How Allocation Rules Shape the Environmental Story

Mass versus Economic Allocation in ELCA

Jessica Bosseaux, Eugene Mohareb

TUKFS Mandala, March 2026

The team

The Plymouth Fish Finger Team

- **Clare Pettinger,** Principal Investigator of the Plymouth Fish Finger
- **Louise Hunt,** Post Doctoral Researcher

The partners

- **Edward Baker,** Plymouth Fishing and Seafood Association
- **Caroline Bennett**, Sole of Discretion

The environmental impact team

- **Eugene Mohareb,** Associate Professor
- **Jessica Bosseaux,** Post Doctoral Researcher

Context

Selective fishing

- Targets specific species, sizes, or sexes
- Reduces by-catch and ecological impacts
- Protects juvenile fish and vulnerable species
- Can raise questions about balanced harvesting

Non-target species

- Some edible adult fish are still caught
- Often low market value species
- Releasing them may still cause injury or mortality
- Keeping them could reduce waste

Context
The Plymouth Fish Fingers

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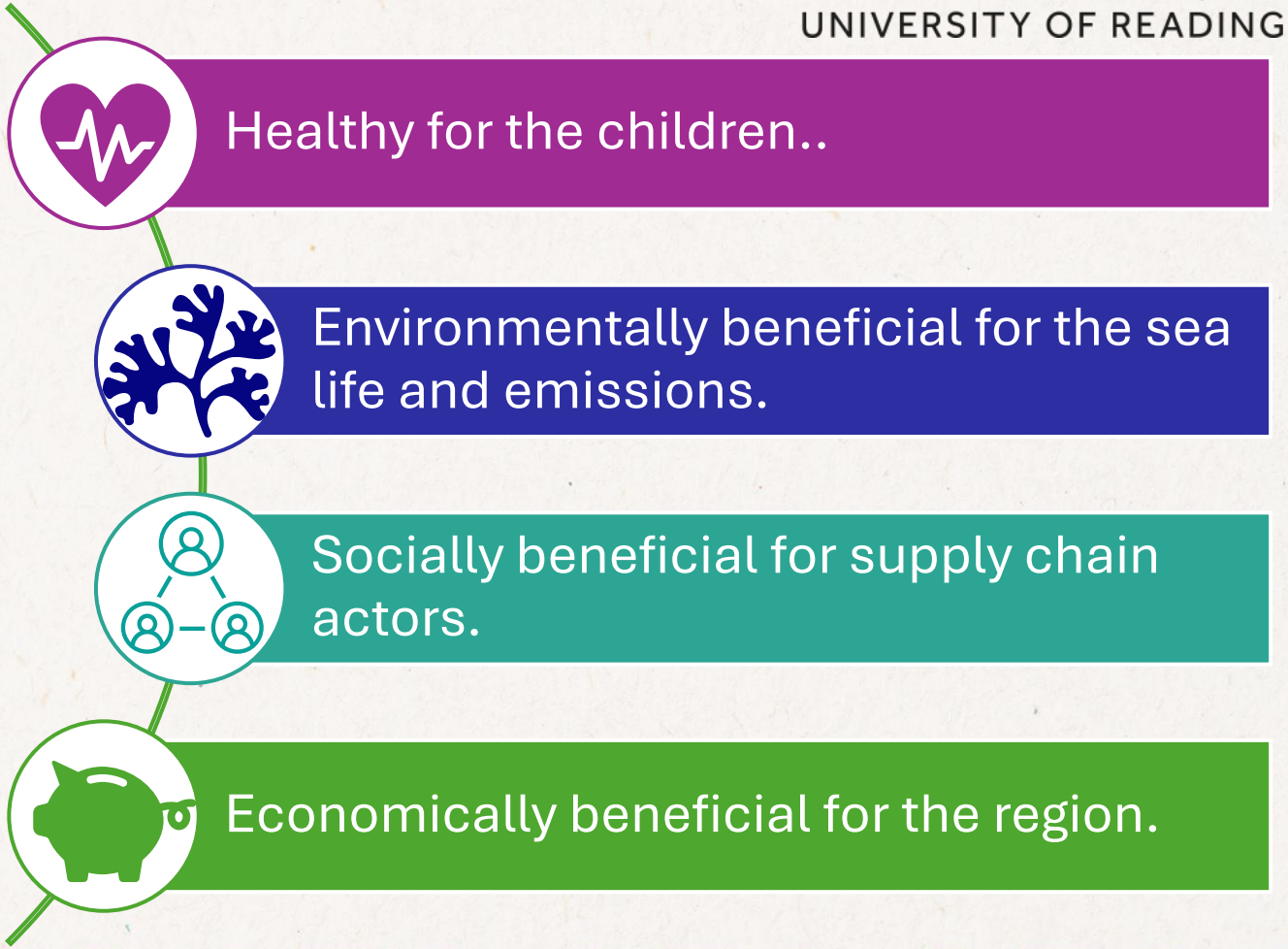
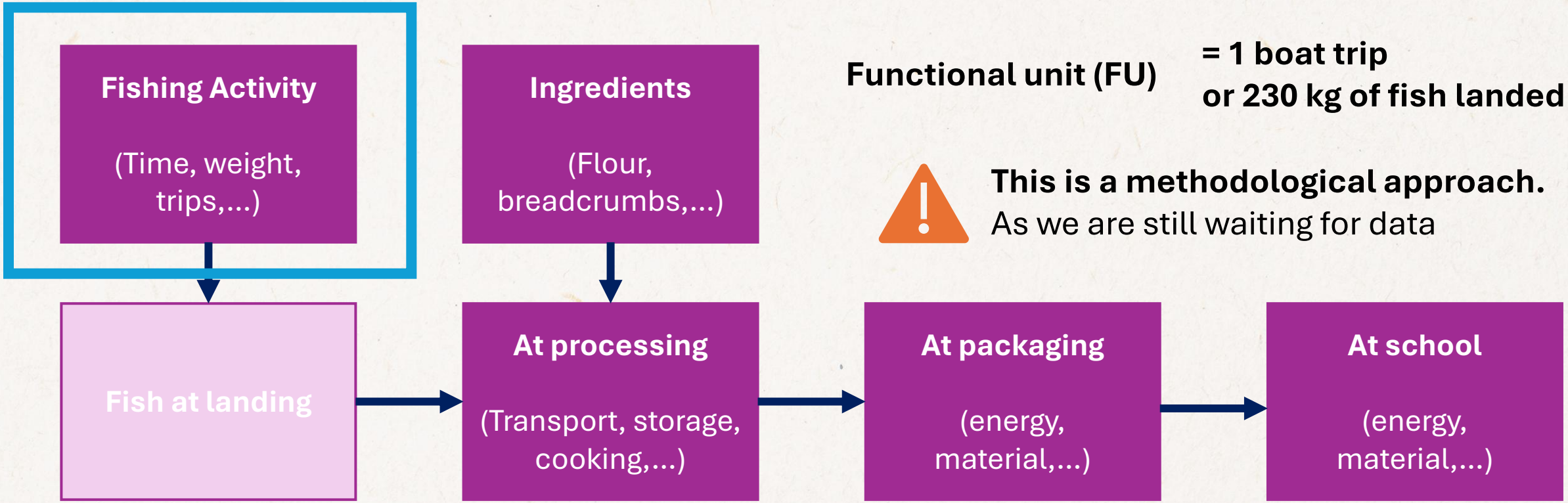
- Small-scale coastal fishers
- Non-target species are landed and served in local schools
