Comparative Life Cycle Assessment (LCA) of Steel and Concrete for feeding barges

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SCALE AQ

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How can we achieve this?

🎯 **Compare** the **environmental impact** of the **steel and concrete barges** in the same scenario.

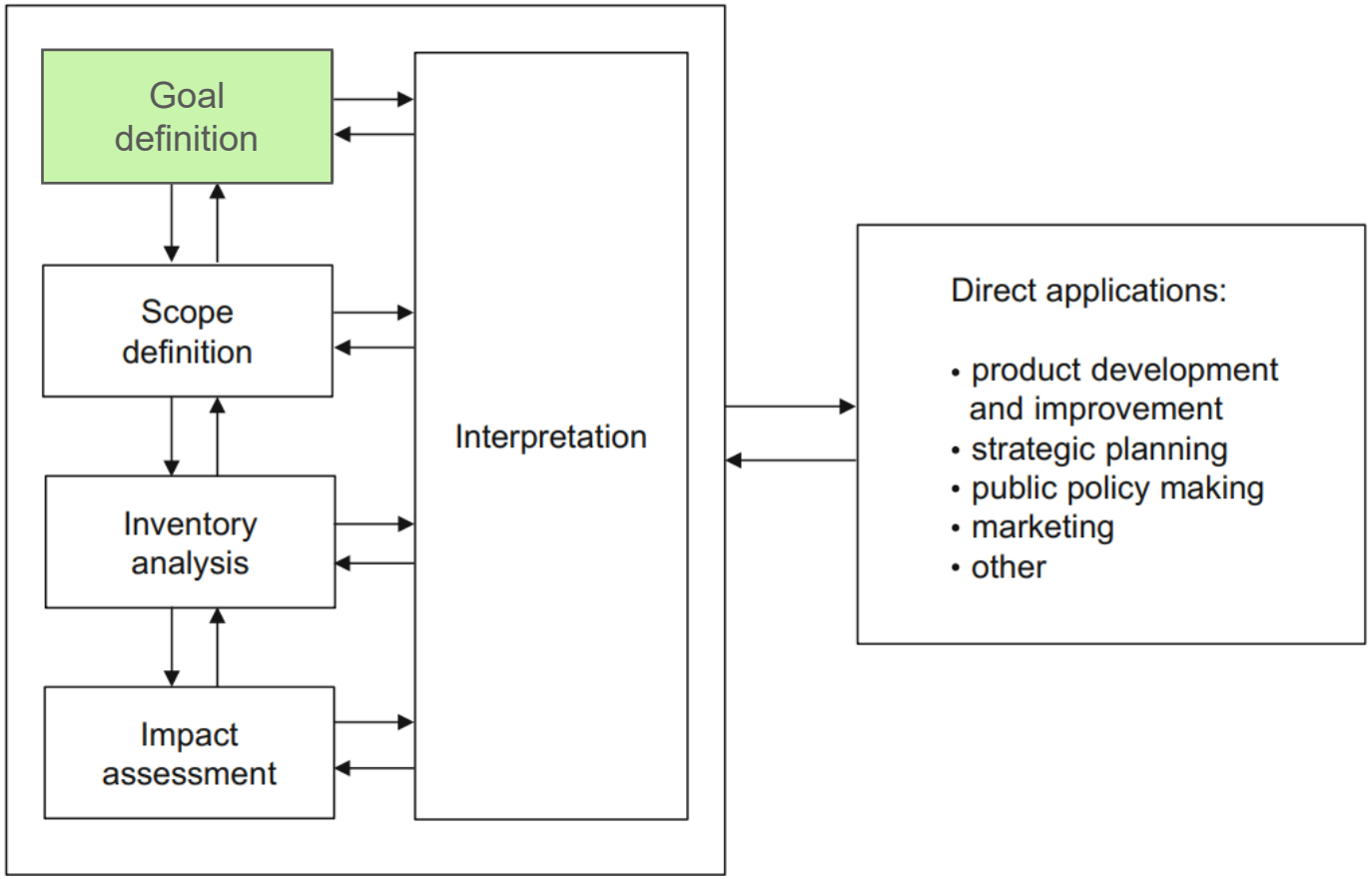


Figure 1: Framework of LCA (Hauschild, M. 2018)

How can we achieve this?

600T barges.
Steel and concrete materials for both **main structures** (including painting)

NOVA Concrete 600T

Length x Width
40 x 20 m

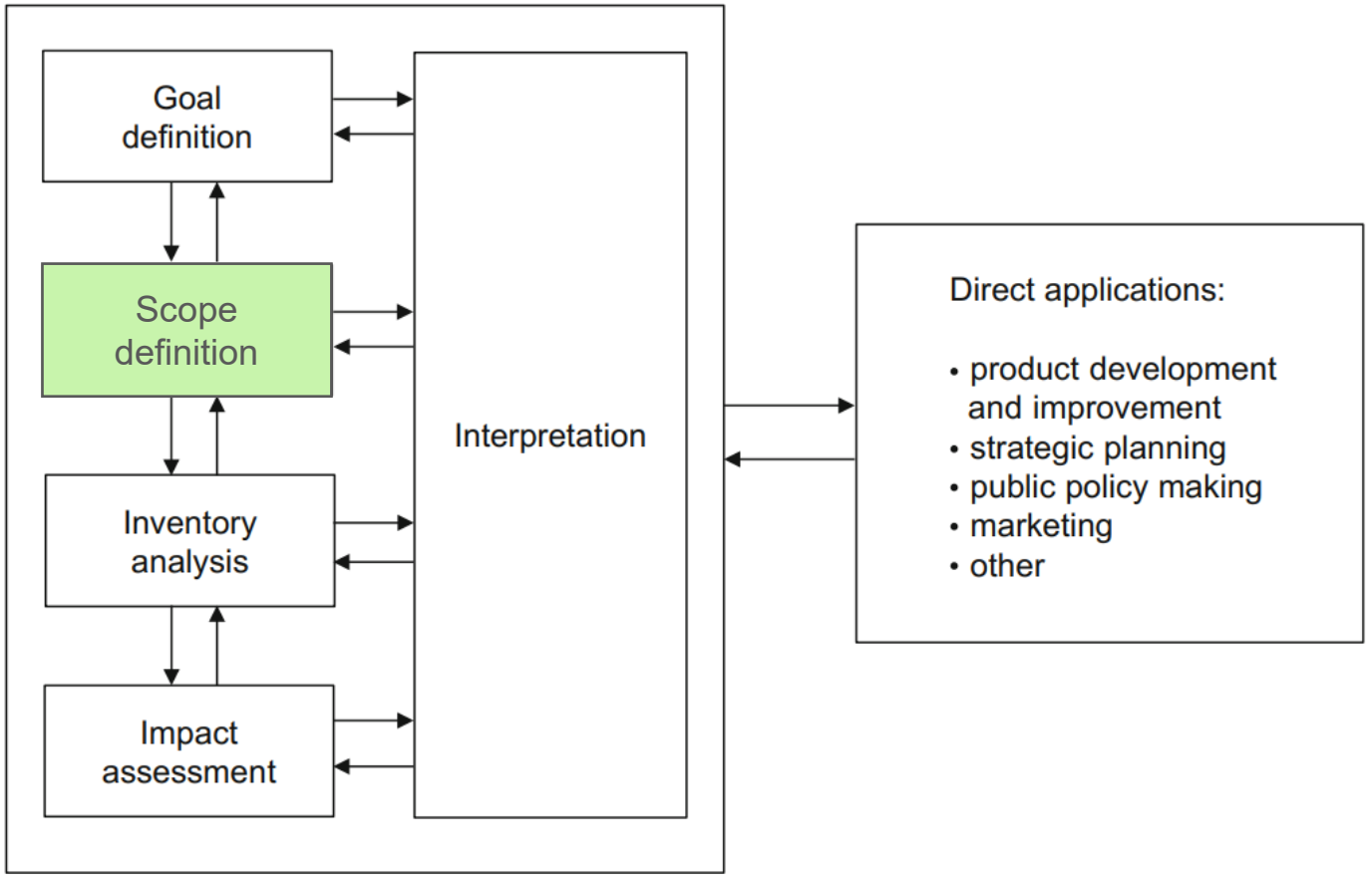


Figure 1: Framework of LCA (Hauschild, M. 2018)

How can we achieve this?

