Coronavirus, Climate Change & Smart Shipping

THREE MARITIME SCENARIOS 2020 – 2050

A White Paper by
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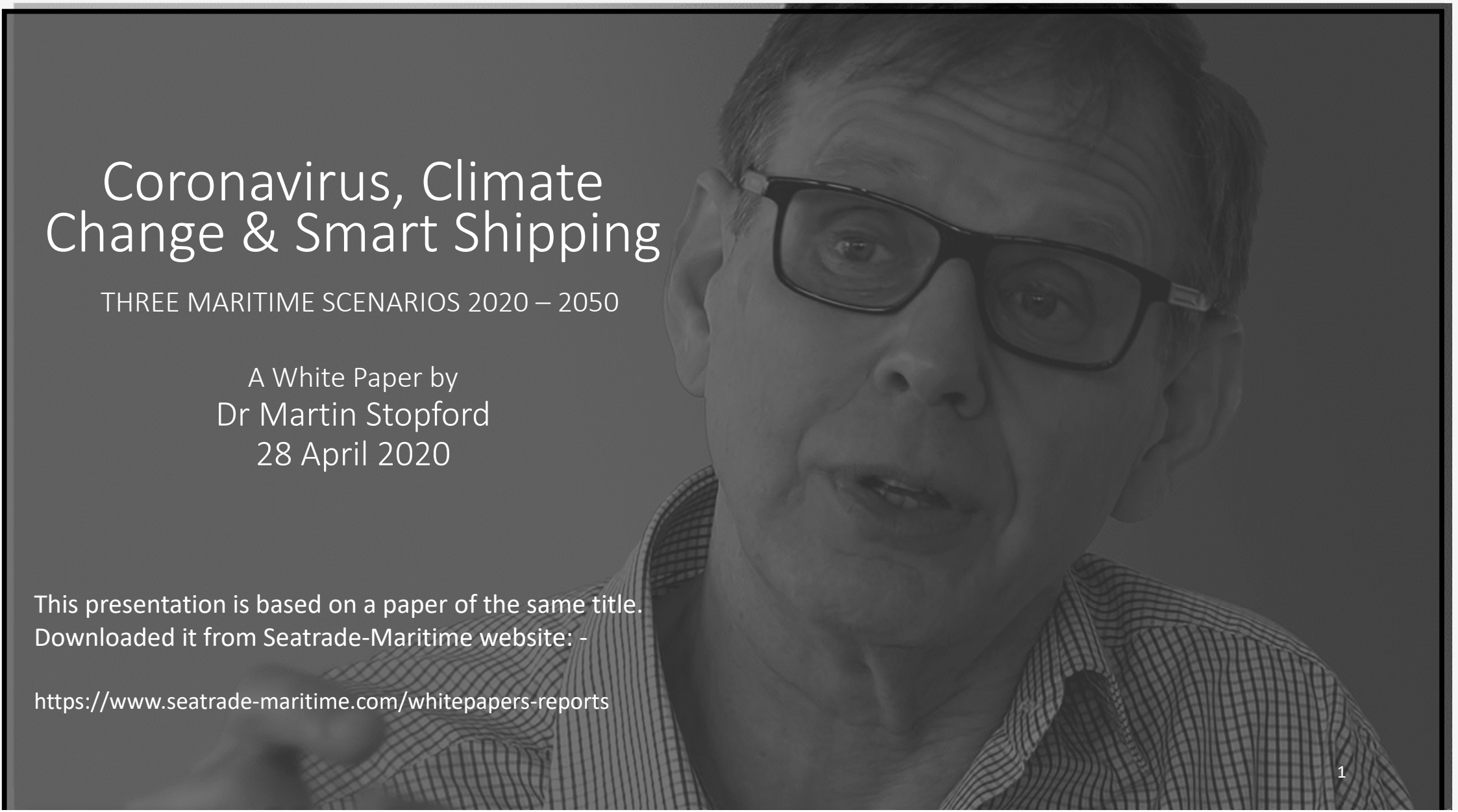
28 April 2020



This presentation is based on a paper of the same title. Downloaded it from Seatrade-Maritime website: -

https://www.seatrade-maritime.com/whitepapers-reports

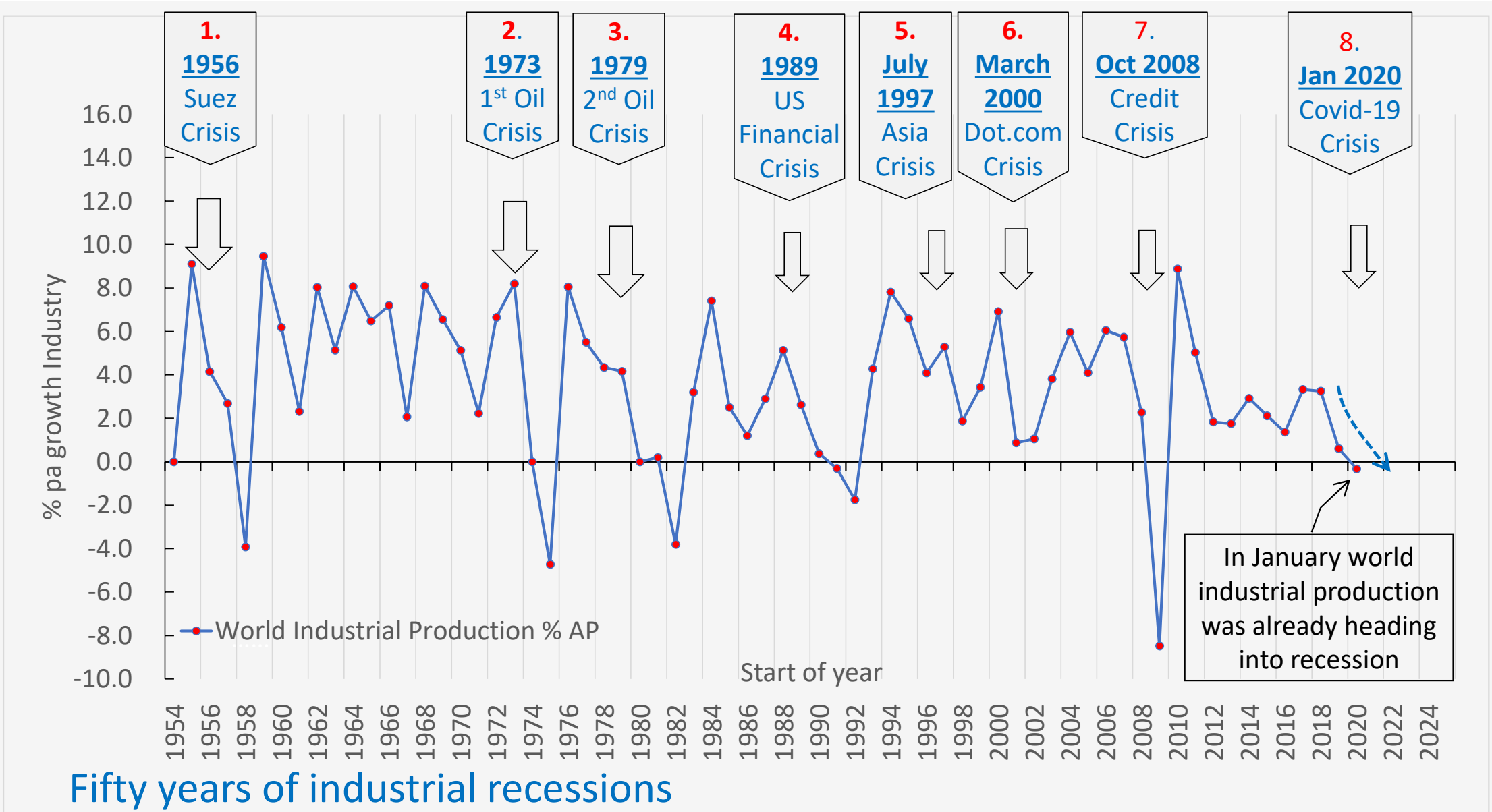
A NEW ERA FOR SHIPPING

To see on line video of earlier version of this slide presentation go to:-
https://vimeo.com/386285569