- Using a culturally appropriate and iconic British product, fish fingers,
- co-designed with secondary school students and stakeholders.
- The Plymouth Fish Finger aims to be:



Environmental Life Cycle Assessment

Simplified flowchart for Fish Fingers



Functional unit (FU) **= 1 boat trip or 230 kg of fish landed**

This is a methodological approach.
As we are still waiting for data

Scenarios
Fishing Activity in Plymouth : What to expect ?

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	Scenario A Selective fishing (Target species)		Scenario B Non-selective fishing (Target + non-target species)	
Time in the Sea		+		-
Fuel consumption		+		-
Impact on biodiversity		+		-
Income		+		-

Scenarios
Fishing Activity in Plymouth

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	Scenario A Selective fishing	**Scenario B** Non-selective fishing
Fish landed per trip (kg)	230	230
Retained share, s	0.77_1	1.00
Effort multiplier, r = 1/s	1.299	1.000
Time at sea (h)	8 × 1.299 = **10.39**	**8.00**$_2$
Distance steamed (nm)	12 × 1.299 = **15.58**	**12.00** $_2$
Distance steamed (km)	28.86	22.22
Fuel per trip (L)	50 × 1.299 = **64.9**	**50.0** $_1$
Fuel per kg landed (L/kg)	64.9 / 230 = **0.282**	50 / 230 = **0.217**

