade, specifically focusing on end-of-life (EoL) outcomes and circularity.

Step 1, Compare production stage emissions (A1-A3): The innovative blade uses a new resin system that requires more energy to manufacture than standard epoxy.

Option A: Standard blade:

- Material: 10,000 tonnes composite.
- Emission factor: 3.0 tCO₂e/t.
- Total (A1-A3): 30,000 tCO₂e.

Option B: Recyclable blade

- Material: 10,000 tonnes novel composite.
- Emission factor: 3.5 tCO₂e/t (higher manufacturing intensity).
- Total (A1-A3): 35,000 tCO₂e.

Step 3, Compare end-of-life (C3-C4) and Module D: The standard blade is sent to landfill or incineration (C4), while the recyclable blade undergoes chemical recycling (C3) to recover high-value resin, creating a potential benefit beyond the system boundary (Module D1).

Option A: Standard blade

- C4 (Disposal): 10,000 tonnes x 0.1 tCO₂e/t = 1,000 tCO₂e.
- Module D1: 0 tCO₂e (no material recovery).

Option B: Recyclable blade

- C3 (Processing to end-of-waste): 10,000 tonnes x 0.05 tCO₂e/t (sorting/shredding) = 500 tCO₂e. (note: Emissions from the recycling process itself are allocated to the recycled material in the next life cycle, not the OSW development, per Section 2.6.3).
- Module D1 (Displacement): 9,000 tonnes recovered resin x -2.0 tCO₂e/t (virgin resin displaced) = -18,000 tCO₂e.