Data from:

- Production process and documentation
- EPDs (Environmental Product Declarations) from suppliers
- Generic datasets for LCA

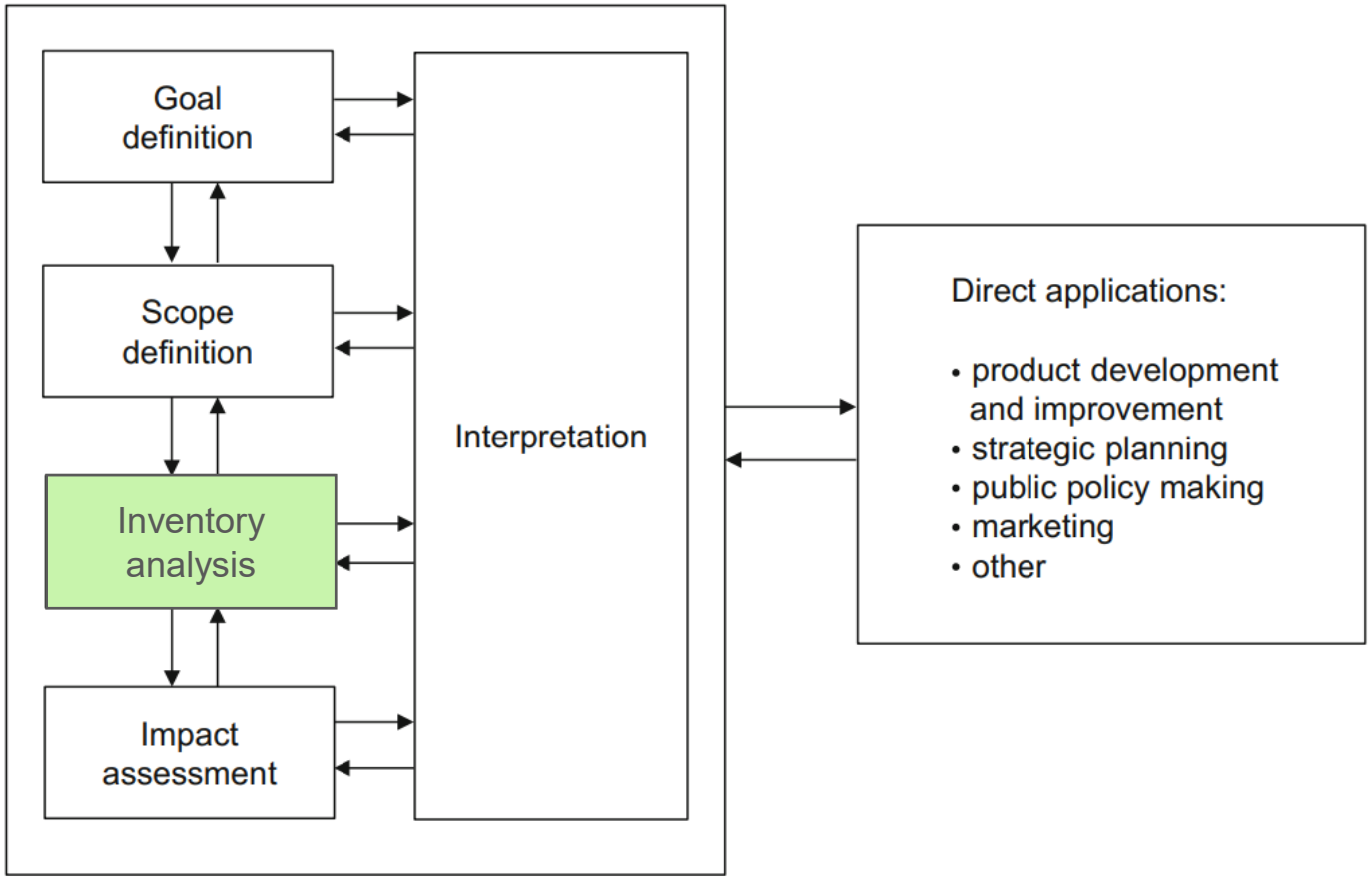


Figure 1: Framework of LCA (Hauschild, M. 2018)

How can we achieve this?

Global Warming Potential

Accumulated warming effect in relation to CO2 over a selected period of time.

10 impact categories

- **GWP =** Global Warming Potential
- **ODP =** Ozone Depletion Potential
- **AP =** Acidification Potential
- **EP =** Eutrophication Potential (freshwater, marine & terrestrial)
- **POCP =** Photochemical oxidation
- **ADP =** Abiotic Depletion Potential (minerals & fossil)
- **WDP =** Water Deprivation Potential

