
ASSOCIATION OF ESTONIAN
MARINE INDUSTRIES
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PROPELLING
OUR FUTURE
ICOMIA
International Council of
Marine Industry Associations

About ICOMIA

- We have been a global advocate for the recreational marine industry since 1966
- We unite national boating federations & associations into one global organisation
- We present a strong and unified voice for the advancement of our industry through collaboration, research and advocacy
- Promote the improvement of boating safety, sustainability and responsibility

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NAVIGATING THE FUTURE: SAFETY FIRST!

ISO

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Technologies Investigated

Suitability Analysis of 5 Power System Options

Gasoline or diesel ICE

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

Hybrid-electric

Battery electric

H_2 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

Task 1 — **Decarbonisation Options**
Overview of each propulsion system type including systems required, impact on craft, infrastructure required and fuel supply options

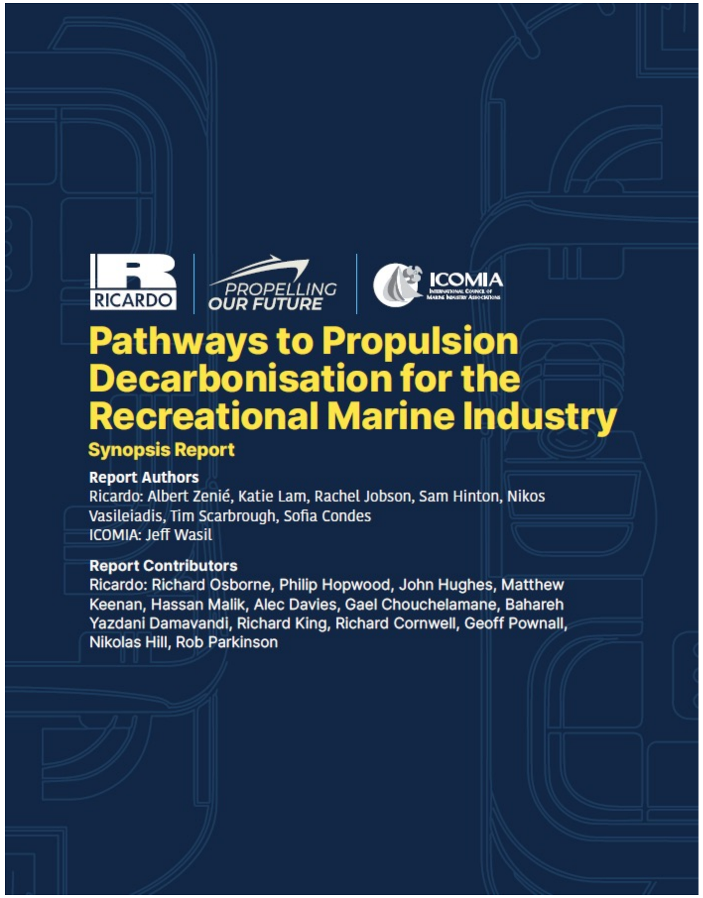
Task 2 — **Greenhouse Gas Life Cycle Assessment (LCA)**
Lifecycle assessment to ISO 14044 and 14067 including manufacture, use phase and end of life for energy converters and energy carriers

Task 3 — **Total Cost Of Ownership**
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


