Energy Transition – Green Shipping

FGV

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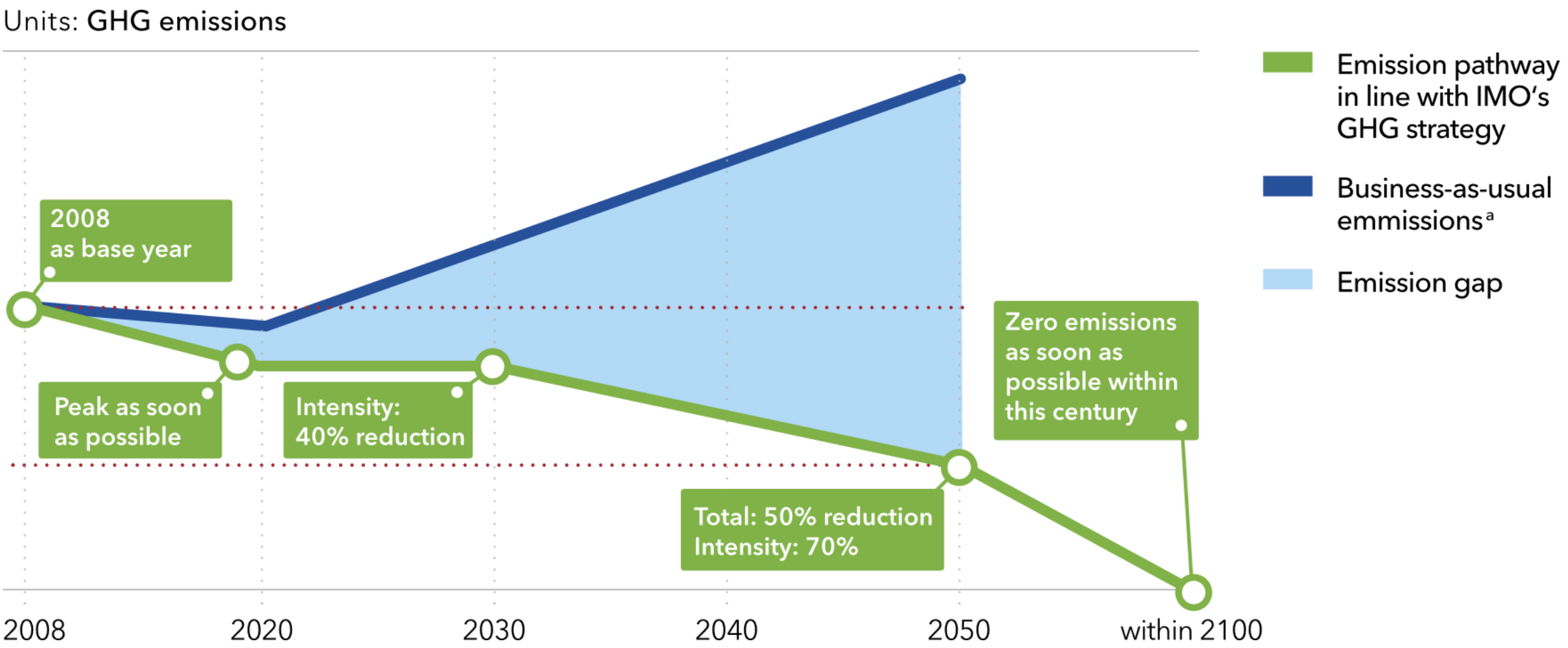
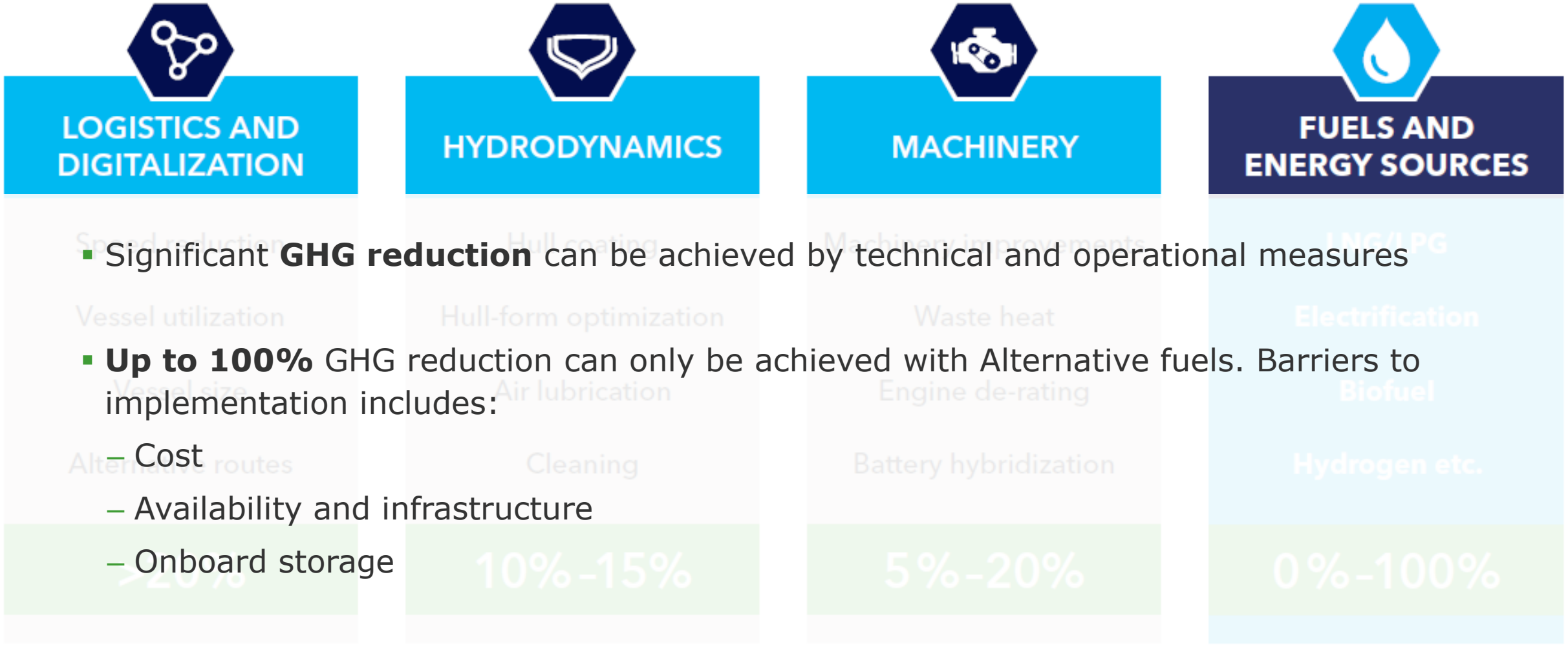
The foundation for the outlook up to 2050 is the IMO GHG strategy



