

# Trends and Challenges in Maritime Energy Management

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# The Least Emission Boat in the World



# Motivation and Drivers (Why?)

- Environmental impact of Air Pollutants and GHGs (climate change, ..)
- More stringent environmental regulations (MARPOL Annex VI Chapter 4)
- Volatile fuel oil price
- World population, energy demand and prices
- Energy resources scarcity and Energy security
- UN2030 Agenda (SDGs 7, 12 & 13 in particular)

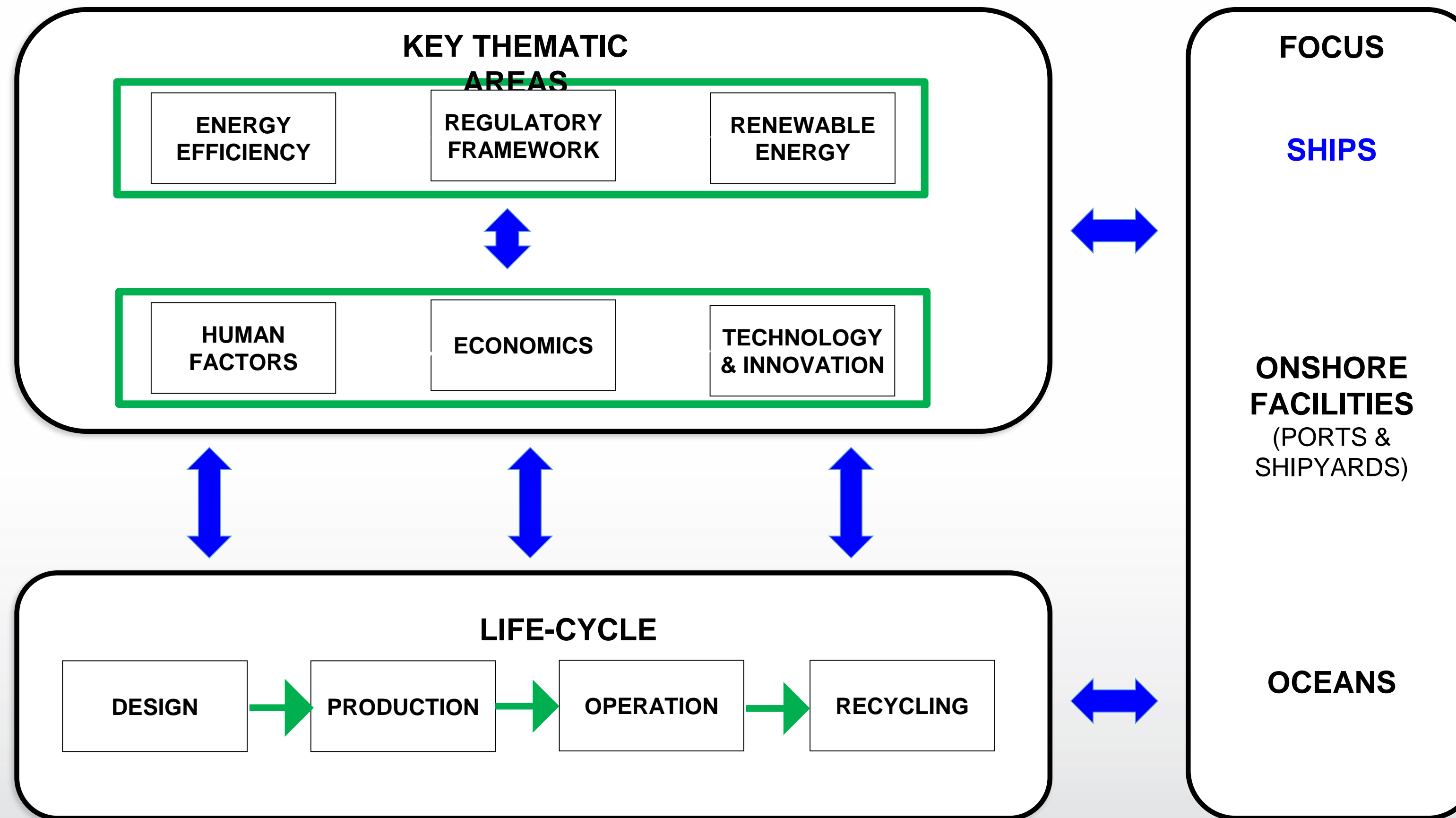
# Maritime Energy Management (What?)

