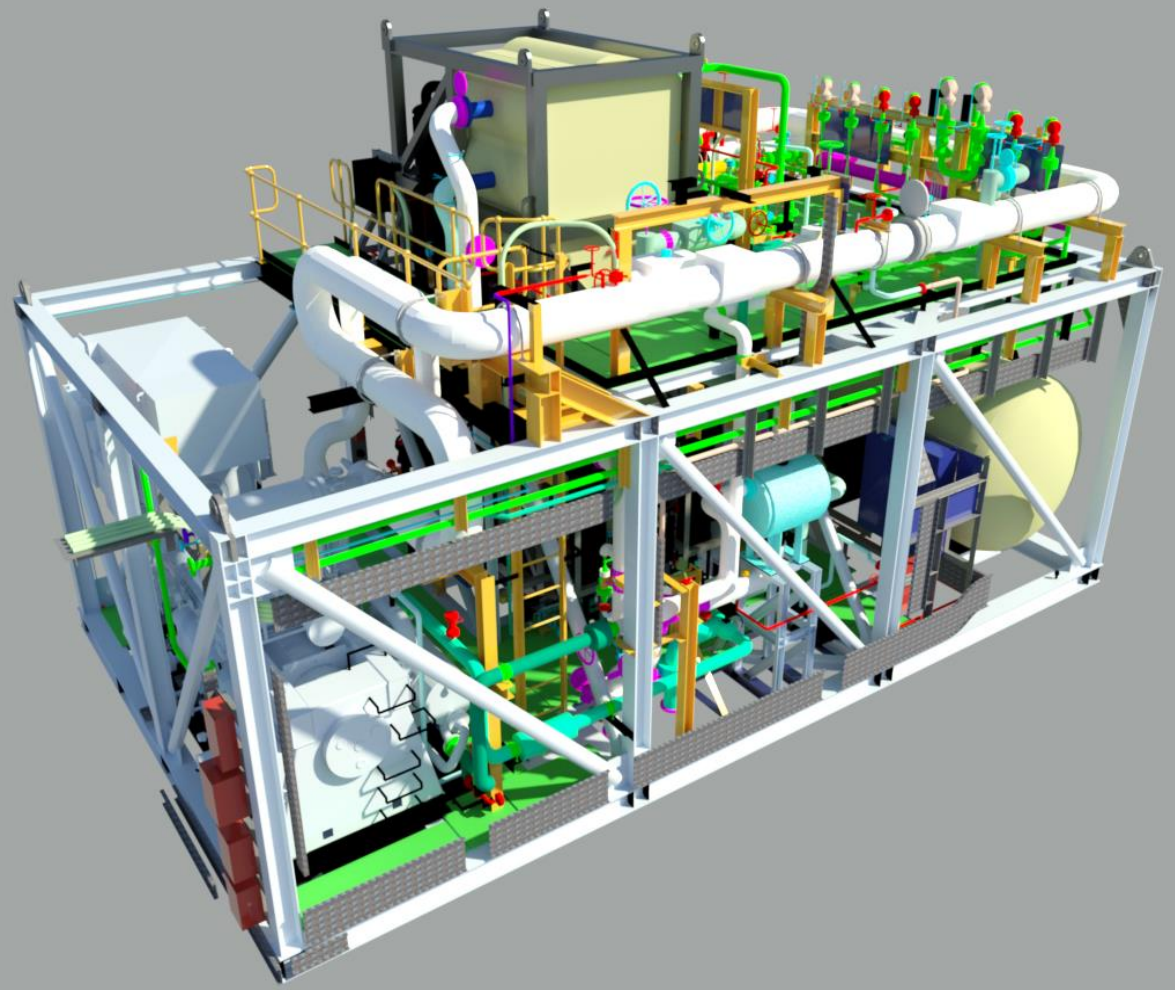
babcock™



Babcock LGE – Scottish Maritime Cluster Technology Enabling the Transition to Net-Zero

Tuesday 3rd November 2020

Babcock LGE – Who are we?