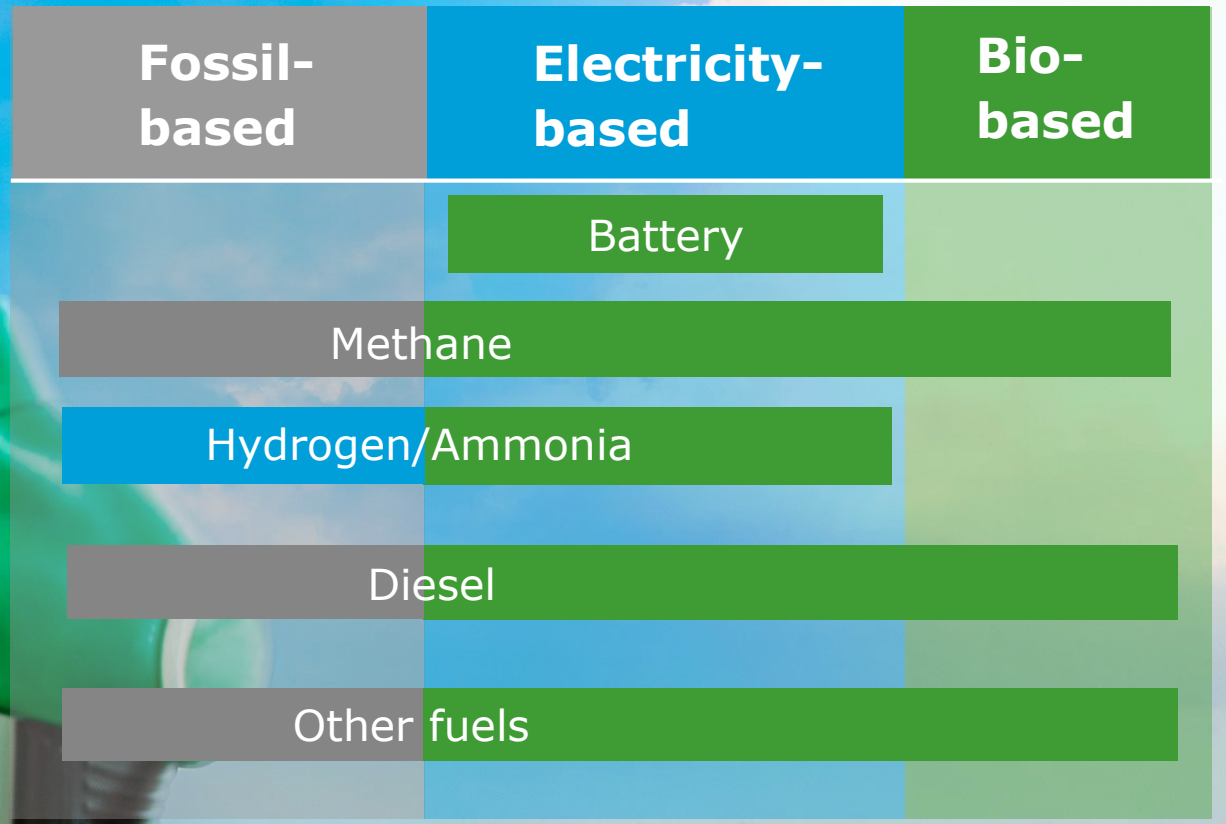
Decarbonization options for shipping



- Significant **GHG reduction** can be achieved by technical and operational measures
- **Up to 100%** GHG reduction can only be achieved with Alternative fuels. Barriers to implementation includes:
  - Cost
  - Availability and infrastructure
  - Onboard storage

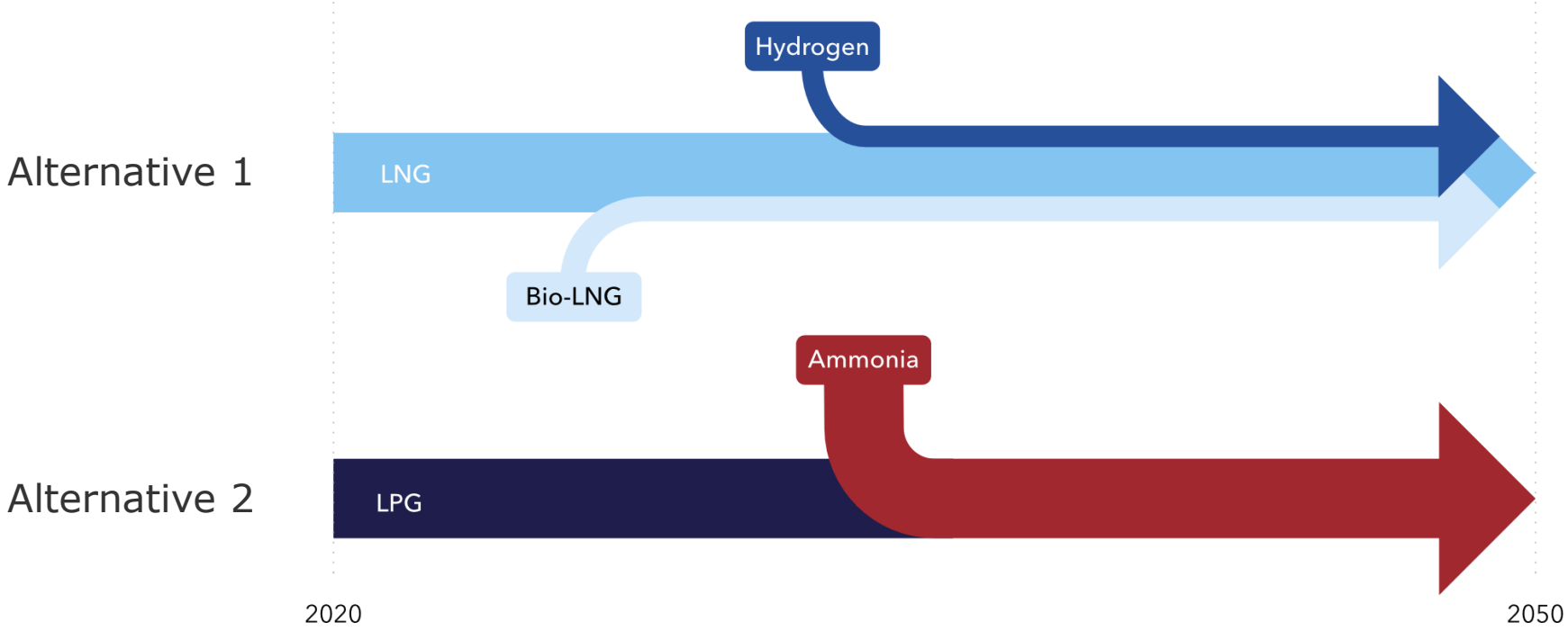
Decarbonization options for shipping - alternative fuels and energy sources

- **Three** main "family types" of fuels, categorized based on energy source.
  - Similar fuels can originate from different energy sources, but lifecycle emissions and cost vary greatly
  - A given energy converter (e.g. combustion engine) may apply many alternative fuels



Fuel flexibility and bridging technologies

- can facilitate the transition from traditional fuel, via fuels with lower-carbon footprints, to carbon-neutral fuels
- require limited investments and modifications along the way