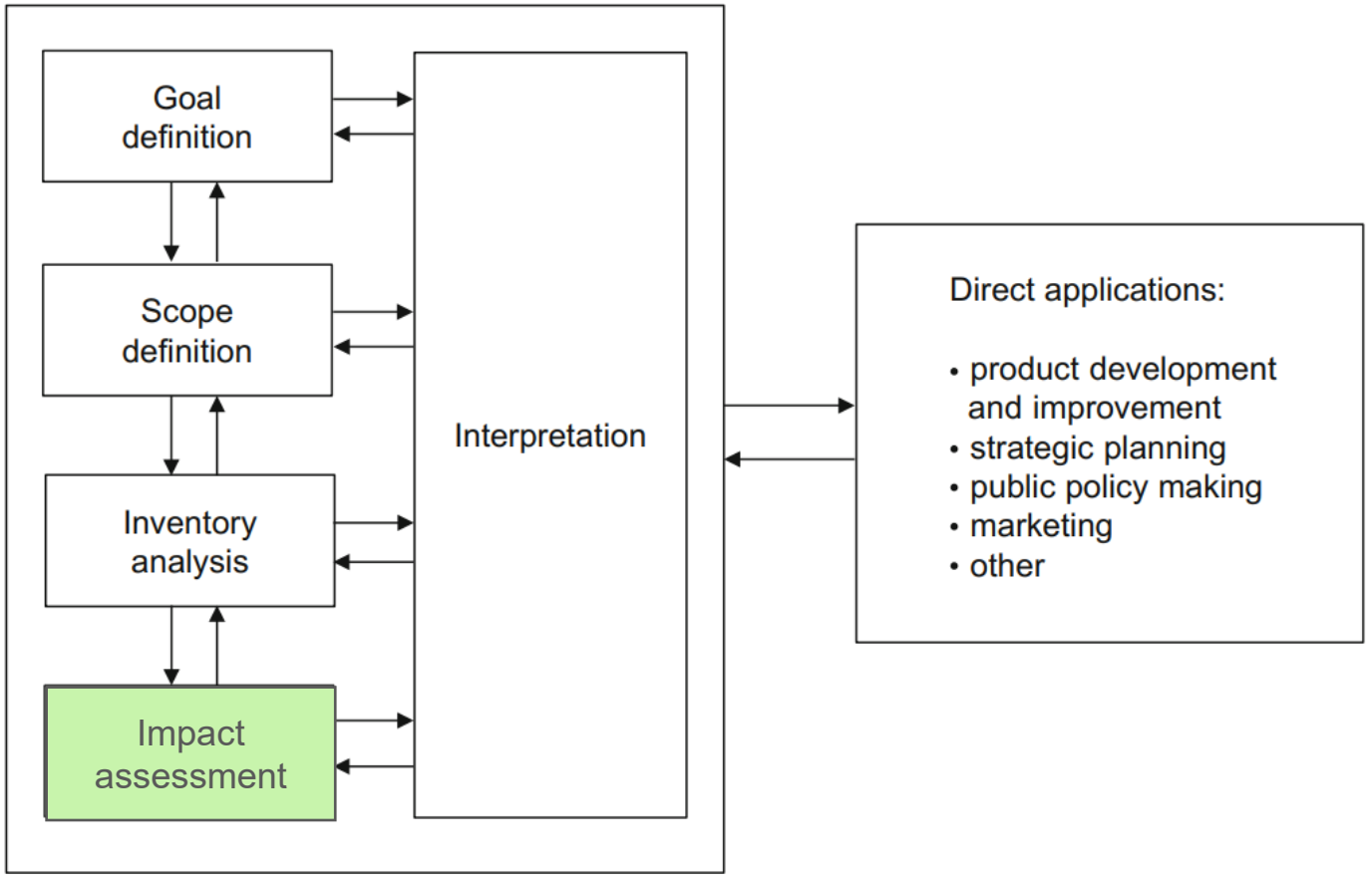


Figure 1: Framework of LCA (Hauschild, M. 2018)

How can we achieve this?

Results:

- Steel vs Concrete

Sensitivity Analysis:

- Energy use by customer during use phase (electricity & 100% diesel)
- Life extension for steel barge

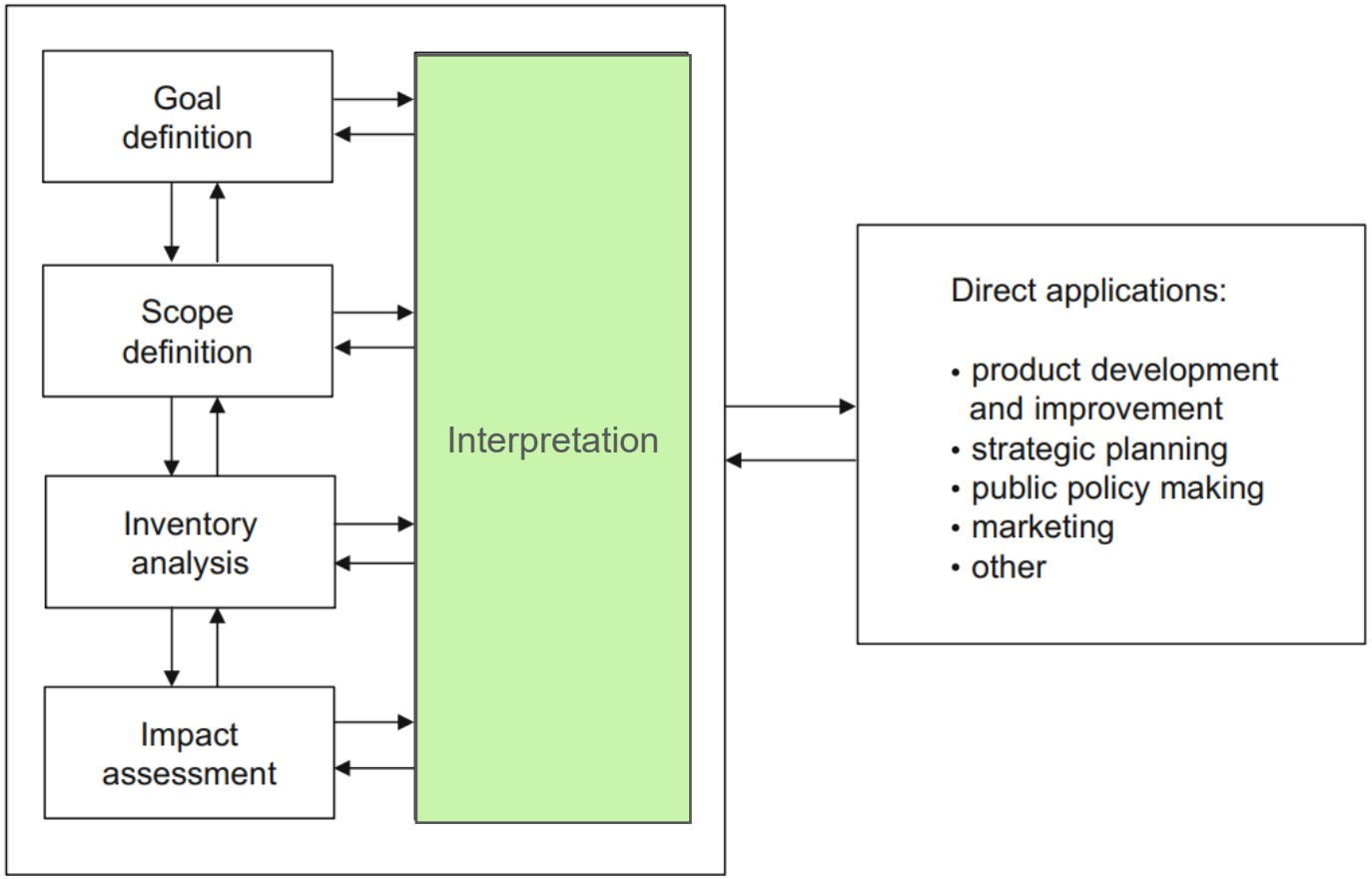
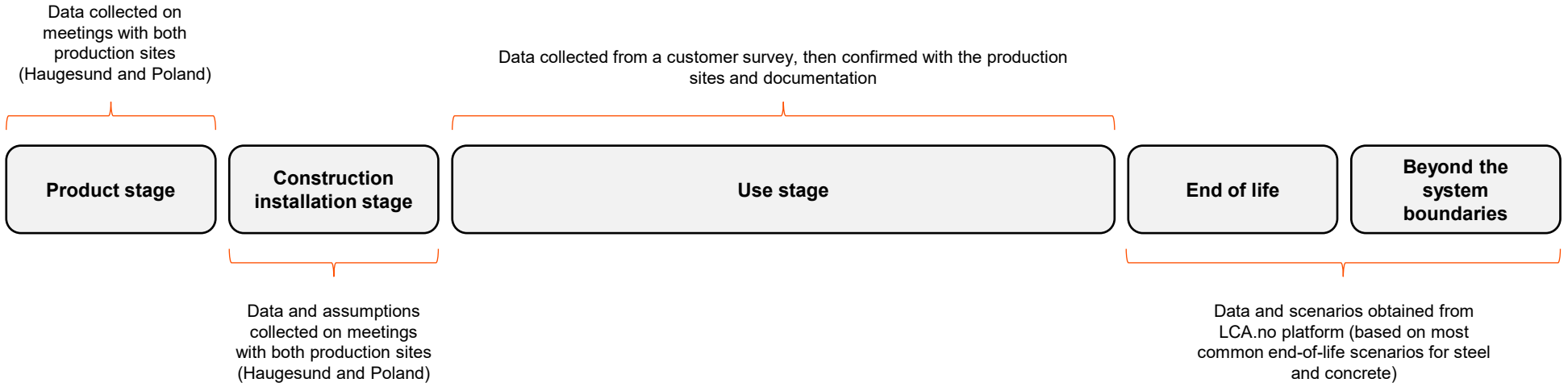