- Babcock LGE: Liquid Gas Equipment Ltd, part of the Babcock International Group
- Engineering, Procurement, Project Management (EPPM) company
- Market-leader providing environmentally focussed and engineering-led, cargo handling and fuel gas solutions to our customers, through the application of innovation in all that we do
- Primary customers are major shipyards, vessel owners and Energy Majors
- Based at Rosyth Naval Base, Scotland with offices in South Korea, China and USA

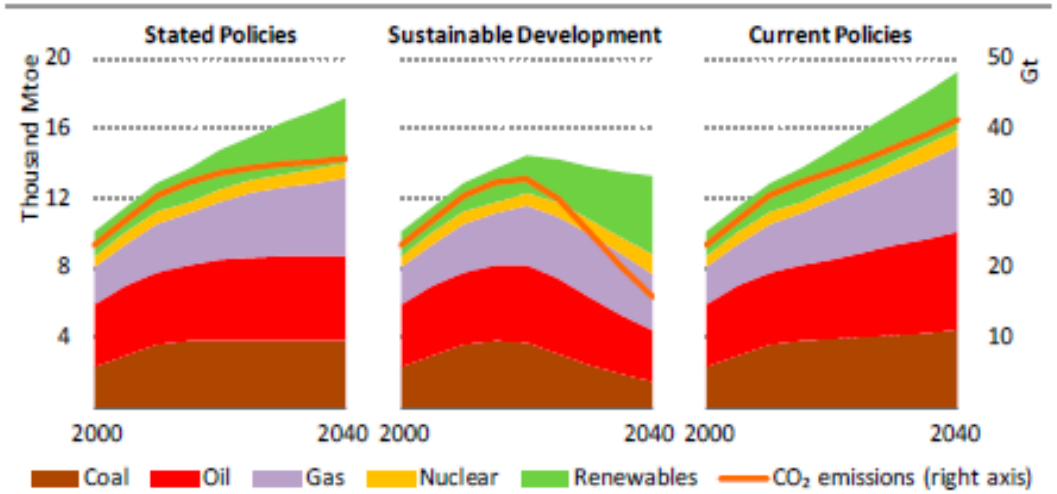
2016 winners of 2 **Queen's Awards**
International
Trade & Innovation

2020 final shortlist
Royal Academy of Engineering
MacRobert Award for *Innovation*

World energy transition – led by Renewables & Natural Gas

- The International Energy Agency (autonomous inter-governmental organisation of OECD) Stated Policies Scenario predicts “energy demand rises by 1% per year to 2040”. Of that 1%;
  - Low-carbon sources, led by solar supply, > 50%
  - Natural gas, boosted by rising trade in liquefied natural gas (LNG), ~ 35%
  - Oil demand flattens out in the 2030s, and coal use lowers
- Energy sources continue transitioning from;
  - current heavy hydrocarbons (coal & oil),
  - through lighter hydrocarbon transition fuels (LNG)
  - to destination fuels (zero-carbon (e.g. H_2) and renewables)

World primary energy demand by fuel and related CO_2 emissions by scenario



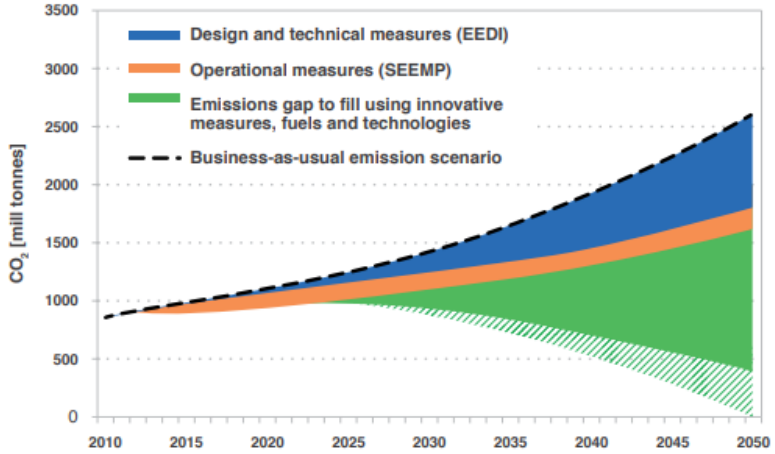
Existing policies and announced targets slow growth in global emissions to 2040, but they are not strong enough to force a peak in an expanding energy system