- *“Understanding the transformation of energy sources into different energy forms, and*
- *Managing its consumption in an optimised way in order to be able to minimise negative environmental and economical consequences resulting from this consumption”* (Ölçer and Ballini, 2018), (Ölçer, Baumler, Ballini and Kitada 2017)
- The above will result in increased energy efficiency (EE)

# Key Pillars of Maritime Energy Management

- Regulatory framework
- Energy efficiency
- Renewable/cleaner energy
- Technology and innovation
- Human factors
- Economics of energy management

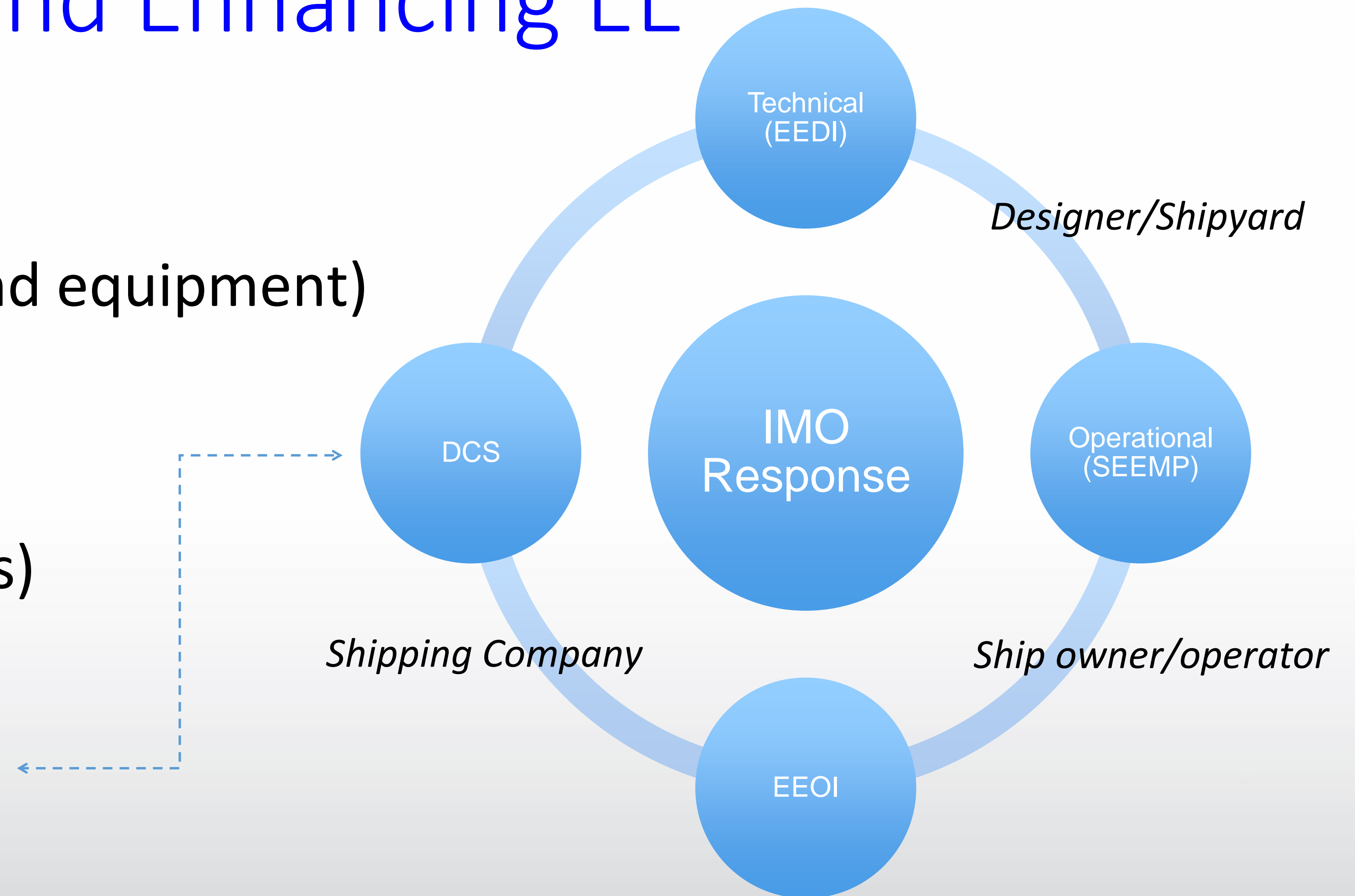
# Key Thematic Areas and LC Perspective



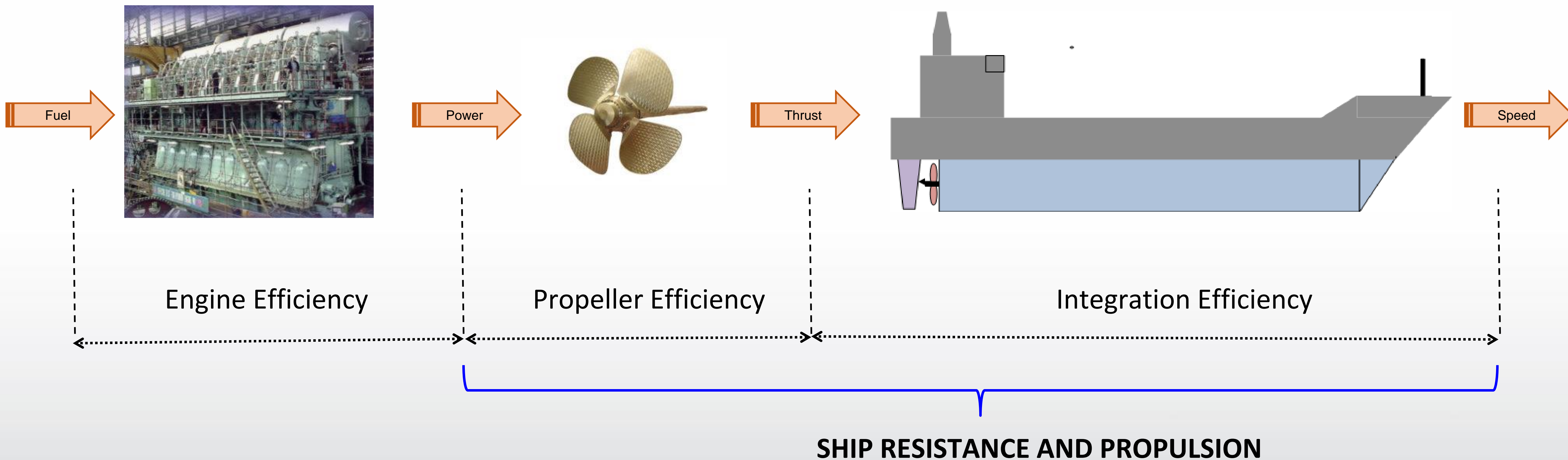
Source: Appendix I: Maritime Energy Management Research Strategy, Trends and Challenges in Maritime Energy Management, Ölçer, A.I., Kitada, M., Dalaklis, D., Ballini, F. (Eds.), ISBN 978-3-319-74576-3, Springer

# IMO Response and Enhancing EE

- Technical Measures  
(Better design of ships and equipment)
- Operational Measures  
(Better operation of ships)
- MBM  
(Discussions suspended)



