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Sustainability considerations for end-of-life fibre-reinforced plastic boats

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Sustainability considerations for end-of-life fibre-reinforced plastic boats

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Sustainability

“Meeting the needs of the present without compromising the ability of future generations to meet their own needs”.

The World Commission on Environment and Development
(Brundtland Commission Report 1987)

Sustainability

A balance of five factors (TEESG)

	factor:	fit for:
i.	technology	purpose
ii.	economics	market
iii.	environment	planet
iv.	social	people
v.	governance	rules
	September 2023	

ESRS/ISSB
technology
market
environmental
societal
policy
May 2024

ESRS European Sustainability Reporting Standards
ISSB International Sustainability Standards Board

- B Moutik, J Summerscales, J Graham-Jones and R Pemberton, Life Cycle Assessment Research Trends and Implications: a bibliometric analysis. Sustainability 2023, 15, 13408. https://doi.org/10.3390/su151813408
- ESRS-ISSB Standards interoperability guidance, EFRAG/IFRS Foundation, 02 May 2024.

Technology (T)

Boat materials

- aluminium — corrodes in seawater
- iron/steel — corrodes in seawater
- wood — rots and suffers biological attack
- ferrocrete — out of fashion

- composite
  - ~ easily formed to shape
  - ~ hydrodynamic clean surface
  - ~ low maintenance
  - ~ durable

- antifouling paint toxins/microplastic paint flakes/lubricants, etc.

Technology (T)

- 1930s continuous fibreglass
- 1940s US Navy boats
- 1950s GRP replaces other boat materials
- 1960s expansion of recreational sailing

- 2000s boats reaching end of design life
- 2000s original owners less fit to sail
- 2000s recyclable thermoplastics, vitrimers, cleavable epoxy

Technology (T)

Osmosis and blistering
no longer
a durability issue for
well-constructed
composite boats

http://www.insightmarinesurveyors.co.uk/osmois%20ringed.jpg

Technology (T) ~ disposal

Idea | Laboratory | Scale-up | Industry

End-of-life boats

Re-use

Re-purpose

Recycling

Energy recovery

Disposal

re-use and life extension

street furniture

ionic liquids

solvolysis

biodegradation

high voltage fragmentation

depolymerise

pyrolysis

pressolysis

incineration with energy recovery

Not sustainable/ TRL inappropriate

backyard burning

landfill

scuttle

Abandoned, Buried or Cremated (ABC)

TRL 1 TRL 2 TRL 3 TRL 4 TRL 8 TRL 9

Product Feedstock Energy Waste

End-of-life boats (and ships)

HMS Wilton
46 m 450 tons GRP
converted to the
Essex Yacht Club HQ

Economic (E)

Estimated costs for recycling old boats (2021):

• 7 m	23 ft	€800	£ 706
• 11 m	36 ft	€1,500	£ 1,324
• 15 m	50 ft	€15,000	£13,243

- assumes delivery to boat-breaker

Compton, N. What's the future for derelict GRP boats? Yachting Monthly, 2021, accessed 06 June 2024.

Economic (E)

Boat recycling facilities

- Boatbreakers
  Gosport, UK
- Marine & Boat Recycling
  roughly equidistant between Devon N/S coasts

- Association pour la Plaisance Eco-Responsable (APER – France)

Environmental (E)

for a processed wreck …

- identify as abandoned
- transport to recycling facility
- break to treatable size
- process energy
- remnant waste stream

