

11th Hour Racing team IMOCA 60 Sustainable Design & Build Report - 2021 -

SCENARIO ANALYSIS - MOLDS



Supporting the main report
this document **Scenario analysis - Molds**
quantifies the environmental impacts of the construction
of 11th Hour Racing team IMOCA 11-2 molds.

Measurements used are
kilos (kg), metric tons (t), Greenhouse gas (tCO₂e) or (kgCO₂e)

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DISCLAIMER

The team's LCA results were calculated using MarineShift360. Backed by 11th Hour Racing as Founding Sponsor, MarineShift360 is a purpose-built marine industry life cycle assessment tool. MarineShift360 is an ISO 14040:2006 & ISO 14044:2006 compliant and certified life cycle assessment tool. LCA results herein are calculated using MarineShift360, which is under development and is currently in beta stage. No statements regarding accuracy are made and results may change over time as the development of MarineShift360 continues.

Objective

The following study concerns the assessment of the environmental impacts of 11-2's hull and deck moulds built in 2019 in Spain using the Life Cycle Assessment (LCA) approach.

The objectives are defined as follow :

- Evaluate the potential environmental impacts of an IMOCA60 hull and deck moulds.
- Identify the improvement tracks and evaluate the potential environmental gains.

Scope of the study

Includes the raw materials, manufacture process and the transport of the plugs and molds, it does not include the manufacture and assembly of 11-2 which is compiled in the LCA-2 (11-2).

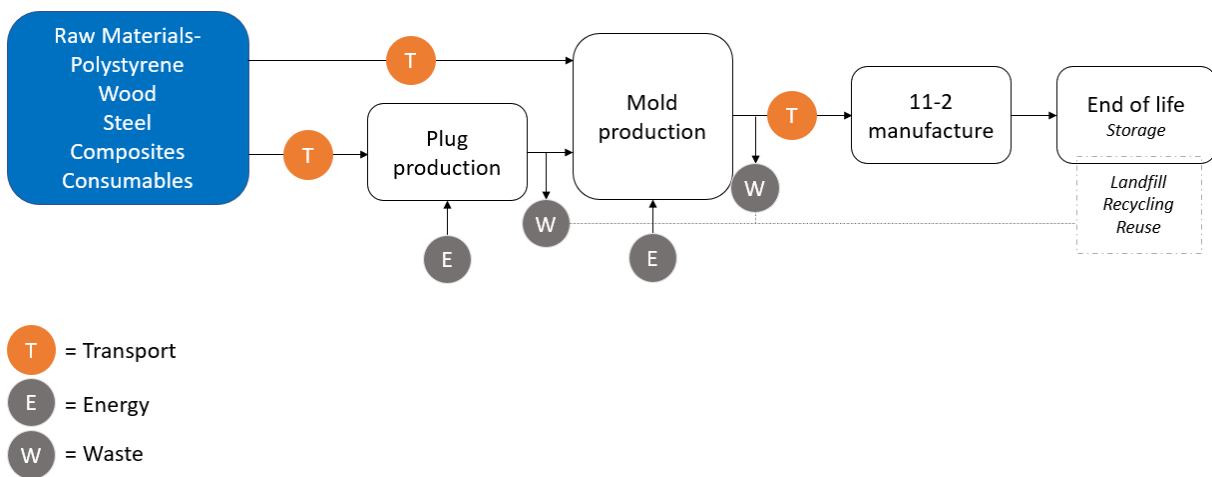


Figure : System boundaries 'cradle to grave '
Calculated with MarineShift360 beta software, June 2021

Functional unit : The life cycle of an IMOCA60 hull and deck moulds built in Spain.

Inventory

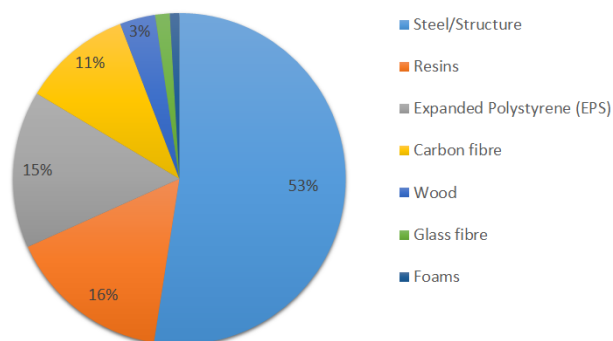


Figure: Material inventory (in mass ratio)

Results:



Global Warming	Mineral Resource Scarcity	Energy consumption	Water consumption	Marine Eutrophication
tCO2e	kg Cue	MJ	m3	kg Ne
171	1,050	4,200,000	2,440	79

Table: Results of environmental impact indicators
Calculated with MarineShift360 beta software, June 2021

