



ICOMIA LCA Study

Preliminary information regarding the LCA Decarbonisation Study for recreational small craft

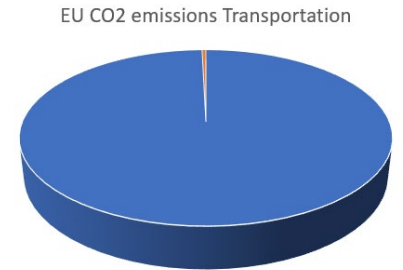


Background

Recreational boating is a major employer, tourism activator and economic contributor

Being in, on, or around water improves human health

Recreational craft account for **0.4%** of transportation CO2 emissions in Europe (0.7% in US).



**THRIVING OCEAN,
THRIVING PEOPLE**

THE CONNECTION BETWEEN OCEAN RESTORATION
AND THE BLUE WELLBEING ECONOMY

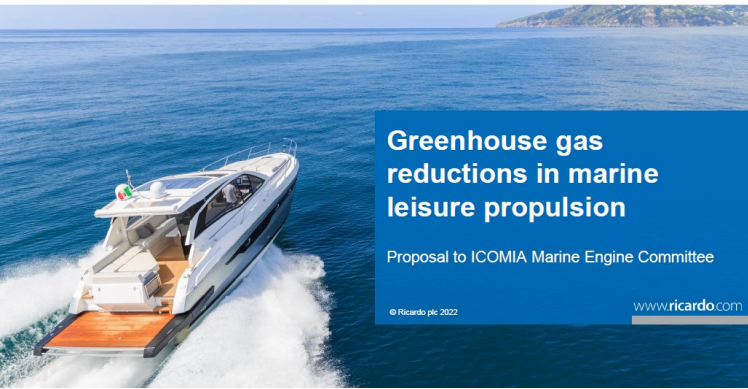
Panteia
Research in Progress
Research and Social | DM | NCA | SD | Studies | RPI

emisia
CONSCIOUS OF TRANSPORT'S IMPACT

TNO

**Review study on the Recreational
Craft Directive 2013/53/EU**





Creating a pathway to decarbonise the recreational marine industry

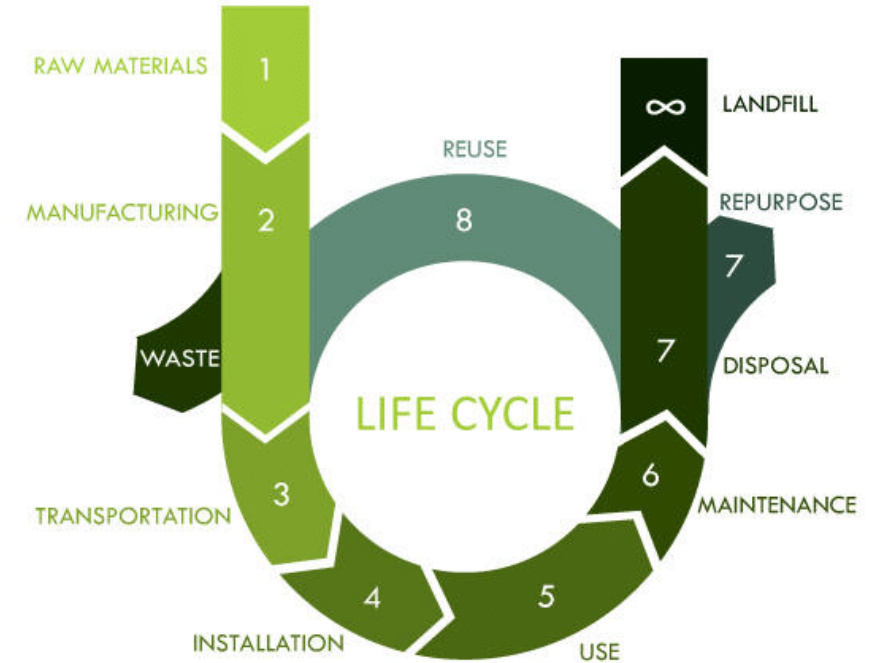
RICARDO – ICOMIA – GREENHOUSE GAS REDUCTIONS IN MARINE LEISURE PROPULSION

LIFE CYCLE ASSESSMENT (LCA)
BACKGROUND REPORT FOR ICOMIA

ISO 14040:2006 Environmental management -Life Cycle Assessment-Principles and Framework

ISO 14067:2018....