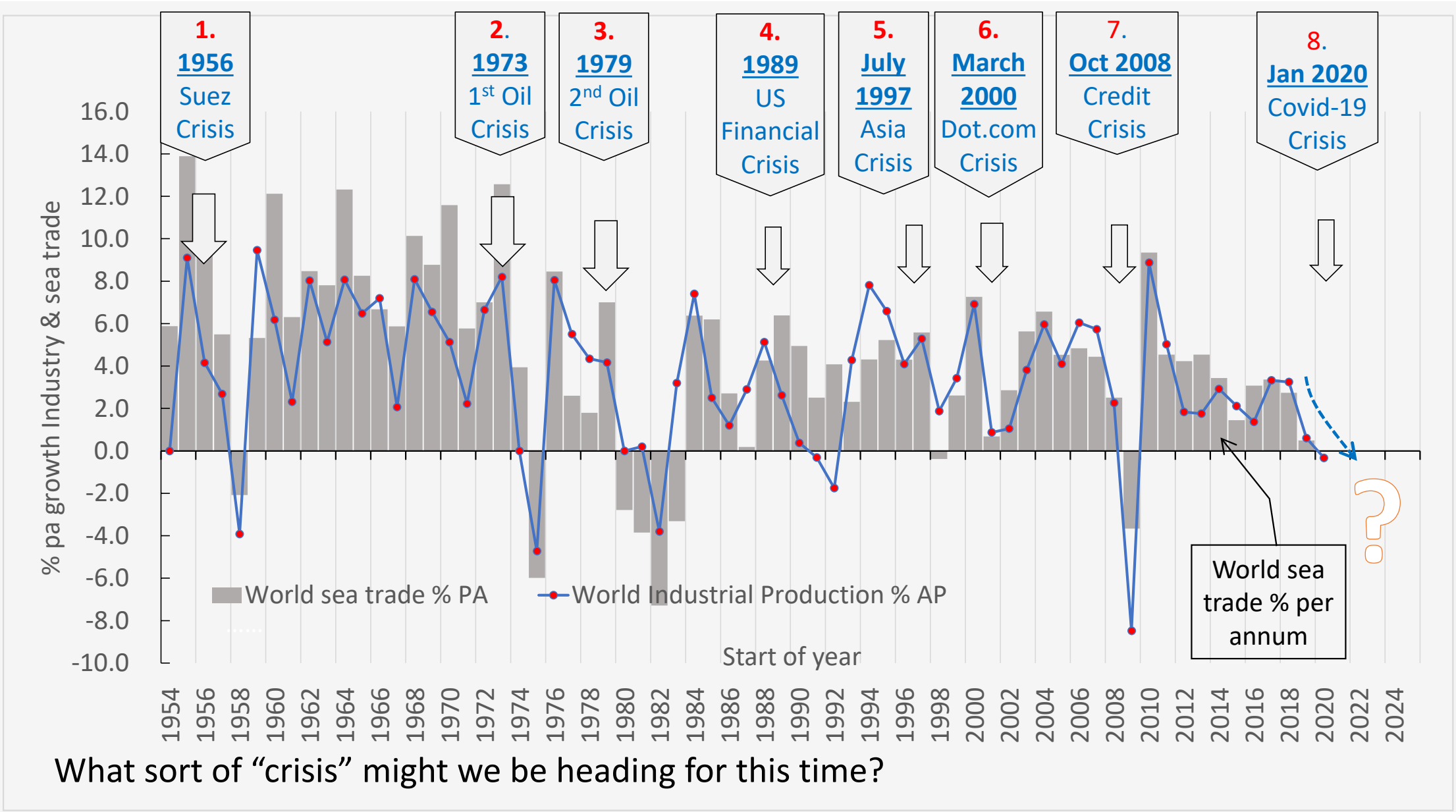
1. The starting point

INTRODUCTION

- The immediate issue is the virus
- "Lockdown", backed by fiscal measures, is launching the world economy on a precarious *tightrope walk* leading to recession and less trade.
- The key question is "how deep and how long?"



Fifty years of industrial recessions

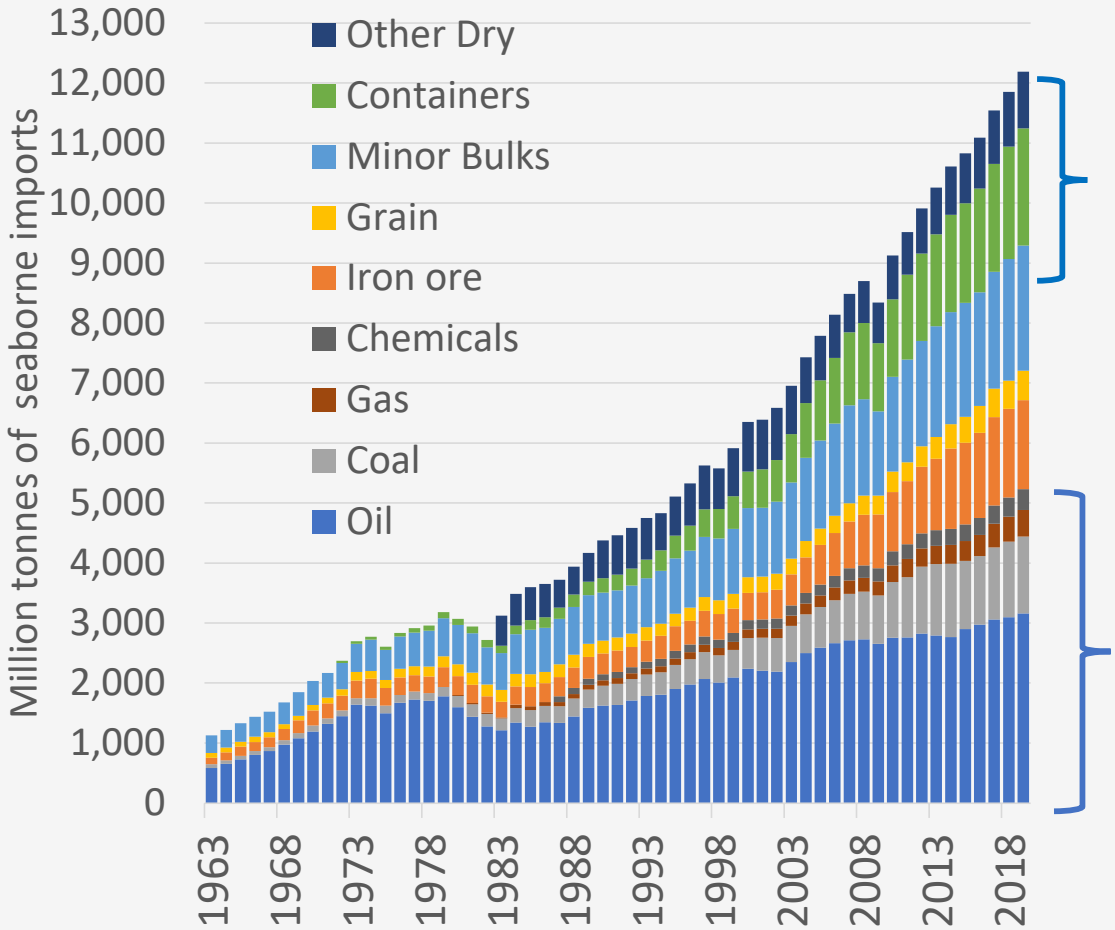


What sort of "crisis" might we be heading for this time?

Structural reasons for slower trade growth in future:-

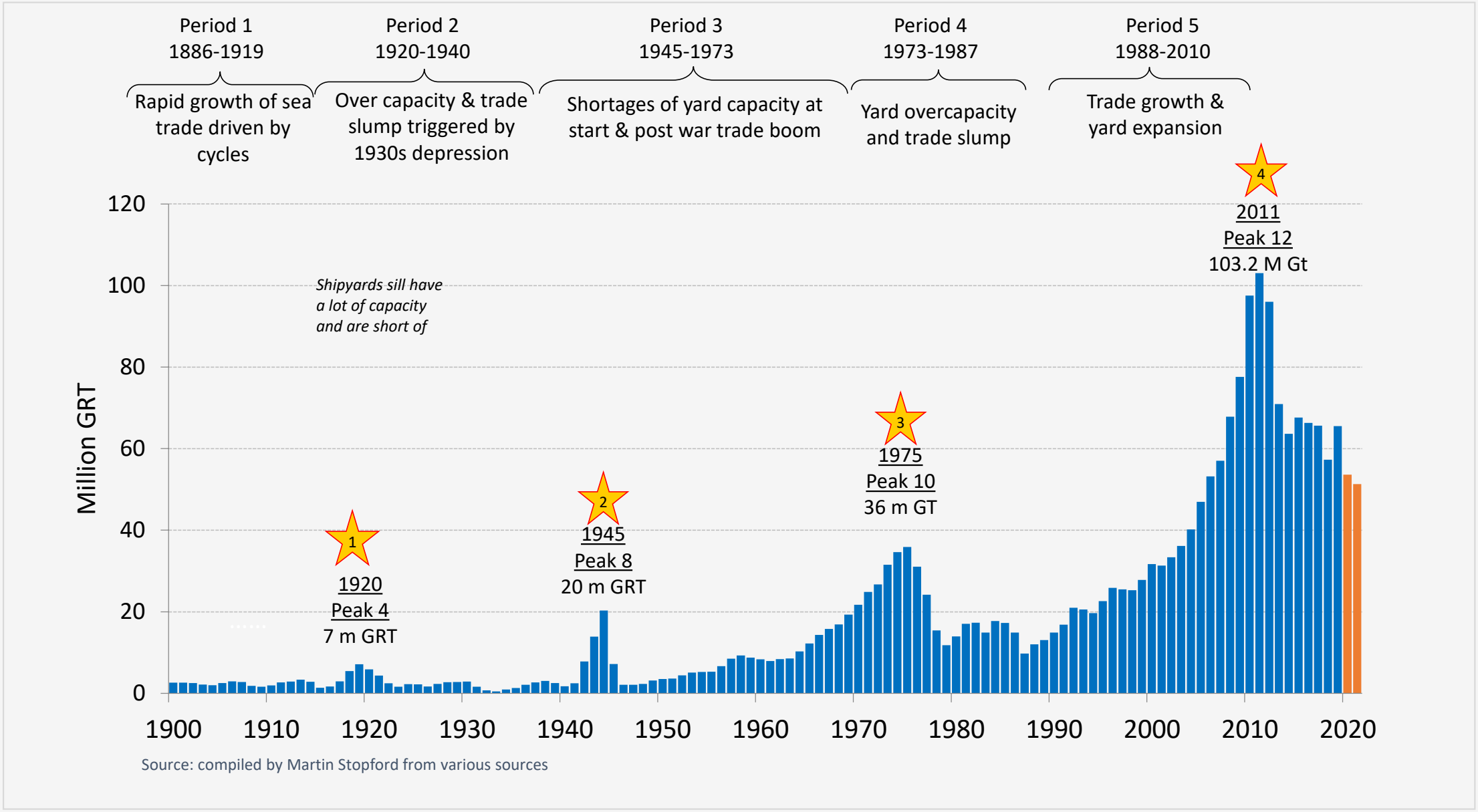
Seven ways to change trade volumes:-

1. Tell customers their carbon footprint
2. Improve logistics services & options
3. Process cargo before shipment
4. B2B direct sea transport where viable
5. Charge more for zero carbon transport
6. Use local suppliers where possible
7. Tax emissions e.g. 150% bunker tax



Issue 1:
27% Growth since 2008.
But regional economies maturing

Issue 2:
40% of sea trade is fossil fuel – What should we plan for in 2050?



Source: compiled by Martin Stopford from various sources

Now let's look at what happened to dry cargo during these cycles….

