Ship Energy Efficiencies
Regulatory Backdrop

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IMO Strategy for CO2 Emission Mitigation

Enters into force 1 Jan 2013

Technical Measures

EEDI

MARPOL Annex VI Energy Efficiency Regulations

Operational Measures

SEEMP

MARPOL Annex VI Energy Efficiency Regulations

Market Based Measure

?

3 main competing concepts:

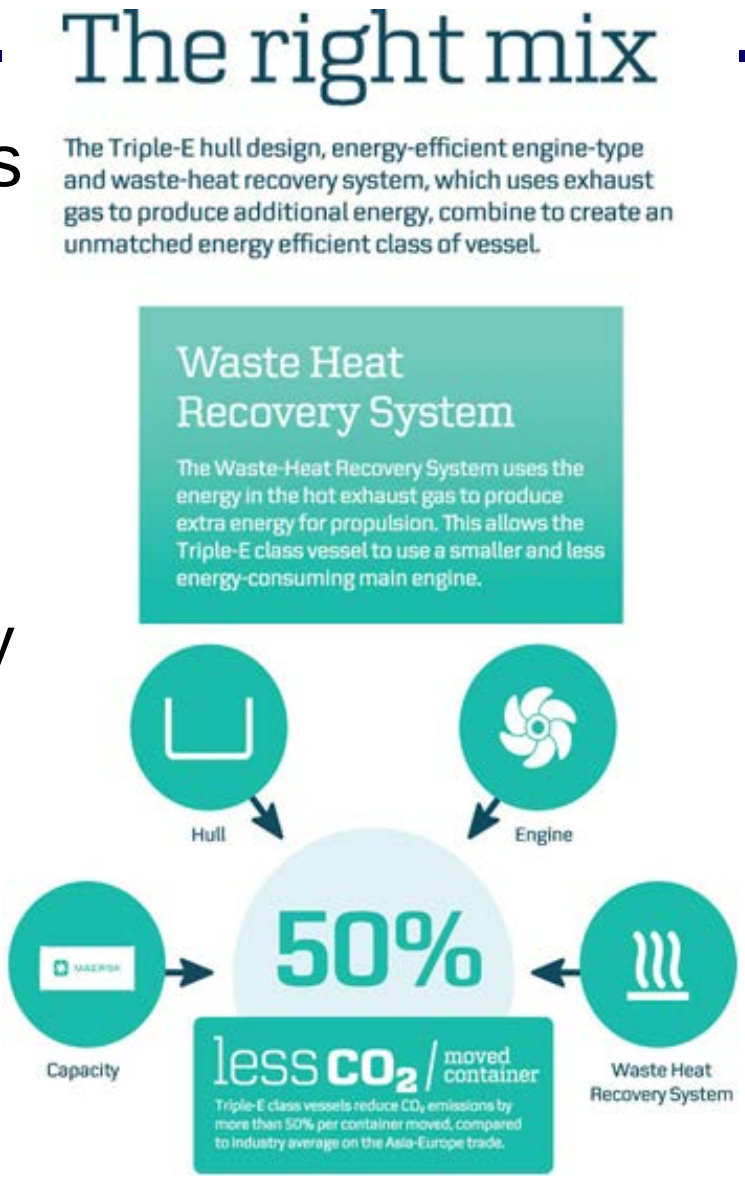
- Emission trading scheme
- Bunker levy
- Efficiency incentive scheme

Framework for energy efficiency

- **EEDI**
  - Measure “Energy Efficiency” in terms of CO_2 emissions at full-load draft and 75% MCR
  - Benchmark “Energy Efficiency” of new ships against that of the world fleet of 1999-2009
  - Benchmark to improve in phases
- **SEEMP**
  - All ships to implement energy efficiency measures in service
  - Continuous improvement