RICARDO
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Pathways to Propulsion Decarbonisation for the Recreational Marine Industry
Synopsis Report
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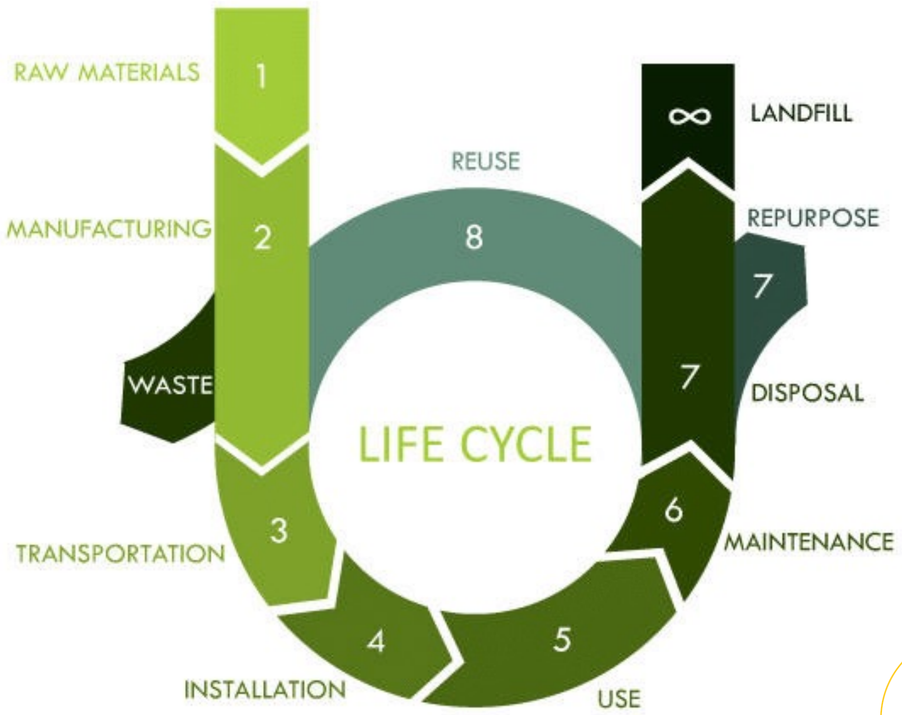
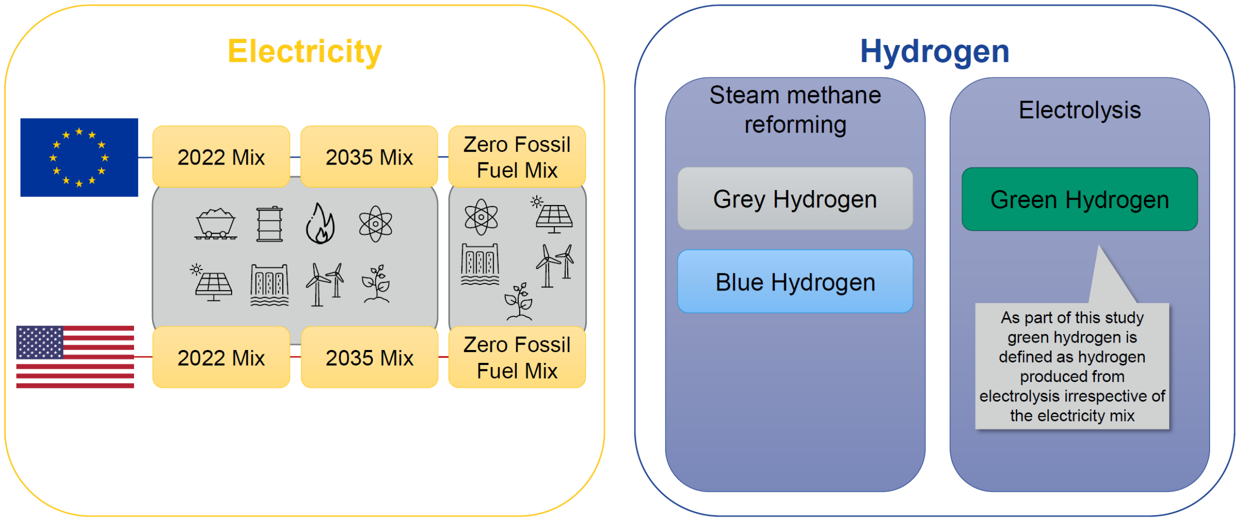


Environmental Life Cycle Assessment of a Standalone Hybrid Energy Storage System for Rural Electrification
Ayesha Shaik Mohiddin, Supervisor: M. L. Dennis Wong, and Co-Supervisor: Chee Ming Choo

- A full independent peer-reviewed cradle-to-grave lifecycle analysis needed
- This included specific well-to-tank breakdowns of each fuel or energy pathway and met ISO and IPCC requirements and recommendations
- Other inputs included emissions data, energy consumption, operational profiles, bill of materials, benchmark data, end-of-life assumptions of materials



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What the majority of cars are doing right now…

