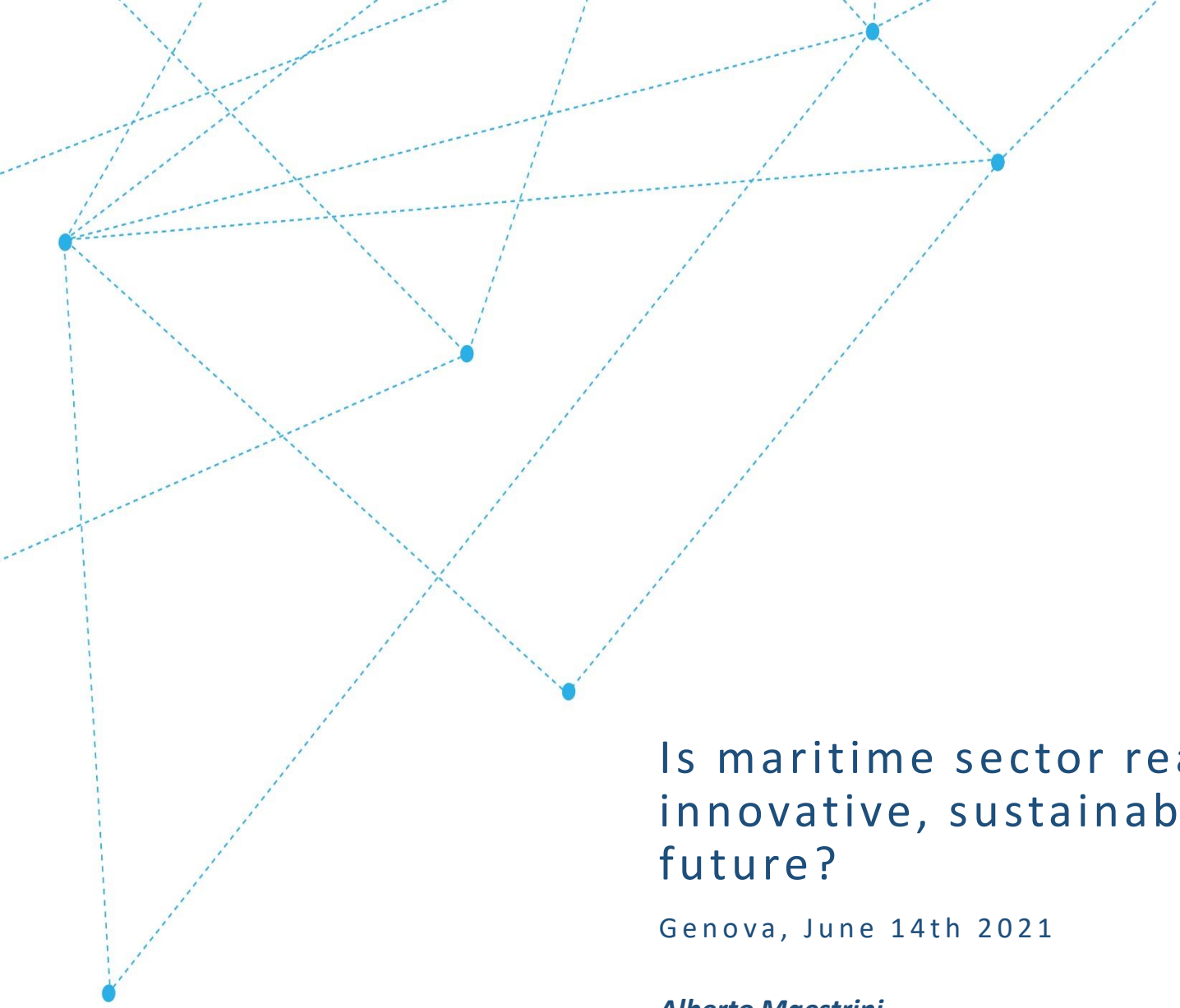


Is maritime sector ready for an innovative, sustainable, and clean future?