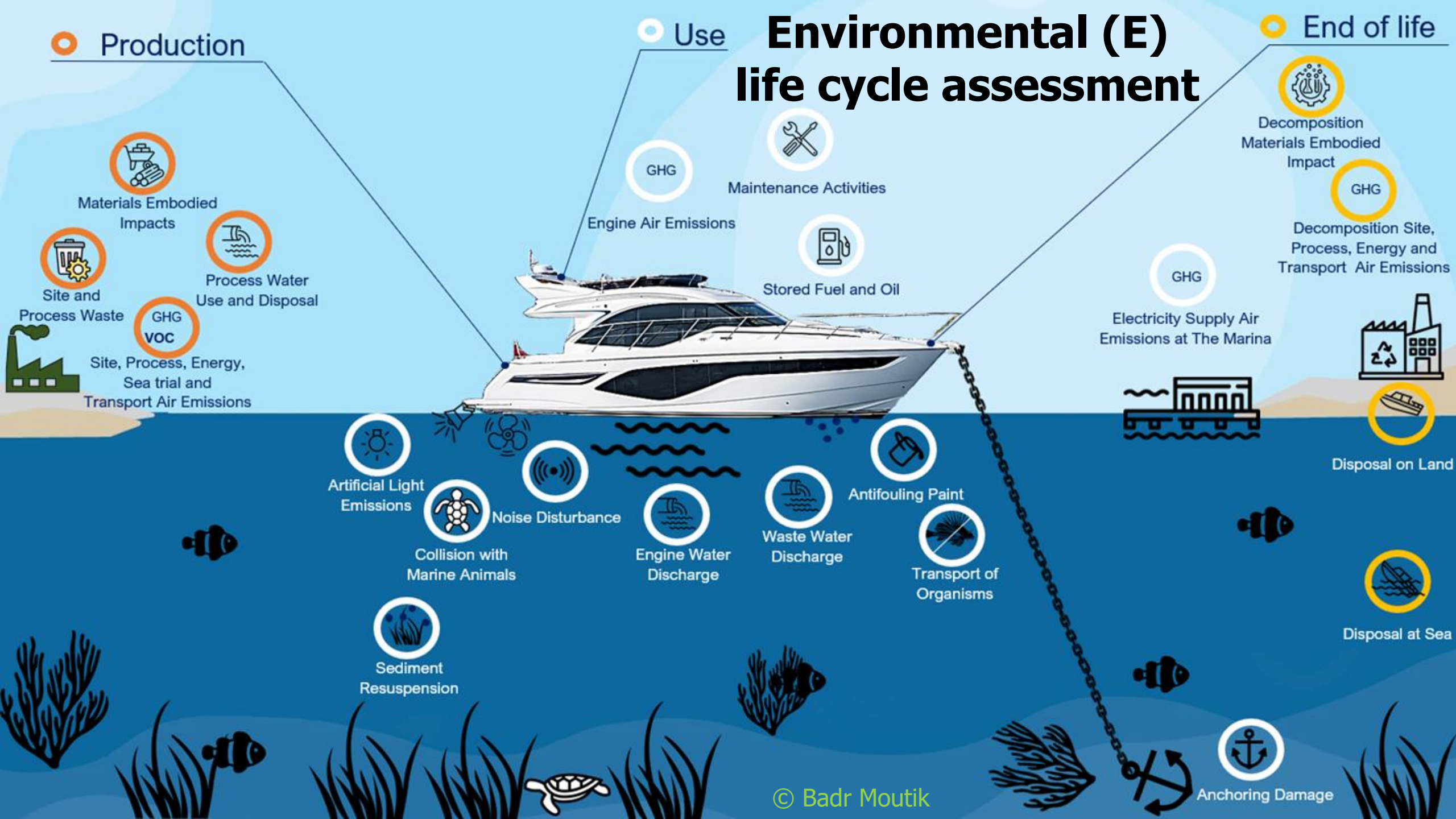
Environmental (E)

but **avoid** an unprocessed wreck …

- slow fragmentation
  - anti-fouling paints
  - microplastic pollution paint flakes
  - lubricants
  - battery chemicals
  - microfibres
    - ingestion by micro-orgamisms
    - potential to enter human food chains
      - perhaps we deserve it!

1. Wright, S.L., Thompson, R.C. and Galloway, T.S. The physical impacts of microplastics on marine organisms: a review, Environmental Pollution, July 2013, 178, 483-492.
2. Hidalgo-Ruz, V., Gutow, L., Thompson, R.C. and Thiel, M. Microplastics in the marine environment: a review of the methods used for identification and quantification, Environmental Science and Technology, 2012, 46(6), 3060–3075.
3. Rees, A.B., Turner, A., Comber, S. Metal contamination of sediment by paint peeling from abandoned boats, with particular reference to lead, Science of The Total Environment, 2014, 494–495, 313-319.
4. Ciocan, C., Annels, C., Fitzpatrick, M., Couceiro, F., Steyl, I. and Bray, S. Glass reinforced plastic (GRP) boats and the impact on coastal environment - evidence of fibreglass ingestion by marine bivalves from natural populations, Journal of Hazardous Materials, 5 July 2024, 472, 134619.
5. Ciocan, C. Abandoned fibreglass boats are releasing toxins and microplastics across the world, The Conversation, 4 August 2020.
6. Ciocan, C., Kristova, P., Annels, C., Derjean, M., Hopkinson, Glass reinforced plastic (GRP) a new emerging contaminant - First evidence of GRP impact on aquatic organisms, Marine Pollution Bulletin, 2020, 160, 111559.

Environmental (E) life cycle assessment



Social (S)

Permission

- one person's pride and joy is another person's eyesore ?
- if no indication of ownership,
  then can we move a boat?
- berthed in my marina,
  but no-one is contactable for mooring fees?
- washed up on the shoreline,
  but may have broken mooring in harsh weather?

End-of-life boats?

Governance (G)

- Fit for legislation/rules/codes/ethics

- Canada
  - Wrecked, Abandoned or Hazardous Vessels Act

- United States of America
  - Abandoned Watercraft Abatement Fund (AWAF)
  - Derelict Vessel Act
  - Surrendered and Abandoned Vessel Exchange (SAVE)
  - Vessel Turn-In Program (VTIP)

What next?

ADVeNT: **A**bandoned and **D**erelict **Ve**ssels
Network for **T**ransformation

- Technology (T)
  - establish how many ADV exist and where they are located.
  - re-engineer boat building with manufacture for end-of-life.
  - seek low impact disposal routes at top of the recycling hierarchy
    - E.g. waterproof shelters for displaced people
- Economics (E)
  - explore funding disposal of owned/abandoned/derelict, vessels.
  - assess cost of transport to, and handling at, recycling centres.
- Environmental (E)
  - LCA to assess the impacts of different disposal routes.
- Social (S)
  - harvest tacit knowledge from senior personnel in the industry.
  - link between vessel and owner (serial number/person concordance).
  - assess the potential for job creation in handling ADV wrecks.
- Governance (G)
  - work with classification societies to regulate ADV disposal.
  - evidence-based policy making (facts *vs* opinion or theory)

Questions?

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