European Wave and Tidal Energy Conference

Environmental and socio-economic assessment of a 34 MW tidal energy farm based on the NEMMO project

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15th ewtec 2023 European Wave and Tidal Energy Conference Series | BILBAO 3rd -7th SEPTEMBER 2023

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Life Cycle Assessment (LCA)

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Objectives

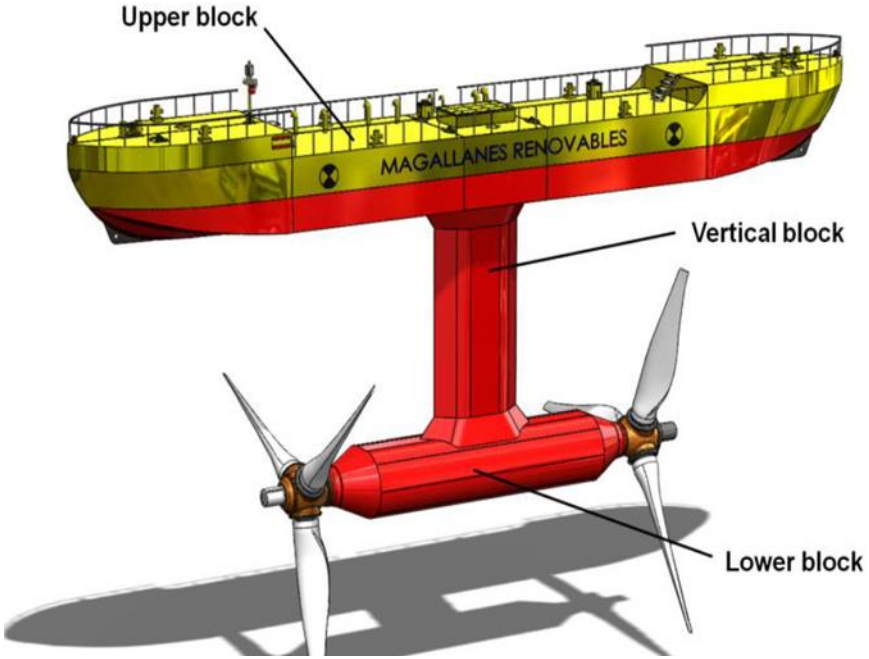
- ✓ To assess the **environmental** impacts generated by the construction and operation of a 34.5 MW tidal farm based on 23 platforms of 1.5 MW each.
- ✓ To assess in detail the impacts caused by the blades manufactured in NEMMO project.

Functional Unit: one kWh of electricity produced by the Magallanes tidal system at the output of the tidal farm.

System boundaries: cradle-to-gate[1]

Impact categories: PEF guide

- Climate Change
- Freshwater ecotoxicity
- Land use
- Water use



1 In line with the recommendations given by the PCR "electricity, steam and hot/cold water generation and distribution" (EPD International System).