Figure 1: Framework of LCA (Hauschild, M. 2018)

The scenario



The scenario

* Assuming both barges with 50 years lifespan
* Pre-war scenario for the steel barge production

Product stage

Only main structure, no outfitting or other components included

Raw materials

Everything assumed by Truck

Raw materials transport

Only main structure, no outfitting or other components included

Product Manufacturing

Steel: cutting, abrasive blasting, welding, painting, electricity
Concrete: Cutting, formwork, electricity

Construction installation stage

Product transport to costumer

Construction & Installation

Place assumed: Florø

Use stage

Use

Maintenance

Repair

Steel: Transport to drydock, cleaning (hydro blasting), and painting (antifouling) in the underwater area (every 4 years)

Concrete: underwater cleaning with divers on site (every year)

Assumption: Diesel as energy source

Replacement

Refurbishment

2.5 steel barges are needed in 50 years

Operational energy use

Operational water use

The barge works only with diesel (most common scenario)

100000 liters/year

End of life

De-construction & Demolition

Transport of Products & Equipment

Waste processing

Disposal

Steel: 10% steel to landfilling
Concrete: 32% concrete and 10% steel to landfilling

Steel: 90% steel to recycling, incineration of hazardous waste from painting.
Concrete: Demolition of concrete, 90% steel to recycling.

Beyond the system boundaries

Reuse – Recovery – Recycling - potential

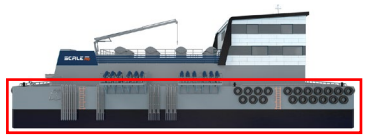
Steel: 90% used as substitution of primary steel with net scrap
Concrete: 68% used as substitution of primary aggregates, gravel round

Place assumed: Drydock in Florø

Transportation assumed by Truck from the drydock.

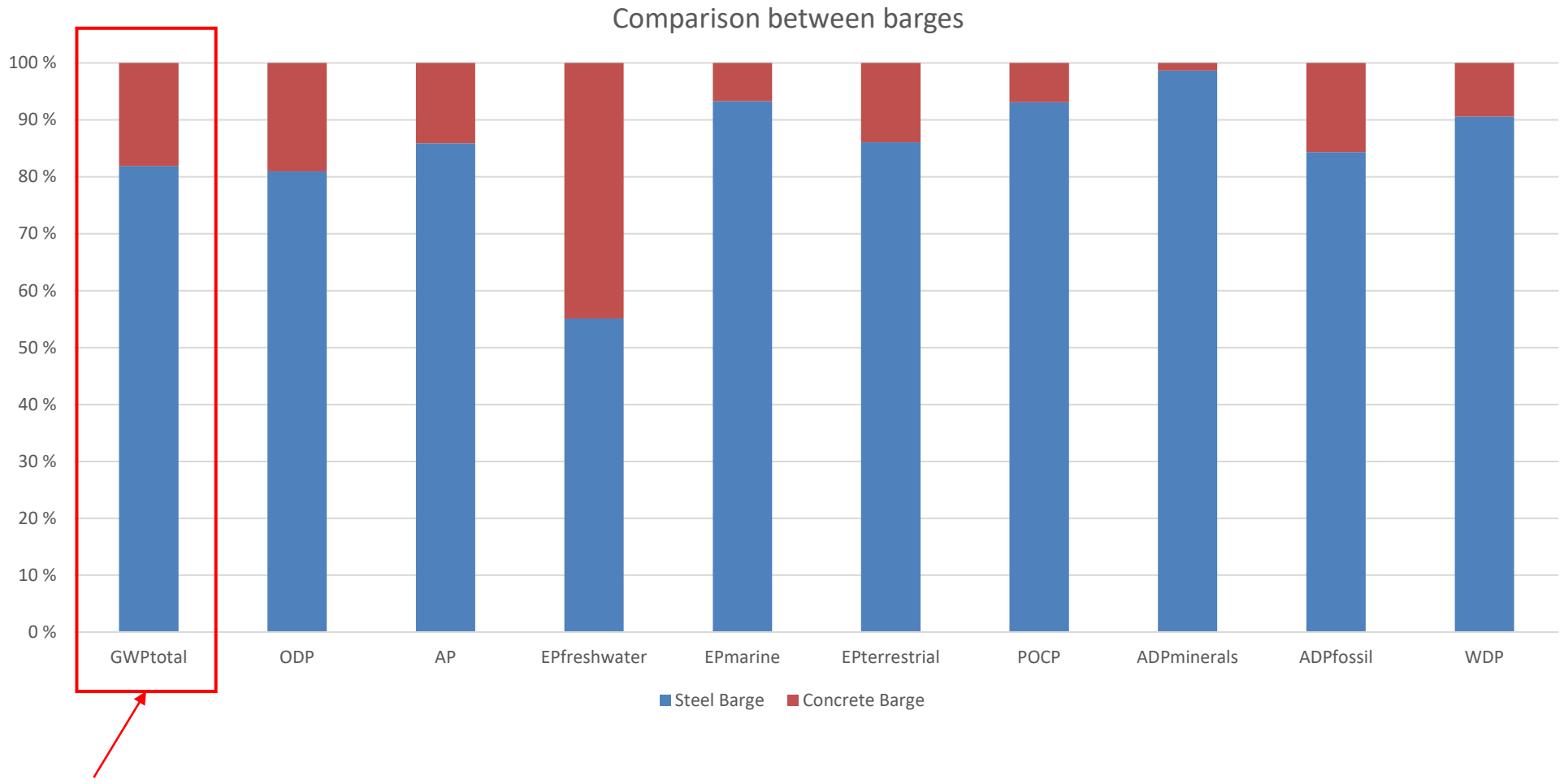
Places assumed for waste processing:

Steel: Fosen Recycling As, Revsnes
Concrete: AF Environmental Base Vats, Nedre Vats