# Ship Design and EE

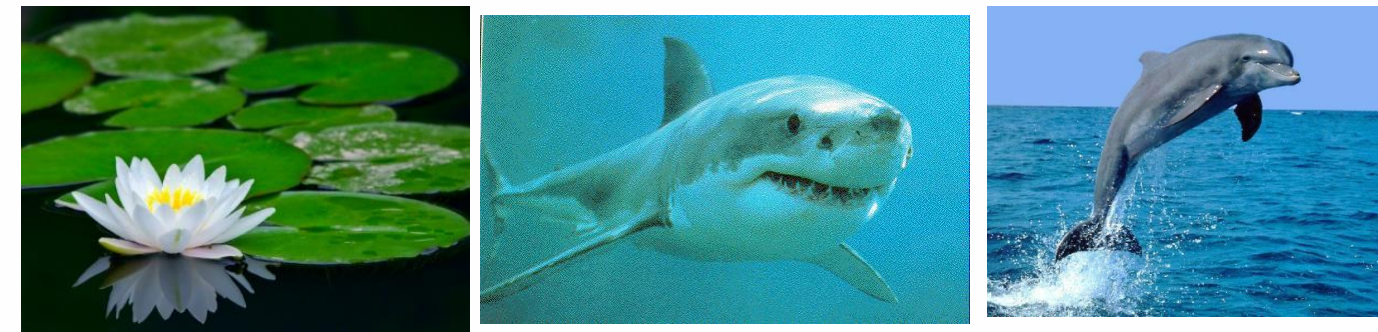




# Design Solutions for EE

- Wave-making resistance

- Viscous resistance  
(WSA, boundary layer)