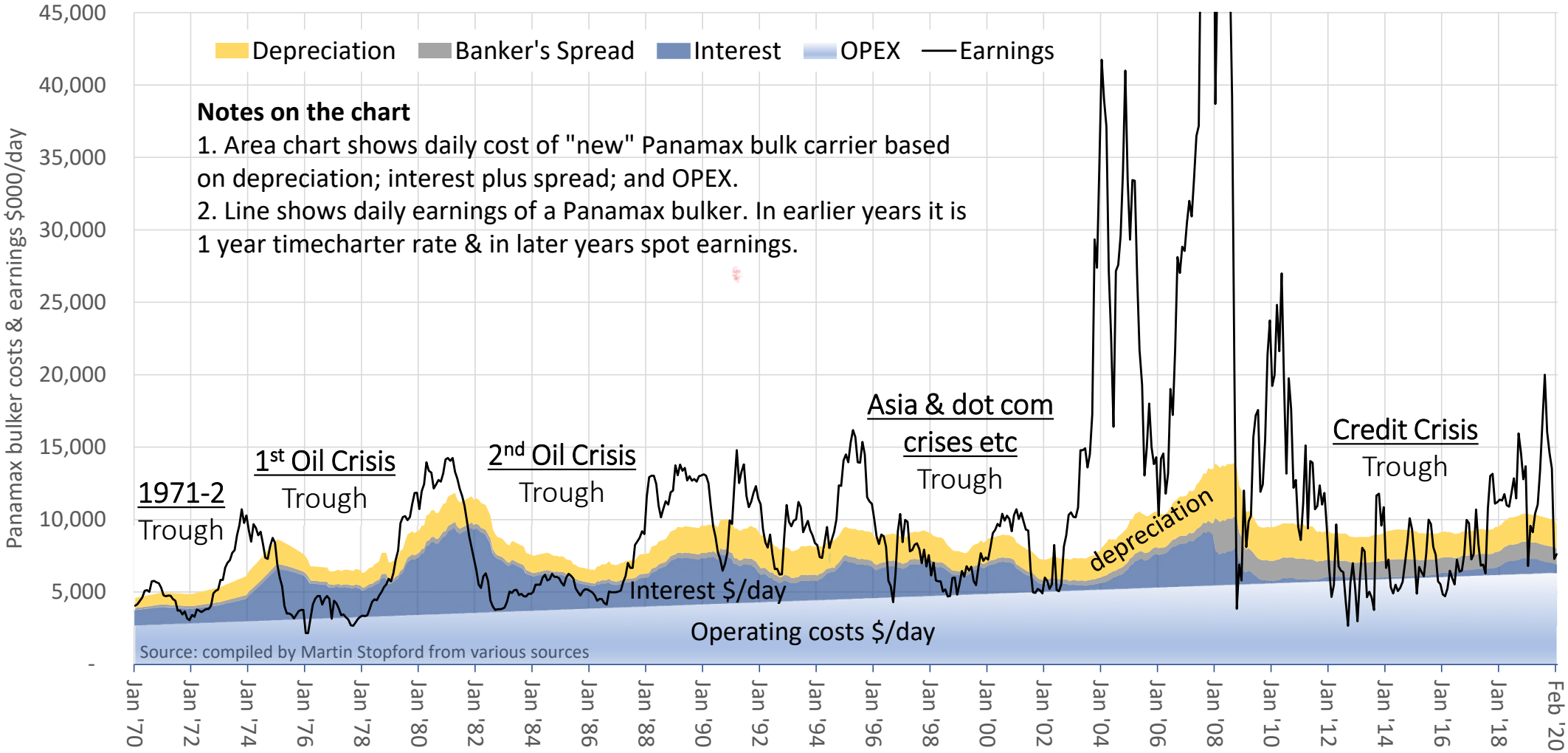


Figure 1 Panamax bulk carrier shipping market cycles, comparing costs and revenues 1970-2020

The Three Scenarios

- The scenarios start with the effect of the current crisis:-
  1. Scenario 1 goes to plan, and sea trade picks up 2023,
  2. Scenarios 2 & 3 discuss less favourable outcomes, stretching to 2025.
  3. The longer term brings in climate change & the digital revolution.

The three Corona virus scenarios

These short-term scenarios are designed to illustrate the different outcomes in terms of:-

a) Fiscal cost

b) Disruption of “real” economy

c) Behavioural change (business & consumers).

As a framework we use the following three Corona virus scenarios: –

- **Scenario 1 (mild):** China back to work in summer of 2020. Europe and USA see infections peak in April and social measures relaxed in May and June. Fiscal support (15-20% of GDP) gets businesses back to work and by year end. Issues with global supply; materials and logistics mean weak trade growth in 2021, recovering briskly in 2022.
- **Scenario 2 (extended)**: containment is quite effective in Europe & USA but the virus persists, with infections re-occurring over the summer. Businesses are able to operate later in the year, but not business as usual. Patchy recovery drags through winter, and it is 2023 before the major G7 economies are back onto an even keel. Global trade sluggish, with metals and energy well down. In 2024 sea trade finally picks up.
- **Scenario 3 (severe)**: restrictions not producing required results in Europe and USA and resurgance in China. By mid-summer the lockdown becomes a major problem, as infections continue to mount or re-appear in different sectors. Governments funding problems, and the shutdown eats into the real economy. Problems drag on for the next three years (though no effort was made to think through the detail of what this means – just assumed trade growth was badly hit for three years).

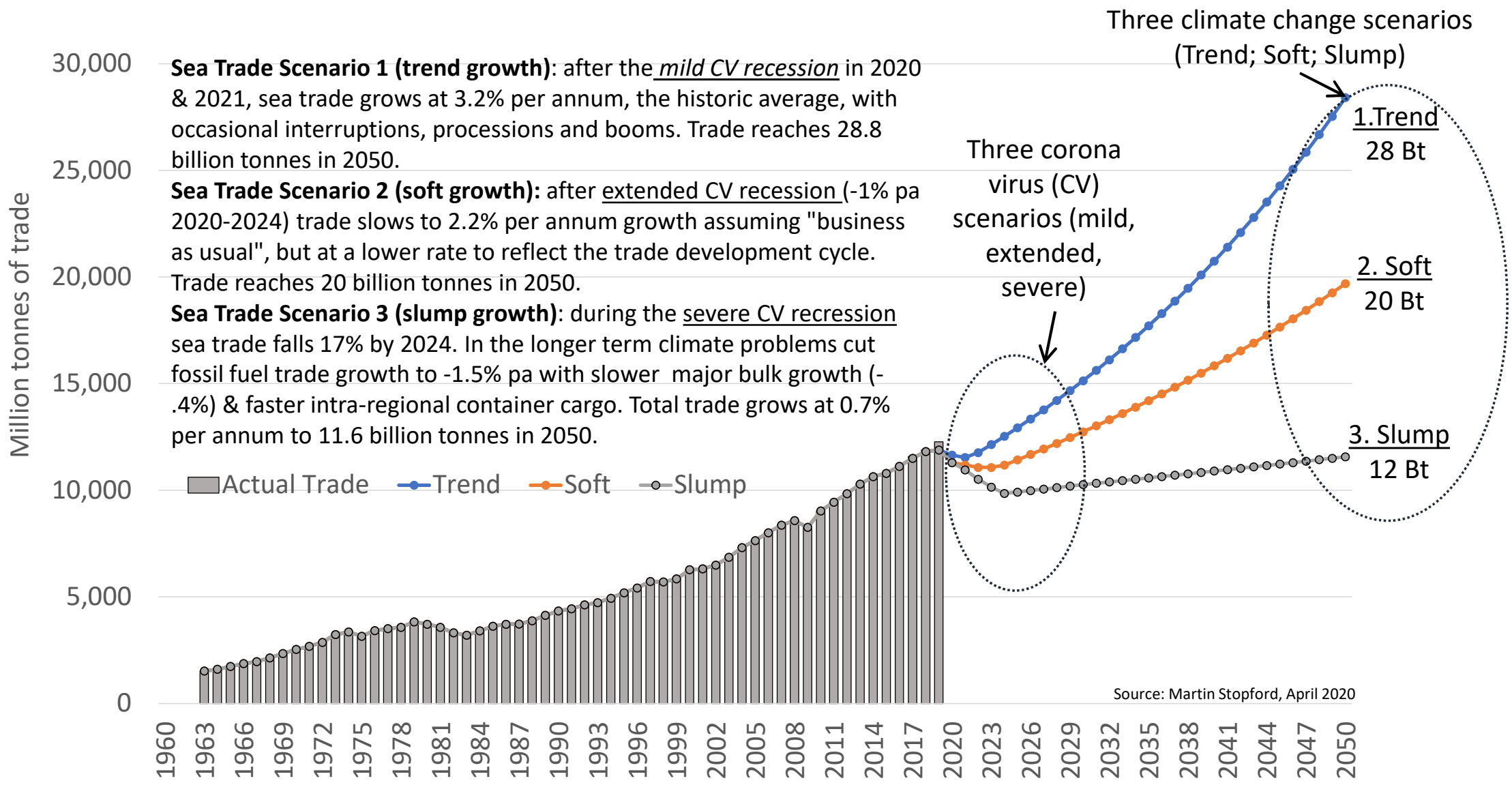


Figure 2: Three sea trade scenarios of corona virus & climate change developments 2020-2050

The Three Shipbuilding Scenarios

1. The *Shipbuilding Scenarios* confront shipyards with a sharp downturn in “requirements” over the next two or three years…but new orders will probably not follow “requirements”.
2. Key issue will be counter cyclical ordering for speculative, social and strategic reasons. How will prices behave?
3. The longer-term S*hipbuilding Scenarios* (Figure 3) point to the need to rebuild the fleet due to trade growth; slower operating speeds; and the re-design and re-engineering of ships for climate change and smart shipping (I4).

