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Methodological approach for sustainable offshore wind farm decommissioning

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SeeGff

Strategieentwicklung zum effizienten
Rückbau von Offshore-Windparks

SeeOff - Strategieentwicklung zum effizienten Rückbau von Offshore Windparks

(development of strategies for sustainable offshore wind farm decommissioning)

Project duration:

November 2018 – April 2022

Projekt coordination:

City University of Applied Sciences Bremen

Prof. Dr.-Ing. Silke Eckardt

Aim:

Support stakeholders at developing and assessing efficient, project specific decommissioning strategies

www.seeoff.de

Supported by:



Federal Ministry
for Economic Affairs
and Climate Action

on the basis of a decision
by the German Bundestag



Reference offshore wind farm

Components

- 80 wind turbines (WTG) (Siemens SWT-3.6-120)
- Transition Piece (TP) with grouted connection to Monopile (MP)
- Scour protection layer (SPL) (filter and armour layer)
- Sea cables: 33 kV Inner array cables (IAC) and 155 kV export cable
- Offshore substation (OSS) on jacket foundation

Further conditions

- Located within the German Economic Exclusive Zone
- Water depth of 20 to 30 m
- Distance to reference base harbour of 110 km

Decommissioning scenarios

Baseline scenario + 9 alternative scenarios:

- **Offshore logistics:** Shuttle vs. Feeder concepts
 - **Offshore dismantling technologies:** Abrasive water jetting, diamond wire cutting machine and vibratory extraction
 - **Scope of decommissioning:** IAC and/or SPL left in situ, MP is cut 3 m above seabed and complete removal of MP
- Investigation of decommissioning scenarios by documenting and parametrizing decommissioning processes
- Assessment of decommissioning scenarios regarding their sustainability

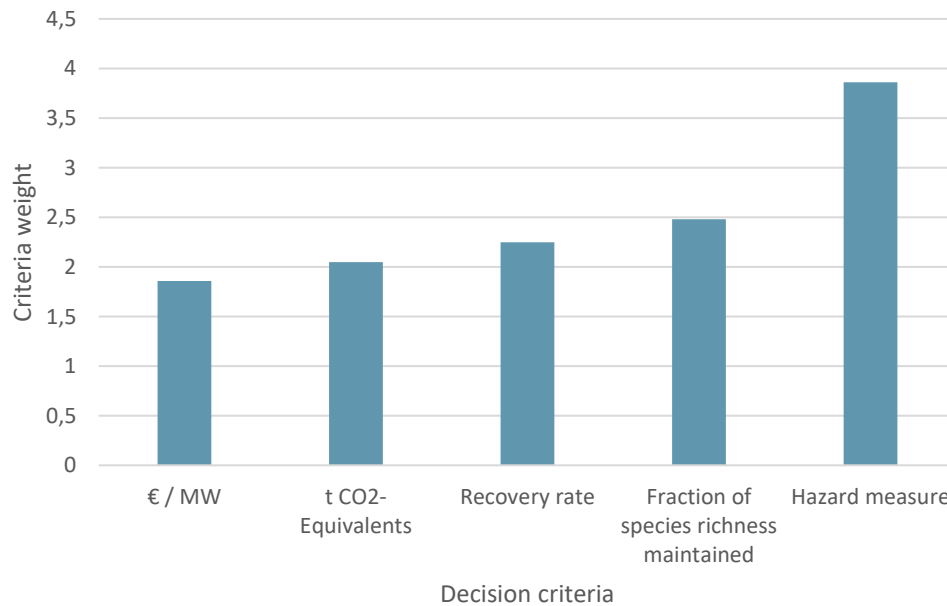
Multi criteria decision analysis

Tool that supports decision making incorporating multiple objectives

Sustainable decommissioning of offshore wind farms					
Category	Economy	Environment			Health and safety
Objective	High economic efficiency	Low GHG-Emission	Minor impact in biodiversity	High resource efficiency	Few hazards
Attribute	€ / MW	CO ₂ -Equivalent	Fraction of species richness maintained	Recovery rate	Hazard measure