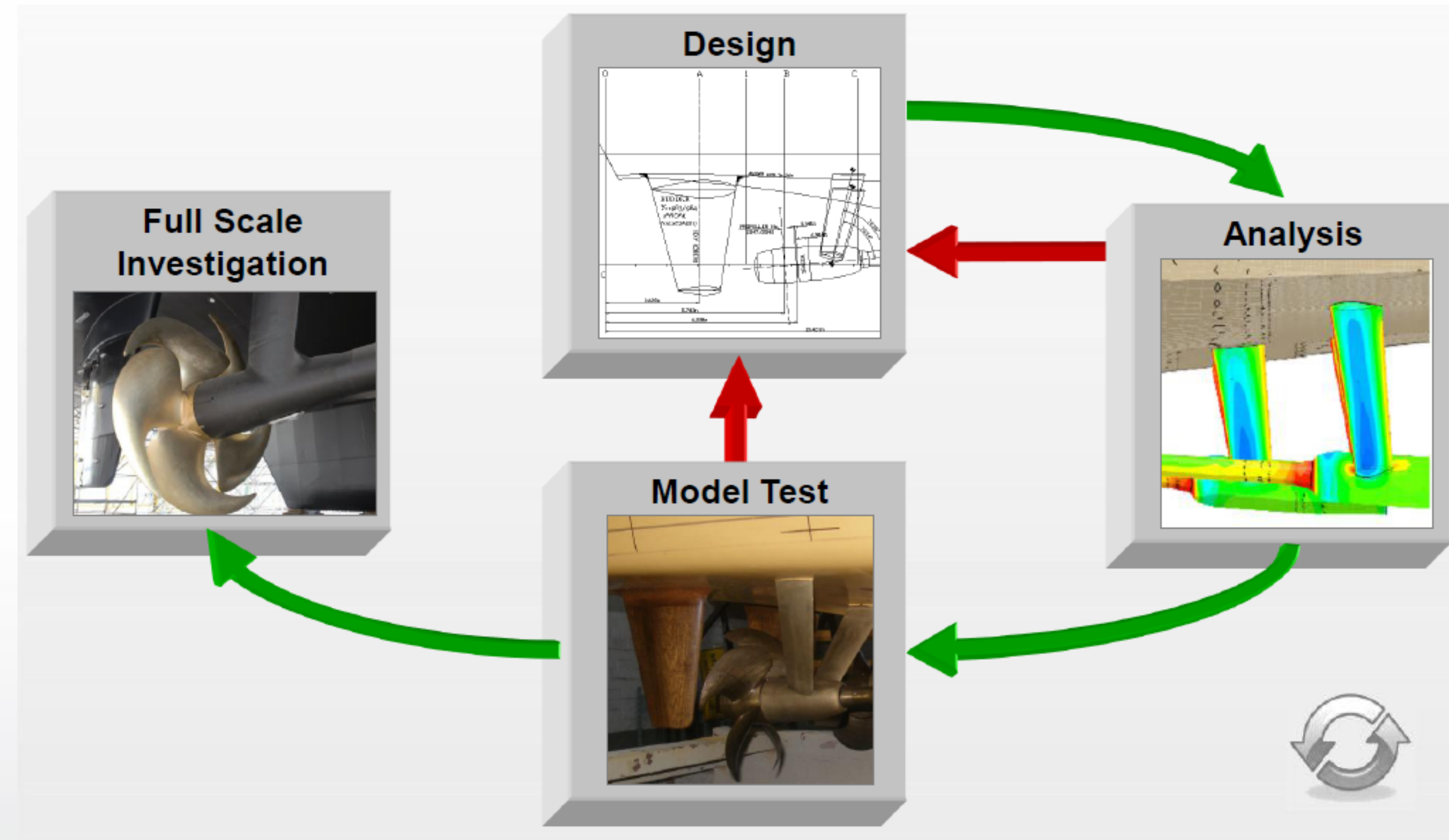


- PIDs (Ducted propellers, fins, PBCF etc.) to improve hull efficiency

- ....

# Accuracy

- Numerical
- Model tests
- Sea-trial
- Full scale



# Ship Operation and EE

- Optimal ship handling
- Fuel efficient ship operation
- Maintenance (engine, hull, propeller)
- Ship-port interface
- Training of crew and on-shore staff
- Load management