Comparing the two scenarios

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Objective

- First, compare Scenario A and Scenario B
- Same functional output: 230 kg
- Identify whether the fishing strategy changes environmental impacts

What we check

- Which scenario performs better overall
- Which impact categories change the most
- Whether Scenario B is worth exploring further

Comparing SA and SB for 230 kg

Method: ReCiPe 2016 Midpoint (H) V1.06 / World (2010) H / Normalisation

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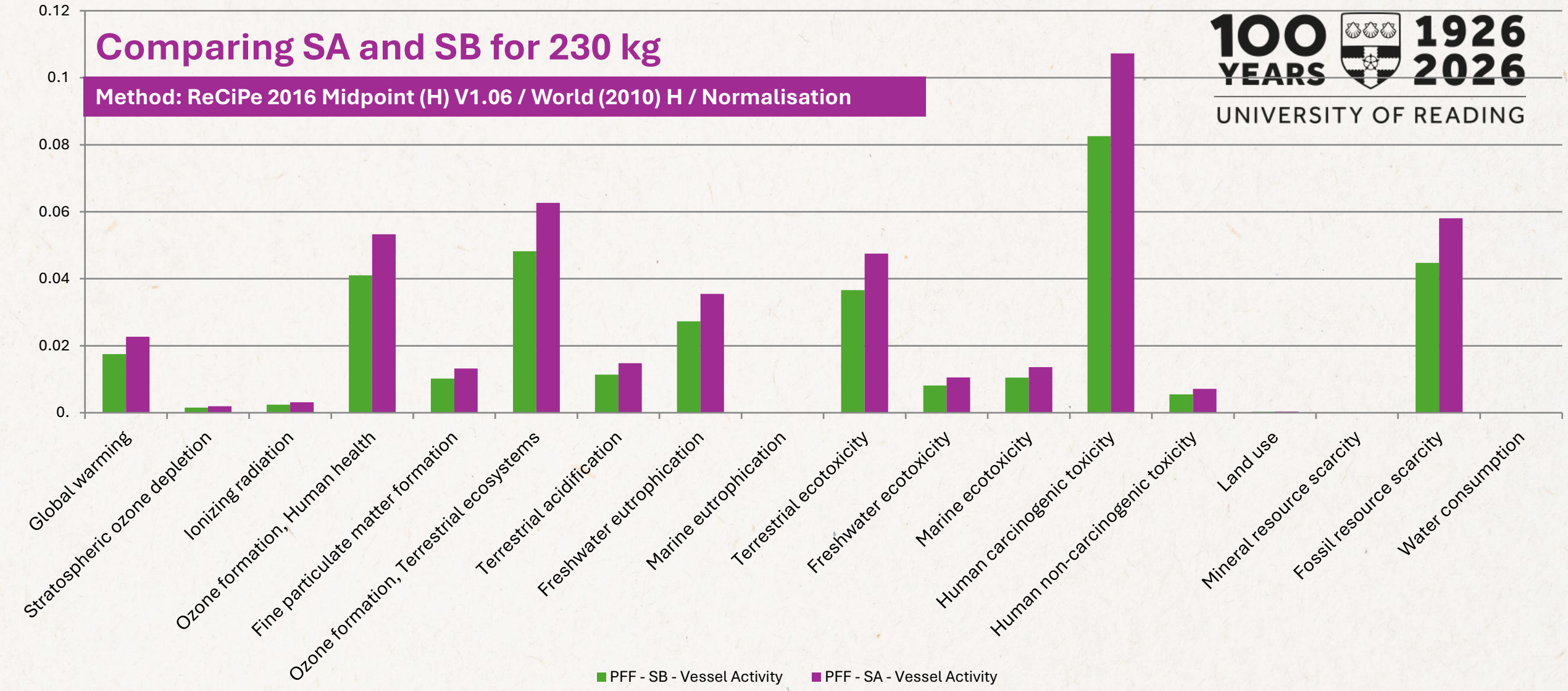

Focus on Scenario B

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Objective

- Scenario B includes both targeted and non-targeted species
- The fishing trip therefore produces more than one output
- Environmental burdens must be distributed between these outputs