ISO 14044:2006+A1+A2:2020....



Environmental Life Cycle Assessment of a Standalone Hybrid Energy Storage System for Rural Electrification
Ayesha Shaik Mohiddin, Supervisor: M. L. Dennis Wong, and Co-Supervisor: Chee Ming Choo

Greenhouse gas reductions in marine leisure propulsion

Proposal to ICOMIA Marine Engine Committee

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Task with study

Suitability Analysis of 5 Power System Options



Gasoline
or diesel
ICE



Sustainable
drop-in fuel
ICE (HVO or
E-gasoline)



Hybrid-
electric



Battery
electric

H₂

H₂ ICE or
fuel cell

For 9 craft categories



Inflatable boat



Runabout /
day cruiser



PWC



Inland waterway
vessel



Sailing yacht



Fishing boat



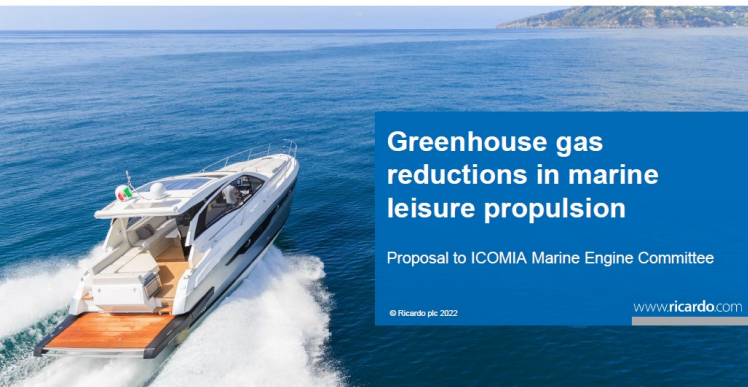
Pontoon boat



Displacement
motorboat



High performance
motoryacht



Approach

Task 1

• DECARBONISATION OPTIONS

- Overview of each energy converter and energy carrier type including systems required, impact on craft, infrastructure required and fuel supply options

Task 2

• GHG LCA

- Lifecycle assessment to ISO 14044 and 14067 including manufacture, use phase and end of life for energy converters and energy carriers

Task 3

• CAPEX AND OPEX

- Purchase cost and operational costs including energy and maintenance for energy converters, energy carriers and new infrastructure

Task 4

• BOAT POWER SYSTEMS IMPLICATIONS

- Analysis of life expectancy, maintenance requirements, performance, safety and commercial availability