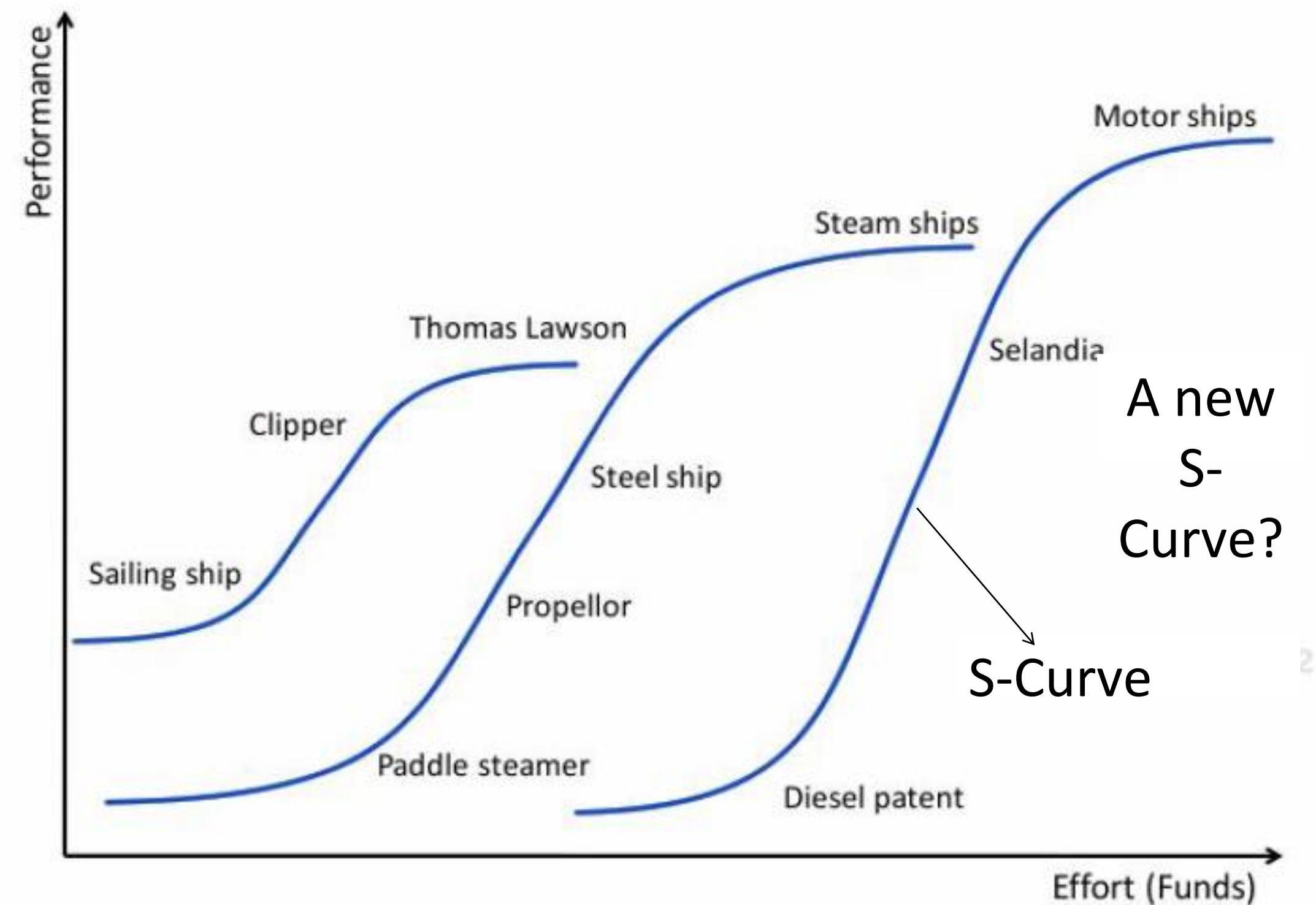
# Decision Making Under Trade-Off

- Cost/Benefit
- Cost? (CAPEX, OPEX, Externality?)
- Benefit?
- Perspective and decision maker
- Individual solutions and right combination? (Source: IMO/MEPC-67-INF-9-TARGETS)

No.	ESP	Cost	Savings
1	Slow steaming	negligible/indirect	High
2	Virtual port arrival	Zero	High
3	Propulsion efficiency monitoring	High	High
4	Weather routing software	High	High
5	Port turn-around time	Zero	High
6	Ballast & trim optimization	Low / Medium	High
7	Speed optimization	Negligible	High
8	Autopilot upgrade/ adjustment	Low	Low
9	Optimized voyage planning	Negligible	High
10	Optimization of use of fans and pumps	Zero	Medium
11	Optimization of use of bow-thrusters	Zero	Medium
12	Efficiency control of HVAC system	Zero	High
13	Speed/ Power control units for electrical equipment	Low	Medium
14	Cargo heating and temp. control optimization	Zero	High
15	Optimum lighting operation management	Zero	Low
16	Usage of Fuel Oil additives	Low	High
17	Ballast water exchange optimization/minimization	Zero	Medium
18	Even main engine / e-load operation	Zero	Medium
19	Elimination of voltage unbalance in motors	Low	Low
20	On-shore power supply (Cold Ironing)	High	High
21	Proper use of FO purifiers	Zero	Medium
22	Improved Machinery Maintenance <sup>1</sup>	High	High
23	Energy Management	High	Medium