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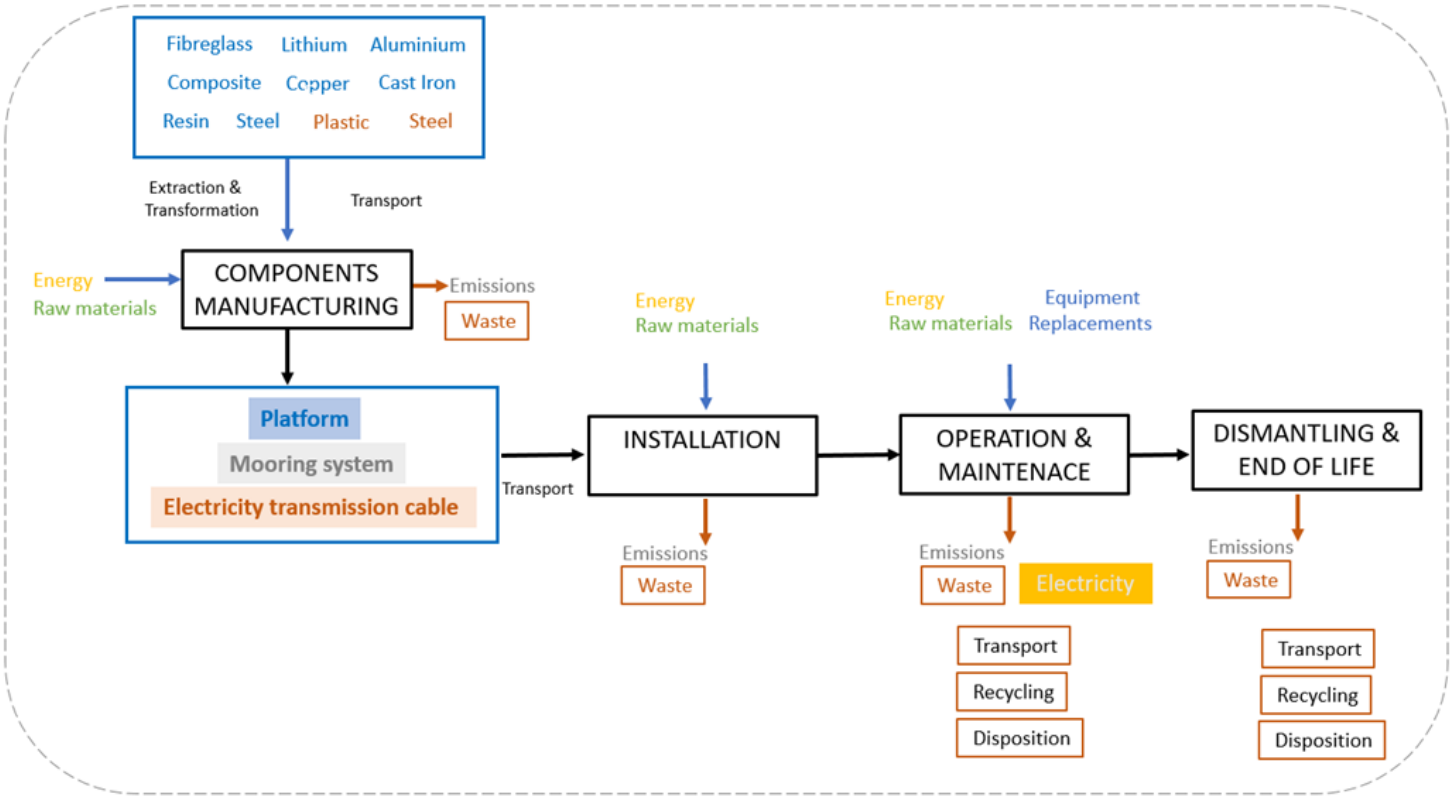
System boundary diagram of the Magallanes tidal farm

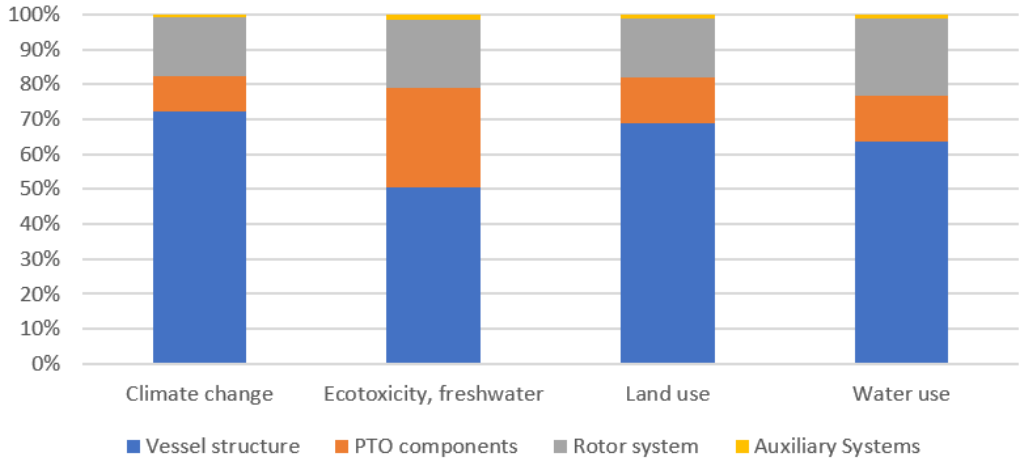


Life Cycle Stages:

- Upstream module.
- Core module (I). Tidal farm infrastructure.
- Core module (II). Tidal farm operation.