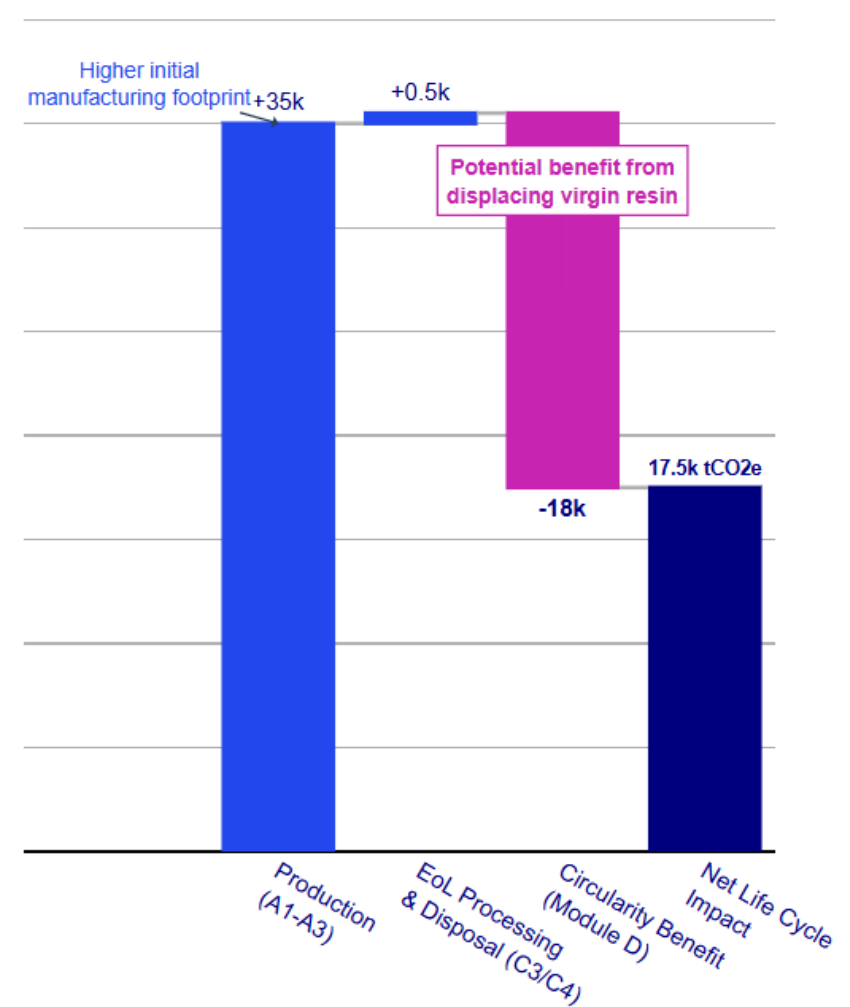
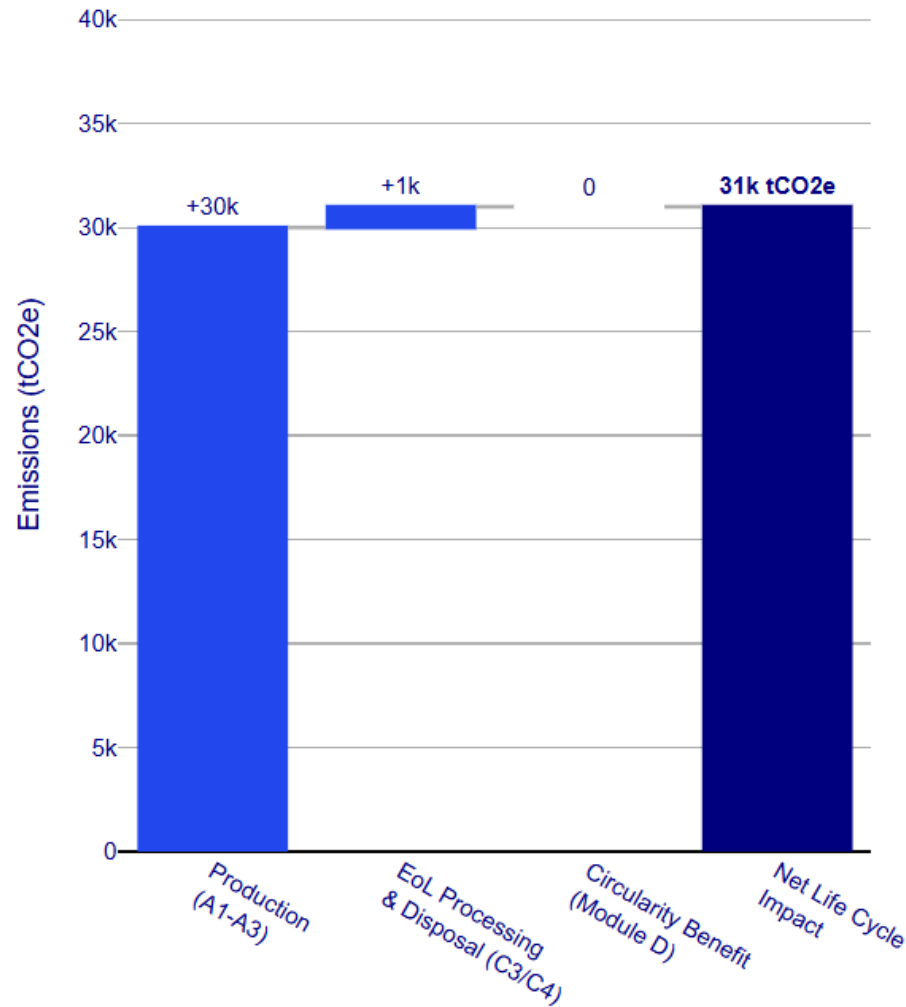
Outcome: The analytics for this scenario reveal that while the recyclable blade has an estimated 17% higher upfront carbon footprint (A1-A3), it may offer a net life cycle benefit (with associated uncertainty, which may be analysed using section 3 of 13,500 tCO₂e when the system consequences of producing a recyclable blade in Module D benefits are considered. The researchers use this data to publish a recommendation for policy incentives that reward circularity (Module D) in future auctions.

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SUS-JIP use case 5: Research, innovation and analytics

Comparing life cycle decarbonisation impact of recyclable vs. standard blades (emphasising circularity)

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Research outcome: The recyclable blade shows a potential net life cycle benefit of 13,500 tCO₂e, primarily driven by the circularity benefit of displacing virgin resin requirements (Module D).

(Note: This potential depends on future market recovery systems and requires further testing to understand broader system impacts.)

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