Future Operational Energy

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Context

- ‘A **fuel technology transition is already underway** in the maritime industry, with half the ordered tonnage capable of using LNG, LPG, or methanol in dual-fuel engines, compared to one third of the tonnage on order last year.’
    - DNV Maritime Forecast 2050 (2023)

- ‘I will ask NATO civilian and military authorities to develop a new “**Energy Transition By Design**” initiative’
    - NATO Secretary General (2022)

- ‘The MOD will seek to maximise **operational advantage** through its energy choices’
    - Defence Operational Energy Strategy (2023)

Scope of task

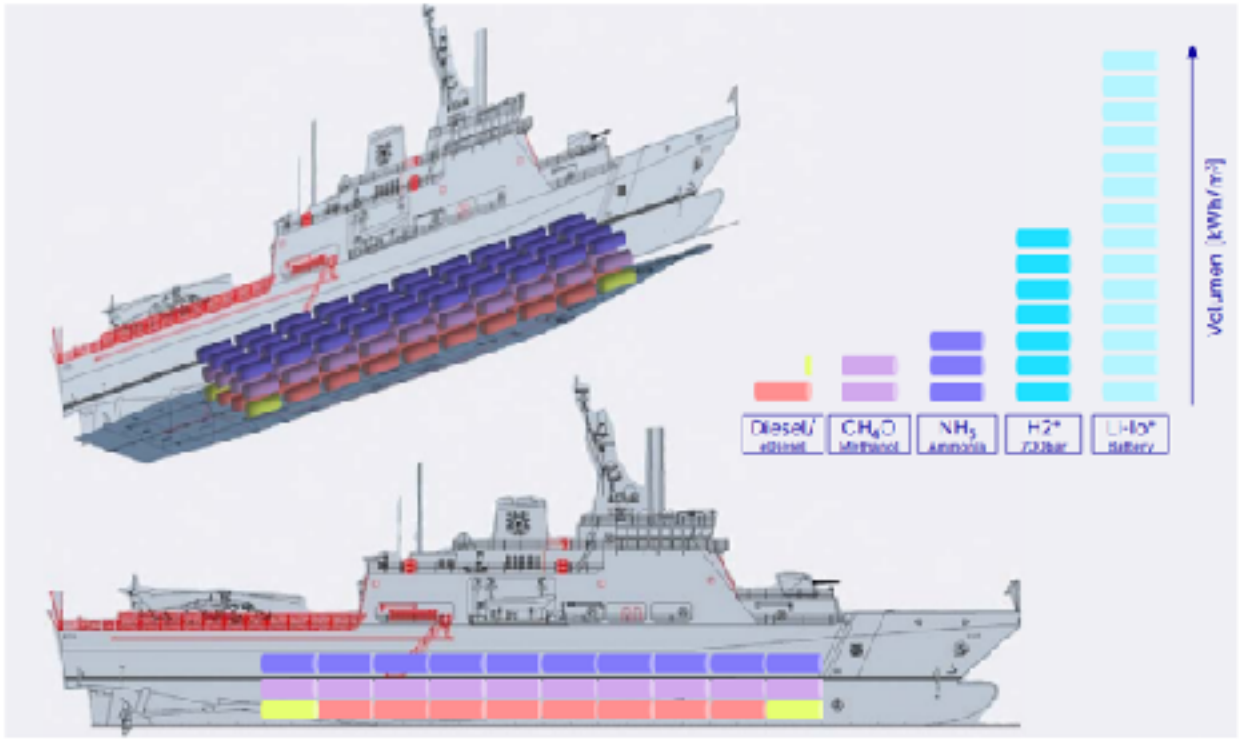
- Inform RN plan for response to global maritime energy transition
- Evaluate options
- Provide breadth of perspective – military, industry, academia
- Be coherent with Defence Operational Energy Strategy
- Shape future discussions with allies and partners
- Aligned with complementary study by Defence Science & Technology Laboratory (DSTL)

- Military requirements above and beyond commercial
  - Survivability limits due to energy volatility
  - Underway Replenishment at Sea
    - Practicality and safety aspects
  - Interoperability with other Navies
    - E.g. NATO. Commonality of fuels incl. RAS.
  - Fundamental need not to be placed at an operational disadvantage
- Significant impacts on platform design
- Plus IMO regulations, legislation and price risks, etc.

- Collaborative effort
- Provide industry and academic perspectives
- Highlight impacts of commercial marine efforts on RN
- Identify what industry could deliver and when
- Identify potential opportunities for cross-sector leverage or international collaboration

University of Southampton
QINETIQ
Rolls-Royce
Cranfield University
Imperial College London
THALES

Fuel storage needed for an OPV with various energy sources (18 MW main engine / ~4,000t)