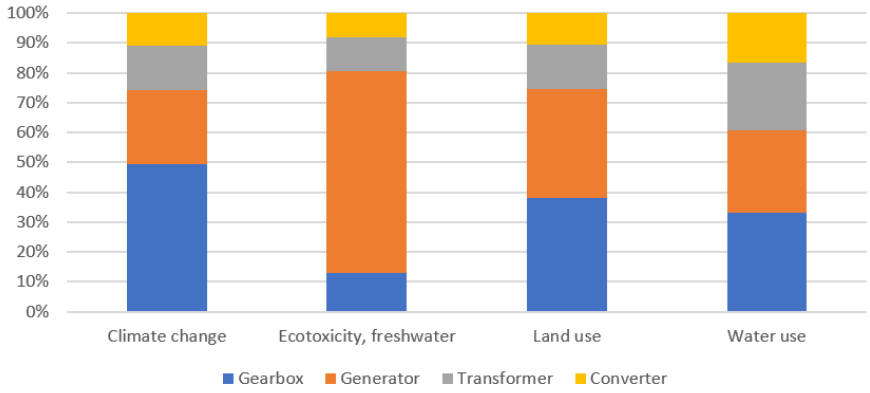
Overview of environmental impacts generated by one platform

Platform

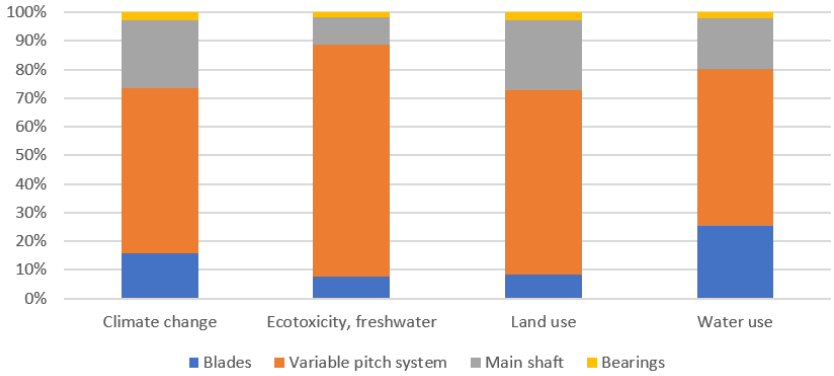


>50% of all categories of env. impacts are generated by the vessel structure (→ 360 tonnes of steel)

PTO components



Rotor system



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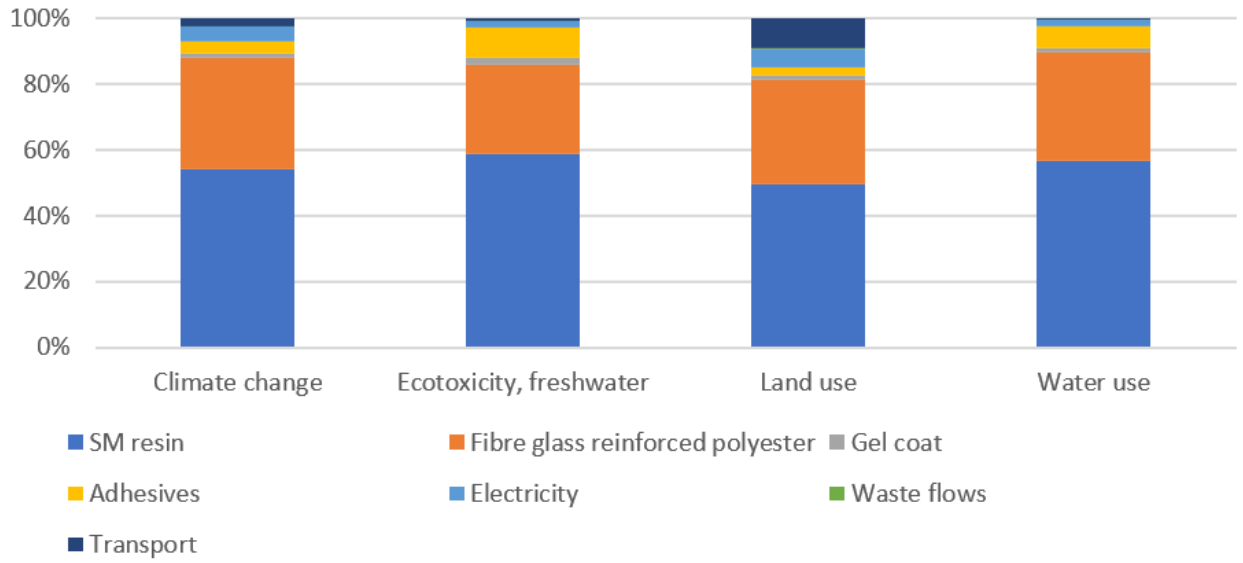
Environmental impacts generated by one blade



The production of one blade generates around 10.2 tonnes of CO_2eq.

