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Technological, Operational and Energy Pathways for Maritime Transport to Reduce Emissions Towards 2050

ETIP BioEnergy Stakeholder Plenary Meeting
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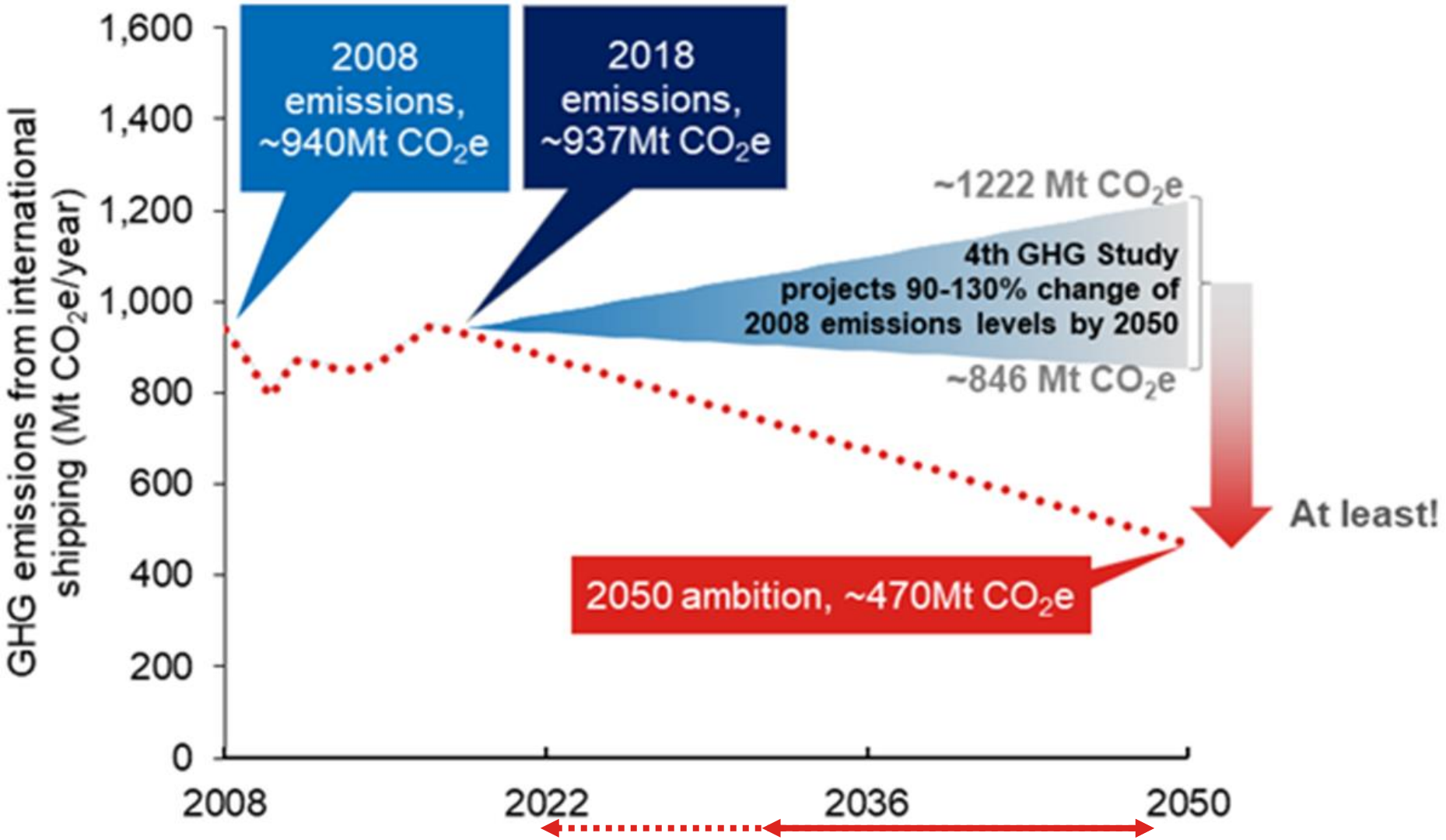
IMO's initial GHG strategy set a level of ambition that will require not just technical innovation but also zero carbon, net zero and low carbon fuels