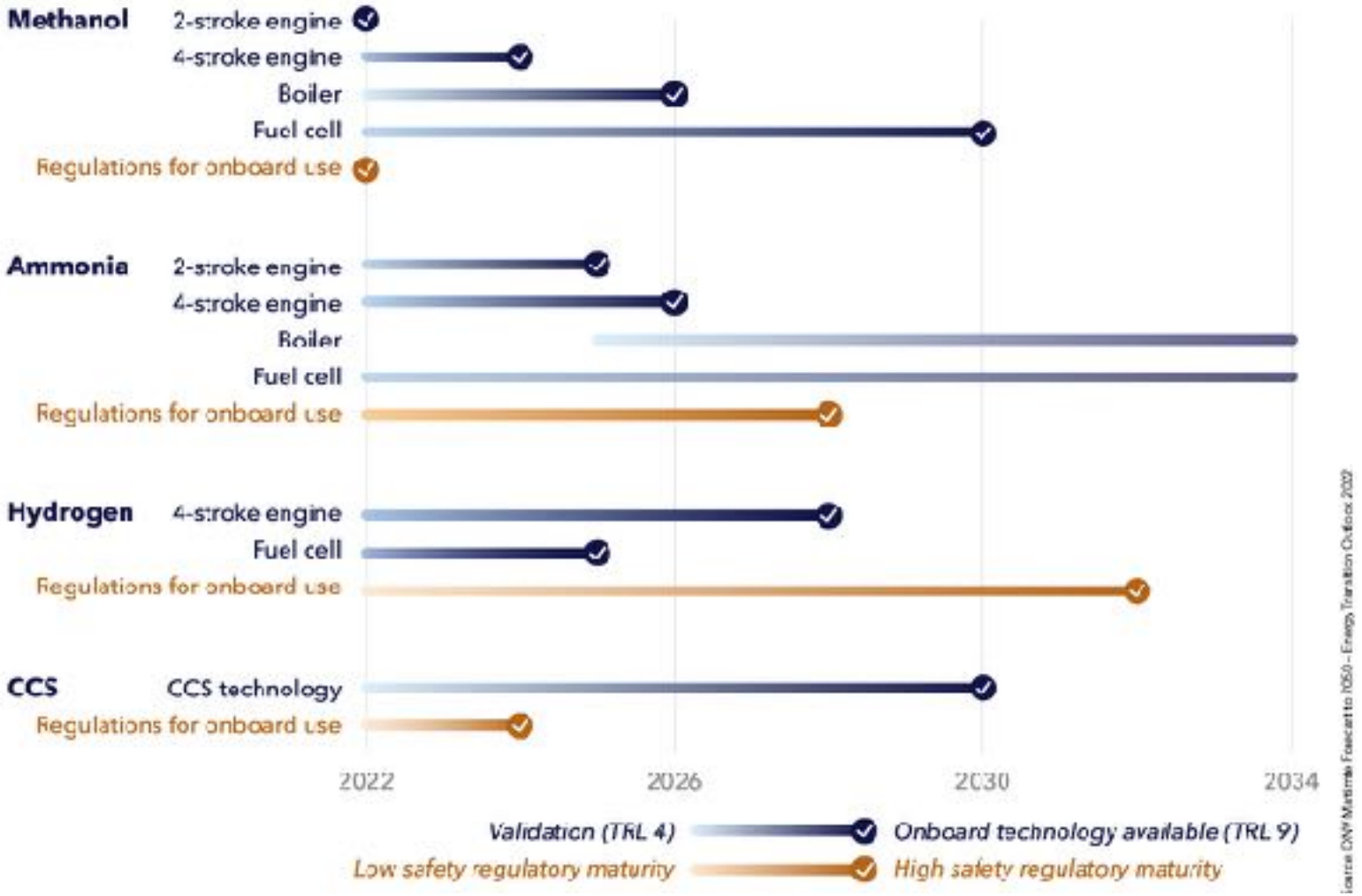


*Hydrogen (H_2) and batteries not reasonably presentable

- Highest carbon reductions are achieved by most complex fuels and systems with highest risks and costs
- Fuel cost predictions are highly complex and uncertain – risks in all choices and will ultimately depending on availability (and cost) of feedstock, infrastructure, and green energy
- Potentially a decade away from knowing energy front runners – places increased value on transitional fuels

- R&D is ongoing and maturing – early 2030s is a key period for development:
  - Navy specific/ development deltas need understanding in 2020s
- The rise of ‘green corridors’ helps commercial shipping, but not navies
- Impossible to select final fuels/ energy sources – markets too immature:
  - Transition fuels enable RN to maintain options without selecting a single fuel –an ‘optionality strategy’
  - Dual fuel options de-risk expected uncertainty and variability in availability and carbon intensity of alternative fuels

Estimated maturation timelines for energy converters, onboard CCS technologies, and corresponding safety regulations for onboard use with alternative fuels other than LNG/LPG



- Methanol – seen as a transition fuel only
  - Longer term uncertain and green production low but growing

- SAF – potential as a single fuel
  - But widespread expectation supply will not meet aviation needs, let alone maritime sector

Energy Source	Short-term	Medium-term	Long term
Drop-in	Y	Y	N
SAF	Y	Y	N
Methanol	ish	Y	N
Ammonia	N	N	N
Hydrogen (liquid or solid storage)	N	Y	Y
Nuclear	N^	?	Y
Electric/Batteries	Y*	Y*	Y*
Energy Independent	Y**	Y**	Y**

- Use 2025-2035 to trial biofuels on selected RN / RFA vessels to inform viability
- Further in-depth investigation of:
  - Methanol – learning from operators
  - Nuclear – investigate developments and investments needed as soon as possible
  - Hydrogen – fuel cells
- Engagement and collaboration:
  - Partnerships with other navies
  - UK shipbuilding and European operators as well as equipment suppliers
  - International forums (NATO, IMO, etc)
- Work with MOD and industry energy authorities to manage this energy transition

Next steps

- Further research, development and experimentation, building on DSC report findings
- Collaboration with allies and partners
- Decisions for specific platforms and programmes