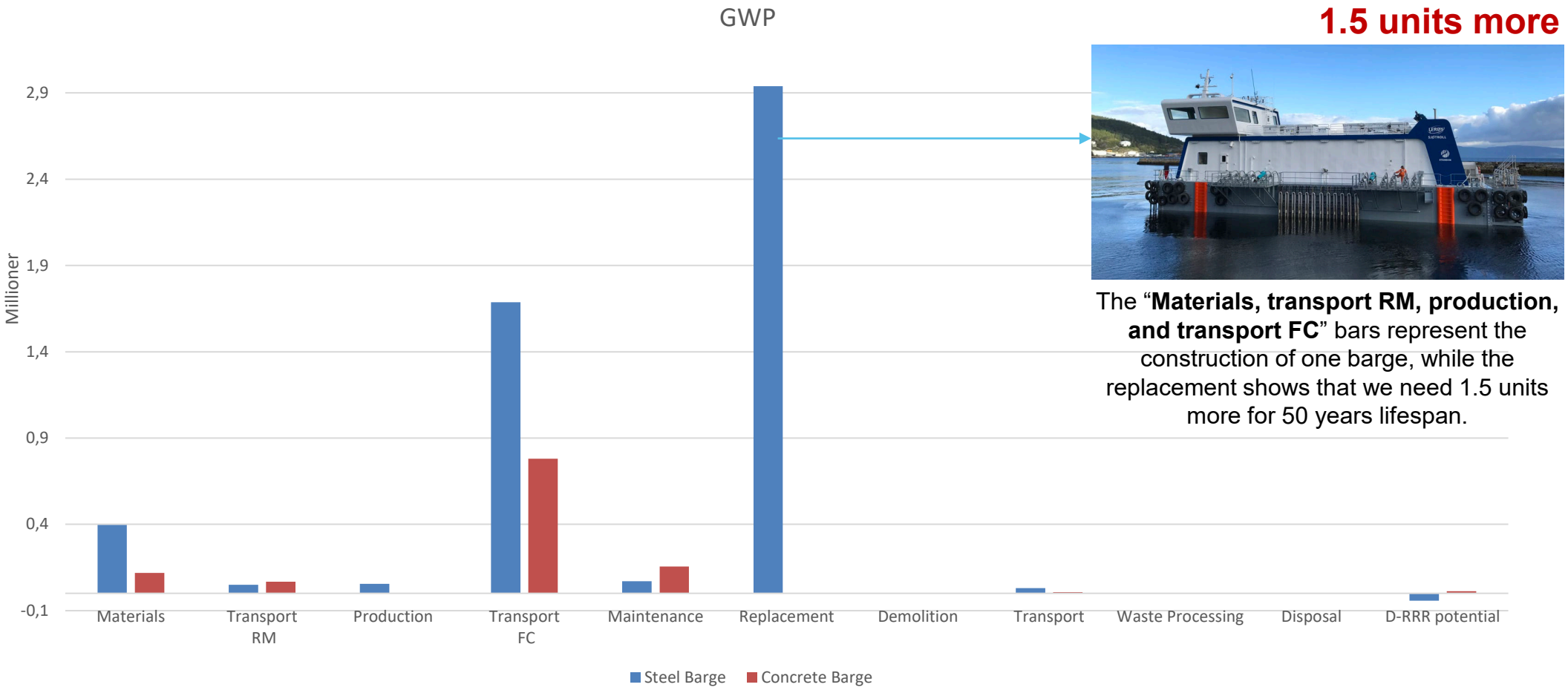
Results

Results – Steel vs Concrete



We will focus on this impact category

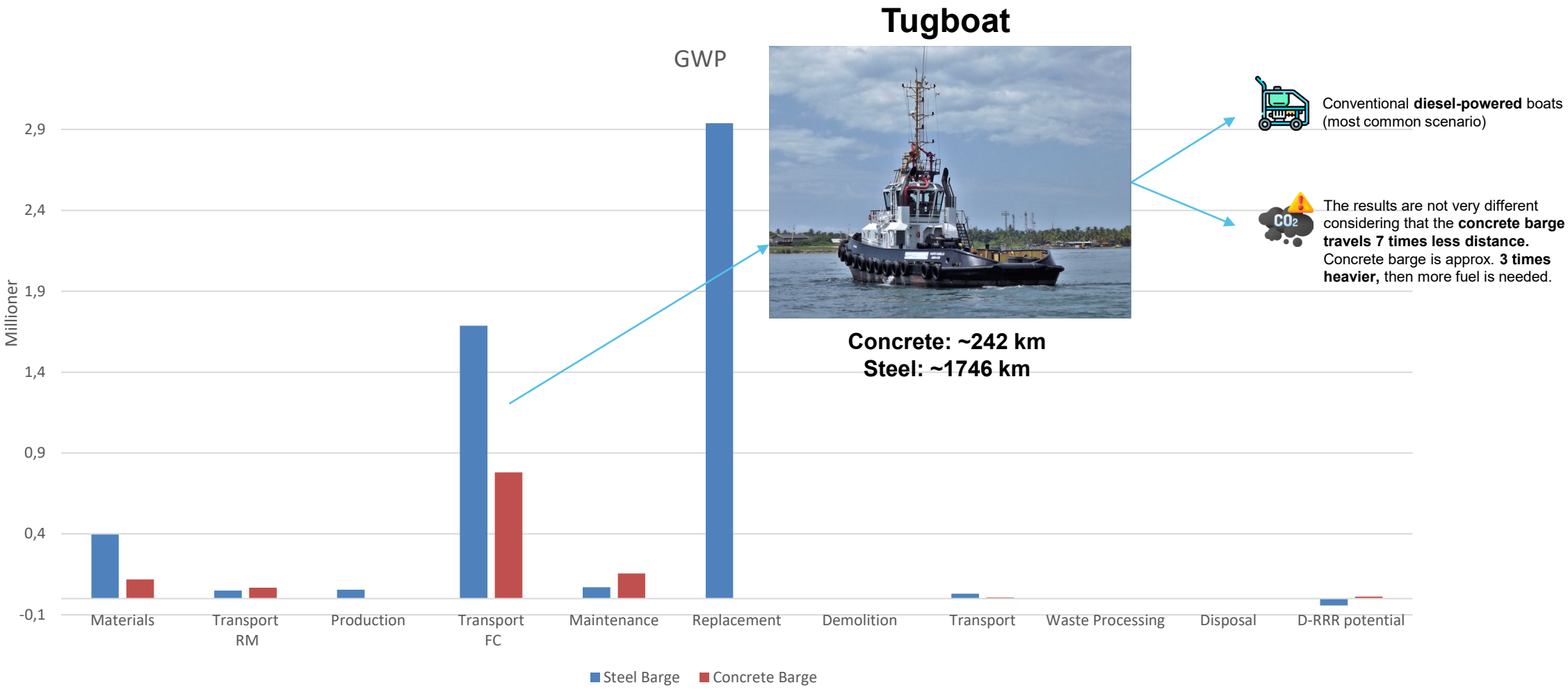
Results – Steel vs Concrete



1.5 units more

The "**Materials, transport RM, production, and transport FC**" bars represent the construction of one barge, while the replacement shows that we need 1.5 units more for 50 years lifespan.

Results – Steel vs Concrete



Tugboat

Concrete: ~242 km
Steel: ~1746 km

Conventional **diesel-powered** boats (most common scenario)

The results are not very different considering that the **concrete barge travels 7 times less distance.** Concrete barge is approx. **3 times heavier,** then more fuel is needed.