IEA – World Energy Outlook 2019

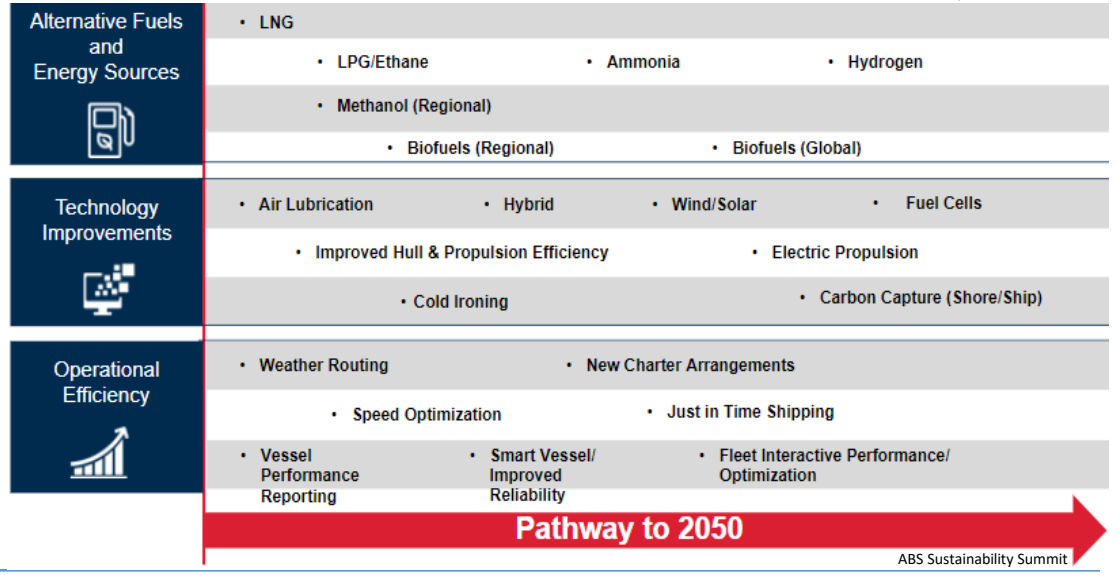
Gas in general and LNG in particular will be a significant part of the World energy future.
Our challenge was to develop technology enabling efficient global marine transportation of liquid gas, in particular, LNG.

Marine Market / Future Legislation

- The marine gas market is on the cusp of a major change. IMO initial strategy on GHG emissions;
- *'reduce CO_2 emissions…by at least 40% by 2030, pursuing efforts towards 70% by 2050, compared to 2008'*
- There are options available to meet this legislation within the marine industry;
  - Alternative fuels
  - Technology improvements
  - Operational Efficiencies
- With the IEA indicating that the marine gas market – specifically LNG market – will expand to support the increase in energy demand, Babcock LGE have developed technology to specifically focus on driving efficiency and environmental impact reduction