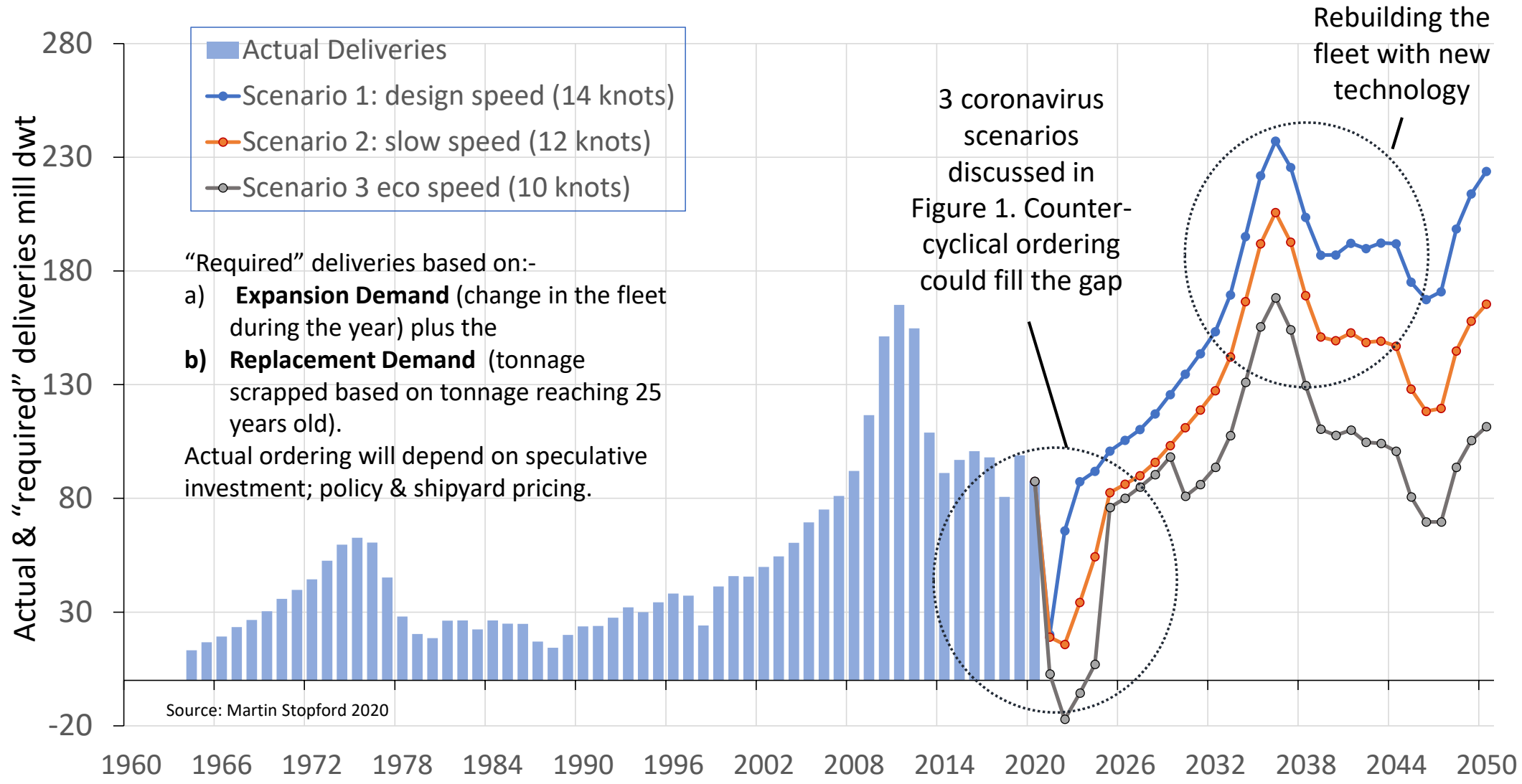


Figure 3: three shipbuilding scenarios showing actual deliveries to 2019 and "required" deliveries scenarios 2020-2050

The Three "Waves" of Technology

- The *Technology Scenario* (Figure 4) suggests three "waves of innovation" to rebuild the fleet with robust and commercially viable ships, with new (but untried) mechanical and digital equipment (based on Trade Scenario 2).
- Wave 1 of *enhanced diesel* ships followed (or accompanied) by Wave 2 *gas and hybrid* electric powered vessels; then Wave3 of *zero carbon* ships e.g. using fuel cells.
- Each "wave" allows new technology to be developed and commissioned in real-world operating conditions, on a gradual but cumulative basis.
- There are parallels with the sail to steam revolution between 1866 and 1900

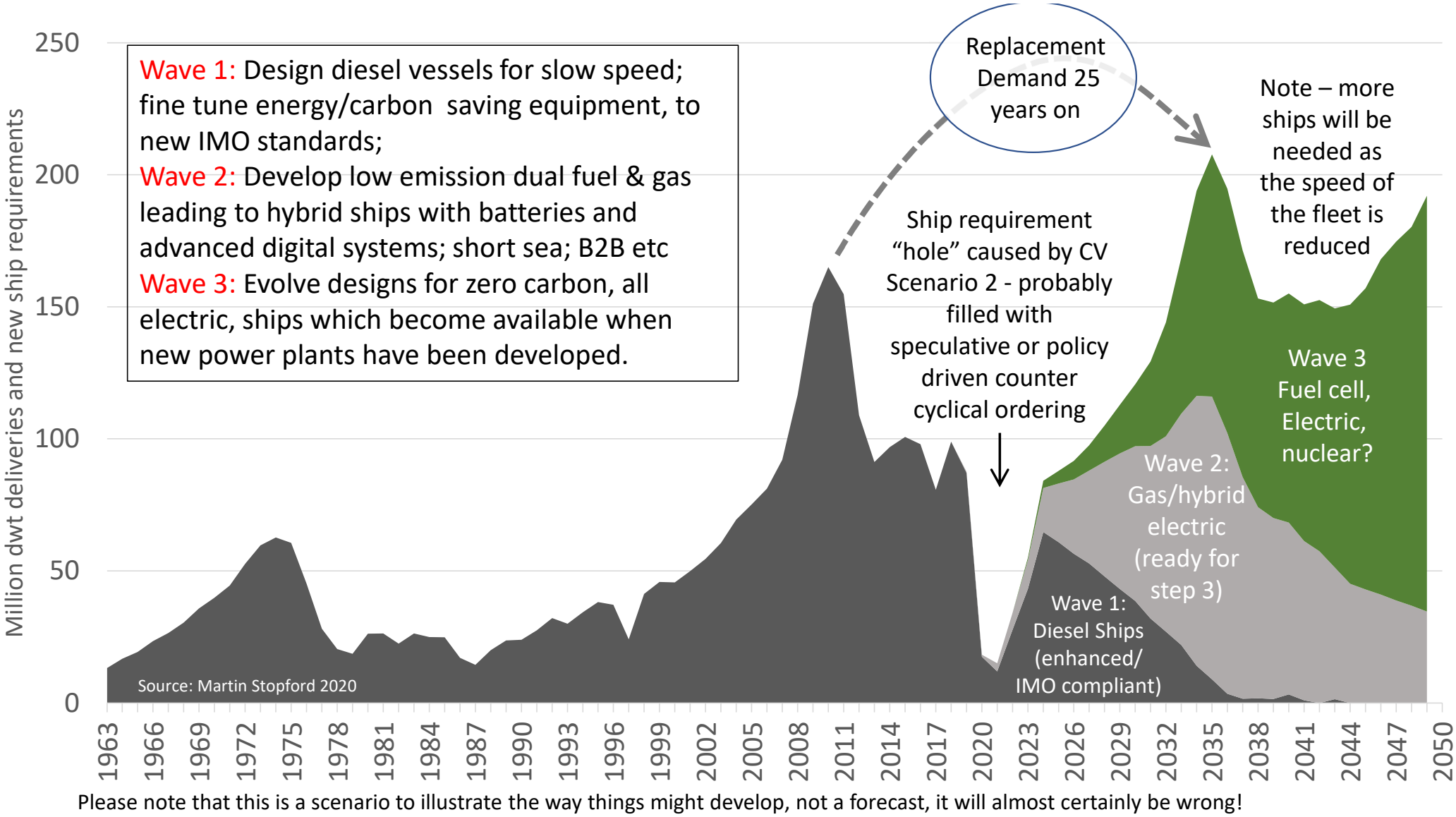
All but 7 of todays fleet of 32,000 ships over 5,000 GT are propelled by fossil fuels

Table 1 World merchant fleet May 2019 by main propulsion type

Engine Type	Number	Mill Dwt	Av dwt	% Number	
Diesel 2-Stroke	25,109	1,783	71,009	78%	
Diesel 4-Stroke	5,385	55	10,289	17%	
Diesel Electric	1,198	33	27,812	4%	
Steam Turbine	306	26	84,005	1%	
Non Propelled	170	23	132,374	1%	Fossil Fuel
Hybrid Mech./Elec.	105	8	72,962	0%	
Combined	13	1	99,505	0%	
Gas Turbine	14	0	14,217	0%	
Batteries & Diesel	18	0	3,932	0%	
Nuclear	7	0	7,547	0%	
Steam Reciprocating	2	0	2,686	0%	
Grand Total	32,341	1,929	59,656	100%	

From file in market data fleet (owner)