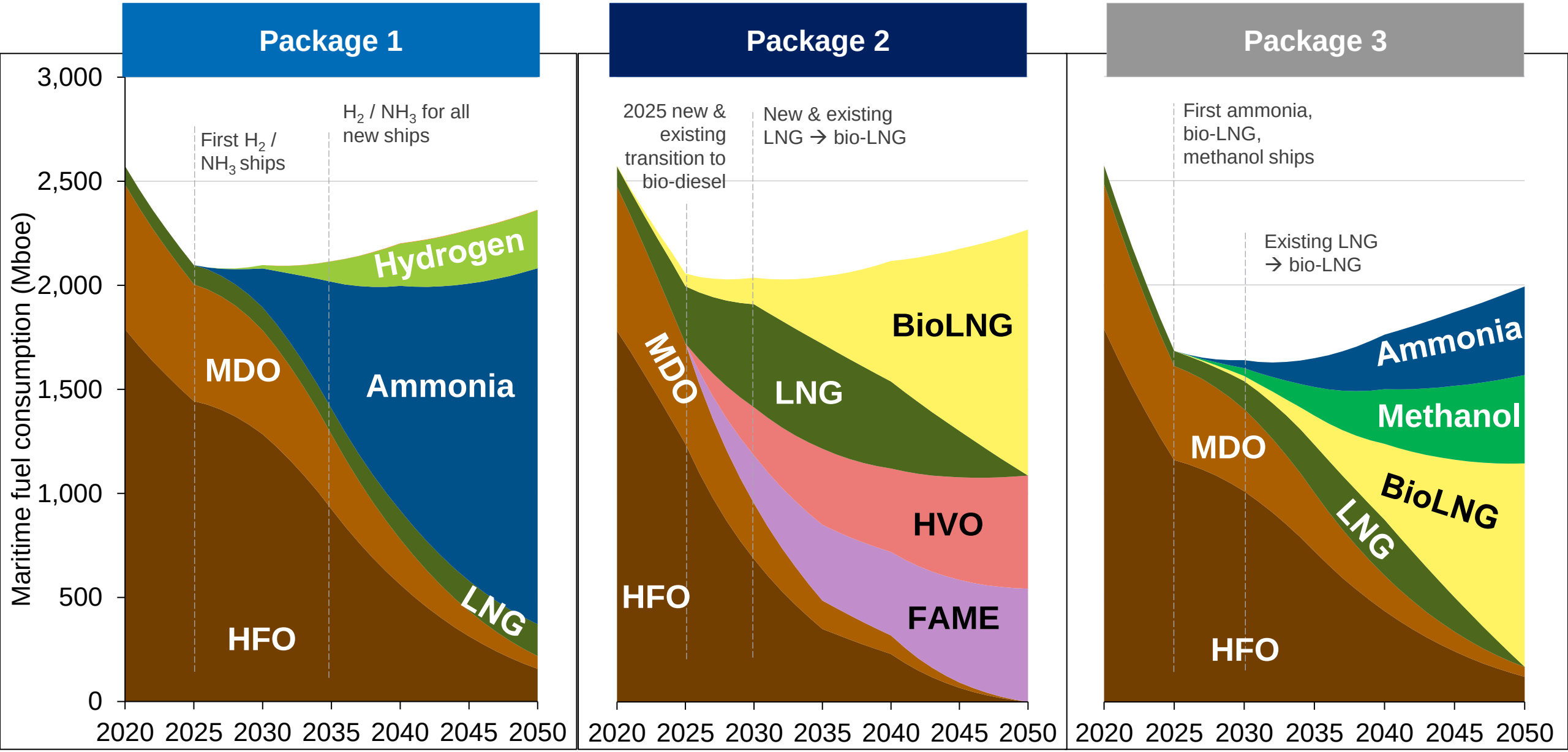
Graphic source: Ricardo

- IMO's short-term measures at the vessel level supporting this ambition:
  EEDI, EEXI, CII, SEEMP
- Revised IMO strategy planned for 2023
- Current "tank-to-wake" estimates may give way to "well-to-wake"
- New vessels should start using zero GHG energy carriers by 2030

Three packages of technical, operational and alternative fuel measures were assembled as plausible pathways to achieve the IMO's decarbonisation ambition