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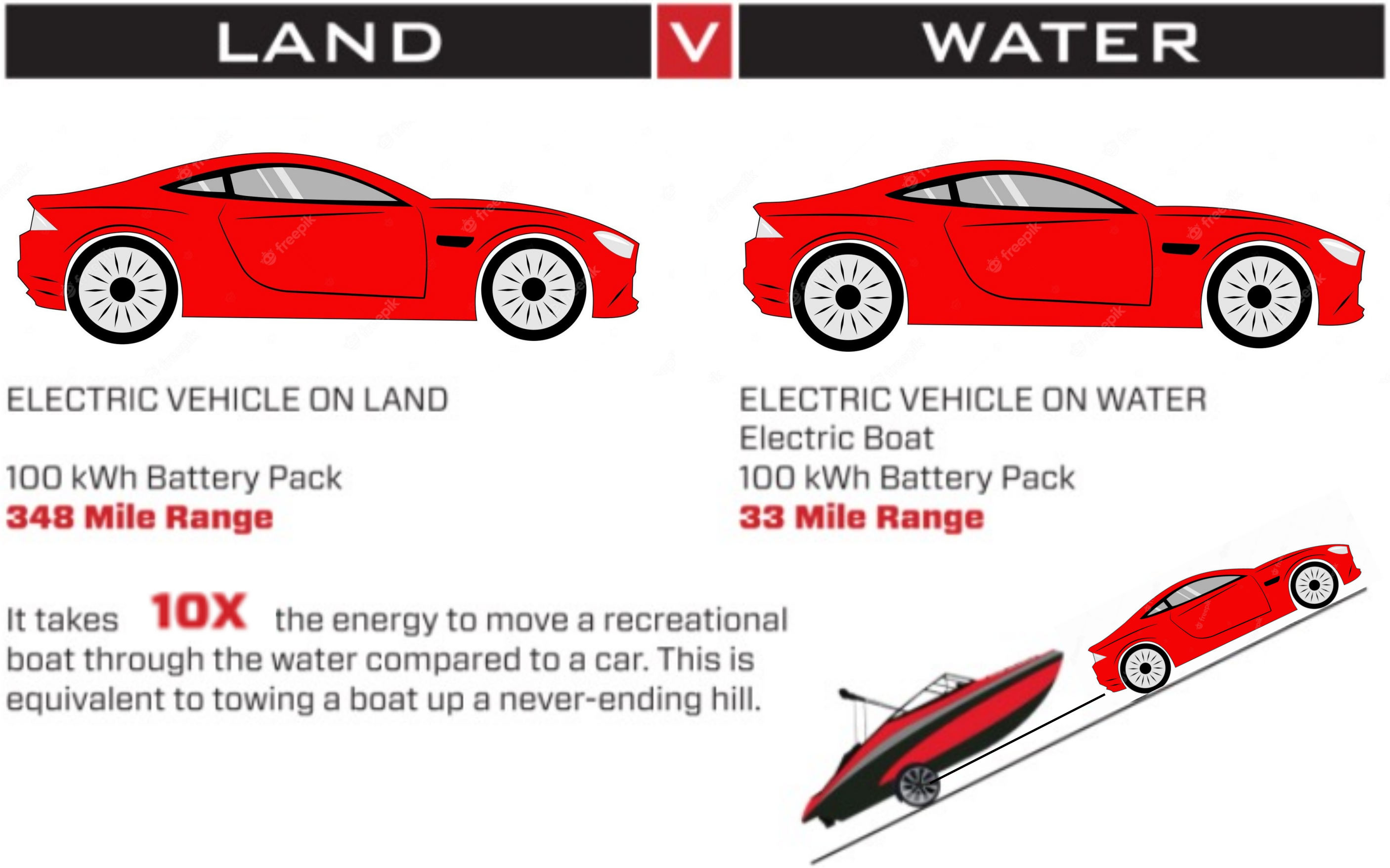
What the majority of boats are doing right now…

Electric Propulsion Comparison

If a car were a boat…



Key Considerations

1. The Carbon Balance Sheet of the existing fleet – 80% of the current fleet do not meet the requirements of RCD II
2. Understanding the supply chain and manufacturing — utilising full LCA analysis of the power systems and hull & deck structures
3. Acceptable levels of compromise for range, performance, space and cost
4. The typically low levels of usage for most recreational boats, typically < 50 hours per year with a long service life
5. GRID MIX — The report assumes a reduction in the carbon associated with electricity generation between now and 2035