# Future Ship Propulsion

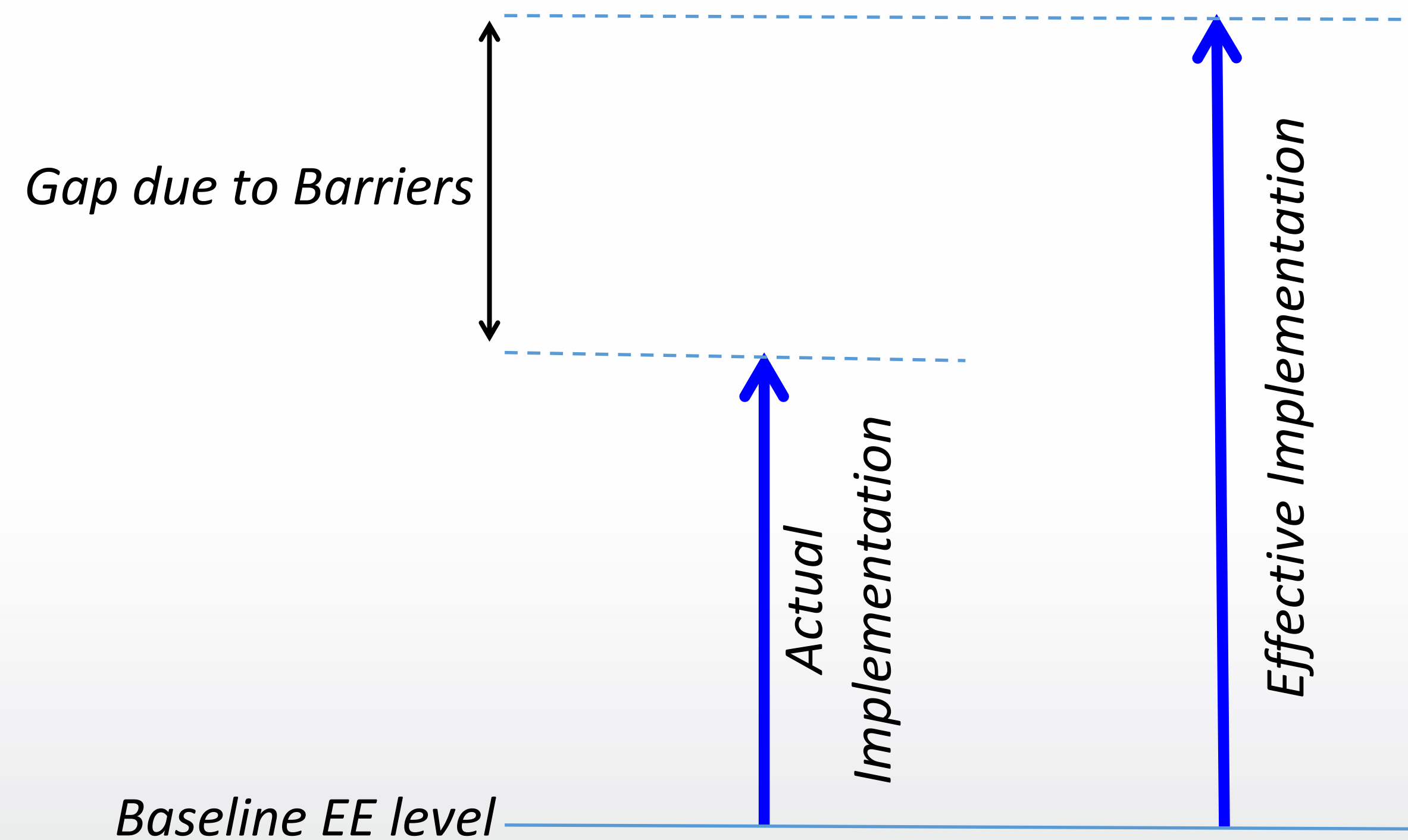
- From Human to Diesel Engines
- Fuel cells, batteries
- Nuclear (Thorium?)
- Hybrid (right mix?)
- Alternative fuels (LNG, bifuel, Methanol))



(Ref: Shipping innovation, Figure 407, page 378)

# Barriers

- Individual
- Organisational
- Technological
- Economical
- .....



# Other Challenges

- Maritime Digitalisation (big data)
- Autonomous shipping
- System blindness
- ..

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Thank You

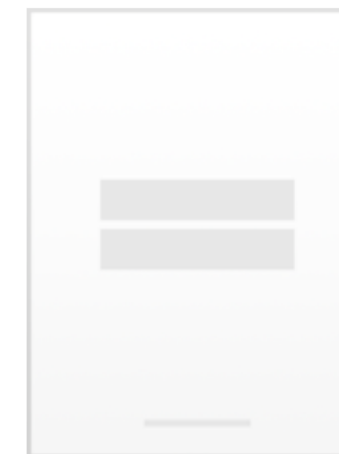
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WMU Studies in Maritime Affairs



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## Trends and Challenges in Maritime Energy Management

Editors: Ölçer, A.I., Kitada, M., Dalaklis, D., Ballini, F. (Eds.)

Provides an overview of contemporary trends and challenges in maritime energy management (MEM) Covers broader industry perspectives, as well as academia, and regulatory bodies

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This book provides an overview of contemporary trends and challenges in maritime energy management (MEM). Coordinated action is necessary to achieve a low carbon and energy-efficient maritime future, and MEM is the prevailing framework aimed at reducing greenhouse gas emissions resulting from maritime industry activities. The book familiarizes readers with the status quo in the field, and paves the way for finding solutions to perceived challenges. The 34 contributions cover

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