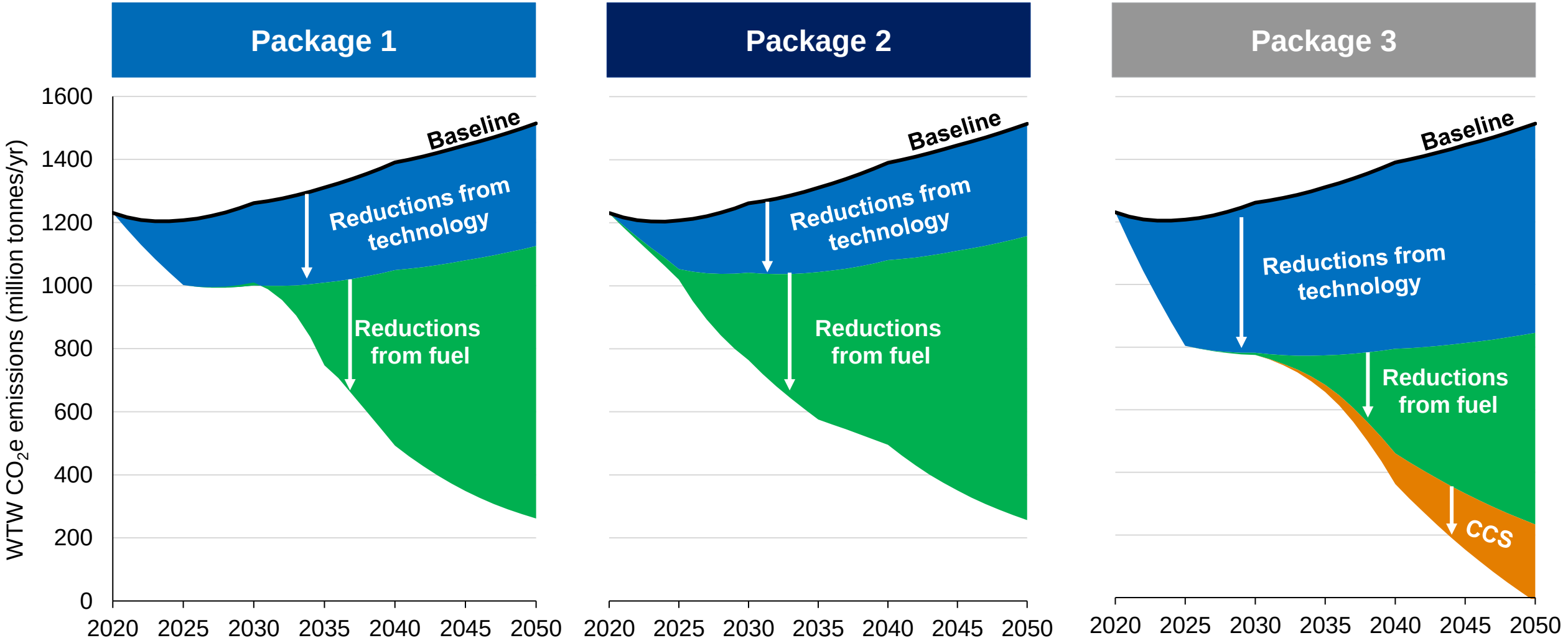
Package 1	Package 2	Package 3
Characterised by **an early pursuit of carbon-free alternative fuels**	A **moderate uptake of interim and drop-in fuels (LNG, bio-LNG, FAME, HVO) in the short-term**	**Maximum use of decarbonisation measures** while using conventional fuels.
Introduction of new build ships using grey **hydrogen** and grey **ammonia**, and battery electric (coastal shipping) from 2025. Followed by a transition from grey to blue fuel pathways and to green from 2035 onwards. **Medium take up** of energy efficiency technologies and operational measures. A **10% speed reduction** is assumed for slow steaming. No onboard CCS.	From 2025, HFO and MDO use is assumed to be increasingly substituted with drop-in biofuels (**FAME, HVO**). LNG transitions to **bio methane** (bio-LNG) from 2030 onwards. **Medium take up** of energy efficiency technologies and operational measures. A **20% speed reduction** is assumed for slow steaming. No onboard CCS.	Conventional fuels, **HFO and MDO,** with a **later transition to reduced carbon alternative fuels** using pathways that provide some reductions in emissions Gradual transition to use of bio-LNG, green methanol and green ammonia. **High take up** of energy efficiency technologies and operational measures. A **30% speed reduction** is assumed for slow steaming. Onboard CCS post 2030.