Allocation choice can change the interpretation of results

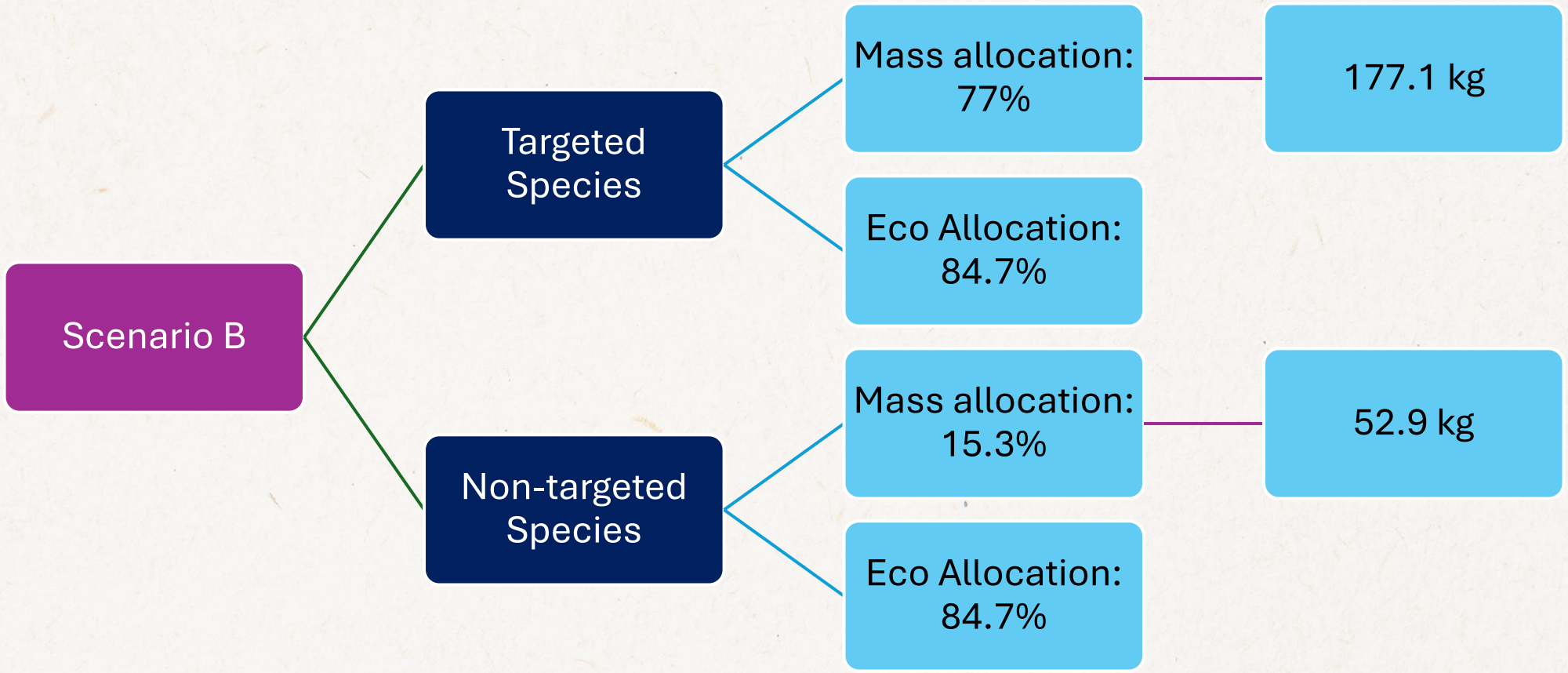
What we check

- Mass allocation :
  - Distributes impacts by physical quantity
- Economic allocation
  - Distributes impacts by market value

Non-target species may represent:

- a noticeable share of the catch by **mass**
- a much smaller share by **economic value**

Mass and Economic Allocation



Mass Allocation

Comparing SB – Targeted Species with Non-targeted species
Method: ReCiPe 2016 Midpoint (H) V1.06 / World (2010) H / Normalisation

