The Struggle to Make Green Ammonia the Maritime Fuel of Choice

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Introduction: Sustainability challenges of marine fuels

- ***Climate impact***: Marine logistics represents 3% of global CO_2 emissions, but growing rapidly because of growth in global trade
- ***Policy objective*** (IMO): 70%:n emissions reduction 2008 → 2040
- ***Technology vision*** of "New H_2 Economy" (EU, USA, China, Japan):

- Yet progress on synthetic ammonia has been slow
- ***We ask: Why slow progress? Possibilities for speeding it up?***

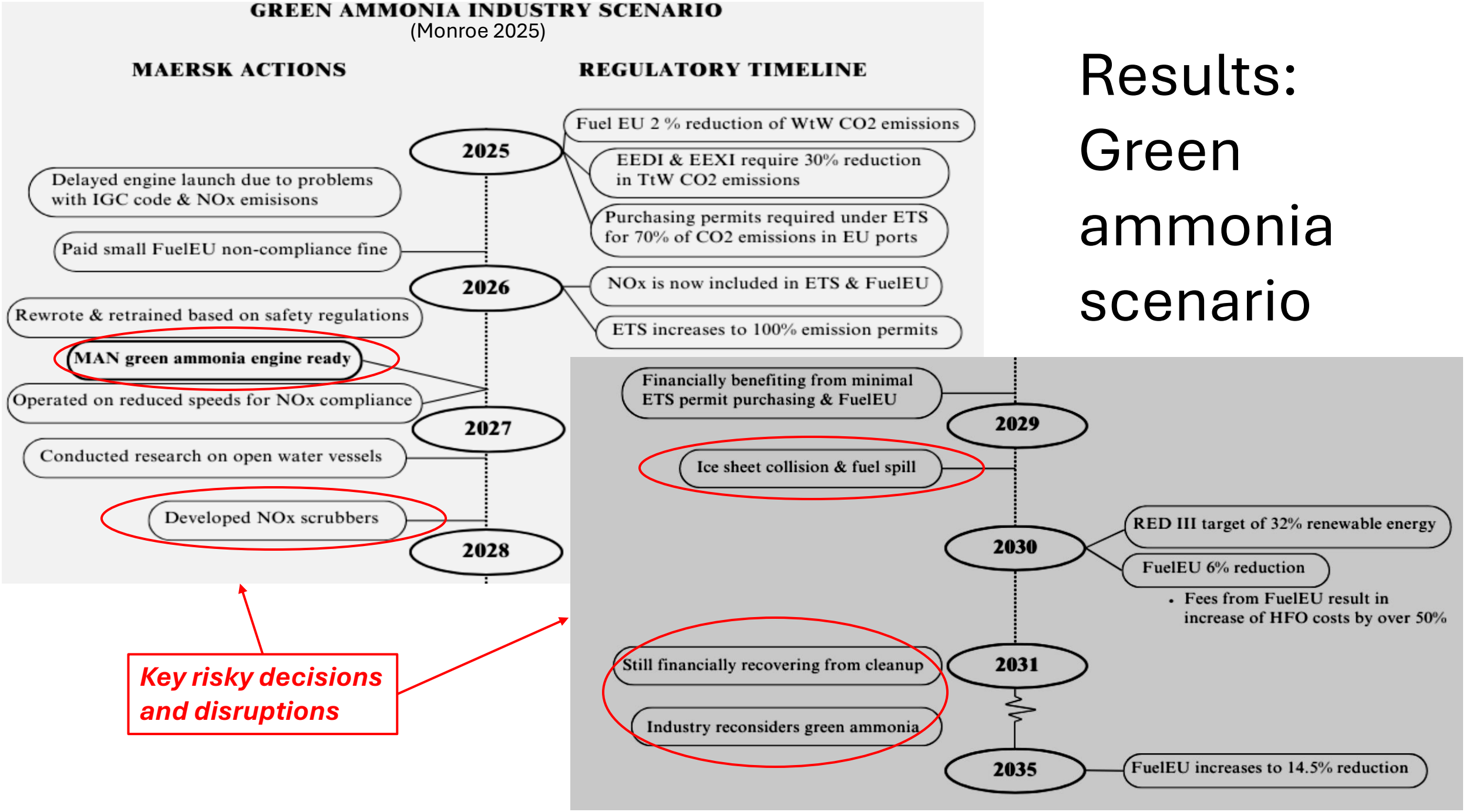
Background: New marine fuels

Fuel	Comment
LNG	”Old new” fuel; fossil
Batteries	Battery technology; short distances
Biofuels	Small supply in relation to demand
H_2	Space; storage
Synthetic methanol	C-emissions; maybe least problematic
Synthetic ammonia	C-free; toxic to environment and humans