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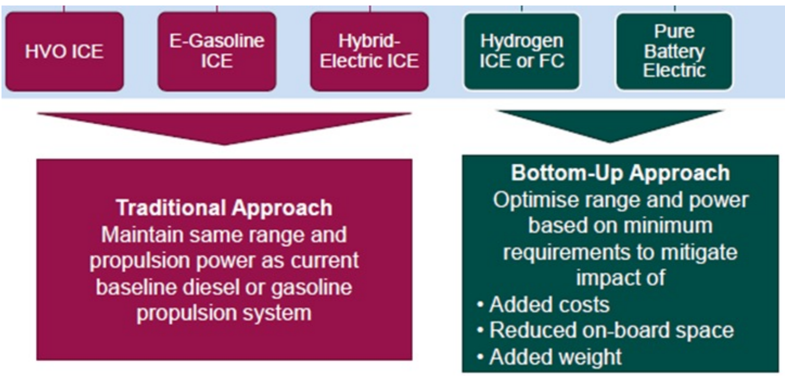
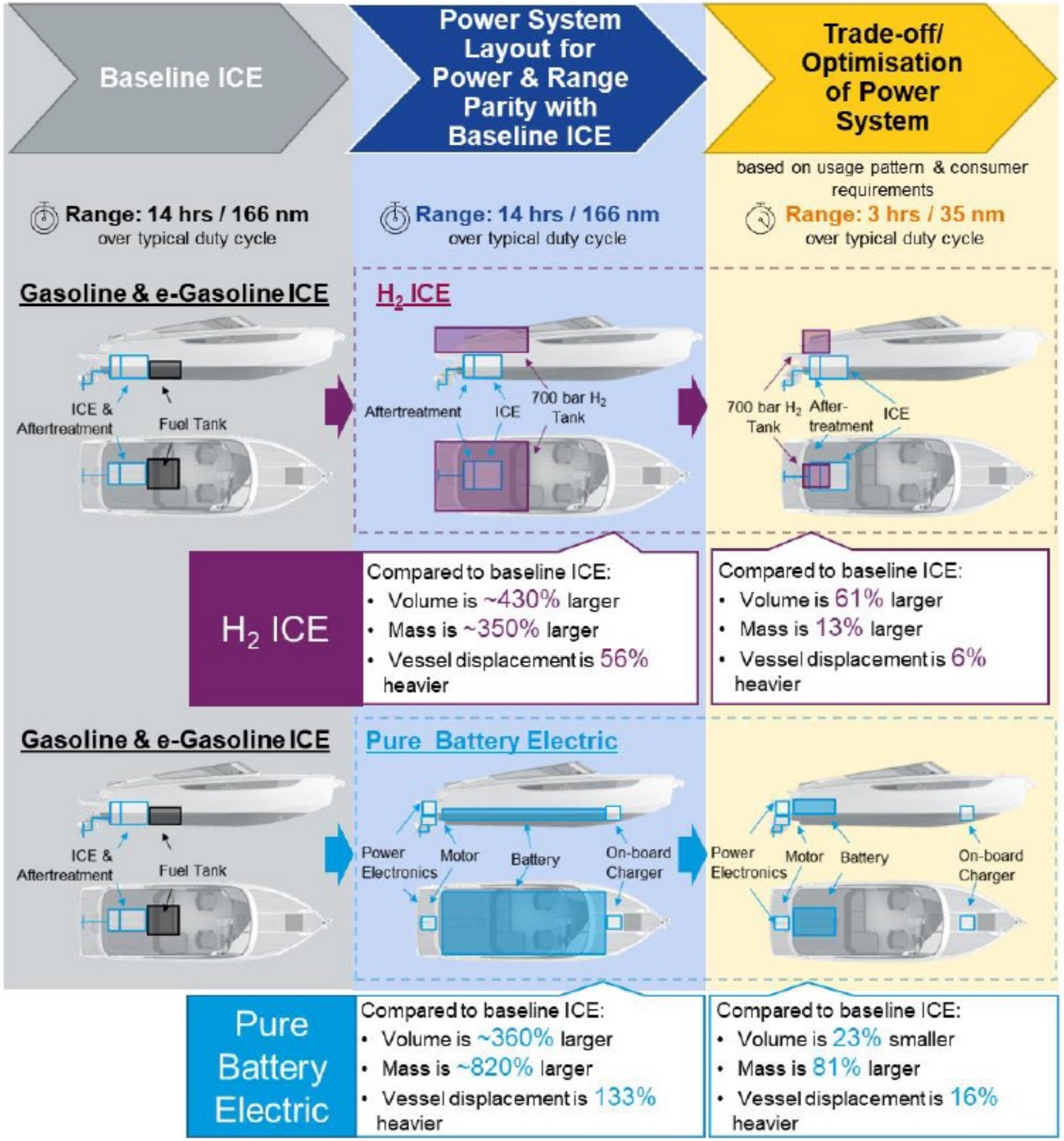
How each technology impacts the craft and why an optimsed power system is used