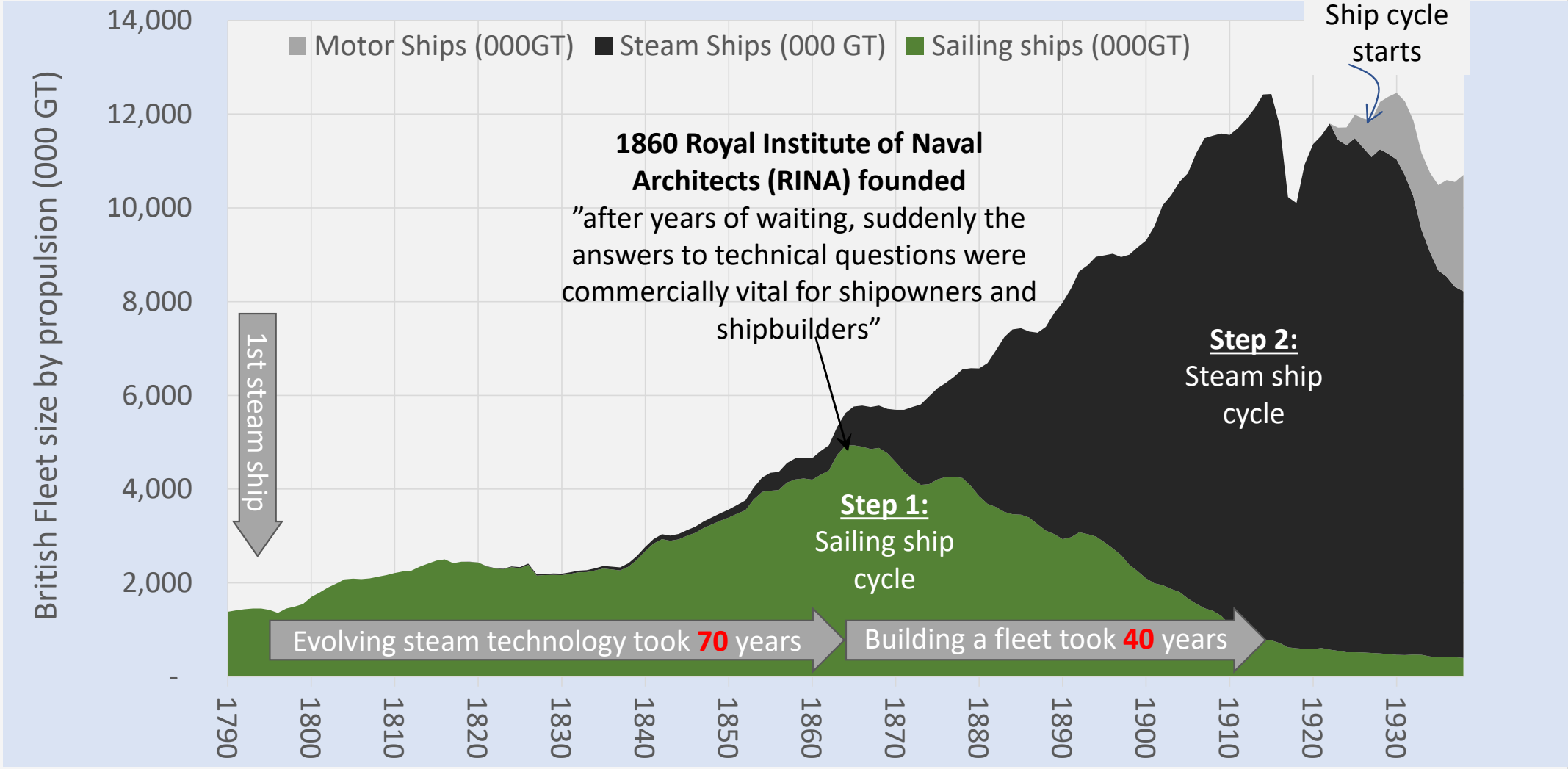
Source: world fleet over 5000GT



Please note that this is a scenario to illustrate the way things might develop, not a forecast, it will almost certainly be wrong!

Figure 4: Technology scenario 2 to reach IMO 2050 CO2 target (based on trade scenario2 and shipbuilding scenario 2)

The steam “revolution” took 70 years to develop & 50 more to finish

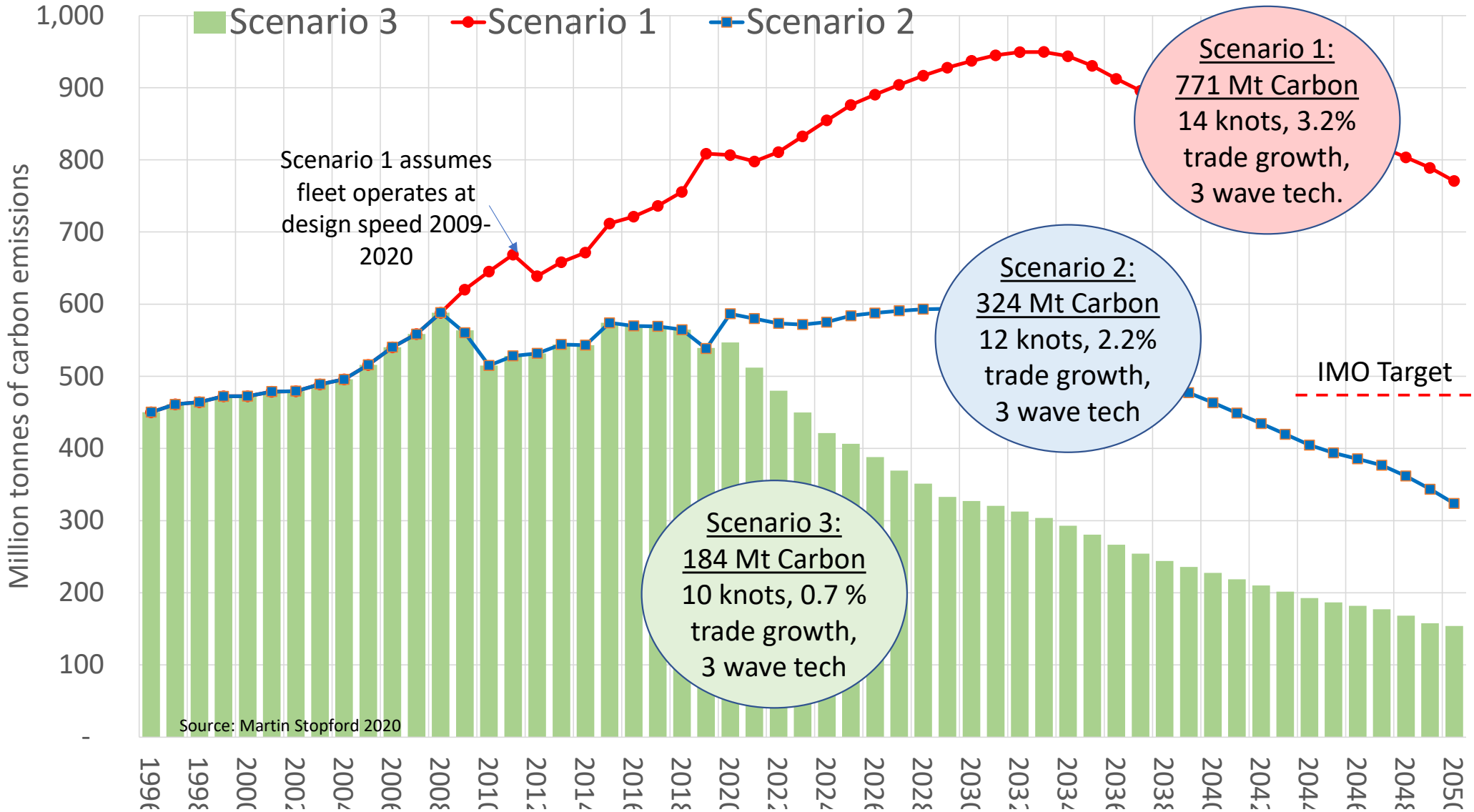


The Three Emissions Scenarios

Finally, the emissions analysis (Figure 5) shows that in 2050:-

- Emissions Scenario 1: produces 771 Mt of carbon, 2x IMO target;
- Emissions Scenario 2 produces 321 Mt of carbon pa and
- Emissions Scenario 3 produces 184 Mt of carbon,

Scenario 2 & 3 are well below the IMO target of half the 2008 carbon emissions.


Scenario 3
Scenario 1
Scenario 2
Million tonnes of carbon emissions
1,000
900
800
700
600
500
400
300
200
100
-
Scenario 1 assumes fleet operates at design speed 2009-2020
Scenario 1:
771 Mt Carbon
14 knots, 3.2% trade growth,
3 wave tech.
Scenario 2:
324 Mt Carbon
12 knots, 2.2% trade growth,
3 wave tech
IMO Target
Scenario 3:
184 Mt Carbon
10 knots, 0.7 % trade growth,
3 wave tech
Source: Martin Stopford 2020
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
2022
2024
2026
2028
2030
2032
2034
2036
2038
2040
2042
2044
2046
2048
2050

The Technology Vision

- In the years ahead shipping must also deal with climate change and the I4 digital revolution.
- There has been much discussion of these challenges, but so far practical progress has been patchy and disjointed.
- By shaking up the status quo, the pandemic will be a catalyst for the radical measures needed.