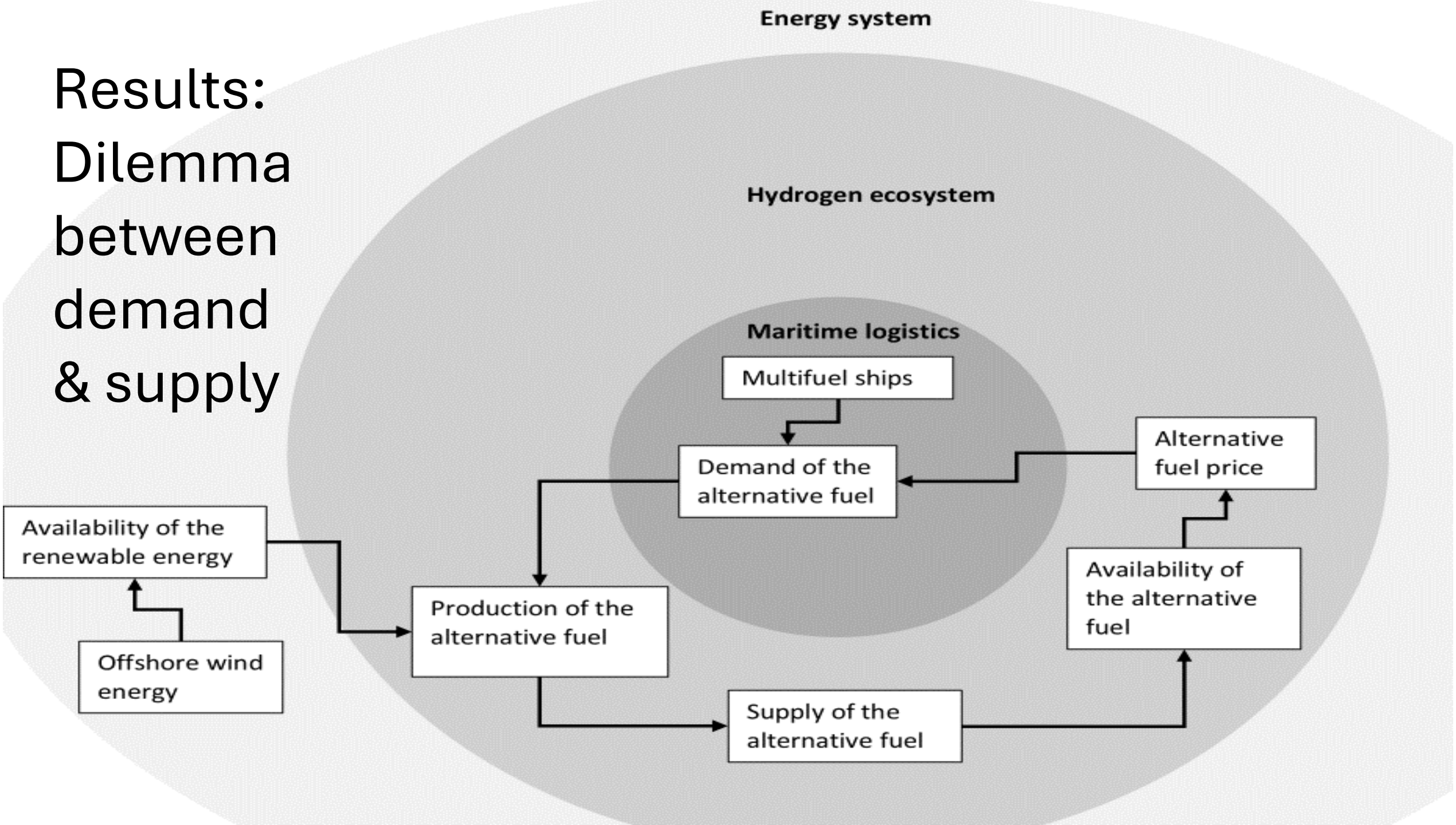
Empirical research

- Interviews and workshops with Finnish experts in marine logistics: researchers, private sector experts, public administration, NGOs
- ***Interviews*** (N=10) in 2023: “Green and digital transition in marine logistics”
- ***Workshops*** (N=3) in 2024: “Challenges and opportunities of uptake of new green fuels in marine logistics”

Results: Green ammonia scenario



Results: Dilemma between demand & supply



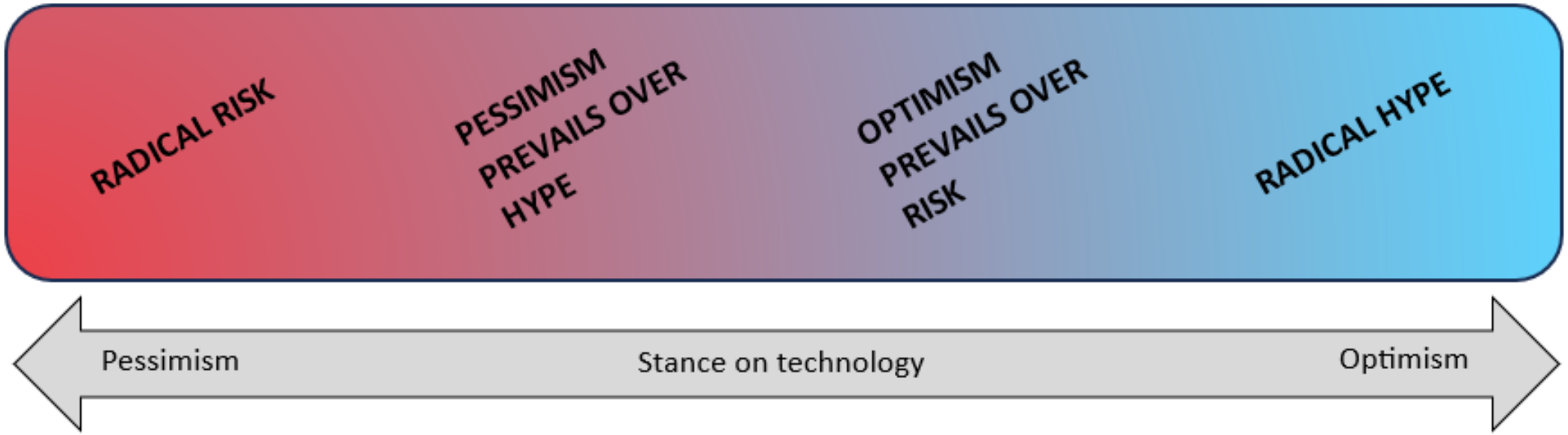
Results: Solution options for breaking the dilemma

Global regulation:

- ***C-taxes, tradeable permits***
- ***Limits on resource use***

Large-scale technology transition:

- ***Large player (Maersk?) invests***
- ***Marine technology standards***



Synthesis: Higher level dilemma

- Technology transition & global regulation are large-scale solutions with ”New H2 Economy” uncertainties
  - No global consensus on strategies, technologies, supply chains, markets, etc. to advance H2 economy
  - Gap between H2 economy objectives and implementation: 97% of 2030 target under study; over 90% of capacity late; hundreds of billions of EUR subsidies
- Higher level dilemma: Must take large-scale risks if want to break dilemma between cautious fuel demand and supply

Conclusion

- Given growth of emissions from marine logistics, need rapid transition to green fuels with technological & regulatory solutions
- Solutions may succeed only partially
- Yet failing to take action for fear of failures will guarantee dangerous social-environmental tipping points

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