Task 5

• INFRASTRUCTURE IMPLICATIONS

- Analysis of life expectancy, safety, expected availability of fuels or energy

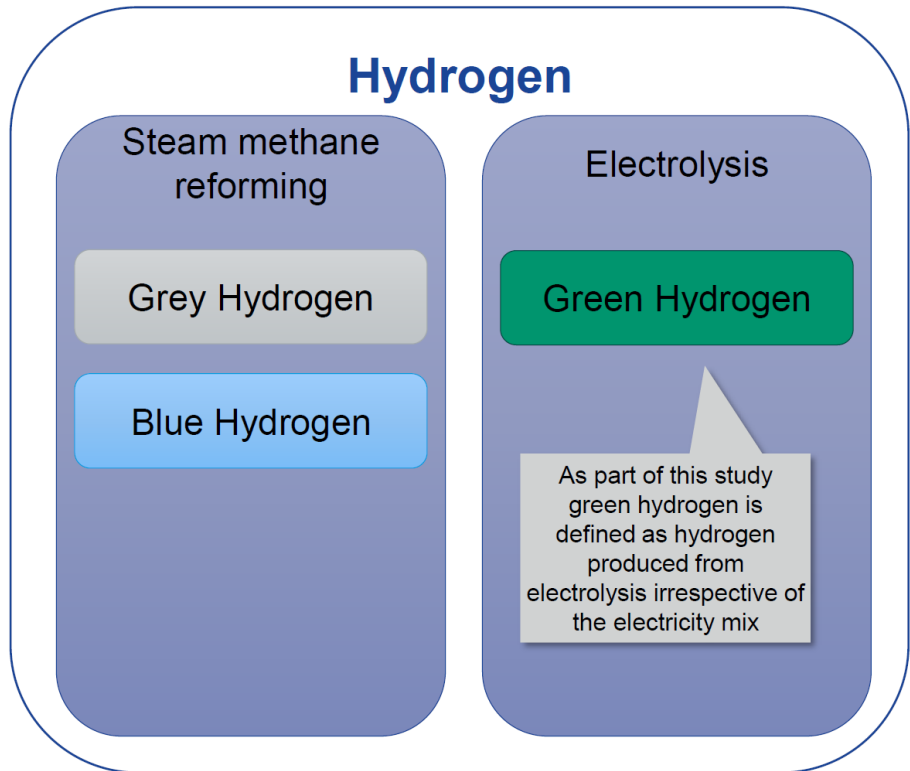
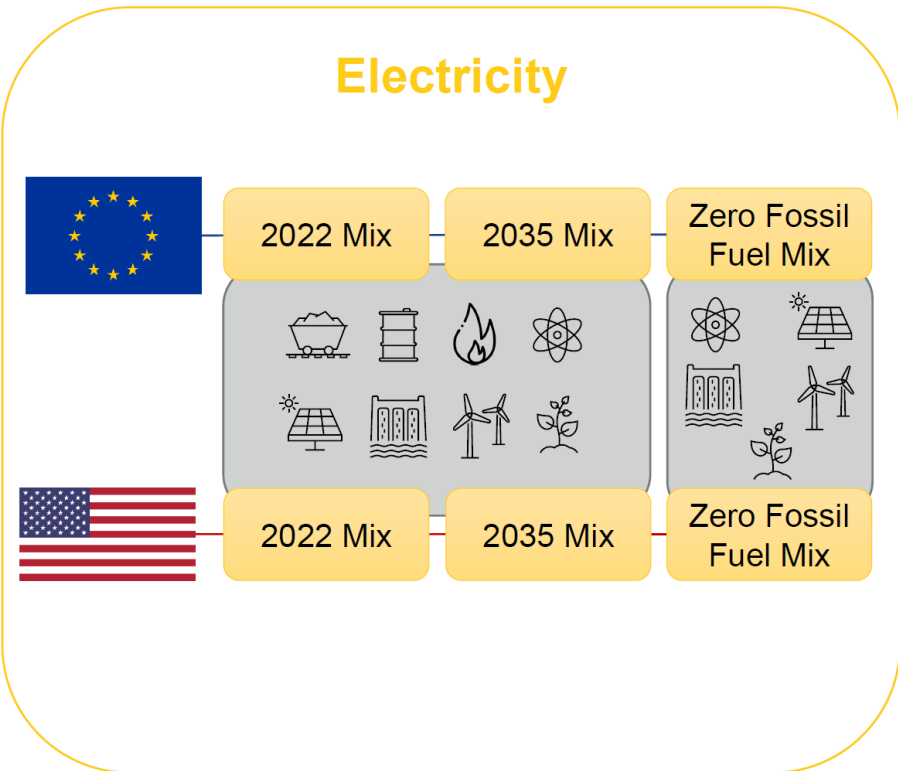
Task 6