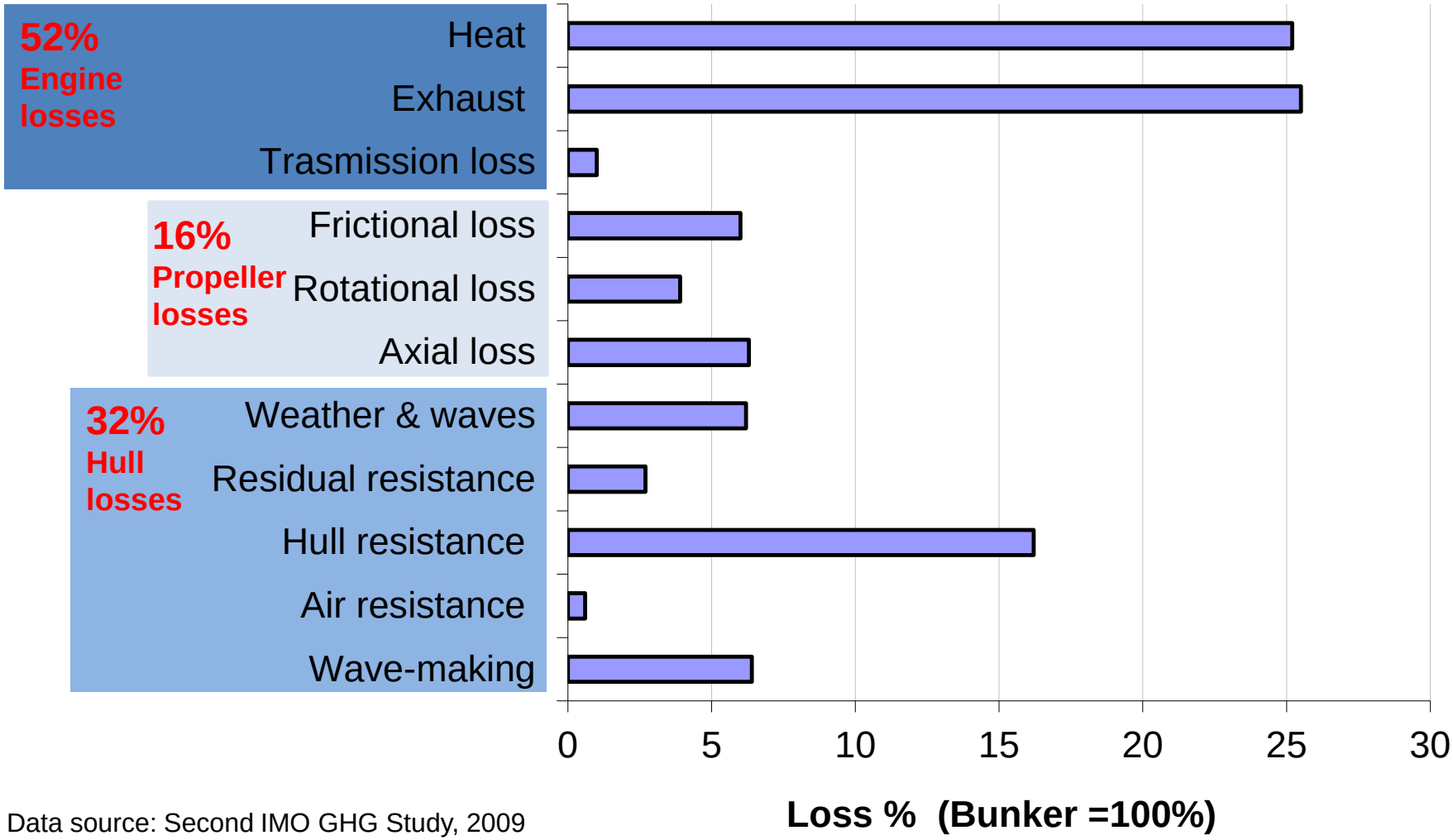
EEDI Impact on Designs

- Introduction of EEDI promotes optimization in all aspects of ship design:
  - Reduce resistance
  - Reduce losses
  - Improve propulsive efficiency
  - Recover waste heat
  - Increase cargo carrying capacity
  - Reduce speed
  - ….