The modelling results of the fuel consumption of the three packages out to 2050



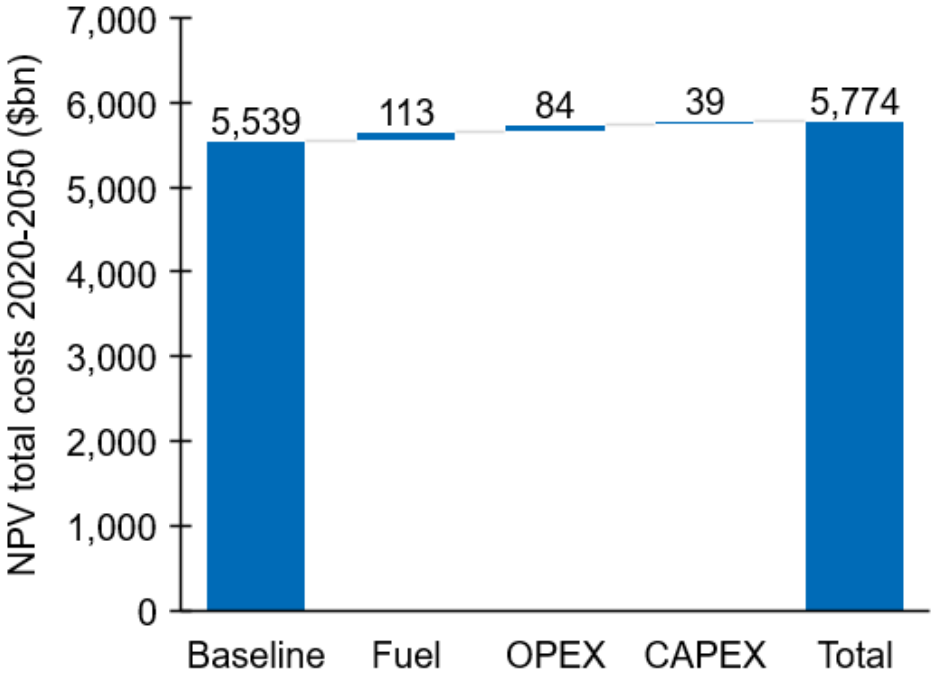
Energy efficiency technologies are key in providing shorter term GHG reductions but are insufficient alone to meet IMO ambition; higher risk CCS a small benefit. The largest reductions in WTW GHG emissions result from fuel switching

WTW CO_2e emissions - contribution of technology and fuels - Central scenario



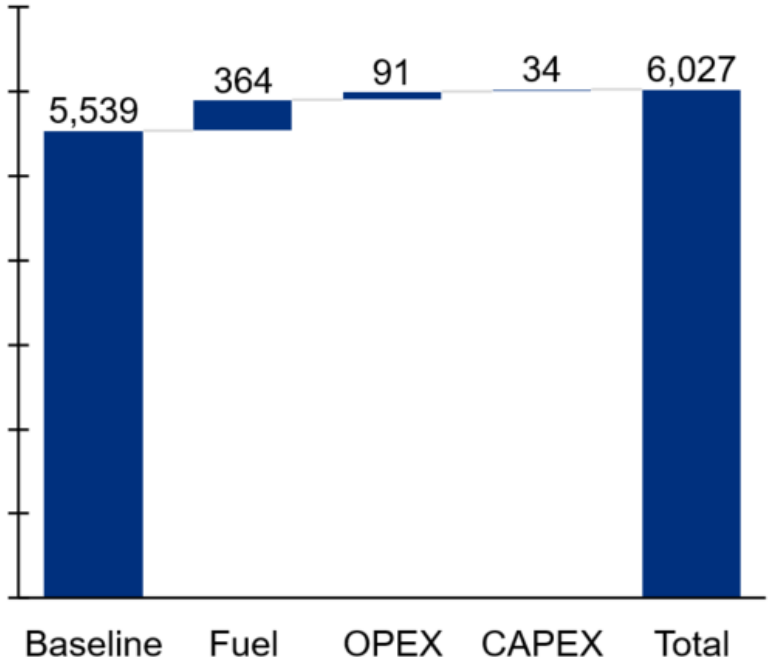
The net present value of the accumulated additional total costs from 2020 to 2050 of package 2 (drop-in biofuels) is estimated to be more than 2x packages 1 and 3