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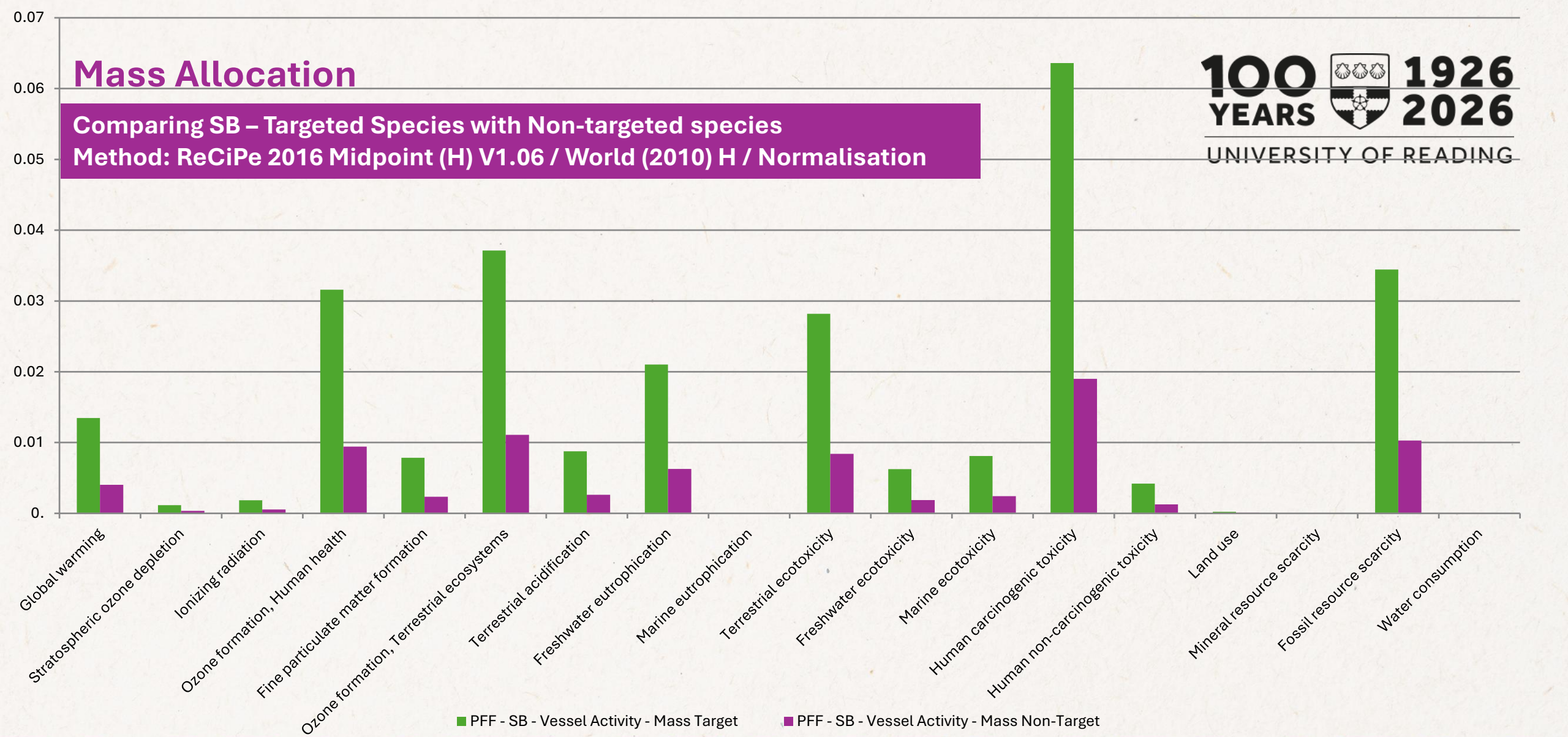

Economic Allocation

Comparing SB – Targeted Species with Non-targeted species
Method: ReCiPe 2016 Midpoint (H) V1.06 / World (2010) H / Normalisation