- 54.3 % are caused by the SM resin production process.
- 33.6 % are produced in the fibre glass reinforced polyester production process.
- The remaining 12% of the emissions are attributed to the rest of the components.

	Climate change	Ecotoxicity, freshwater	Land use	Water use
Unit	*kg CO_2 eq*	*CTUe*	*Pt*	*m^3 depriv.*
TOTAL	**10271.0**	**301790.1**	**27491.7**	**4738.5**
SM resin	5578.1	177808.9	13576.2	2675.1
Fibre glass reinforced polyester	3449.9	81638.4	8772.5	1578.5
Gel coat	126.6	5726.2	326.4	61.8
Adhesives	375.1	28384.4	762.5	309.8
Electricity	495.3	5384.2	1428.8	100.9
Waste flows	1.3	24.2	80.9	1.7
Transport	244.4	2823.6	2544.2	10.5

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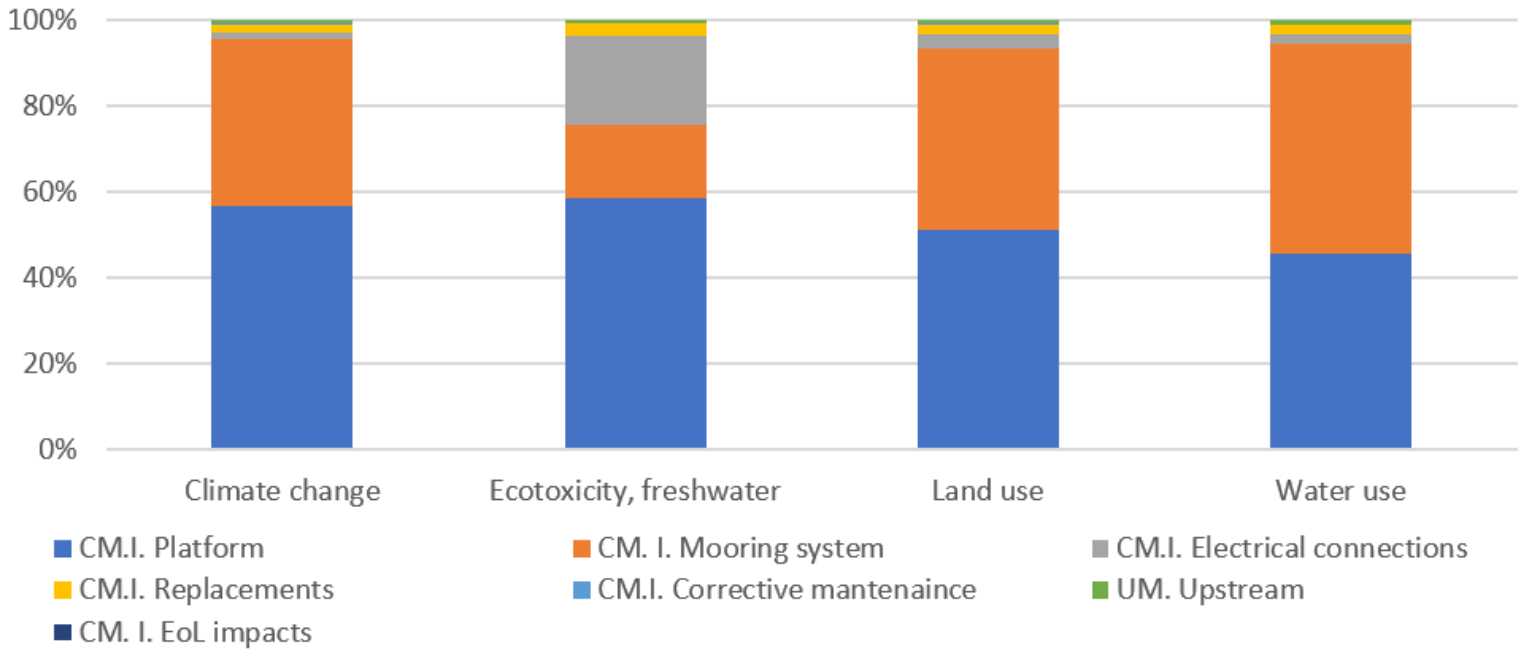
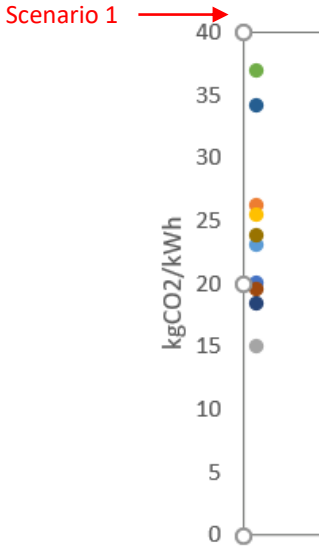
Environmental impact per kWh of electricity produced