Reduce Energy Losses

Typical distribution of energy losses for a tanker in BF6

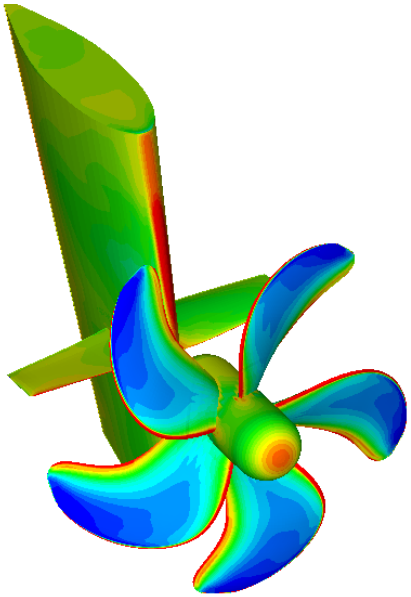


Data source: Second IMO GHG Study, 2009

Off-the-shelf Solutions

- Engine losses
- Propeller Losses
- Hull losses

- Waste-heat recovery systems
- (Organic Rankin Cycle)
- Ducts
- Energy-saving devices for propeller
- Contra-rotating propellers
- CLT, Kappel propeller
- PBCF
- LSE coating
- Hull, bow, stern optimization
- (Air lubrication)
- ….



Improving designs…

- Hull form, bow and stern redesigned and optimized for a range of operational drafts and sea states
- Improved propeller design methodology – considering propeller-rudder interactions and operating profile
- Improved engine technology: electronic control; variable-nozzle turbochargers; longer stroke….spread fuel efficiency across wider operating load range
- Twin-screw? Higher propulsive efficiency at expense of first cost
- …

IMO assessment of
Energy Efficiency Measures

- **Reduce** air/wind resistance
  - optimize superstructures
- **Reduce** wave-making resistance by shape of stern
  - Optimize stern shape
- **Reduce** friction resistance
  - Low friction coating
  - Air lubrication
- **Improve** propeller efficiency
  - Pre-swirl fins
  - Stern duct
  - Post-swirl systems
  - Sprit stern
  - Hybrid pods
  - Contra-rotating propeller
- **Waste** heat recovery system

	300,000dwt Tanker			12,000teu Containership		
	1	2	3	1	2	3
optimize superstructures						x
Optimize stern shape				x	x	x
Low friction coating	x			x		
Air lubrication		x	x		x	x
Pre-swirl fins	x	x	x			
Stern duct						
Post-swirl systems						
Sprit stern			x			x
Hybrid pods						
Contra-rotating propeller		x	x	x	x	x
	x	x	x	x	x	x
Improvement rate of main engine fuel oil consumption	14.5%	26.1%	37.7%	13.4%	17.1%	29.2%