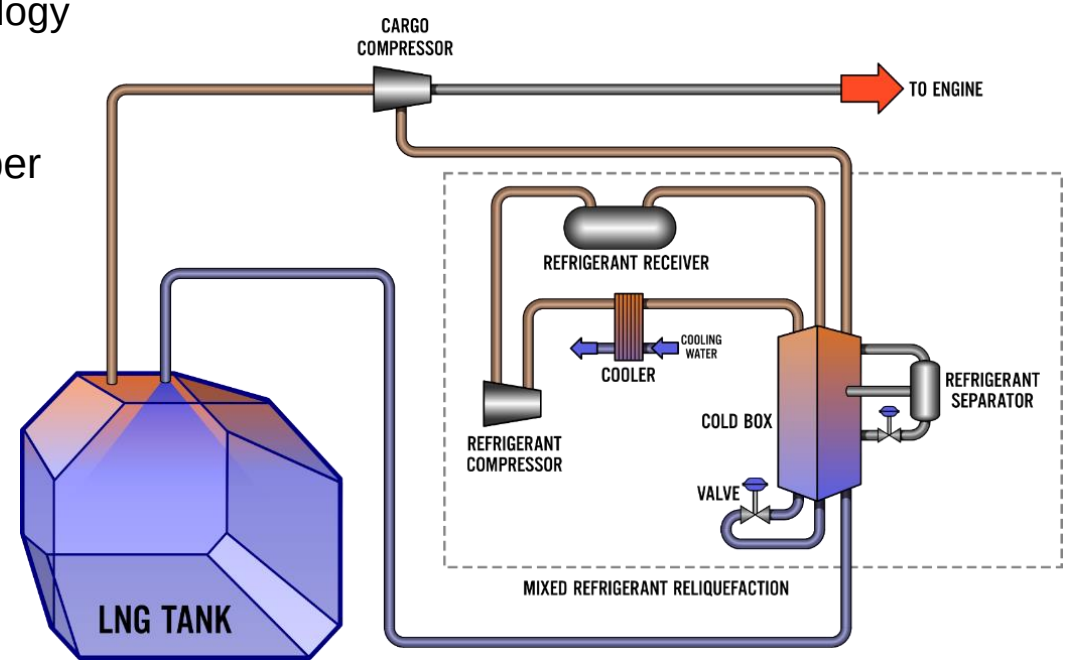


Initial IMO Strategy on reduction of GHG emissions from ships



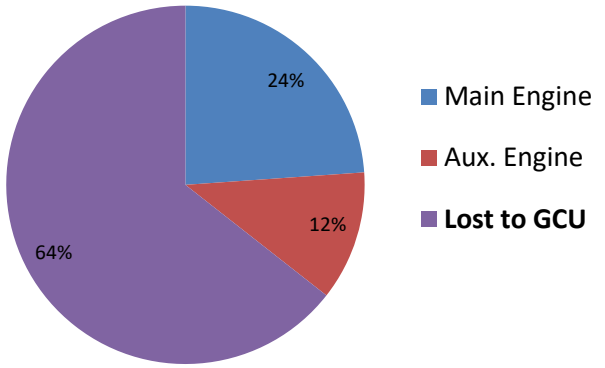
‘Technology Improvements’ - LNG Carriers – ecoSMRT®

- One of the recent technological improvements that we innovated at Babcock LGE is our LNG reliquefaction technology ecoSMRT®
  - ecoSMRT® – ecological / economic Single Mixed Refrigerant Technology
- We started developing ecoSMRT® in 2015 with our first contract in 2018 – we now have contracts to supply 45 ecoSMRT modules (one per LNG Carrier) and will have delivered 10 by the end of 2020
- We developed ecoSMRT® to meet the market need for efficient LNG reliquefaction . Traditional reliquefaction systems were large, costly to operate and expensive to maintain. This encouraged some vessel owners to burn excess Boil-Off Gas (BOG) – this is clearly not economical and, has a significant environmental impact
- Our consideration has been – if we can develop an efficient system, that is easy to operate with good ROI, LNG Owners will benefit from both the economic advantages and, in parallel, assist in pushing the industry towards net zero