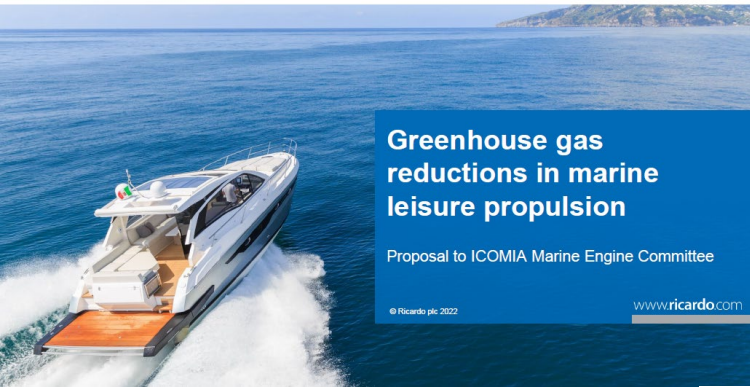
• SUITABILITY AND RANKING

- Overall suitability of different options for each craft type and usage case



→ LCA Scenarios - Three electricity energy mixes were chosen for both Europe and US, and three hydrogen source pathways





Greenhouse gas
reductions in marine
leisure propulsion

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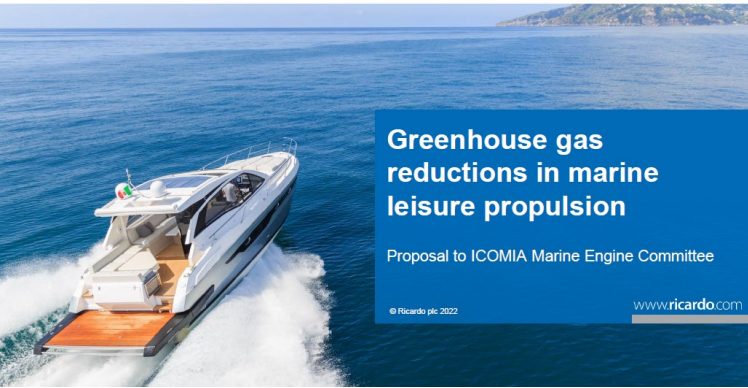


Sustainable
drop-in fuel
ICE (HVO or
E-gasoline)

Approach drop-in fuel

EITHER refinery produced drop-in fuel

OR refinery produced drop-in power to liquid fuel



Suitability and ranking

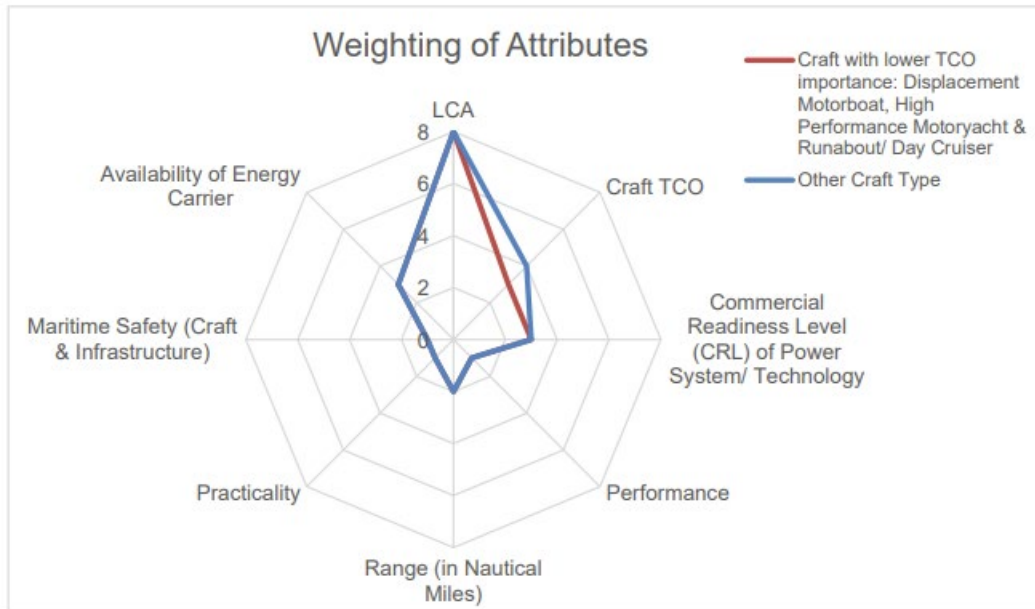
Suitability Analysis of 5 Power System Options



For 9 craft categories



Weighting of Attributes





Long service life and low operating hours

Expected service life
30-45 years

Engine hours
35-48 hours/annum



Carbon footprint relatively small compared to the embodied energy/carbon in the manufacture of the craft