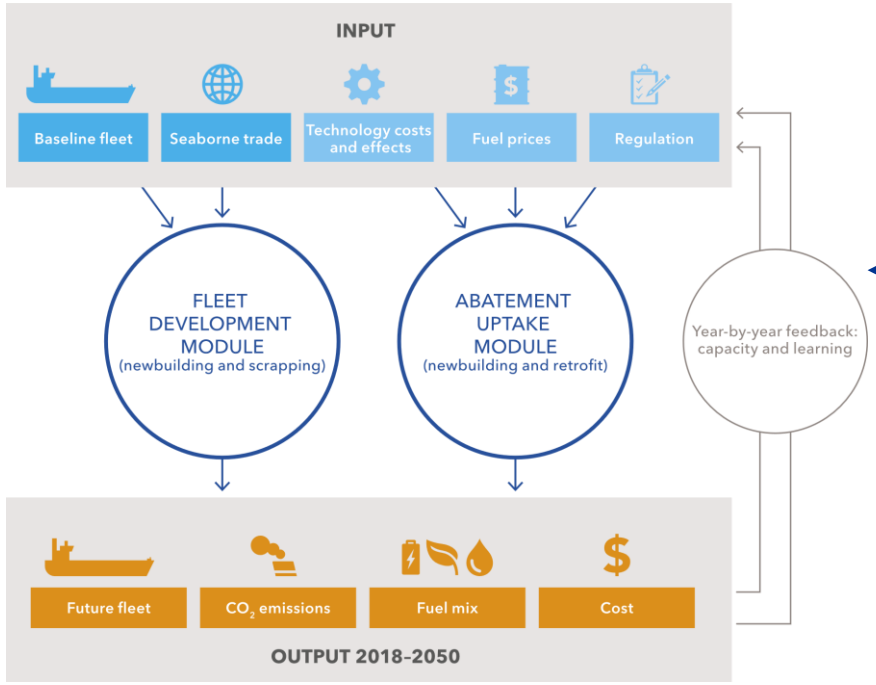
Pathway Model; We explore the impact of specific GHG regulations

Regulatory input to the model: Three different policy designs

1 What would happen if **no further decarbonization policies** are put in place?

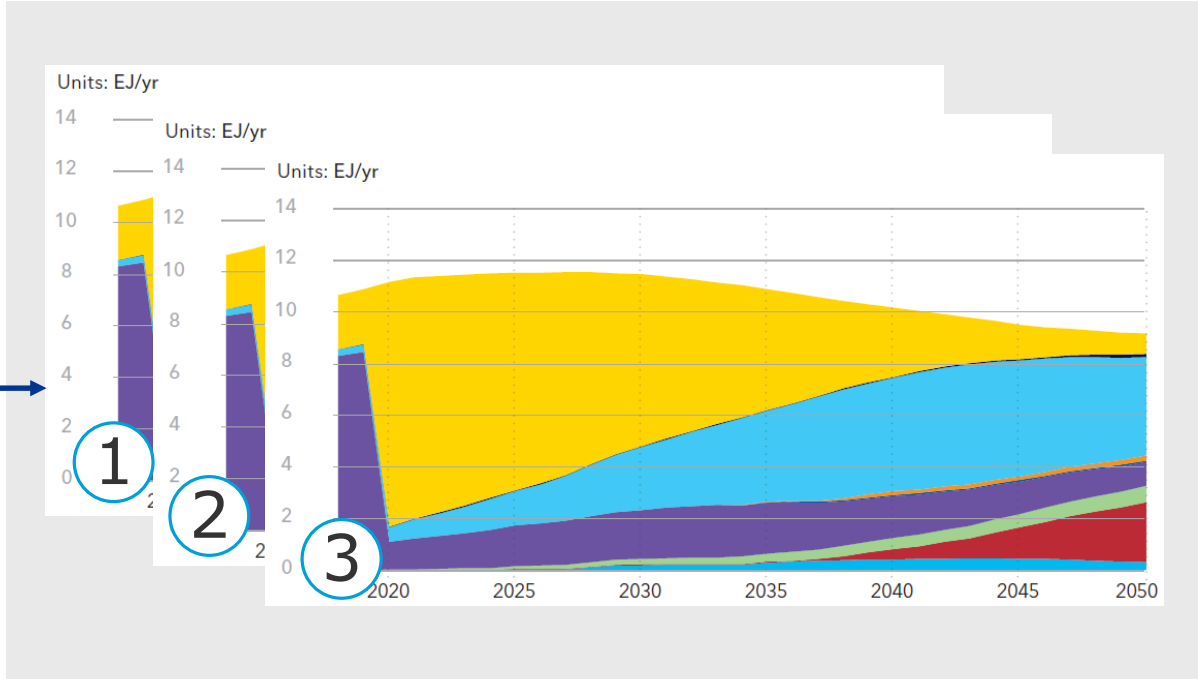
2 What is the effect of stricter **operational requirements?**