Package 1



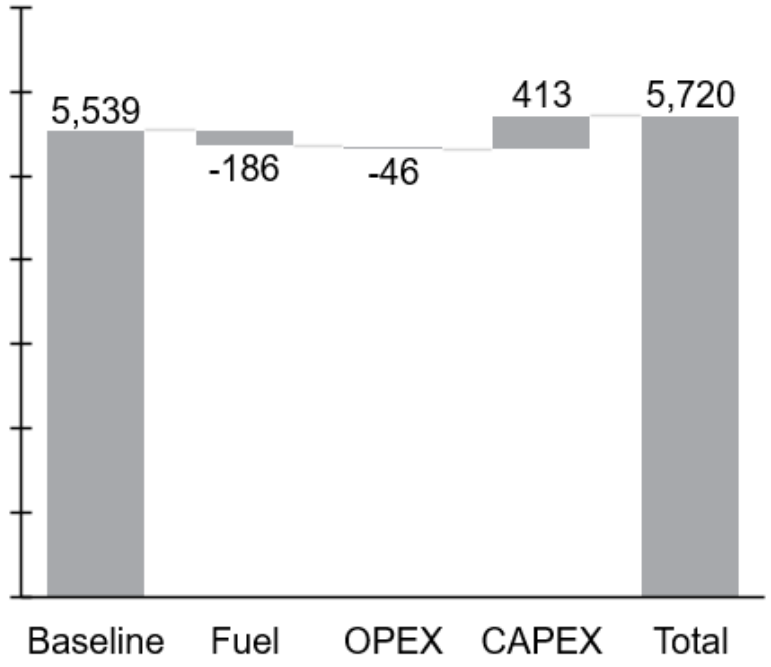
- +$235bn above baseline (+4%)
- Half of additional cost is fuel (inc. infrastructure)

Package 2



- +$489bn above baseline (+9%)
- 3/4 of additional cost is fuel (inc. infrastructure)
- Highest cost per tonne CO_2e abated

Package 3



- +$181bn above baseline (+3%)
- Higher vessel capex spend but lower fuel spend
- Lowest cost per tonne CO_2e abated

Risks and barriers

This study and others show it should be technologically possible to decarbonise the global shipping sector to the level of the IMO ambition. However, despite this technical feasibility we have not so far seen rapid decarbonisation at the rate and scale required; barriers to decarbonising the shipping sector remain.

GHG reduction potential

- Uncertainty between TtW and WtW, and in how WtW defined
- 20 year GWPs make LNG/bio-LNG less palatable

Price differential

- HFO price and scale difficult to match
- Regulatory intervention may help reach price parity

Infrastructure

- Bunkering infrastructure and port refuelling facilities need to be scaled up
- *(Not a barrier for 'drop-in' fuels)*

Production increase, location

- Alternative fuel production needs to substantially increase and be appropriately located (→ dedicated new facilities? Or convert existing assets?)
- Renewable electricity sources may be in different geographies to existing assets

Split incentives

- Customers and charterers not willing to pay or co-fund lower emission solutions
- No clarity on how the preferred fuel(s) will be chosen to allow for scale

Sustainability certainty

- Chemically identical brown/blue/green fuels need reliable certification schemes to provide assurance / guarantees
- Uniform / standardised sustainability criteria may also need global consensus

Conclusions

- There are a range of fuel options currently being assessed; **multiple pathways of different alternative fuels could meet IMO's initial ambition for 2050** (remains to be seen if **2023 update may be tighter**)

- **The IMO ambition is estimated to be met by all three packages when emissions are calculated on a well-to-wake basis**; but only packages 1 (fuel switch: ammonia, hydrogen) and 3 (greater efficiency technology emphasis, CCS, + bioLNG, ammonia, methanol) would meet the ambition on a tank-to-wake basis

- Fuel costs are such a large component of total costs, that **energy efficiency measures to reduce fuel consumption are total cost savers** (reduced spend on fuel; increased capex spend on vessels; reduced impact on fuel supply industry)

- **The 'drop-in' fuel package 2 (biofuel, bio-LNG) which faces fewer barriers to deployment is estimated to be much more expensive** compared to the fuel switches of packages 1 and 3 that would require new vessel engine investments

- Long vessel lifetimes means emission pathways become locked in for longer (e.g. than road transport) hence **important to act sooner rather than later to effect meaningful change**

Thank you for your attention

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