Genova, June 14th 2021

Alberto Maestrini

3 QUESTIONS

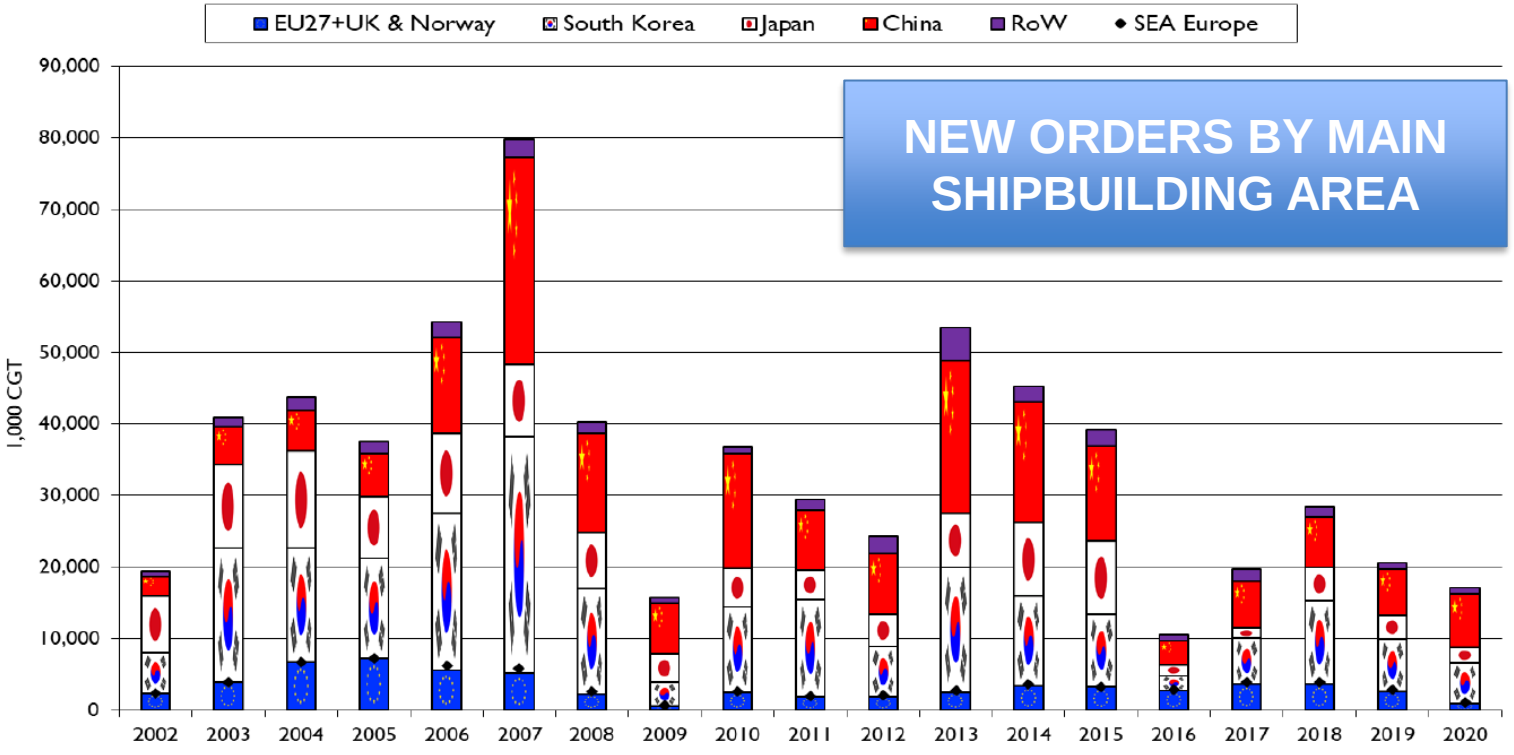
- Do we have the technologies to make the maritime industry clean and sustainable?
- Do we have the right people to make it happen?
- Who pays the bill for the green maritime revolution?