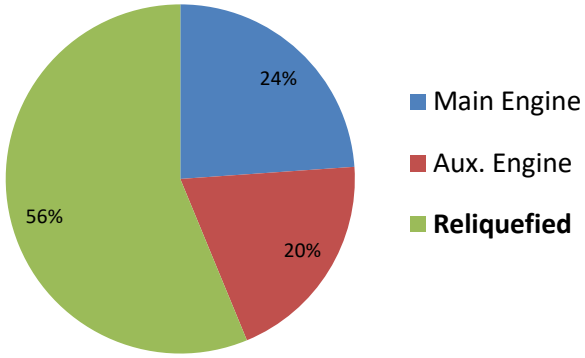


ecoSMRT®- ‘eco’ benefit

BOG utilisation no reliquefaction



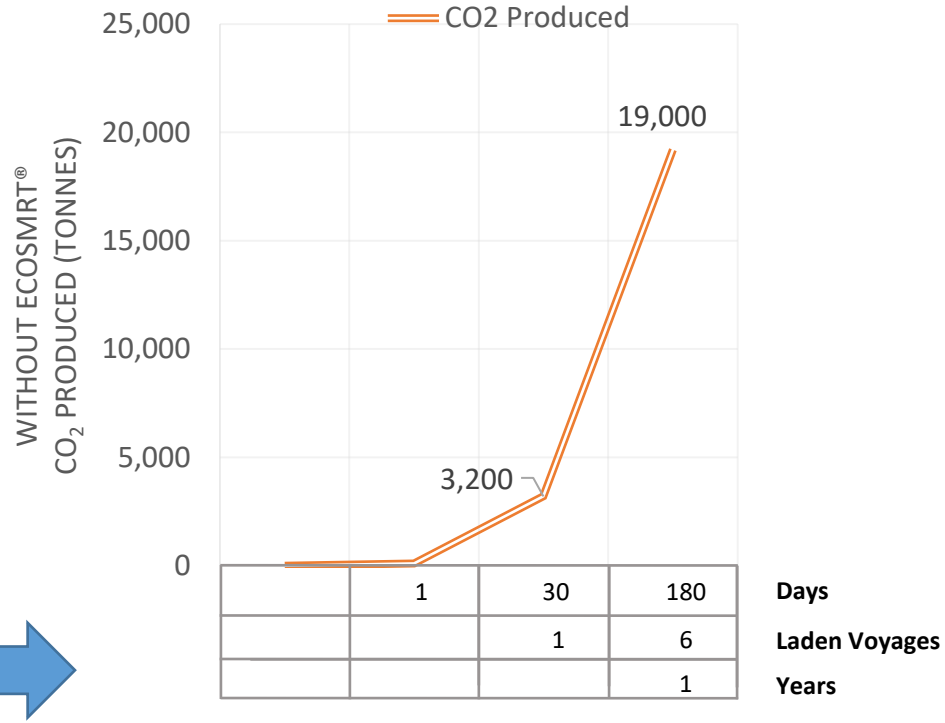
BOG utilisation with ecoSMRT®



	Without ecoSMRT® (kg/h)	With ecoSMRT® (kg/h)
Boil-off gas	3361	3361
Main engine	803	803
Auxiliary engine	393	668
Reliquefied	0	1890
Lost to GCU	2165	0

Conditions

Speed – 11.5 knots
BOG LHV – 43.6 MJ/kg
ecoSMRT® = SMR13_1.9
Aux. Engine Efficiency = 35%
BOR 0.1%/day