- Electric only and hydrogen propulsion craft modelling required a significant reduction in range to mitigate the impacts on vessel mass, on-board volume and purchase price





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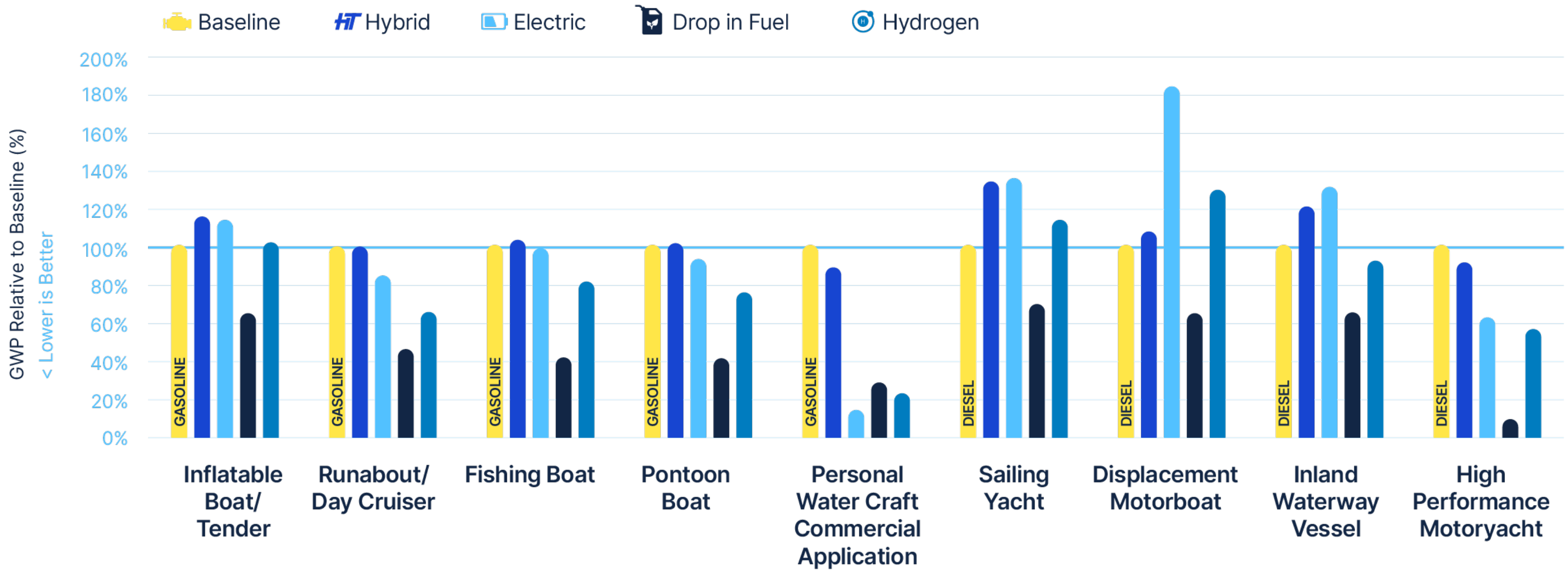
Key Findings

It's critical to understand how the boat will be used during its lifetime including the duty-cycle, annual hours of operation, and power requirements of the vessel before assuming a specific technology will reduce CO_2 emissions



	Inflatable Boat/ Tender	Runabout/ Day Cruiser	Fishing Boat	Pontoon Boat	Personal Water Craft Commercial Application	Sailing Yacht	Displacement Motorboat	Inland Waterway Vessel	High Performance Motoryacht
Annual utilisation (h)	35	43	35	35	156	24	48	48	130
Lifetime (y)	10	30	38	38	12.5	45	45	50	50

Figure 2 - Lowest global warming potential (GWP) for each propulsion system relative to the baseline ICE of each craft in 2035 ($kgCO_2eq/vh$). Lower values result in lower CO_2 emissions over the lifetime of the craft.

Conclusions of the Study

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

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