Economic and technological sustainability

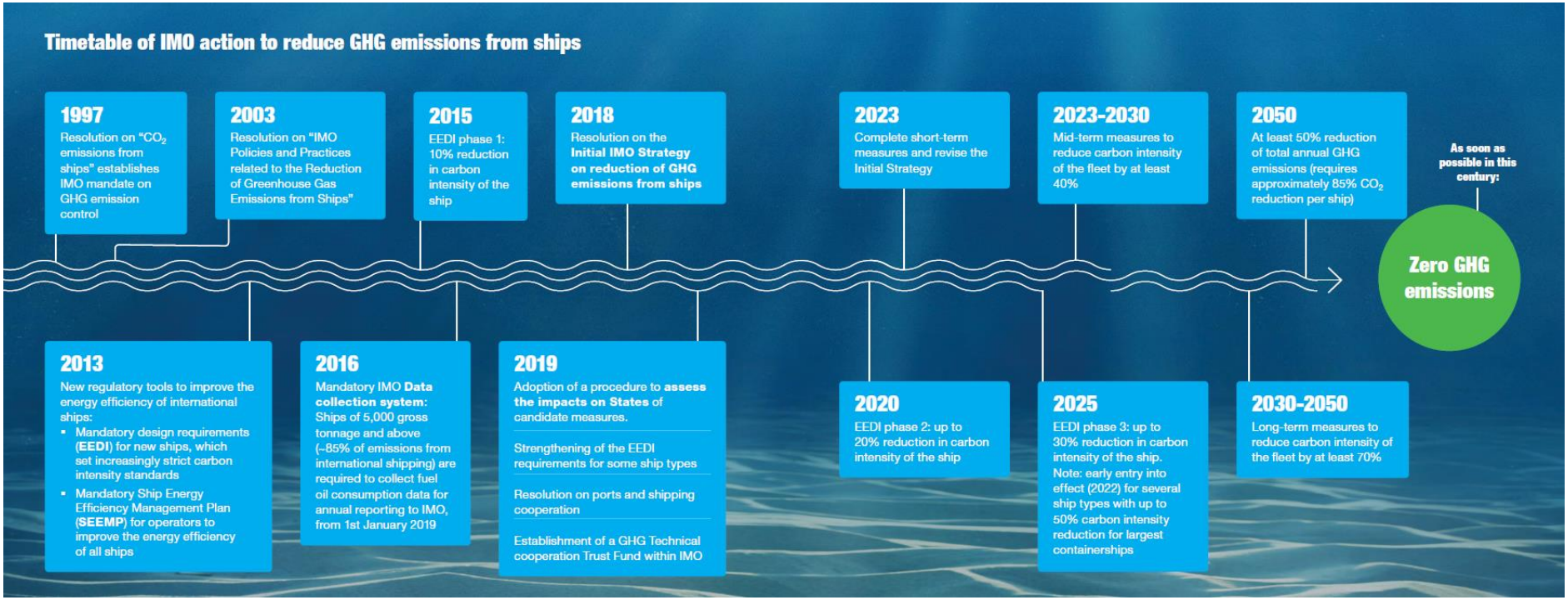
Carbon Footprint

THE VIEW OF THE EUROPEAN MARITIME INDUSTRY

- Europe is probably the most open maritime market in the world, its industry has learnt to survive through innovation but
- Can this industry continue to pay its innovation bill and become cleaner at the same time?
- Are we big enough to sustain innovation costs?



IMO TARGET: ZERO GHG EMISSIONS



GREEN TECHNOLOGIES

- Ships have been using heavy fuel oil (HFO) and marine gas/diesel oils (MGO/MDO) propulsion and on-board operation purposes which emit greenhouse gases (GHG) contributing to global climate change

- Energy currently provided to ships by HFO/MGO/MDO can in the future be replaced by energy stored in batteries or synthetic (electro) fuels such as liquid hydrogen or ammonia which generate no GHG emissions