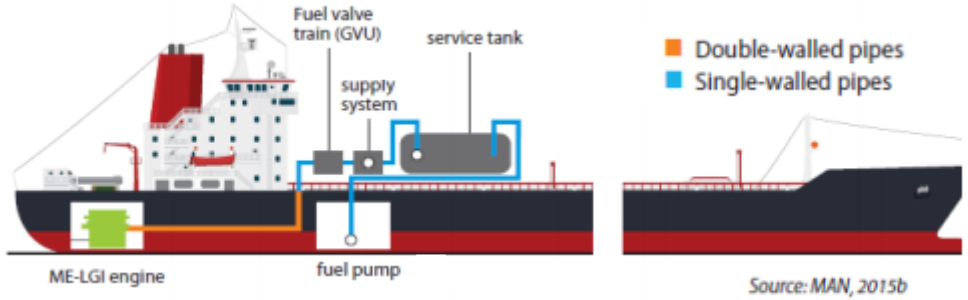


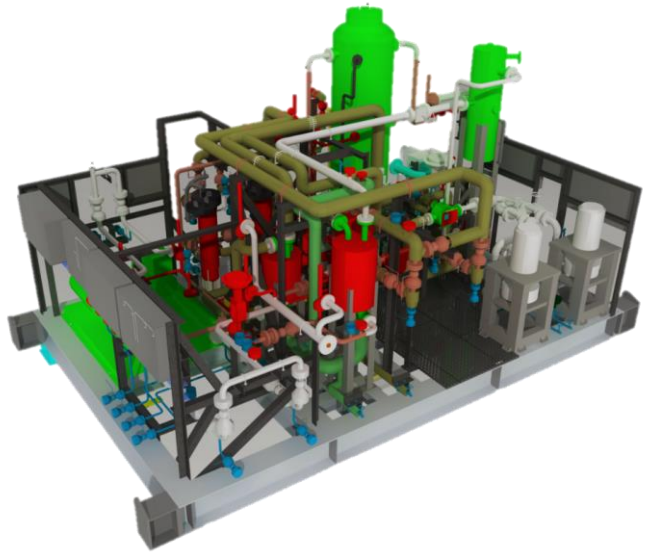
As of November, 2020;

Current Orderbook – 45 modules:
Circa 850,000 tonnes of CO_2 annually

‘Alternative Fuels’ – LPG ecoFGSS®

- Another option to meet current and future IMO legislation is to consider alternative fuels.
- The use of LPG as a fuel was seriously considered in 2017 to enable vessels – primarily LPG gas carriers – to utilise LPG as a means of propulsion to satisfy the IMO Sulphur Cap (Jan 2020).
- LPG as a fuel has a number of benefits;
  - Virtually eliminates Sulphur Oxide emissions (SOx)
  - 10% - 15% lower consumption vs compliant fuels and scrubbers
  - Less volatile fuel price with established infrastructure
- Considering this, Babcock LGE developed the LPG ecoFGSS® to provide a solution for future vessels to meet current IMO legislation, whilst also reducing overall CO_2 emissions (~17% less than HFO)
- Babcock LGE have contracts to install >10 of these systems on LPG Gas carriers over the next 2 years. Future opportunity to utilise bio-LPG in the future will reduce CO_2 emissions further





‘Alternative Fuels’ – Ammonia (NH_3) ecoFGSS®

- Developing on from the LPG ‘transition fuel’, a ‘destination fuel’ for reducing CO_2 and bringing the industry in line with the IMO GHG strategy is to use ammonia (NH_3).
- The key advantage is that using ammonia as a fuel is carbon-free however, there are a number of challenges that ammonia as a fuel must first overcome
- Ammonia also has the potential to be produced via renewables – so-called ‘Green Ammonia’. Whilst it is recognised that the energy demand to produce ‘Green Ammonia’ is significant (electrolysis), there is an opportunity of producing carbon-free marine propulsion with near-zero carbon emissions ‘well-to-wake’
- Babcock LGE have developed preliminary designs for an ammonia FGSS and will work with industry stakeholders to have a solution in the next few years

Advantages	Challenges
• Carbon free - no CO_2 or soot	• Toxicity
• Low flammability risk – 15.15% to 27.35% in air	• Fuel infrastructure
• Can be produced from electrical energy – renewable	• Lack of regulations
• Easily reformed to hydrogen and nitrogen	• Engine development at design stage
• Can be stored and transported as a liquid at a practical pressure and temperature	• Cost
• Established commercial product	• Corrosiveness to certain materials
	• Poor combustion characteristics for IC engine application
	• Possible need for high percentage of pilot fuel
	• Possible increased NOx emission
	• Possible ammonia slip