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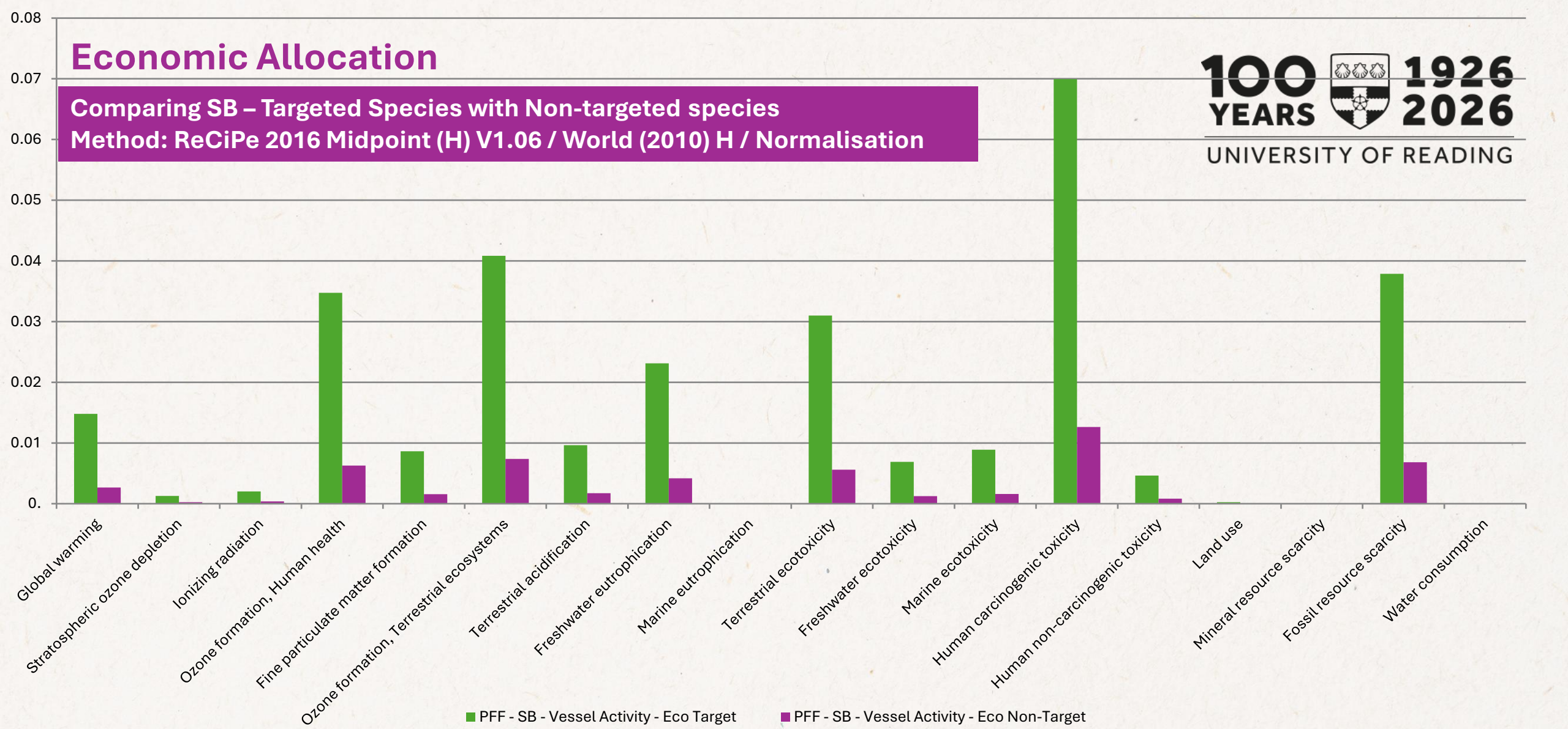

Focusing on non-target species

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Objective

- Mass allocation for non-target species
- Economic allocation for non-target species

What we check

- Non-target species are central to the valorisation question
- Their low market value makes results especially sensitive to allocation
- This affects how their environmental profile is interpreted

Economic with Mass allocation

Comparing SB – Economic with Mass allocation for non-targeted species
Method: ReCiPe 2016 Midpoint (H) V1.06 / World (2010) H / Normalisation