Technology	Propulsion	Energy storage	Energy transformation
Battery ships	Electric motor	Batteries	Directly from batteries to electric motor
Hydrogen fuel-cells	Electric motor	Liquid H_2	Electrochemical via fuel-cells
Hydrogen ICE	Internal combustion engine (ICE)	Liquid H_2	Direct combustion of liquid H_2 in ICE
Ammonia fuel-cells	Electric motor	Liquid ammonia	Extraction of H_2 from ammonia via on-board reformers and electro-chemical transformation via fuel-cells
Ammonia ICE	ICE	Liquid ammonia	Direct combustion of liquid ammonia in ICE
Electro-methane	ICE	Synthetic methane from electricity	Direct combustion of electro-methane in ICE
Electro-diesel ICE	ICE	Synthetic diesel from electricity	Direction combustion of electro-diesel in ICE

GOVERNMENTS REGULATIONS AND ZERO CARBON BUNKER FUELS

VARD a Fincantieri company

Carbon Tax

- **A.P. Moller Maersk** proposed **a carbon tax on ship fuel** of **at least $450 per ton of fuel** in order to bridge the gap between fossil fuels and more expensive green fuels.
- **Fossil fuels cannot keep being cheaper than green fuels**. **Governments and regulators play a key role in securing production and availability of zero carbon fuels for shipping**.
- According to the Fourth IMO GHG Study, 13% of GHGs from international shipping could be reduced by 2030 through the introduction of a low carbon prices of $100/tonne of CO2, combined with investment in wind propulsion solutions and adoption of slow steaming.
- A carbon price of $416/tonne of carbon would be needed to reduce emissions by 64% by 2050 spurring the adoption of zero-carbon fuels.

LNG not a smart choice for transition

- **OECD and the Netherlands** warn against LNG as a transitional fuel to reach climate goals
- **Ikea**, one of the world's largest shippers, makes it clear that the liquefied natural gas is not the way to go for shipping companies to decarbonize
- Meanwhile, **Maersk** has specifically written off LNG as a future fuel
- On the contrary, **other container shipping companies** (CMA CGM, Hapag-Lloyd, Seaspan, MSC) **have ordered or chartered LNG newbuilds**.

Ammonia and hydrogen

- World Bank identifies **“green fuels” - ammonia and hydrogen - as the most promising zero-carbon bunker fuels** within the shipping industry at present.
- Liquefied natural gas (LNG), on the other hand, is likely to play a limited role in the decarbonization of the shipping sector, and countries should avoid new public policy supports LNG as a bunker fuel
- **However, it remains uncertain which of the emerging new bunker fuels will be the most significant in replacing the current fossil fuels**.

OFFSHORE RENEWABLE ENERGIES

- The **strong growth of the offshore wind sector is a great opportunity** that underlies challenges that should not be underestimated.

- The **ecosystem that satisfies this demand** is complex and heterogeneous. It includes not only the wind energy companies from wind turbines manufactures to electric power generation and distribution players, but also the **shipbuilding** together with the **full supply chain of maritime systems and equipment producers**.