3 What if main focus is on stricter **design requirements**?



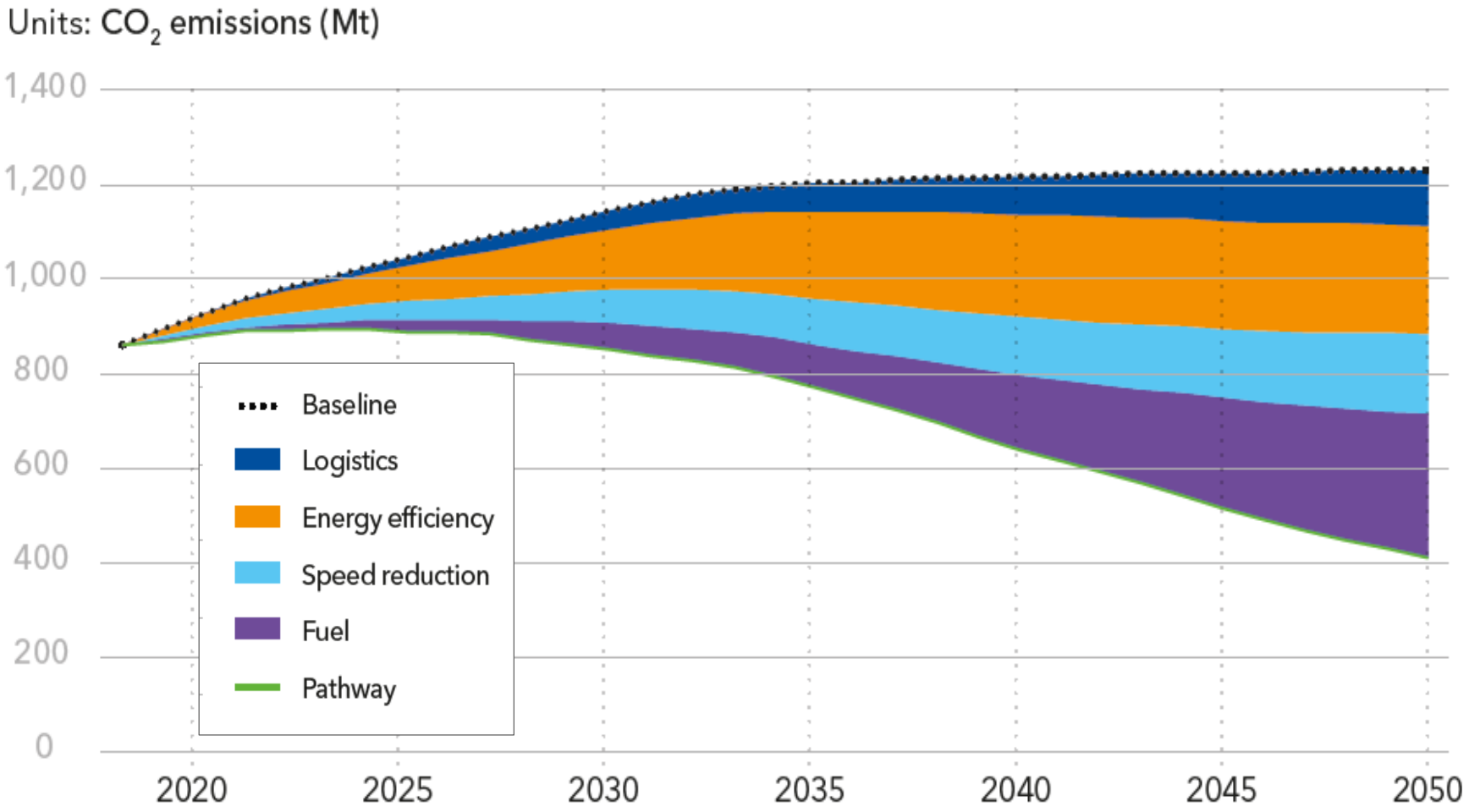
Model

Output