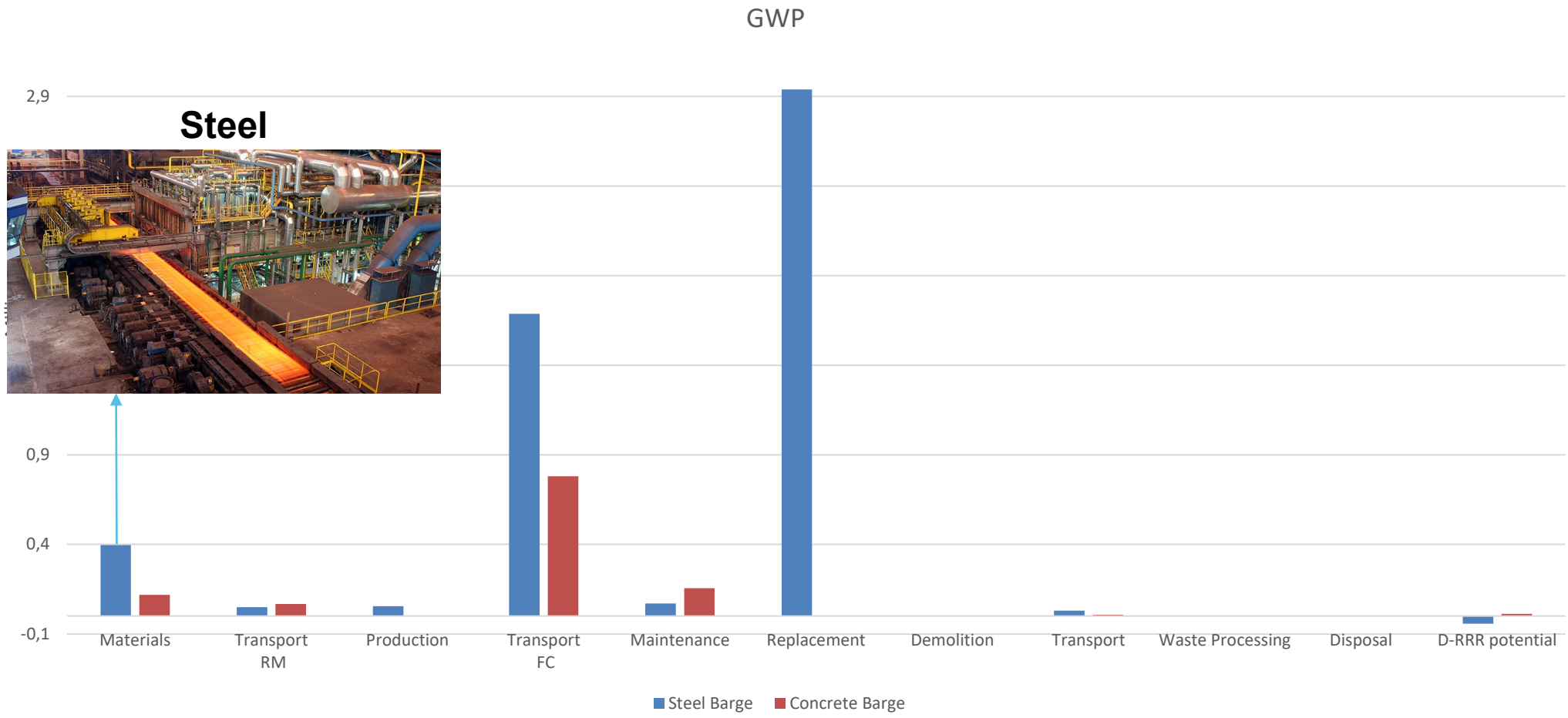
Results – Steel vs Concrete

Production of steel accounts for **7-9% of global CO2 emissions**

Blast furnace that are used **to transform iron ore into steel**

A **complex process** and **use of heat** contribute to have larger CO2 emissions

Steel is made from **coal, iron ore, and limestone** that are **extracted from multiple locations**