- 34.5 MW tidal energy farm (23 platforms)
- AEP per platform 4,104 MWh
- Location Orkney (Scotland),
- Capacity factor of 31%.
- Lifetime of platform and mooring system is considered to be 25 years.

	Units	Scenario 1
Climate change	g CO_2 eq / kWh	40.40
Ecotoxicity, freshwater	CTUe / kWh	2,059,860
Land use	Pt / kWh	229,050
Water use	m^3 depriv. / kWh	11,030

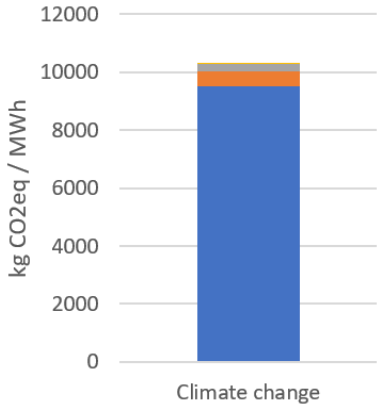


Conclusions



- GHG emissions (i.e. 40.40 g CO_2/kWh) are generally higher than the emissions found in the literature for other tidal energy devices.

- Most of the life cycle impacts of the blades are caused by the **production** of the materials used in the **manufacture of the blades**.



- Improving the **recyclability of composite blades** at the end of their useful life and the **eco-design** of the components that form part of tidal energy farms would be two of the main drivers for improving the sustainability of this innovative energy source.

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Socio-economic assessment (SEA)

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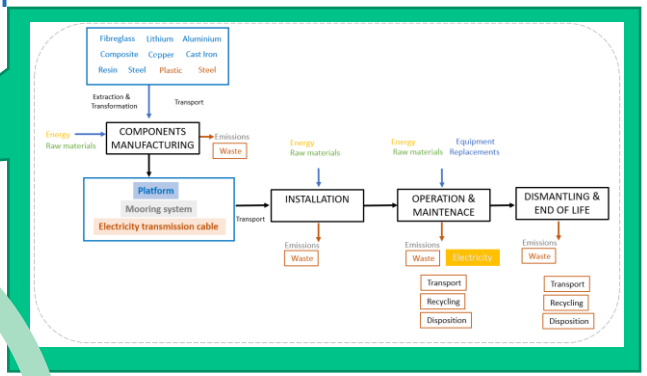
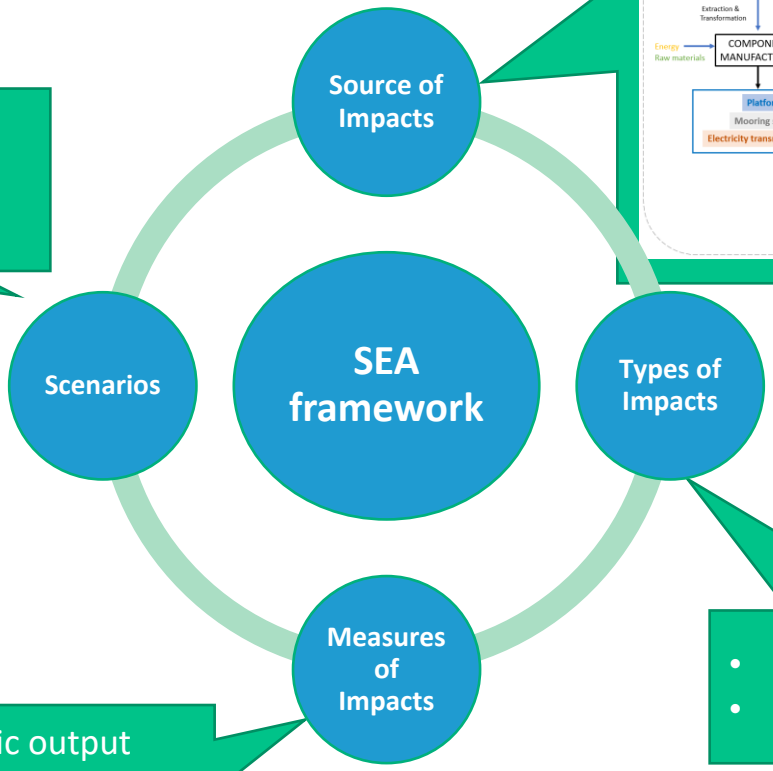
Objectives