Embodied carbon existing fleet

About 50 million boats with
combustion engines globally

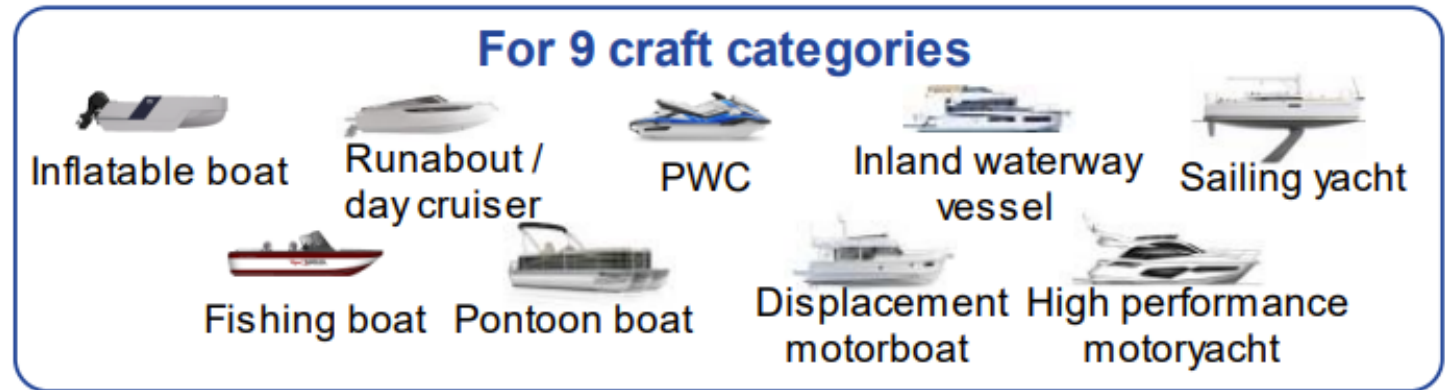
Remaining life at least 20-30 years

Annual sales new crafts around 2%

Greatest gains – Focusing on carbon neutral fuel solutions for existing fleet



Several solutions needed



No single solution or technology that will meet all craft type and all use cases in recreational marine



Greenhouse gas
reductions in marine
leisure propulsion

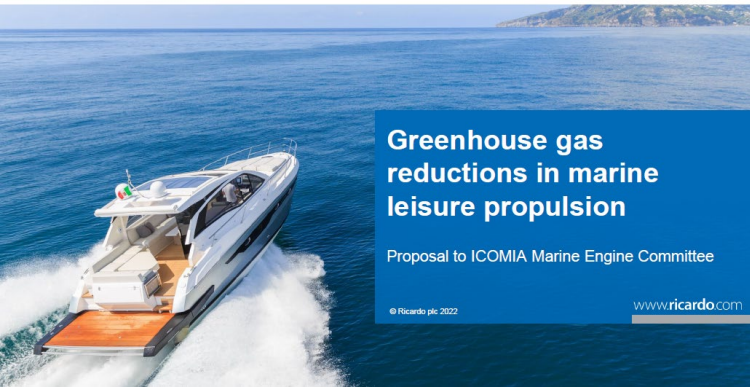
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Preliminary findings of the study

1. There is no "one size fits all" solution
2. There is significant CO₂ in the supply chain of materials and energy
3. Electric propulsion is only part of the solution
4. R&D and technological improvements are required
5. Global safety protocols/standards are required



**Greenhouse gas
reductions in marine
leisure propulsion**

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Global Policy Impacts

1. Support innovation and the best carbon reduction by use case
2. Accelerating fleet replacement adds significant CO2
3. Prioritize infrastructure and distribution of sustainable fuel
4. Safety standards for new technology
5. R&D for emerging technology

METSTRADE in Amsterdam November 2023



The Study is expected to be presented and will be the

- most current and
- comprehensive study

of its kind for the recreational marine industry and will provide the required analysis and intelligence to create a pathway to the decarbonisation of the recreational marine industry.