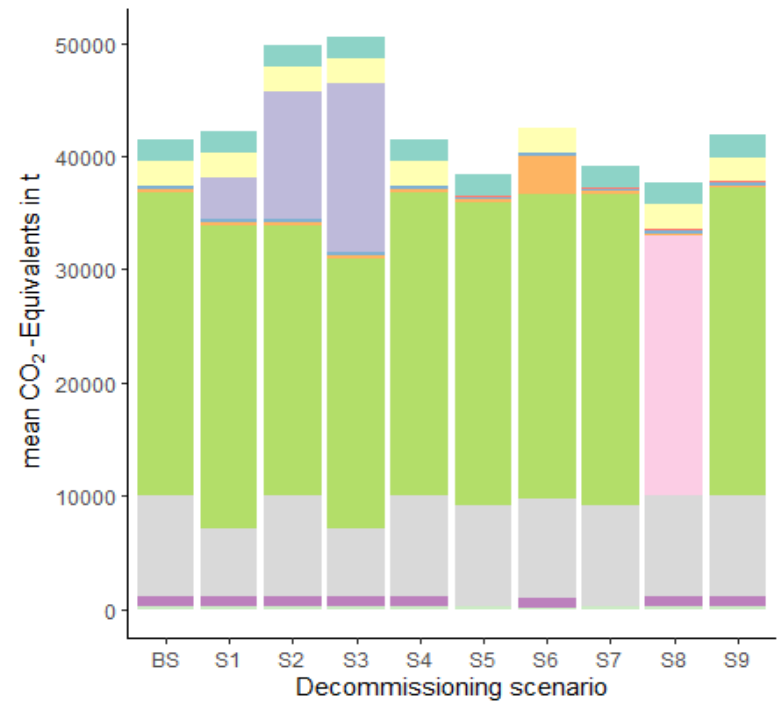
Decision criteria

Multi criteria decision analysis



Criteria weighting

Performance of decommissioning scenarios per criterion

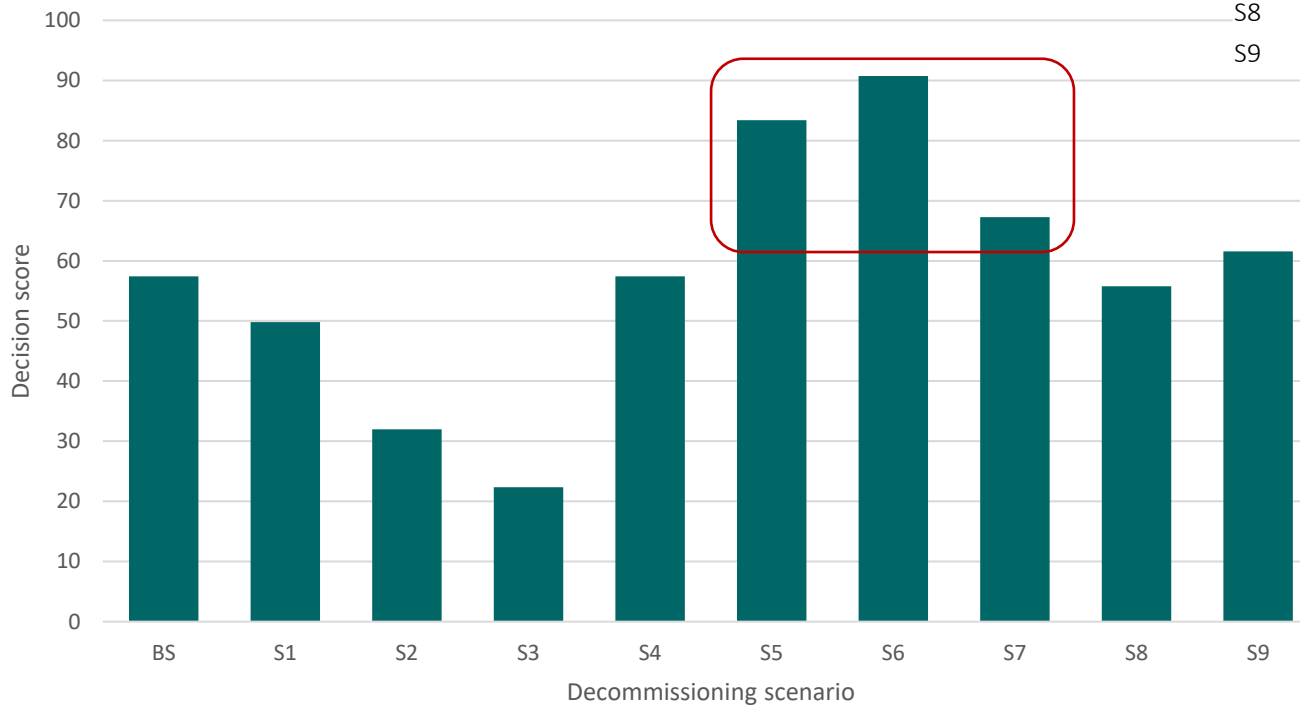