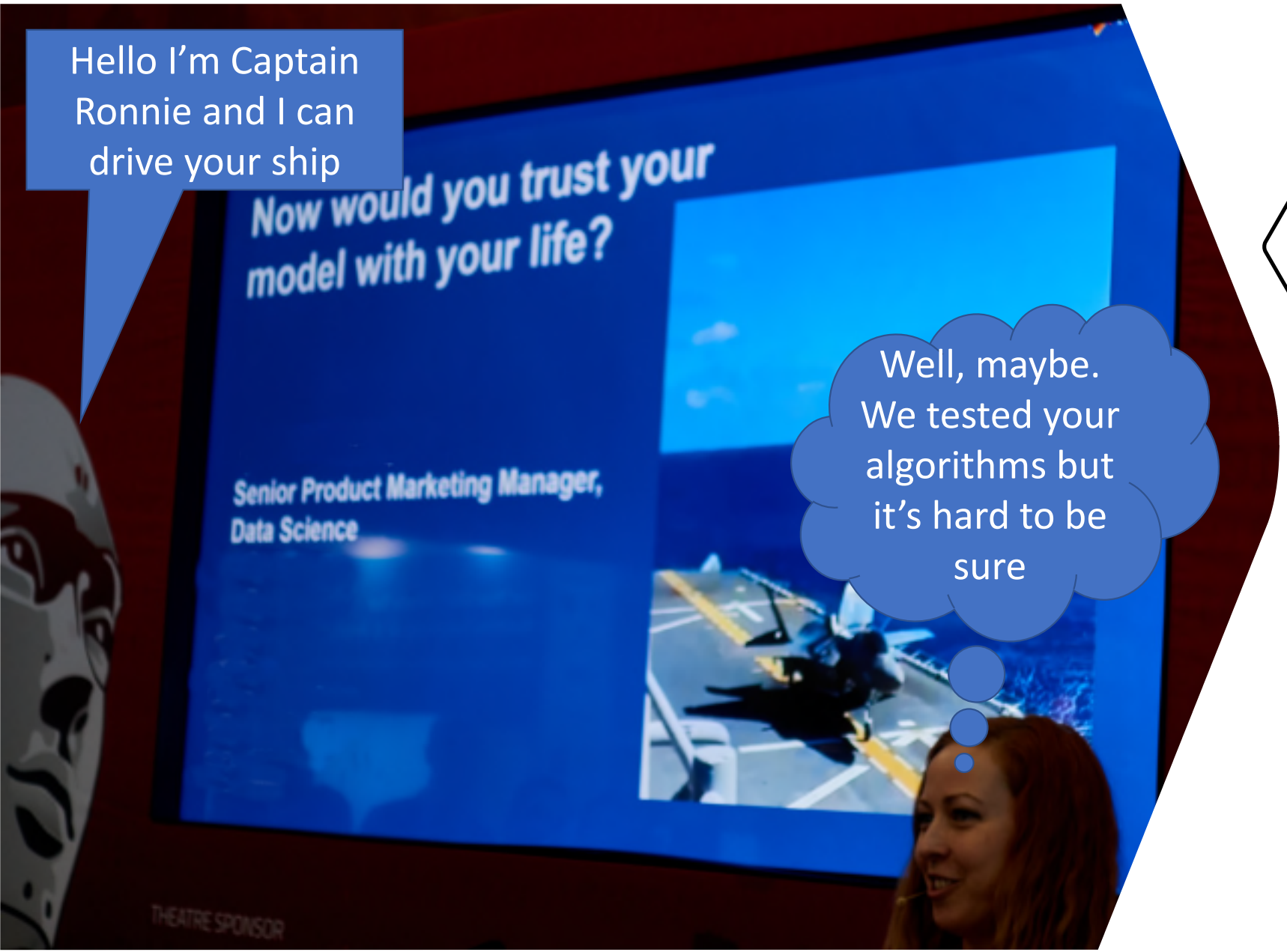
Next year computer technology will be 70 years old, the same as steam technology in 1866

1951: LEO was the first commercial computer It had 8.75 k of memory (using mercury tanks) and many wires

1966: CDC 6600 super-computer had 10 MHz clock speed (10x other machines) & 980k memory. Cost $7 m.

2019: Intel 9700 I7 processor has 8 cores with 12 MB cache, 3.6 GHZ clock speed $393 from Amazon

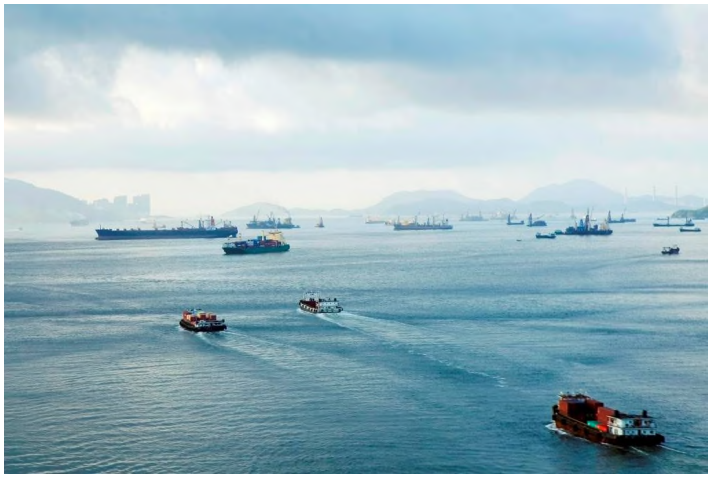
Digital technology is falling into place. Computers are massively powerful; others are tiny, efficient and very cheap! Drawing on all this power, systems like deep learning are shooting ahead. Data gathering, and storage are cheaper and more powerful, thanks to the cloud. Marine satellites offer better band width.



Today’s digital technology is fantastic, but it must be developed by experts, with commercial understanding

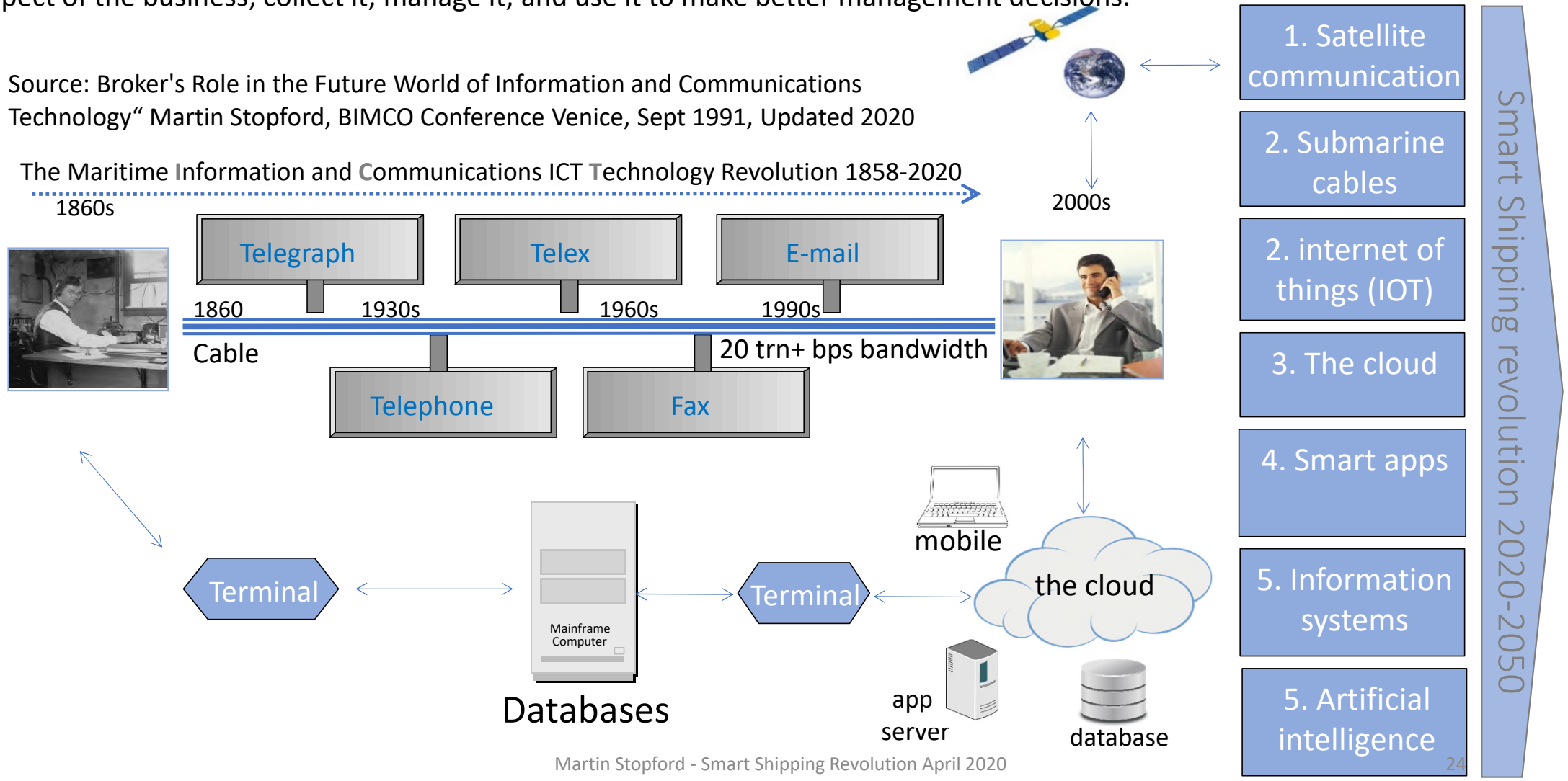
1. Vision – revolutions happen because there is a better way : Over the last 20 years communications and digital technology have advanced to a point where they can be used in business to improve the way sea transport is organised and managed. This is already happening on land. Some of the changes which might occur are listed in this chart.

1. **Seamless** cargo transport services between all parts of the world, integrated with suppliers and receivers
2. **Fast, reliable & flexible** services with fewer accidents
3. **Cost savings** of 30% in real terms as QA works, lower emissions and better focus on providing the services customers really want
4. **Big companies** have cost advantage & providing customer-responsive transport service levels. Maybe small companies too
5. **Professional teams** run big fleets as “transport factories” providing fast, flexible, cheap transport
6. **QA:** Use of deep learning software & robotics make QA systems work throughout the transport chain
7. **Unmanned ships** in suitable trades & semi-manned ships in many others with zero tolerance



3. Digital communications: are not revolutionary in shipping – it started in 1858 when the first deep sea cables were laid! As comms improved, shipping changed. But today we have a "step change" in the technology our ability to generate information about every aspect of the business; collect it; manage it; and use it to make better management decisions.

Source: Broker's Role in the Future World of Information and Communications Technology" Martin Stopford, BIMCO Conference Venice, Sept 1991, Updated 2020



4. Functional system revolution: The digital challenge facing shipbuilders is to integrate on-board systems (as car manufacturers have done). Integrated systems would be more reliable; more manageable; and generate better operational information. But there are major obstacles. Today's shipbuilding systems focus on zones to minimising man-hours, rather than the integration of functional systems. Also equipment manufacturers are promoting proprietary systems. Understandable, but counter-productive.

