Full LCA of Wave Energy Conversion

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Images from www.pelamiswave.com and www.aquamarinepower.com
• Very few Life Cycle Assessments for wave energy conversion

• Generic methodological framework for LCA introduces considerable scope for variation in results

• Existing focus on carbon and energy

• More complete LCA of Pelamis and Oyster, considering a broader range of environmental impacts

NREL data taken from the LCA Harmonization Project, http://en.openei.org/apps/LCA/
Pelamis P1

- Semi-submerged, snake-like offshore wave energy converter made of a series of articulating buoyant steel cylinders.
- The passage of the wave front causes the joints between the cylinders to flex, moving hydraulic rams that pump high-pressure oil through a system to drive induction generators.
- Parker et al. published a carbon and energy audit in 2007 [2].
- Full LCA published in 2014 [5].
Oyster 1

• Buoyant hinged steel flap fixed to the sea bed.
• Wave surges induce oscillations of the flap that are resisted by hydraulic rams; these pump water through a pipe to shore, where a Pelton turbine and generator convert the energy to electricity.
• Walker and Howell published a carbon and energy audit in 2011 [3].
• Full LCA yet to be published.

The Analysis

• Cradle-to-grave
• Inventory of resource use and emissions at all stages:
  – Materials & Manufacture
  – Assembly & Installation
  – Operations & Maintenance
  – Decommissioning & Disposal
• Classify and characterise results to determine impact potentials
Pelamis Results

- Greatest impacts from manufacturing and maintenance stages
  - Steel production
  - Sea vessel operations
- Energy intensity
  - 469 kJ/kWh
  - 31 months payback
- Global warming potential
  - 30 gCO₂e/kWh
  - 15 months payback
Oyster Results

- Greatest impacts from materials
  - Steel production
  - Seabed fixings
- Energy intensity
  - 889 kJ/kWh
  - 59 months payback
- Global warming potential
  - 79 gCO₂e/kWh
  - 41 months payback
Conclusions

• Carbon and energy intensities compare favourably.
• Greatest impacts due to
• Considerable uncertainty is introduced by LCA methodology:
  – Recycling allocation method: 34%
  – Inclusion of all GHGs: 11%

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References