Weighted sum model

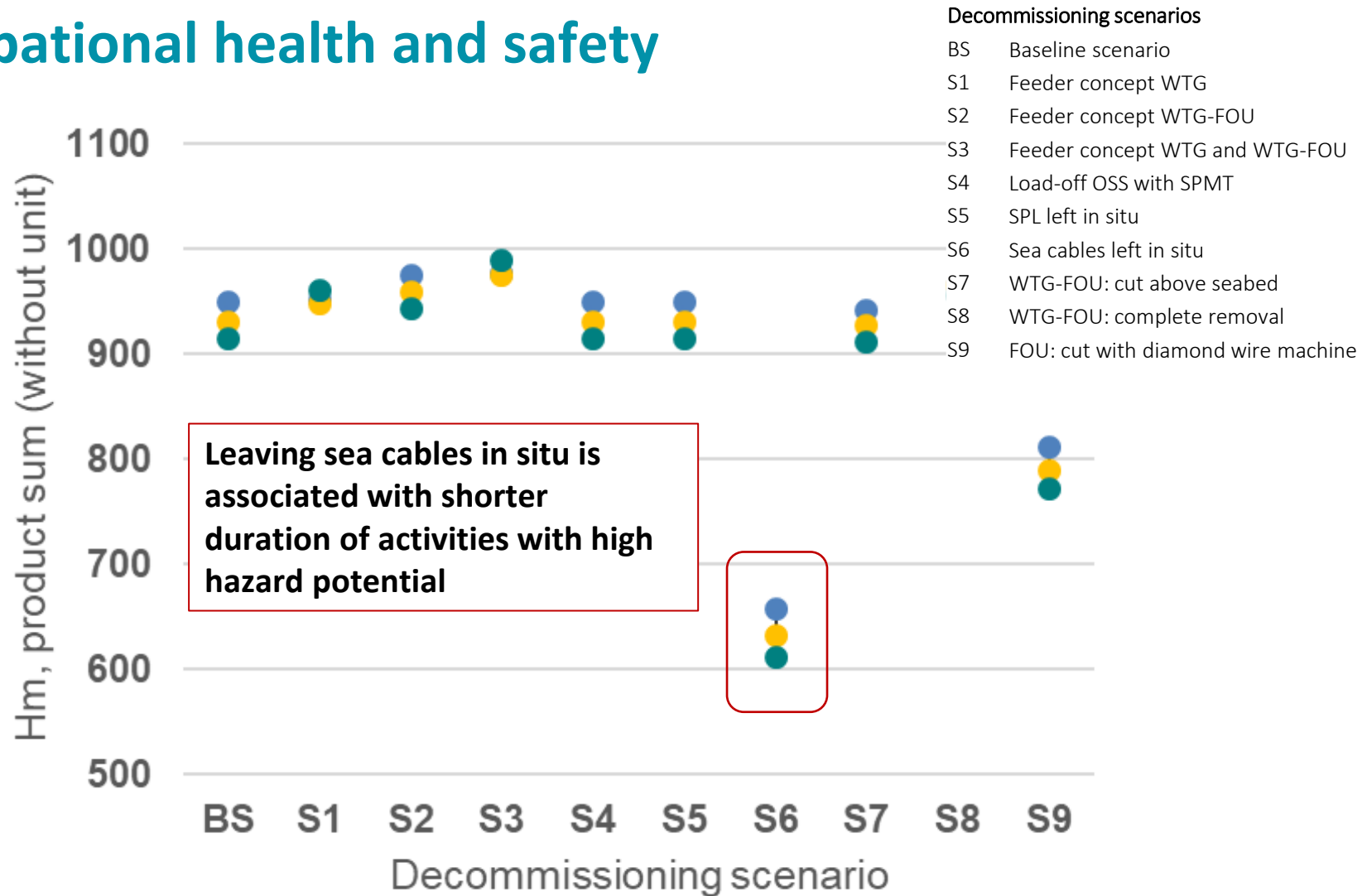
Multi criteria decision analysis

Decommissioning scenarios

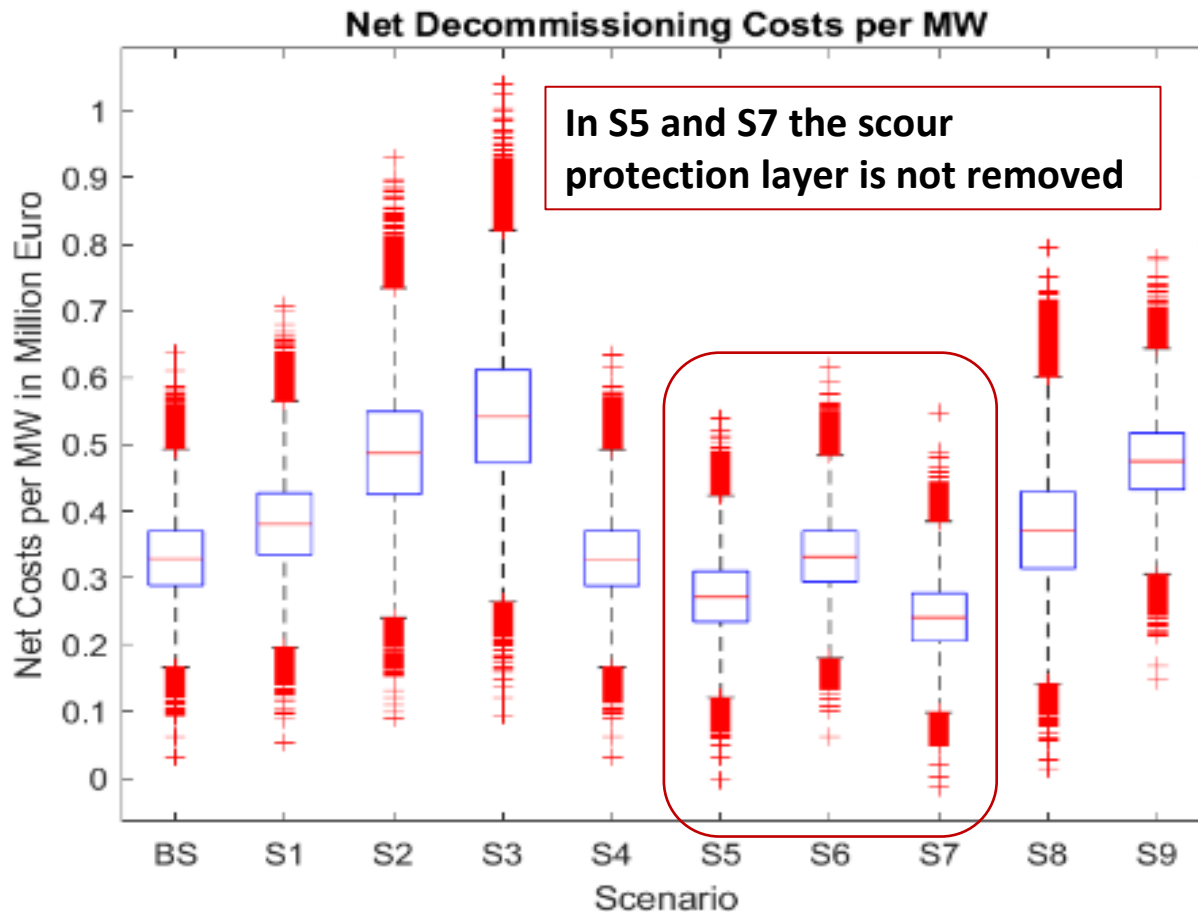
- BS Baseline scenario
- S1 Feeder concept WTG
- S2 Feeder concept WTG-FOU
- S3 Feeder concept WTG and WTG-FOU
- S4 Load-off OSS with SPMT
- S5 SPL left in situ
- S6 Sea cables left in situ
- S7 WTG-FOU: cut above seabed
- S8 WTG-FOU: complete removal
- S9 FOU: cut with diamond wire machine