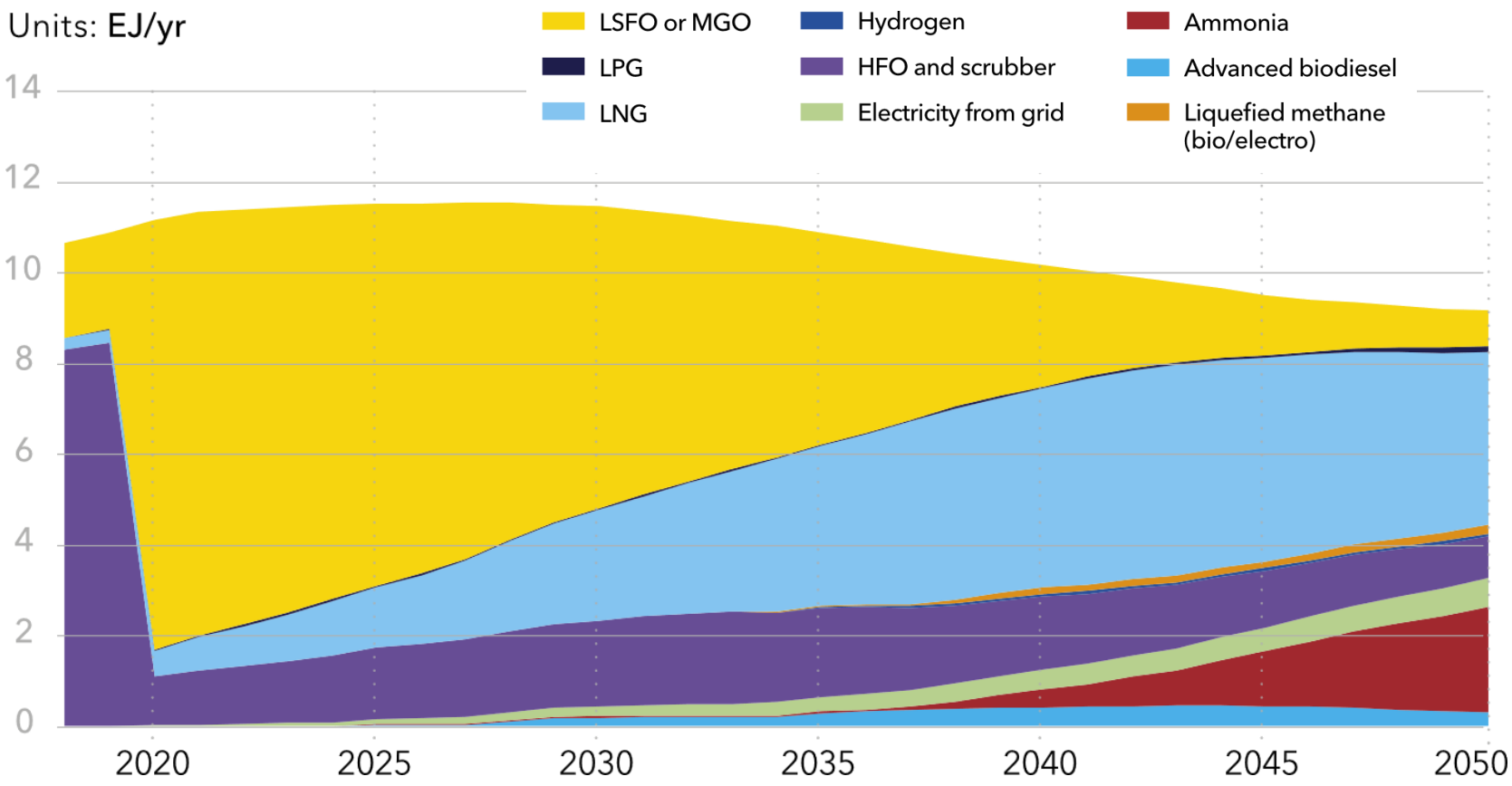


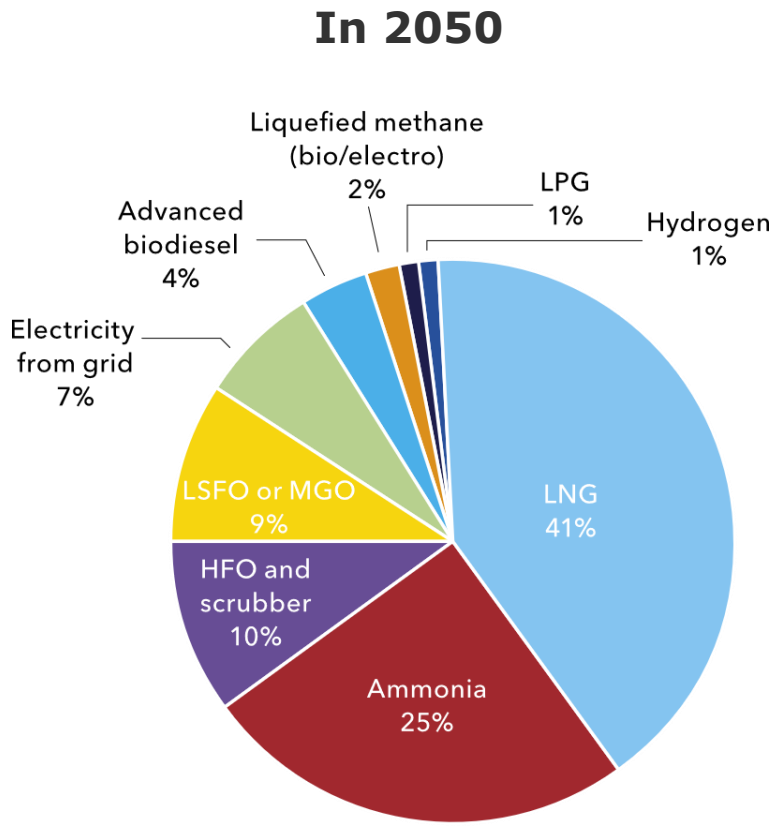
CO_2 emissions towards 2050 in the 'Design requirements' pathway