1. Propulsion. Integrated control systems with real time diagnostics and in service optimisation.

2. Auxiliary power Ship wide power management systems optimising cost, carbon, risk.

3. Auxiliary machinery Systems managing operations, maintenance, efficiency & supplier interface.

4. Ballast & trim Integrated digital management system optimising performance in all operating conditions

Next-generation ships need integrated systems that communicate with each other.

5. Navigation Navigation on network with ability to view on shore as well as ship (e.g. Sperry system)

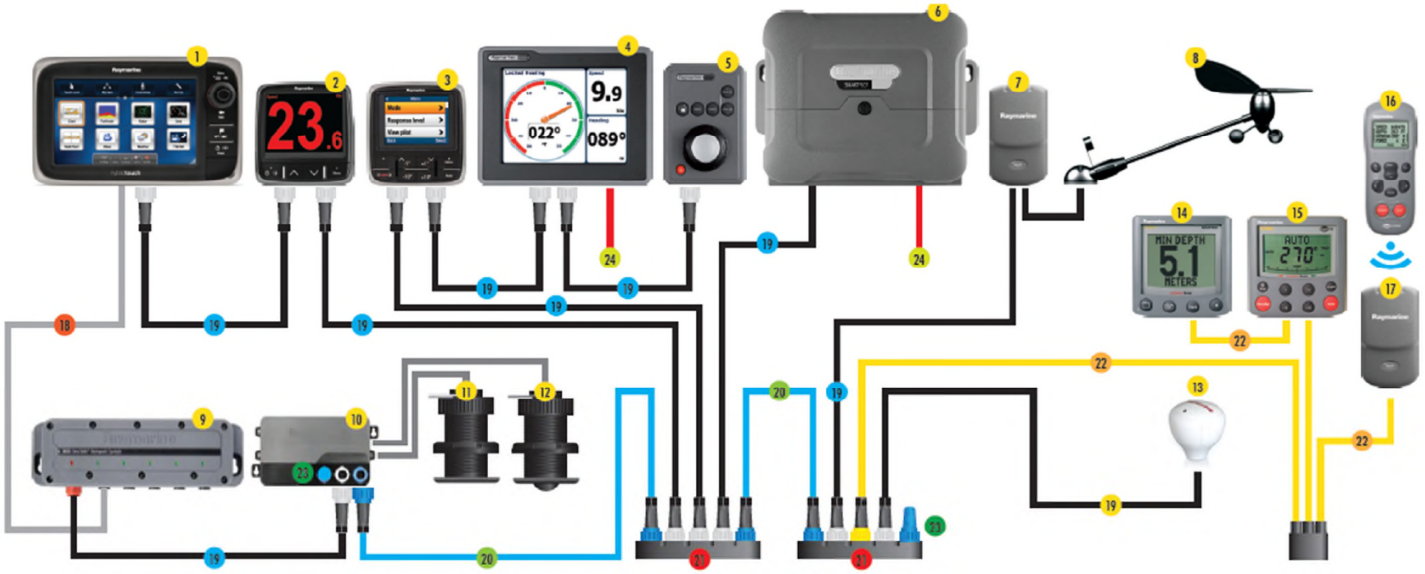
6. Cargo handling Cargo handling systems with cargo management and sharing key data between ship & shore

7. IT & comms Ship systems hosting and managing on board systems. Also rolling out upgrades & providing.

8. Maintenance Ship condition based maintenance system, integrated with company system

5. Replace wires with messages: Integrated on-board systems require a set of protocols so that different equipment can communicate reliably, putting the most important messages first (arbitration). There is a protocol for small ships (NMEA 2000), but not for big ships. This slide shows a system developed by Rymarine, SeaTalk uses the NMEA Marine network protocol, though it is proprietary

SeaTalk*ng* is an interconnection bus for Raymarine products. Small diameter cable connectors are used throughout the system to make installation easier. There's a wide range of cable lengths, all with over-moulded plugs, so there is no need to cut or splice cables. Spur cables connect individual SeaTalk*ng* products to the SeaTalk*ng* backbone.



Note: Imagery for illustrative purposes only. Product images shown in suggested system diagrams are not to scale

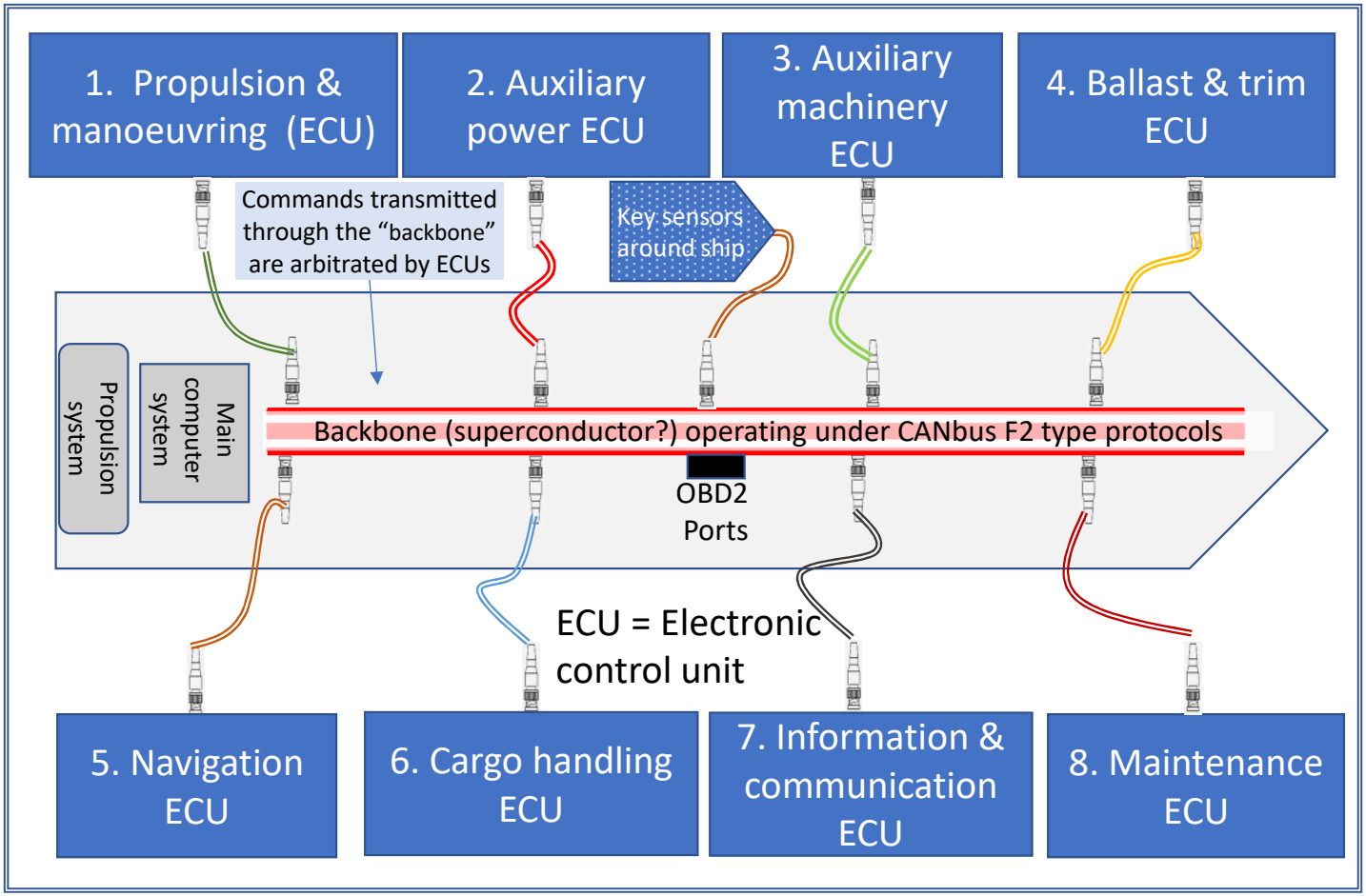
Typical Basic SeaTalk^{ng} System:

1. New e Series **2.** i70 Instrument **3.** p70/p70R Autopilot **4.** ST70 Plus Instrument **5.** ST70 Plus Autopilot Keypad **6.** SPX Course Computer **7.** Pod **8.** Wind Transducer **9.** Network Switch **10.** iTC-5 **11.** Speed Transducer **12.** Depth Transducer **13.** RS130 GPS Sensor **14.** ST60+ Instrument **15.** ST6002 Autopilot **16.** SmartController **17.** Pod **18.** RayNet Cable **19.** SeaTalk^{ng} Spur **20.** SeaTalk^{ng} Backbone **21.** 5-Way SeaTalk^{ng} Connector **22.** SeaTalk **23.** Terminator **24.** Power Supply

http://www.raymarine.co.uk/cruising/

6. Messaging replaces wiring: Ships are big, so integration of systems raises many problems. Well engineered functional systems, (e.g. navigation, cargo handling etc) communicate digitally not through point to point wires. A control area network (CAN) ("backbone") to regulate this communication reliably would require industry protocols. Who would do this?

1. The information and electrical loading on the ship will escalate as installed "smart" technology develops
2. As systems will become more complex, communication and control become priority issues
3. The CANbus derivative backbone (e.g. from NMEA 2000) systems would bring with many ship design benefits:-
   - ✓ **Low cost** – digital interface replaces point to point wiring.
   - ✓ **Centralised** - error diagnosis & configuration are made routine
   - ✓ **Robust** – against electrical disturbances
   - ✓ **Efficient** – priorities and traffic flow optimised
   - ✓ **Flexible** – easy to modify ECUs within the protocol

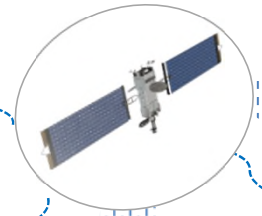


CANbus network for ships – maybe development of NMEA 2000 protocol

7. Company organisation: smart technology opens the way to running a fleet of ships as a "transport factory". The shipping company becomes the spider in the logistics web for both interregional and intraregional trade.