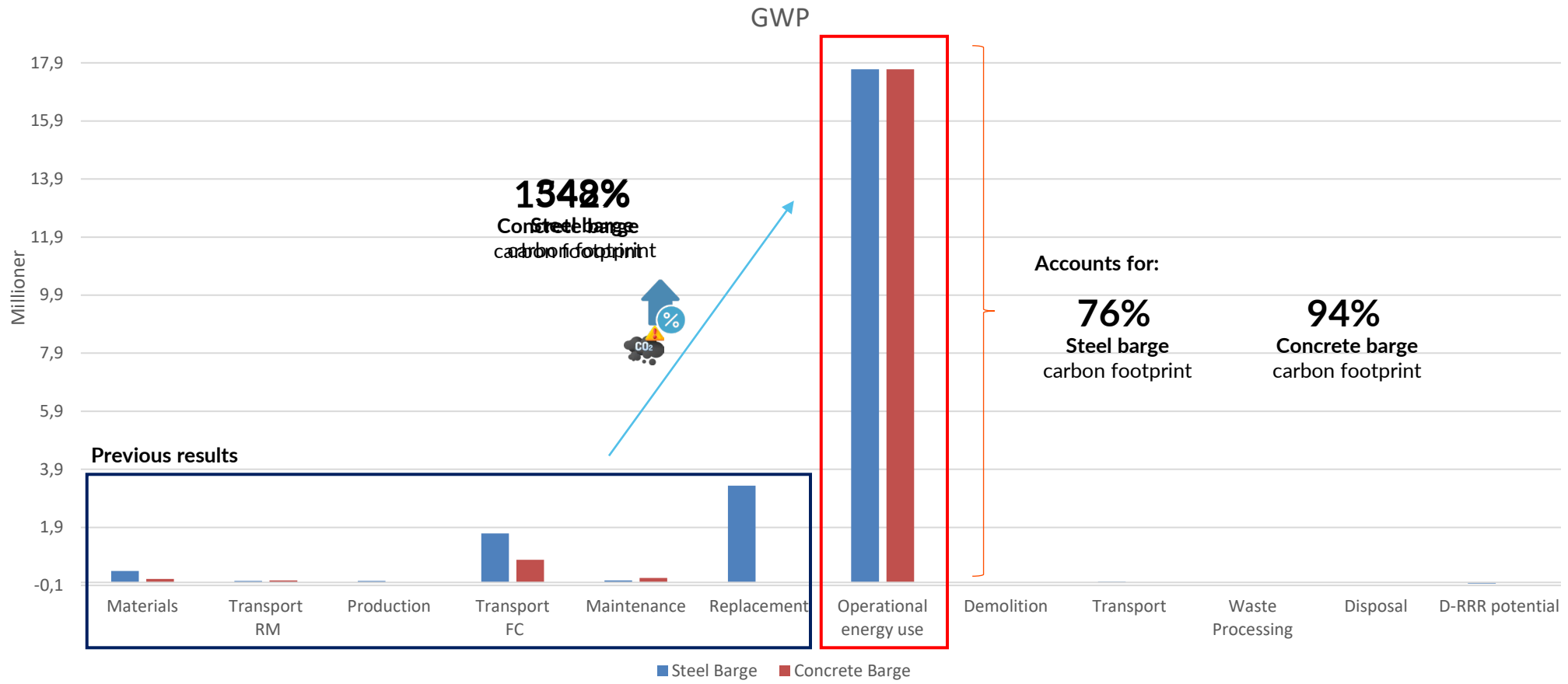


Sensitivity analysis

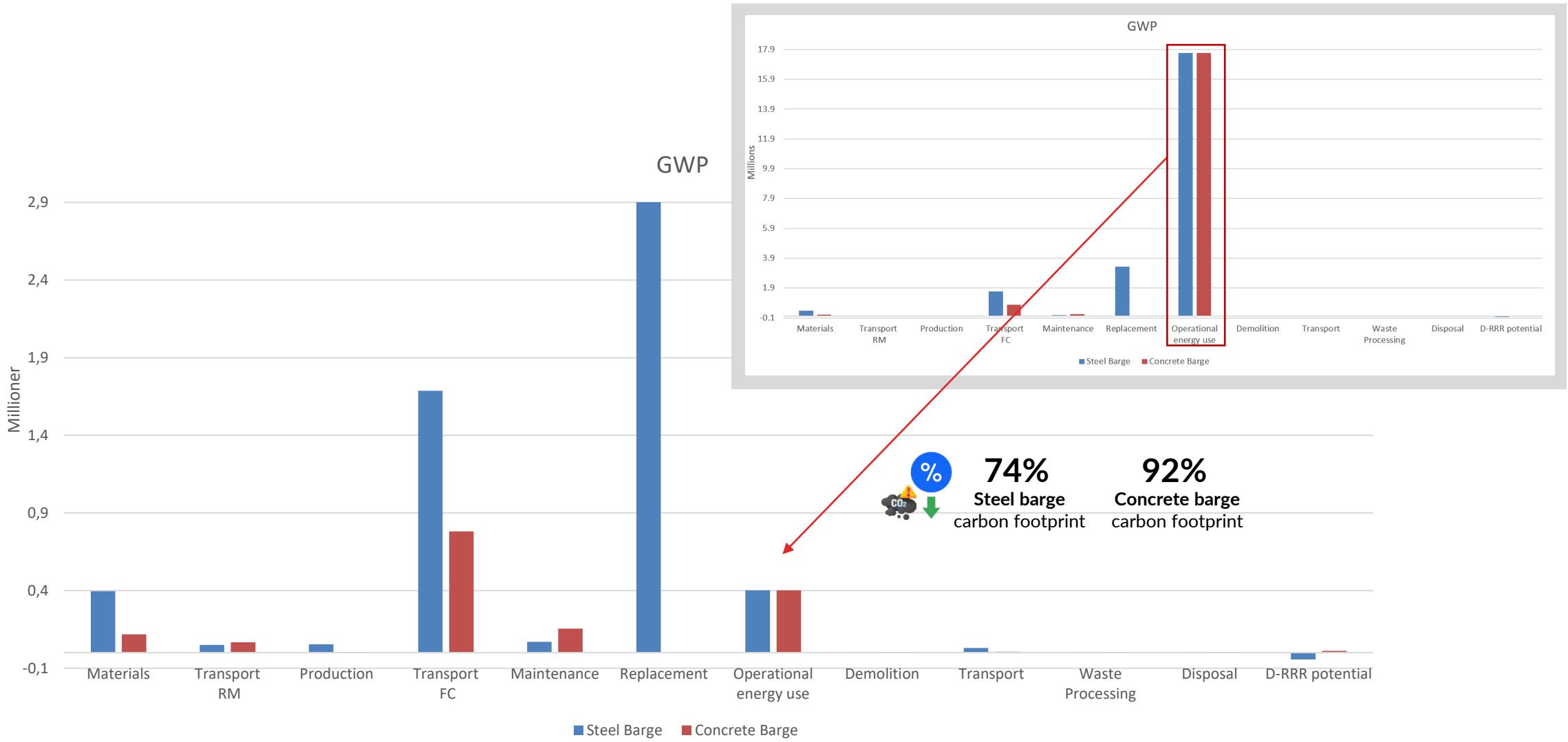
Method of testing how the LCA results change when varying one or more input parameters or assumptions.

Including energy use by the costumer (100% diesel)

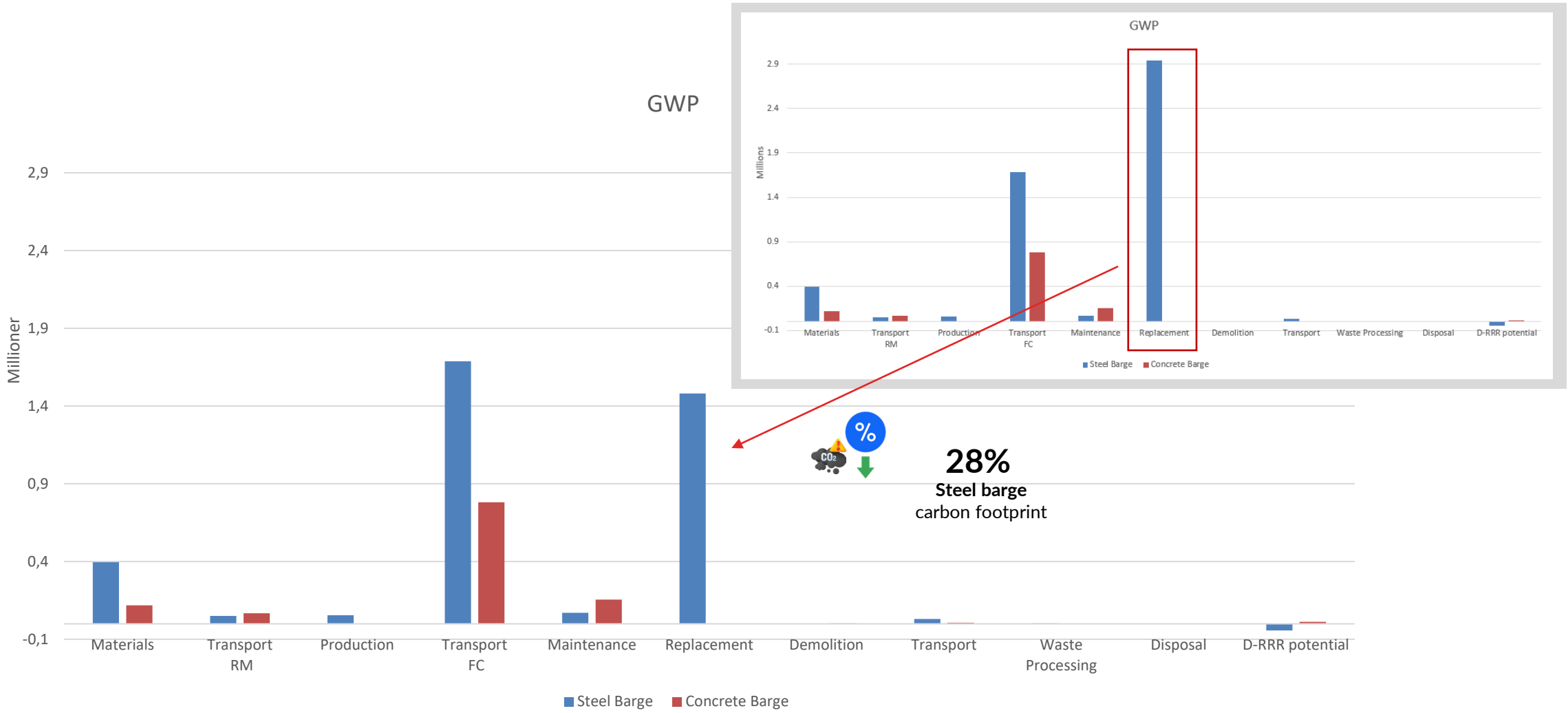
*Most common scenario



Including energy use by the costumer (100% electric)



Life extension – Steel barge (+10 years)



Summary results (GWP)

Scenario \ Barge	 Steel barge	 Concrete barge
Steel vs Concrete	**~5 189 149** kg CO2 -eq	**~1 146 880** kg CO2 -eq
Including operational energy use (100% diesel)	**~23 263 292** kg CO2 -eq	**~18 824 352** kg CO2 -eq
Including operational energy use (100% electricity)	**~5 987 273** kg CO2 -eq	**~1 548 333** kg CO2 -eq
Life extension – Steel barge (+10 years)	**~3 731 496** kg CO2 -eq	