- Both the **design** and **operational** focused regulatory pathways fulfill the IMO ambitions:
  - New fuels, alongside energy efficiency, will play a key role.
  - Carbon-neutral fuels need to supply 30%–40% of the total energy in 2050.
- The "Current policy" pathway **is not** fulfilling the IMO ambitions.



Fuel mix towards 2050 in the 'Design requirements' pathway



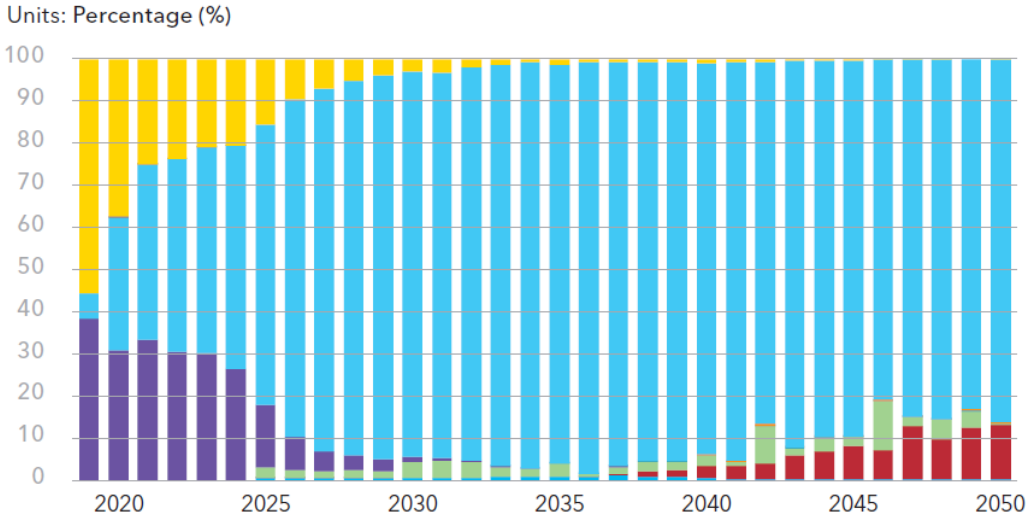


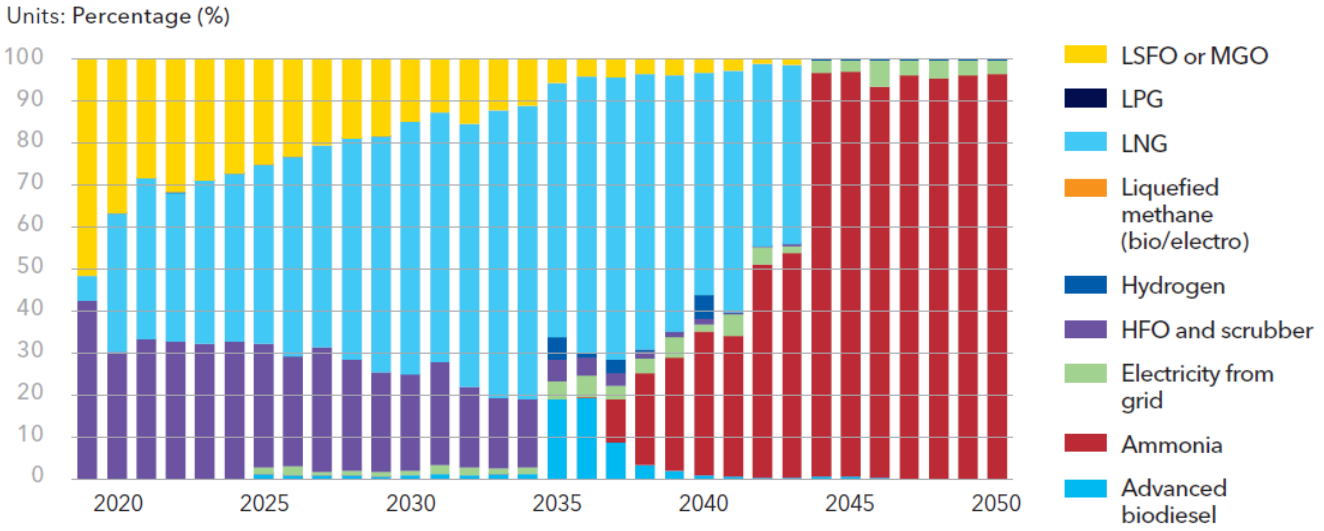
In all three pathways modelled, liquefied methane (both fossil and non-fossil) ends up dominating the fuel mix.