OFFSHORE RENEWABLE ENERGIES

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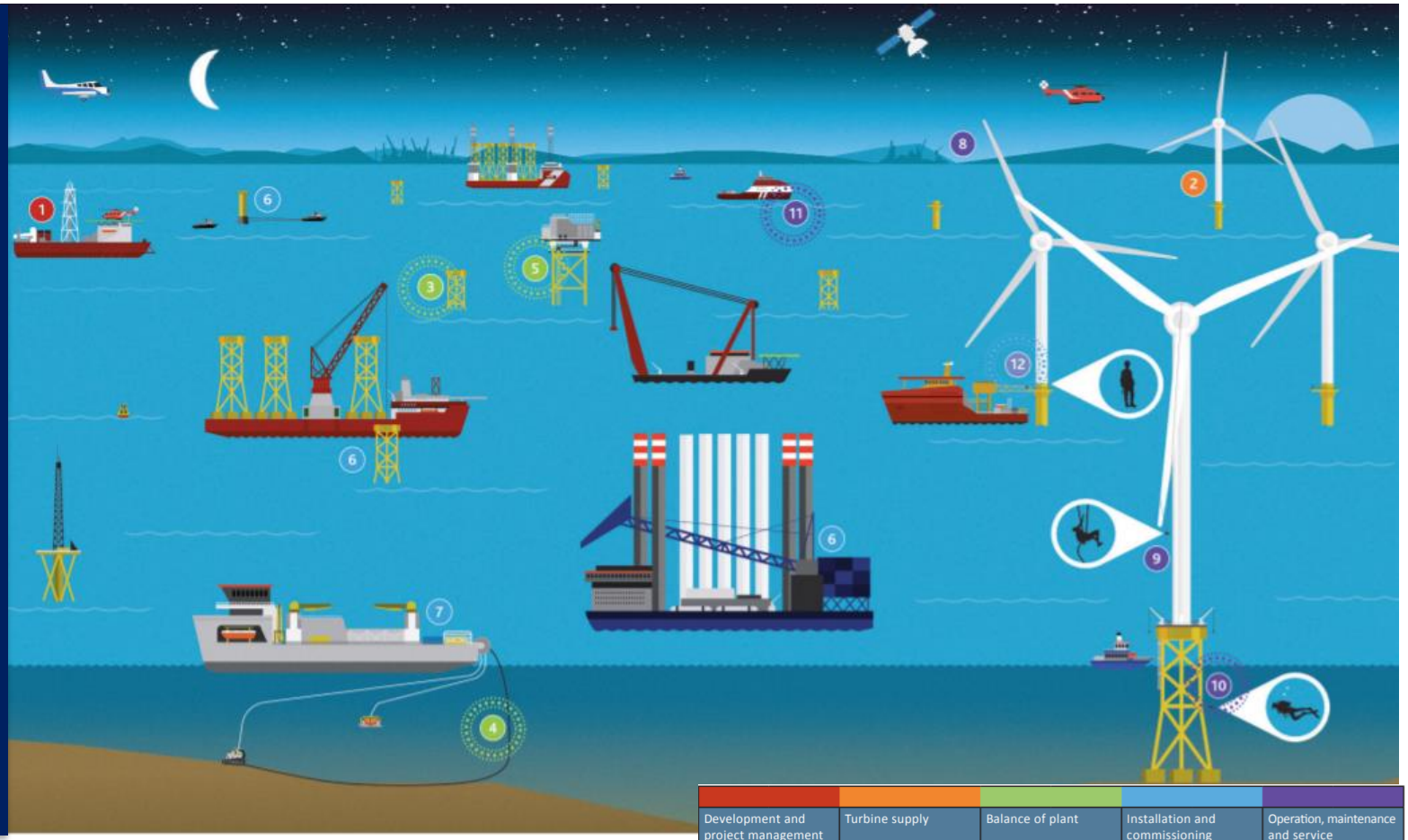
Offshore Wind Supply Chain



Development and project management		Turbine supply		Balance of plant		Installation and commissioning		Operation, maintenance and service	
1	Surveys, site investigations and development services	2	Turbine components manufacture and assembly	3	Foundation supply	6	Turbine and foundation installation	8	Wind farm operations
				4	Cable supply	7	Cable installation	9	Turbine maintenance
				5	Substation supply			10	Inspection and repair services
								11	Offshore logistics

OFFSHORE RENEWABLE ENERGIES

- In a period of 'employment crisis' due to the Covid 19, however some shipbuilding companies continue to suffer from resource shortage. This is true for those companies with a long-term vision and operating in sectors less affected by the crisis such as naval sector, cruise ships production and renewable energy (offshore wind), the latter being characterized by accelerated growth in demand.

- It is the results from the workforce aging and the absence of young people willing to dedicate their lives to this sector whose attractiveness is very low and whose career opportunities are not perceived (lack of knowledge of the sector, of responsibilities and working conditions of different jobs)