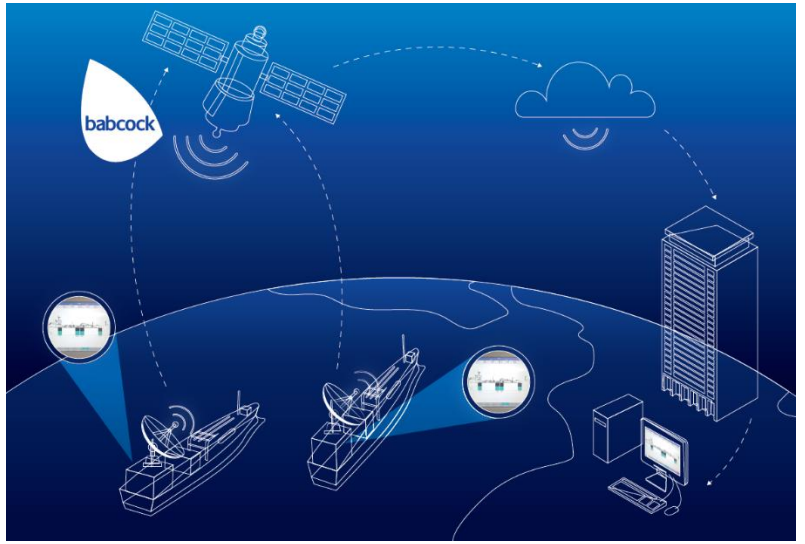
Seatrade-maritime.com

ABS: Ammonia as a marine fuel sustainability whitepaper

Seatrade-maritime.com

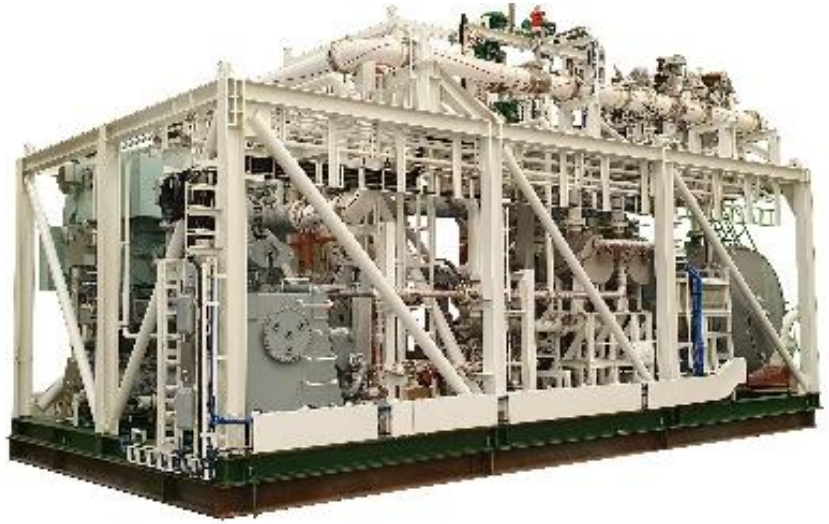
Future Developments / Opportunities

- Whilst we have a number of new technologies in the market, we continue to develop our technological solutions to assist our customers and, the drive towards net-zero. Some areas we are working on;
  - Remote Monitoring Solutions
    - Systems under investigation to provide plant performance management and condition based maintenance support
  - Retrofit ecoSMRT®
    - With LNG carriers operating for 30+ years , it will be more economical to retrofit an ecoSMRT® system onto a vessel, enabling the significant efficiency gains instead of opting for new vessels
  - Increase size of ecoSMRT®
    - Increased reliquefaction plant designs, including reliquefaction capacities of 2.0, 2.5 and up to 3.8 tonnes per hour



Conclusion

- The IMO GHG strategy for CO_2 reduction is ambitious and needs to be considered now if we are going to meet the targets
- Gas – in particular LNG – is a feature of the world energy and fuel economy, and will be for decades to come
- It is therefore imperative that we;
  - Develop the most efficient methods to transport gas globally, minimising CO_2 generation from well-to-wake
  - Begin development of new technologies to accelerate the implementation of destination fuels as soon as possible – this will need engagement across all sectors; from regulators, to charterers, to equipment manufactures and indeed Governments
- Babcock LGE, as a market-leading technology provider to the marine industry, will continue to support, and innovate, to enable the transition to a net-zero marine economy



babcock™