Several ways to meet the IMO targets - policy matters

Focusing on **operational requirements**, the uptake of alternative fuel for newbuilding's is more gradual

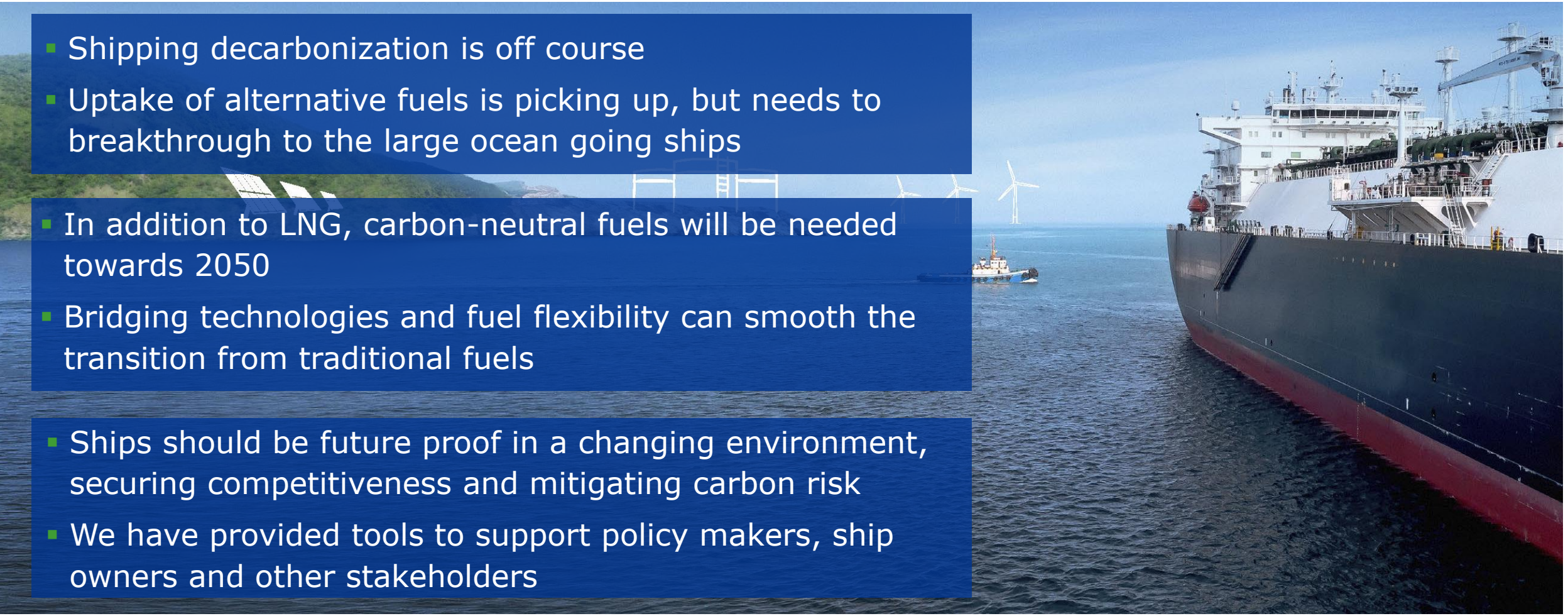
If main focus is on **design requirements**, the shift in fuel and fuel-converter technology on newbuildings is very abrupt





LNG play an important role – transition to carbon neutral fuels will be needed

Key findings



- Shipping decarbonization is off course
- Uptake of alternative fuels is picking up, but needs to breakthrough to the large ocean going ships

- In addition to LNG, carbon-neutral fuels will be needed towards 2050
- Bridging technologies and fuel flexibility can smooth the transition from traditional fuels

- Ships should be future proof in a changing environment, securing competitiveness and mitigating carbon risk
- We have provided tools to support policy makers, ship owners and other stakeholders

Thank you!

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