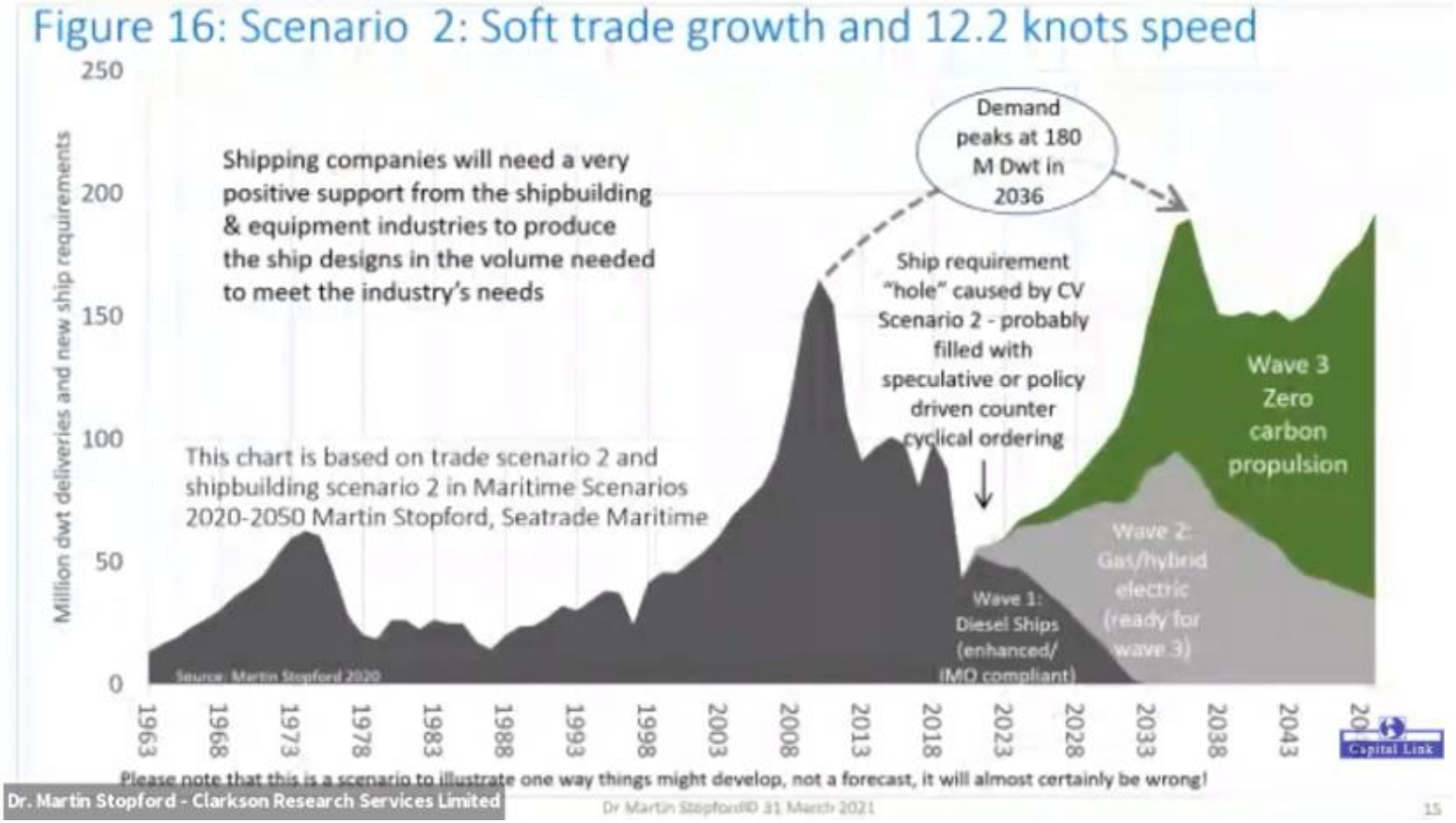
- This trend affects both the shipbuilding companies (main contractors) and the network of suppliers unable to find skilled labour force or professional figures capable of facing the new technological challenges

- Digital / green transition are therefore a challenge, but at the same time they could turn into a major opportunity, rejuvenating this consolidated and outdated image of the sector

MERCHANT SHIPS: THE FUTURE

Forecasting framework[1]

- The **future challenge is decarbonisation**: the renewal of the fleet will take place through the gradual introduction of new technologies as they become available.



1) How to get to 2050 without sinking - keynote remarks by Martin Stopford (Clarkson Research Service), April 2021