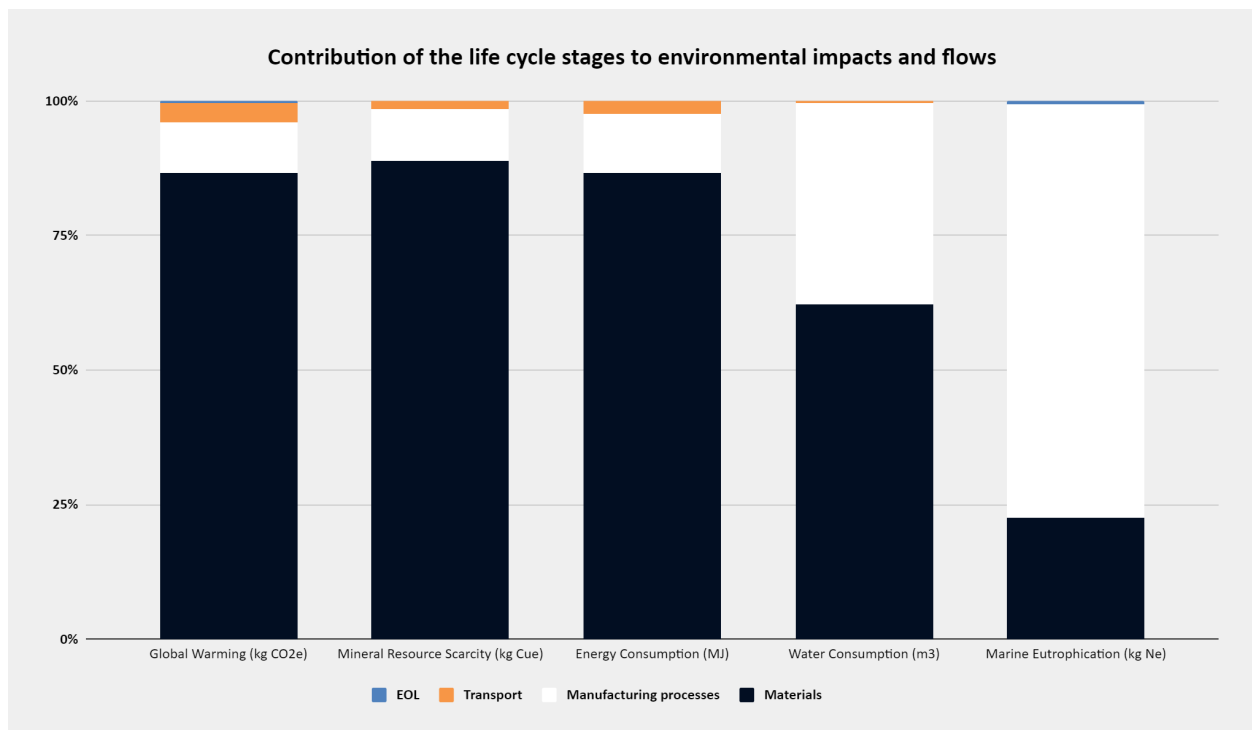


Figure: Contribution of the life cycle stages
Calculated with MarineShift360 beta software, June 2021

Conclusions

The total emission of greenhouse gases (**171t CO₂e**) is equivalent to **673,340kms** driven by an average passenger vehicle.

The energy consumed (**4.20M MJ**) is equivalent to 98 North American homes' energy use for one year.

The material's extraction and production stages contribute to more than 60% for the majority of the impact indicators. This is mainly due to the important amount of material produced from non-renewable resources (steel, carbon fibre, resins..) and their associated energy intensive processes.

The evaluation of the improvement tracks carried out showed that the reuse of steel structure and incorporation of recycled carbon fibre (RCF) in the system has the best environmental potential gain.

Recommendations

Avoid the use of male plugs

Removing male plugs from the build process would reduce waste by 3 tons and greenhouse gas emissions by 46tCO₂e (8% of the total GHG emissions).

Design & build for reuse

Considering the amount of different raw materials extracted, transported and manufactured for a single use part (molds are prototypes and oftenly used once), it seems obvious to take the "reuse" option more seriously if we are seeking to reduce the global footprint of an IMOCA ready to sail. (NB: 11-2's hull and deck moulds were reused immediately by IMOCA team Maître Coq, saving a total of 171t CO₂e)

Implement alternative materials

Certain sectors of the composite industry are already using rCF and/or flax as an alternative to virgin carbon fiber in moulds.

Transport

Transport of the components with a total weight of 7.5 metric tons, is discussed in the Scenario - Transport, and are responsible for 5.5 tCO₂e

Quantifying Improvement tracks

*Table: Hull and deck molds, impact reduction potential, compared to the full system (IMOCA launched and ready to sail - 553 tCO2e)
Calculated with MarineShift360 beta software, June 2021*

	FEASIBILITY	tCO2e	Global Warming (%)	Mineral Resource Scarcity (%)	Energy consumption (%)	Water consumption (%)	Marine Eutrophication (%)
1. Reuse of steel structure at 50%	GOOD	-6.6	-1.2	-2.9	-0.4	-1	-0.2
2. Recycling of production waste (EPS,foams,CF/GF)	POSSIBLE	-2.2	-0.4	-0.1	-0.3	-0.5	-0.1
3. Integrate recycled carbon fibre	POSSIBLE	-23.8	-4.3	-0.3	-4.1	-2.6	-1.6
4. 100% Bioresin	GOOD	-2.7	-0.5	-0.1	-0.3	-0.5	0
5. Local supplier	GOOD	-5.6	-1	-0.1	-0.6	-0.1	0
6. No Plugs	POSSIBLE	-46	-8.3	-4.6	-6.3	-13.5	-13
All improvements tracks		-87	-15.7	-8.1	-12	-18.2	-14.9
Best improvement track Reuse of the molds	EASY	-171	-31	-10	-26	-32	-34