✓ To assess the **socioeconomic impacts** generated by the construction and operation of a 34.5 MW tidal farm based on 23 platforms of 1.5 MW each.

- 34.5 MW tidal farm, 23 platforms with a rated power of 1.5 MW





- Direct impacts
- Indirect impacts

- Gross economic output
- Employment
- Gross Value Added
- Income

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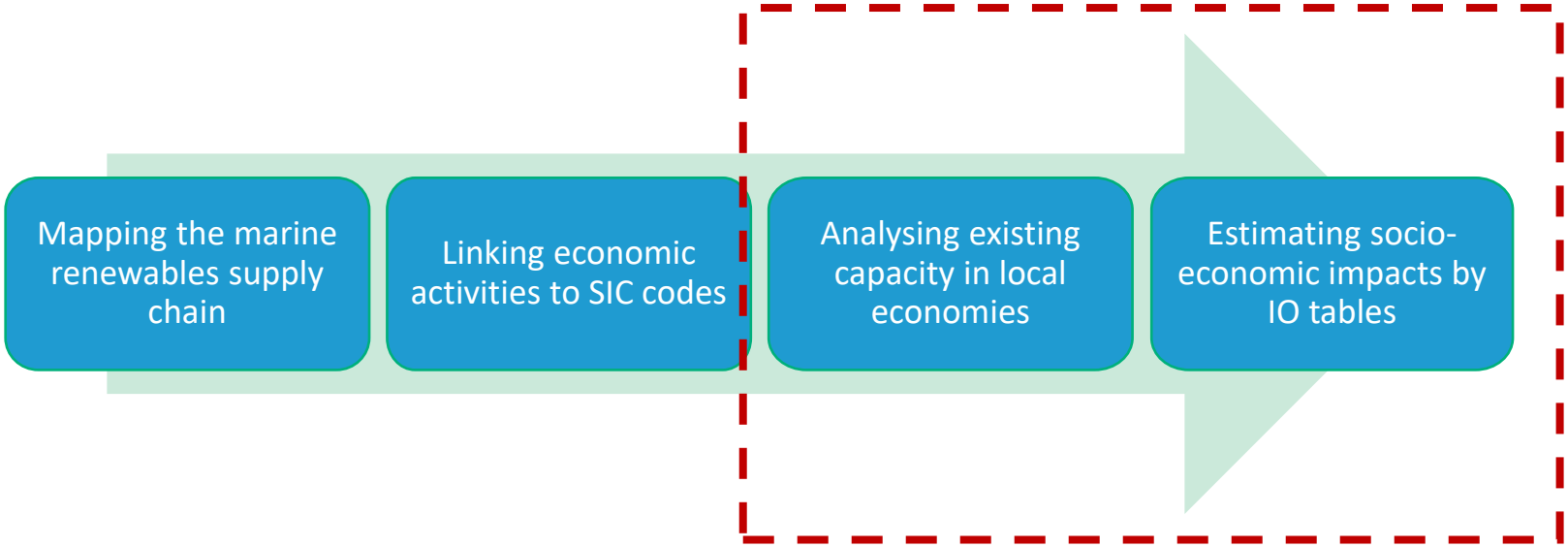
SEA Methodological approach