348%

74%

28%

1541%

92%

Alternatives

Alternatives

Tugboat

- Electric-powered tugboats
- Supplementing diesel with sustainable biofuels
- Hydrogen from renewable energies
- HVO biofuels and methanol
- Hybrid propulsion

Conclusions

- The results shown are based on the main structure, then the **carbon footprint of the barges can be different** when including all the components.
- In terms of the main structure, the concrete barge has a **lower carbon footprint** than the steel barge.
- The **energy source used by the costumer has a big impact** on the overall carbon footprint of the product.
- There is a **certain degree of uncertainty** in the results due to the assumptions considered for the analysis.
- It is important to improve the traceability of the data with the suppliers. **Several challenges to collect the data** when they don't have EPDs published, and the main process is being outsourced.
- Customers think that **it is relevant that suppliers provide environmental documentation** about their products.
- However, when it comes to choosing a barge, the environmental perspective is important, but **there are many other variables involved in the decision**.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Questions? Thank you ☺

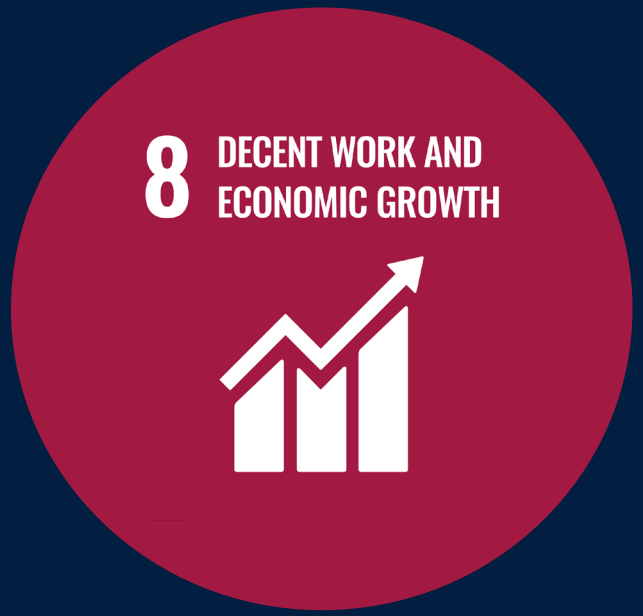
Mapping of HSE-culture in ScaleAQ

Kine Kringen

Background

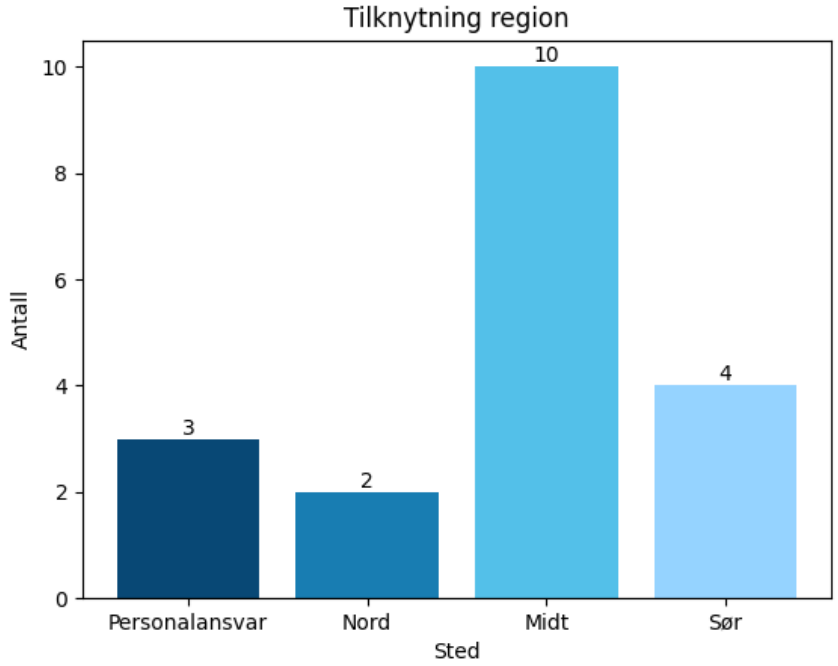

3
GOOD HEALTH
AND WELL-BEING

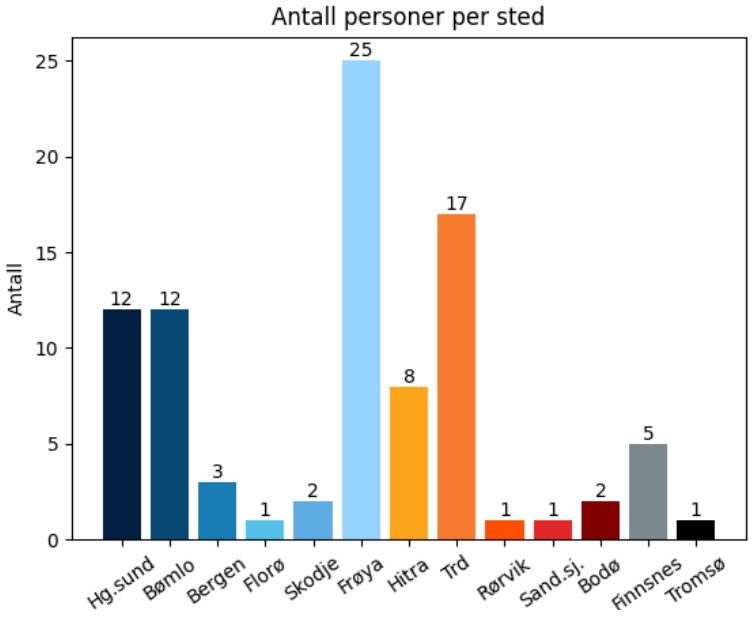

5
GENDER
EQUALITY


8
DECENT WORK AND
ECONOMIC GROWTH

HSE-culture

- Reporting
- Fair
- Flexible
- Learning





		Proportion
Gender	Women	15,6 %
	Men	83,3 %
	Other/don't want to answer	1,1 %
Age	Under 25 years old	6,7 %
	25-34 years old	33,3 %
	35-44 years old	25,6 %
	45-54 years old	26,7 %
	55 years old or older	7,8 %
Job type	Landbased	60,0 %
	Seabased	40,0 %
Job position	Service technician	32,2 %
	Production employee	12,2 %
	Site manager etc	7,8 %
	Other/don't want to answer	47,8 %
Experience	0-3 years	45,6 %
	4-7 years	23,3 %
	8-14 years	13,3 %
	15 years or more	17,8 %

Mapping method

- → The sample
- → Quantitative method
  - → Survey
  - → n = 90 (32%)
- → Qualitative method
  - → Semi structured interviews
  - → n = 16

Where we succseed

- → Well-being at work
- → Feeling of security
- → Communication
- → Knowledge of the SR

Measures and recommendations

- → Procedures and compliance
  - → Use of safety equipment
- → Deviation reporting
  - → EQS and follow-ups
- → Transfer of experience
  - → Training
  - → SR and WEC
- → Increased focus
  - → Cognitive shift

Conclusion

→ Leadership awareness and engagement

→ Cognitive shift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