Occupational health and safety



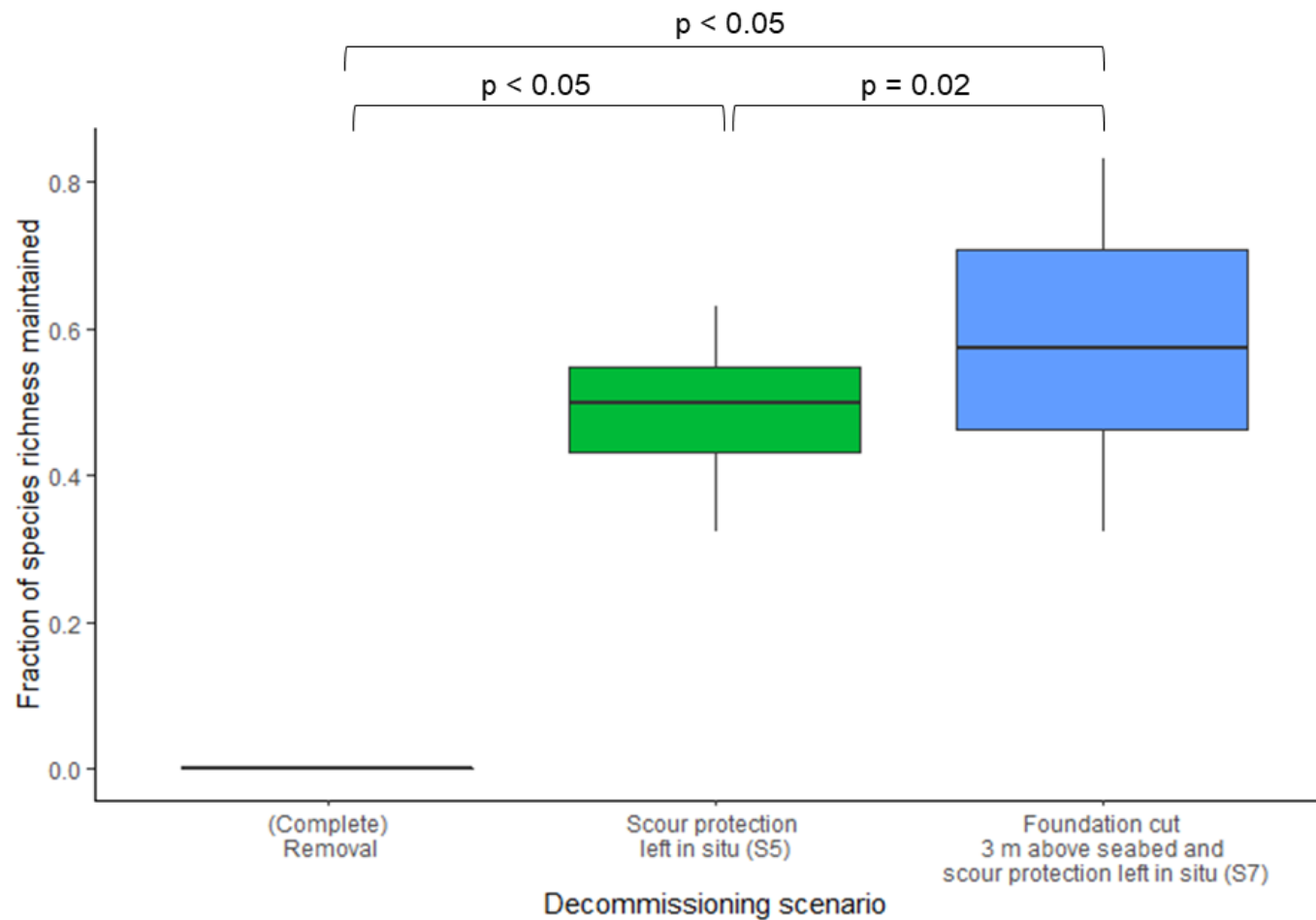
Economic efficiency



Decommissioning scenarios