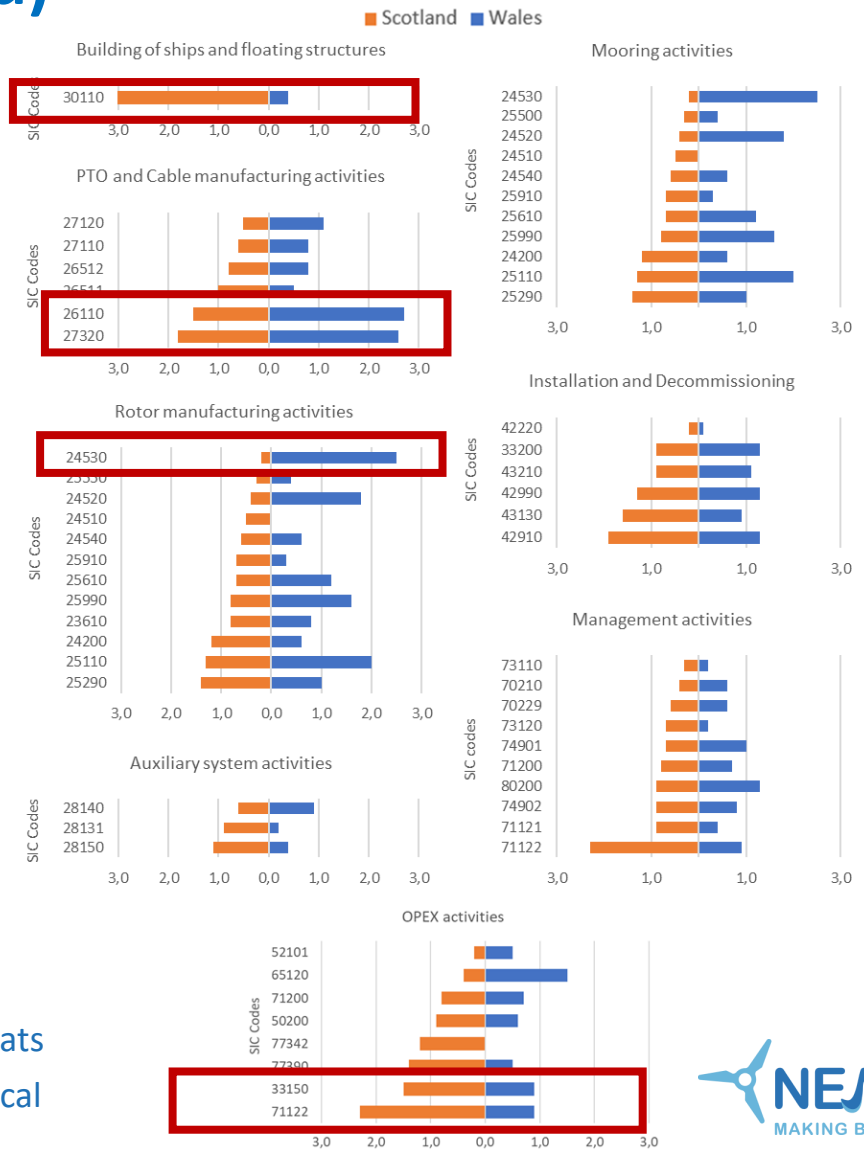
Analysing existing capacity in local economies (Wales and Scotland)

- Building of ships and floating structures

- Manufacture of electronic components
- Manufacture of other electronic and electric wires and cables

- Casting of metals

- Repair and maintenance of ships and boats
- Engineering related scientific and technical consulting activities