Data source: MEPC 60/4/36 – 16 Jan 2010

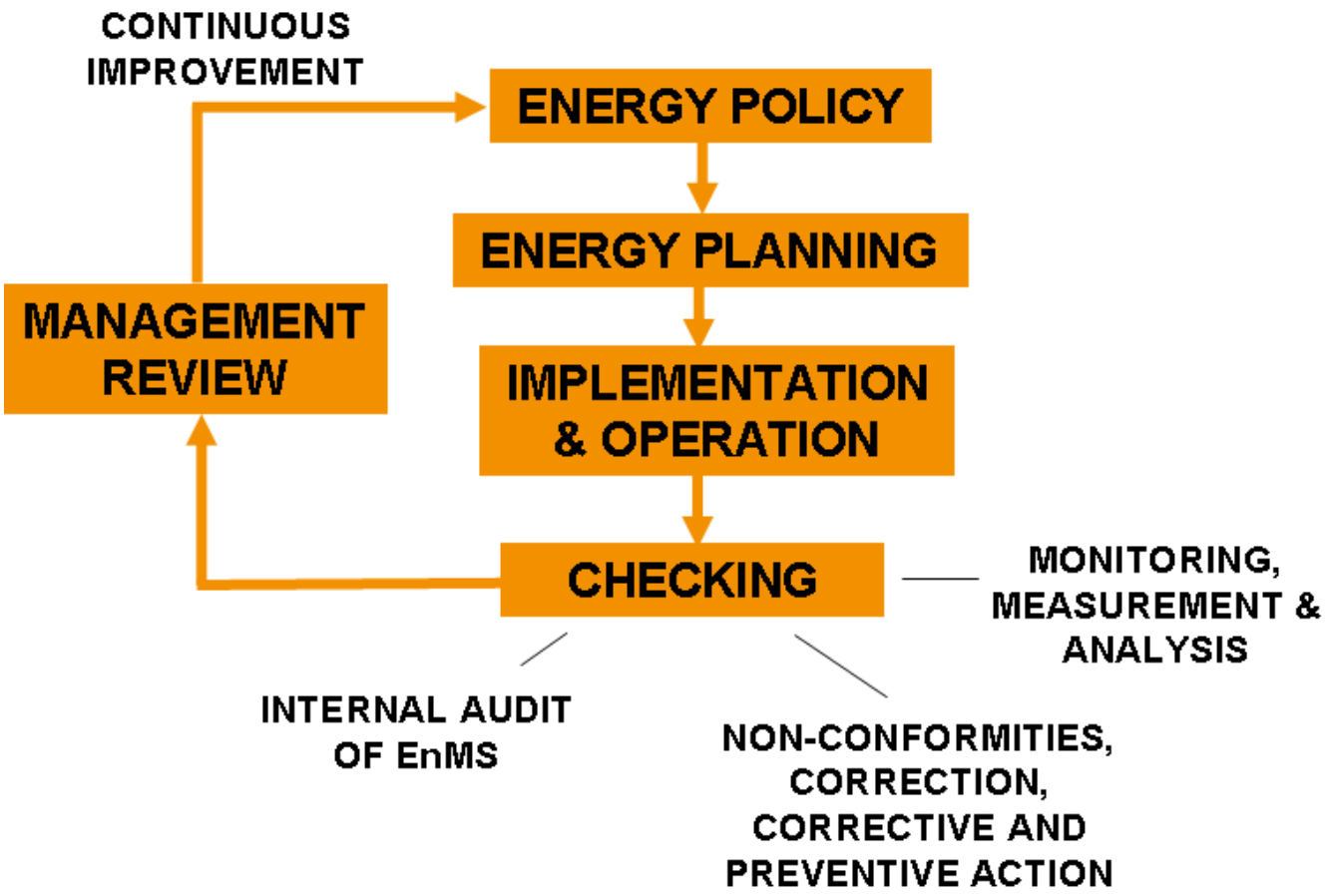
SEEMP Impact on Operations

- **Formalized** energy management on board ships
- **Apply** principle of continuous improvement
- **Apply** industry best practices
  - Hull and propeller maintenance
  - Voyage optimization
  - Machinery optimization
  - Measurement, monitoring, evaluations, benchmarking
- **Crew** training, awareness, buy-in

Industry Guidelines

- MEPC.1/Circ.683 Guidance for the development of SEEMP (as amended)
- INTERTANKO Guide for a Tanker Energy Efficiency Management Plan, 2010
- OCIMF Energy Efficiency and Fuel Management, 2009
- INTERTANKO/OCIMF Virtual Arrival, 2011
- ExxonMobil MESQAC 2010
- MEPC 62/INF.10 Example of SEEMP

ISO 50001:2011 Energy Management Systems



- ABS offers ISO 500001certification under Marine HSQE

Summary

- EEDI and SEEMP provides regulatory & practical framework to advance energy efficiency
- EEDI sets the “floor” for an energy efficiency standard by design
- SEEMP implements energy efficiency measures in operations
- Continuous improvement in energy efficiency
  - Raise the floor for EEDI
  - “*Plan-Do-Check-Act*” in SEEMP

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