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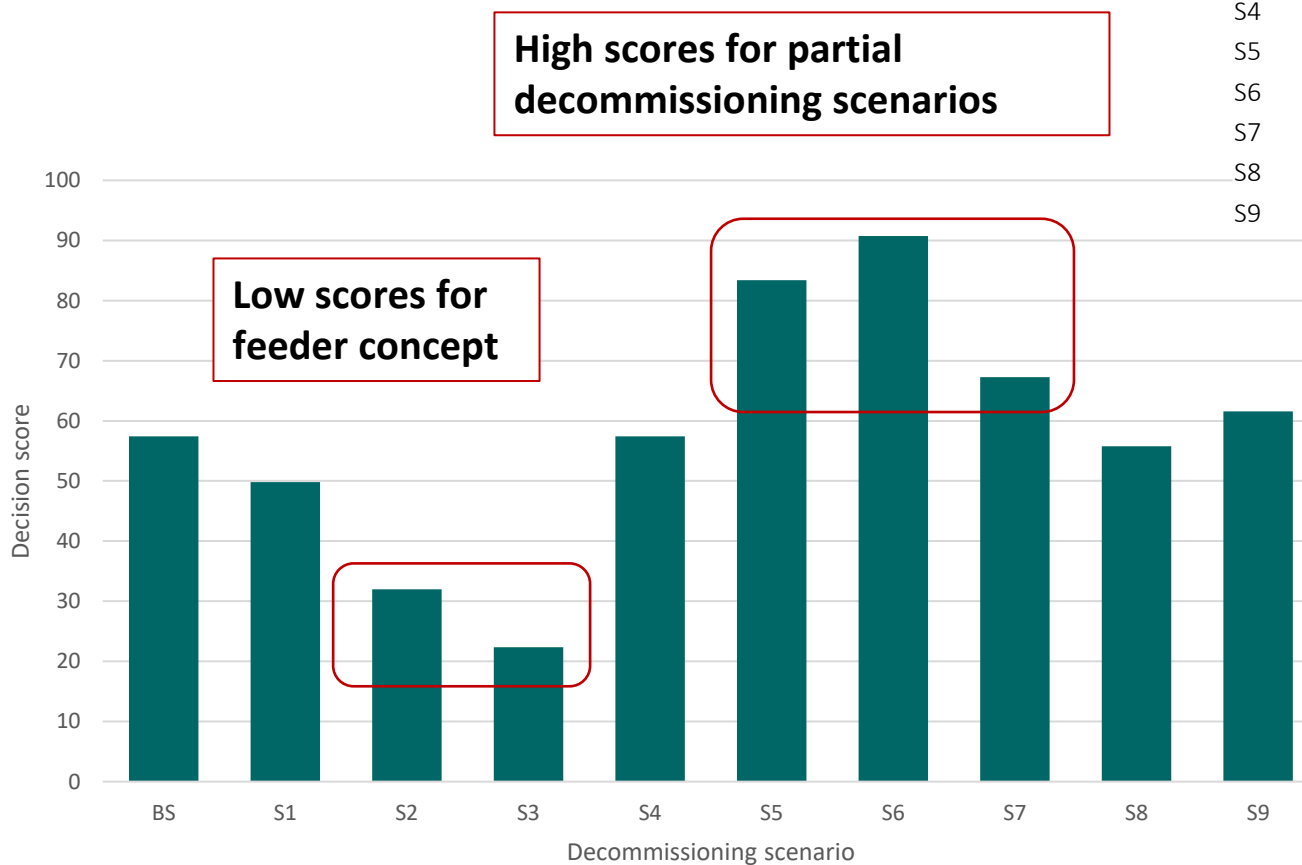
Biodiversity