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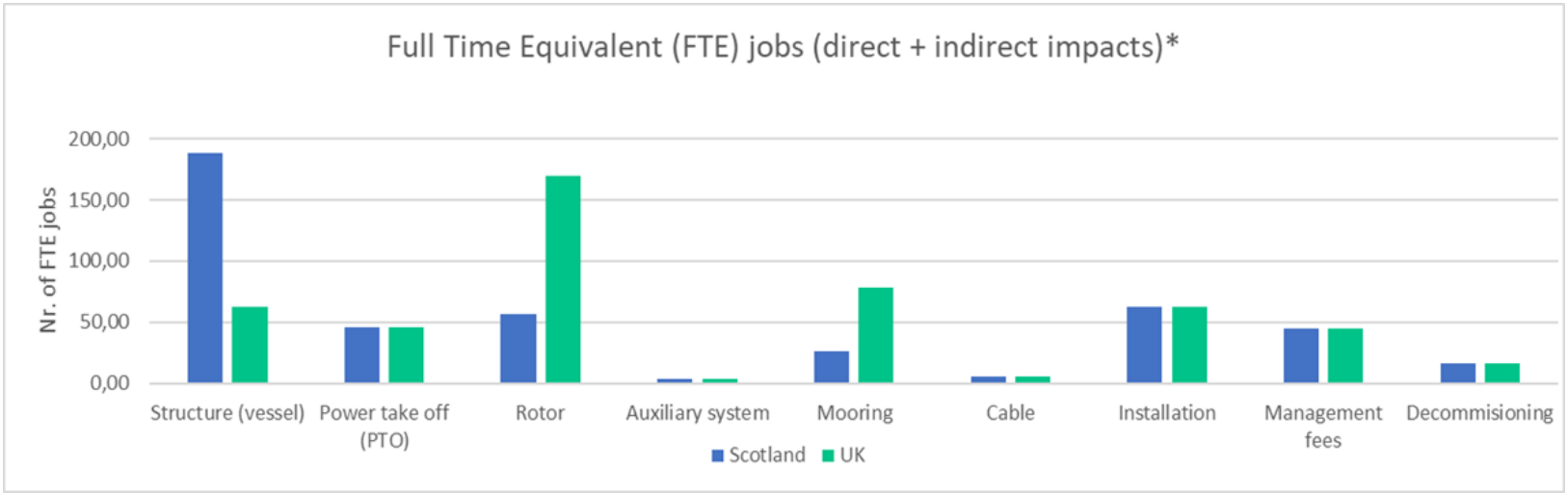
Local (Scotland) + national (UK) socioeconomic impacts

Scotland+UK scenario (34.5 MW tidal farm)	Scotland	Rest of UK	Scotland + rest of UK
Economic impact (gross economic output: direct contribution)	72.8 M€	86.9 M€	159 M€
Employment	457 FTE jobs	497 FTE jobs	954 FTE jobs
Income	19 M€	24 M€	43 M€
GVA	25 M€	38 M€	63 M€



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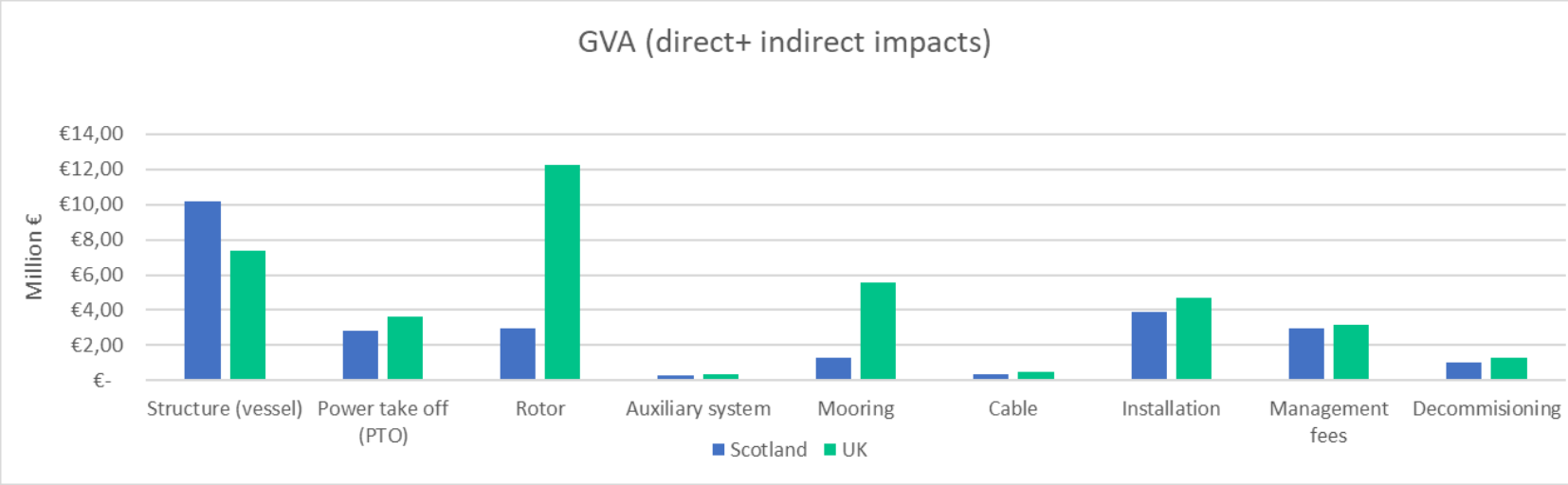

Thank you for your attention!

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This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 815278.

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