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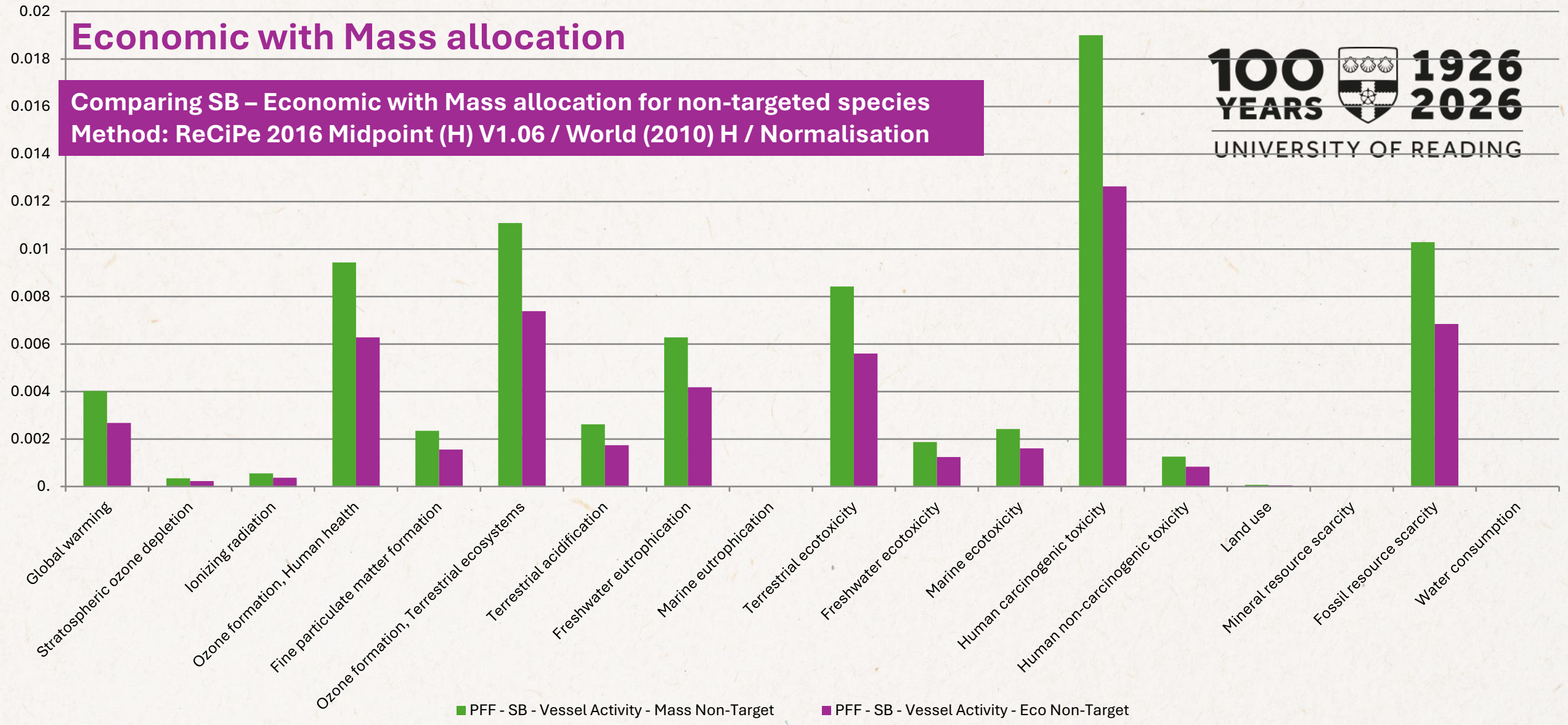

Economic comparison of Scenario A and Scenario B

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Prices

- Target price : **7.28 £/kg**
- Non-target price: **4.39 £/kg**

Link to Maximum Economic Yield

- Seeks the most economically efficient level of exploitation
- Balances sustainable catch, fishing effort, and stock biomass

	Scenario A	Scenario B
Income per trip (£)	1,674	1,521
Income per hour (£/h)	161	190

Discussion

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Opening new markets

- Valorising low-value non-target species can reduce discards
- These species can be used to develop new seafood products
- This may create added value in regulated fisheries

Beyond seafood eco-certifications

- Sustainability may require more than consumer-led certification
- Relational approaches can help connect fishers, markets, and institutions
- Public support may help create and stabilise new markets (e.g. schools)

Discussion

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Environmental trade-offs

- Reduced time at sea may improve efficiency,
- But higher efficiency could also encourage more fishing effort,
- Net biodiversity effects therefore remain uncertain.

Social trade-offs

- Sustainable fishing practices may change workload and time use.
- Impacts on fishers depend on effort, routines, and income stability.
- Social outcomes should be assessed alongside environmental gains.

Conclusion

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Limits

- Results are based on a simplified case-study model.
- The ELCA currently focuses mainly on fuel use.
- Economic assumptions still need to be modelled.

Next Steps

- Strengthen the model with primary data from the fishery
- Include other changing inputs, not only fuel use
- Extend the analysis to economic and social trade-offs

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THANK YOU