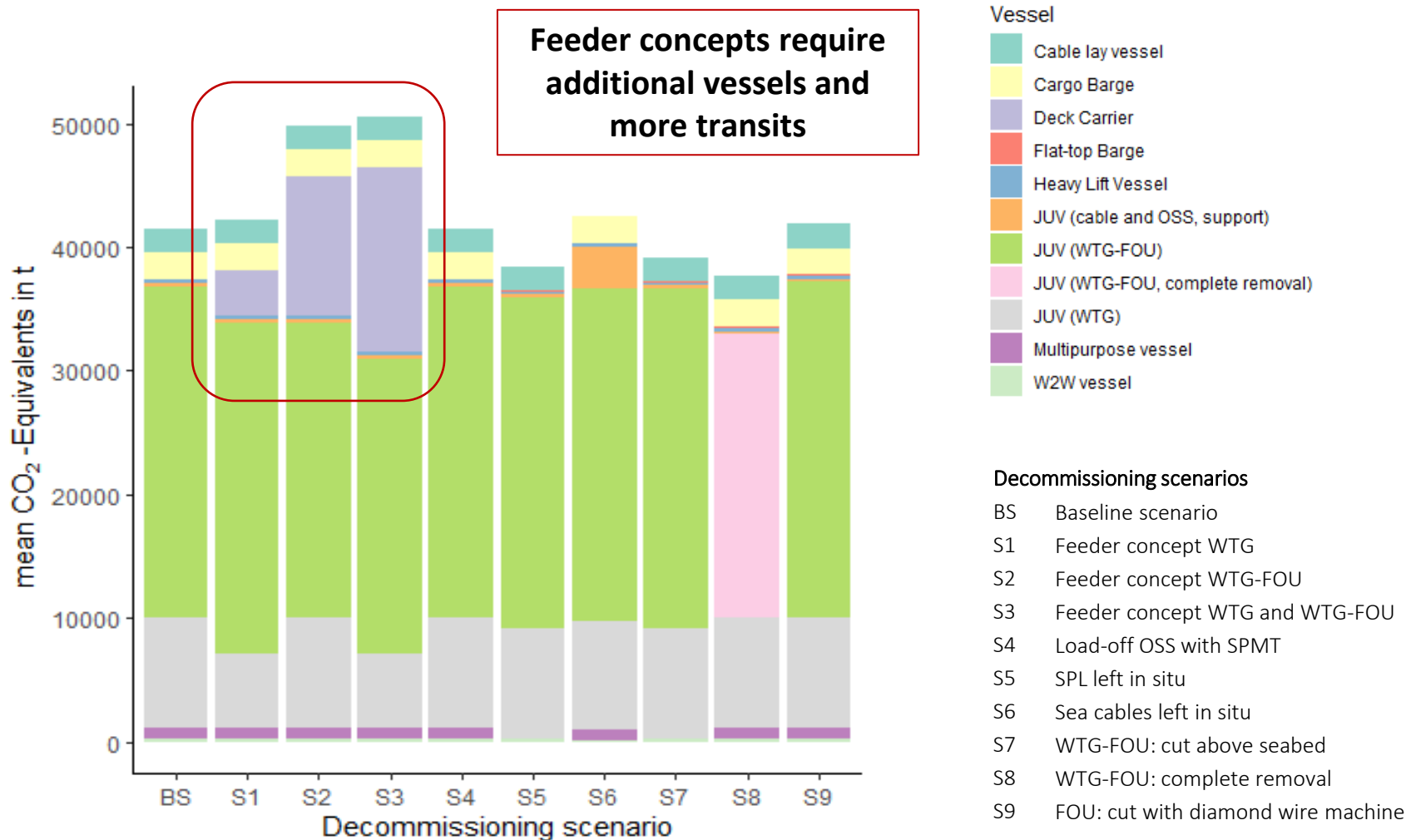
Multi criteria decision analysis

Decommissioning scenarios

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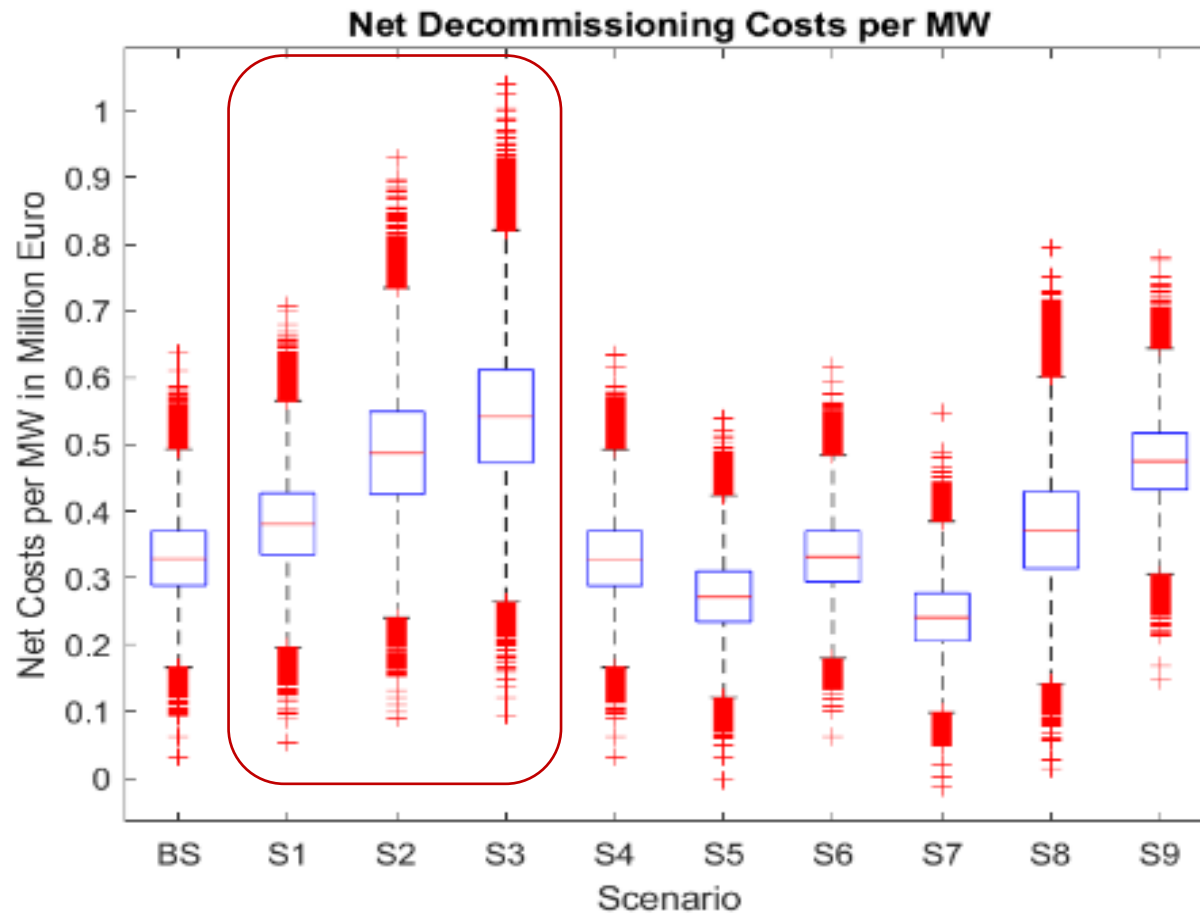


GHG emissions



Economic efficiency

Feeder concepts require additional vessels



Outlook

Improvement of *SeeOff* approach

- Detailed engineering for in-depth knowledge of decommissioning processes and to improve estimations of decision criteria
- Improved data base e.g. on species data, vessel fuel consumptions, accident severity or resource costs to improve estimations of decision criteria
- Innovative concepts for dismantling OWF components at sea with reduced utilisation of large vessels

Final Symposium of the research project *SeeOff*

On March 30th 2022

Registration via www.seeoff.de will be possible soon

Thank you for your attention!

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