7. PORTS & THROUGH TRANSPORT

6. SHIPBUILDERS & EQUIPMENT SUPPLIERS

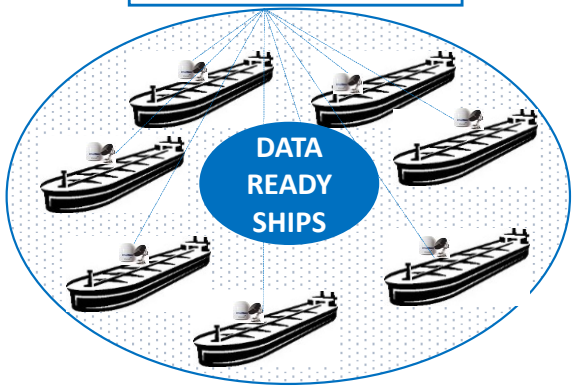


Servers managing data, apps & comms via CANbus

Warehouse (on cloud?)

5.CUSTOMERS WITH CARGO SYSTEMS

TRANSPORT FACTORY



1. SHIP TEAMS

Core systems

1. Navigation
2. Operations
3. Comms.

Performance measurement is key!!

Company Systems:-
1. Process management
2. STQ monitoring
3. Messaging system
4. Intranet & dashboards
5. Fleet maintenance
6. LPWAN & APIs

Fleet management

2. SHORE TEAMS

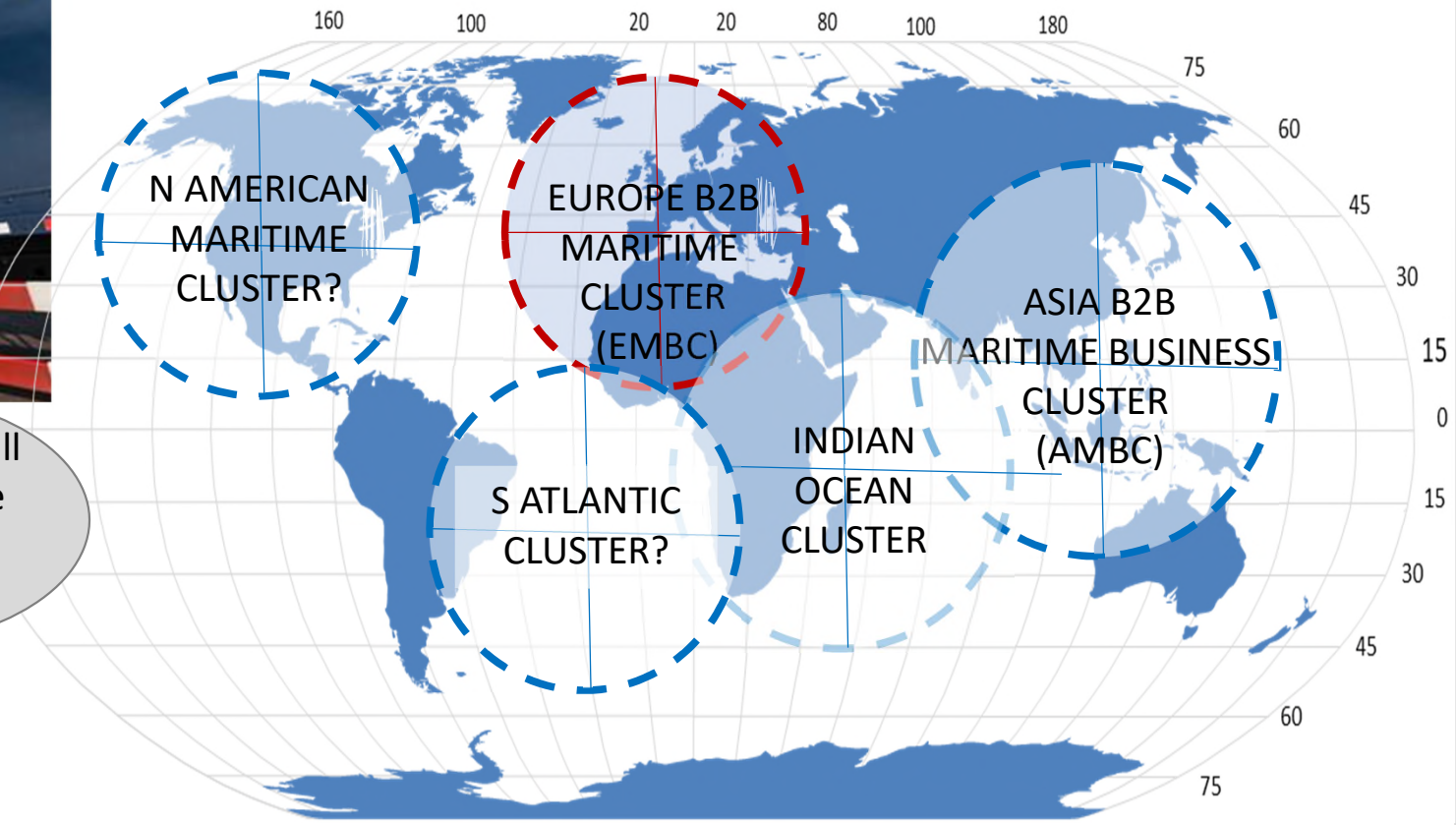
1. Technical support
2. Maintenance systems
3. Regulatory reports
4. Fleet performance
5. Personnel management

4. TECHNICAL TEAMS

1. Support systems
2. Process data
3. Automation
4. Build apps
5. Manage stats

3. SYSTEMS. TEAMS

Short sea systems support regional B2B commerce & lower CO^2

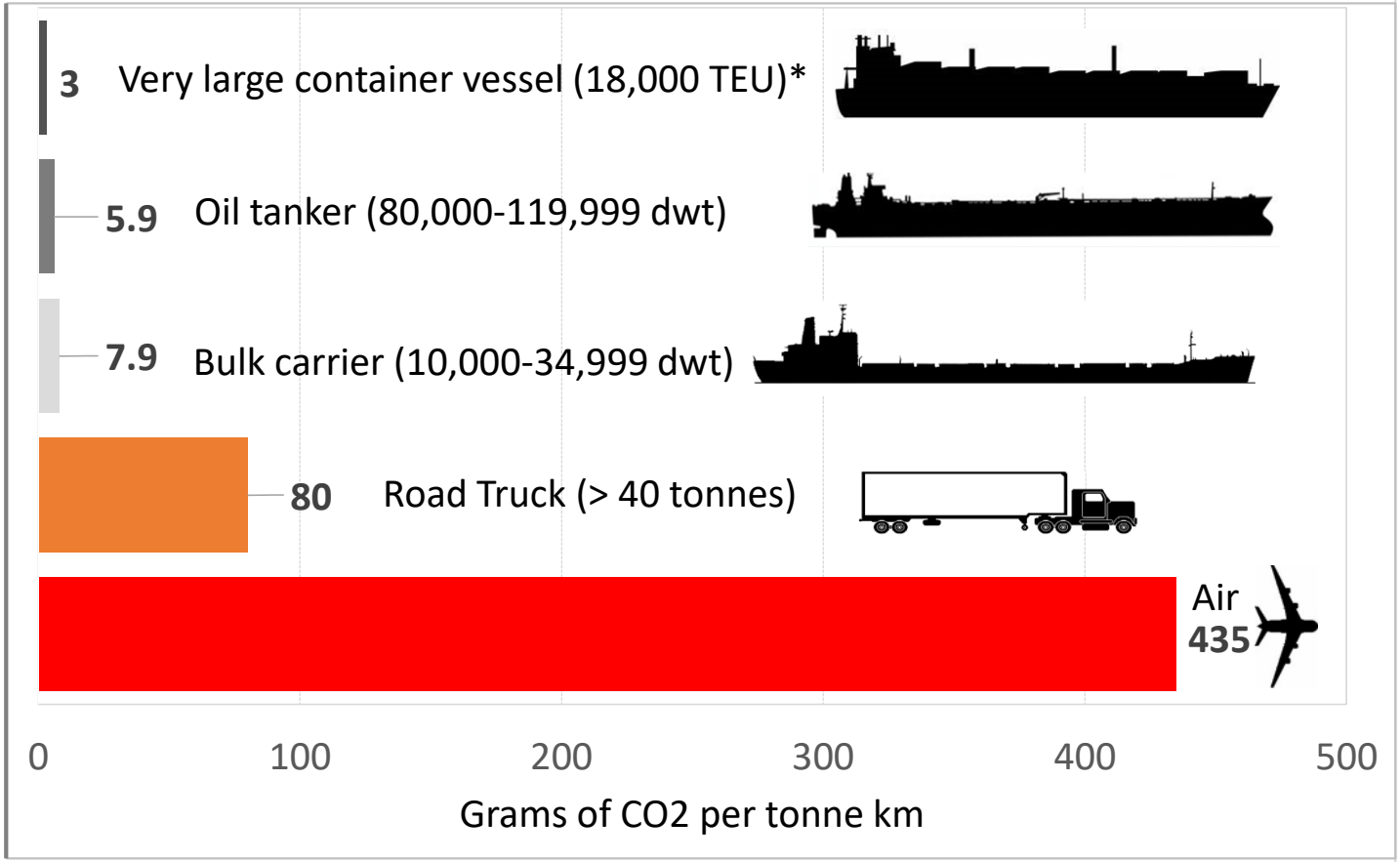


Inland transport is being transformed; short sea services will be needed to complete tomorrow's low carbon B2B networks. It's the ideal proving ground for new generation technology

Digital information is making complex logistics systems viable

SEA TRANSPORT HAS LOWER CO2 EMISSIONS THAN LAND & AIR

- Short sea transport has been neglected for many years.
- Land transport is now very congested and produces much more CO2 than sea transport.
- B2B short sea transport offers can provide transport which is better for business and the environment.



Source: IMO GHG Study 2009, (* AP Moeller-Maersk 2014)


That’s it folks, thanks for listening. Any questions?