Outline of CO_2 Emissions Regulation Measures in IMO and impact on the shipbuilding Industry

3rd ASEF in China

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- **Background**
  - **Circumstance of Global Warming**

Reduction of GHG Emissions from Shipping

UNFCCC : KYOTO PROTOCOL (December, 1997)

- **The Parties included in Annex I shall pursue limitation or reduction of emissions of greenhouse gases not controlled by the Montreal Protocol from Aviation and Marine Bunker Fuels, working through the International Civil Aviation Organization (ICAO) and the International Maritime Organization (IMO).**
- **The Parties included in Annex I shall ensure that their aggregate anthropogenic carbon dioxide equivalent emissions of the greenhouse gases do not exceed their assigned amounts, with a view to reducing their overall emissions of such gases by at least 5 per cent below 1990 levels in the commitment period 2008 to 2012.**

IMO POLICIES AND PRACTICES : Resolution A.963(23) (Dec., 2003)

- **Establishment of a GHG Emission Baseline**
- **Development of a Methodology to describe a GHG Emission Index**
- **Development of Guidelines of GHG Emission Indexing Scheme**
- **Evaluation of Technical, Operational and Market-Based Solutions**
- **Development a Work Plan with a Timetable**
- **Review on the continuing IMO Policies and Practices**
- **Co-operation with UNFCCC and ICAO**

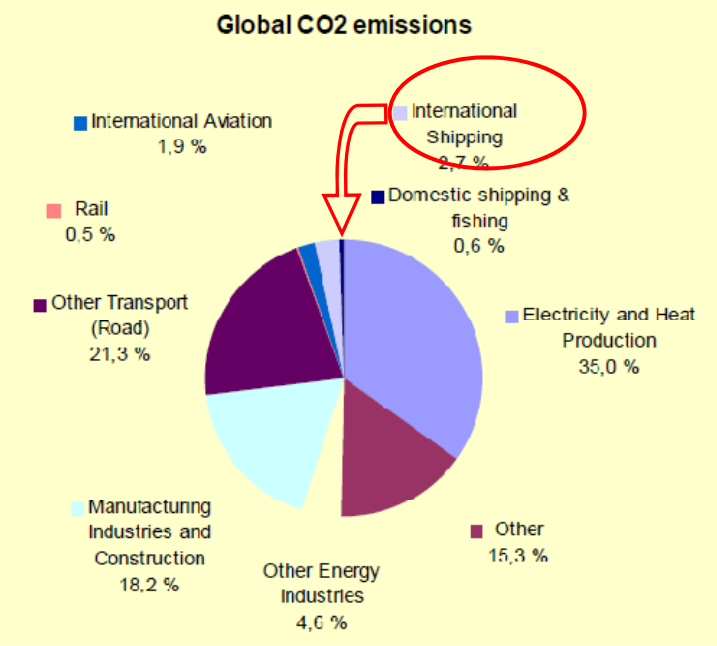
Source: IMO MEPC59/INF.10

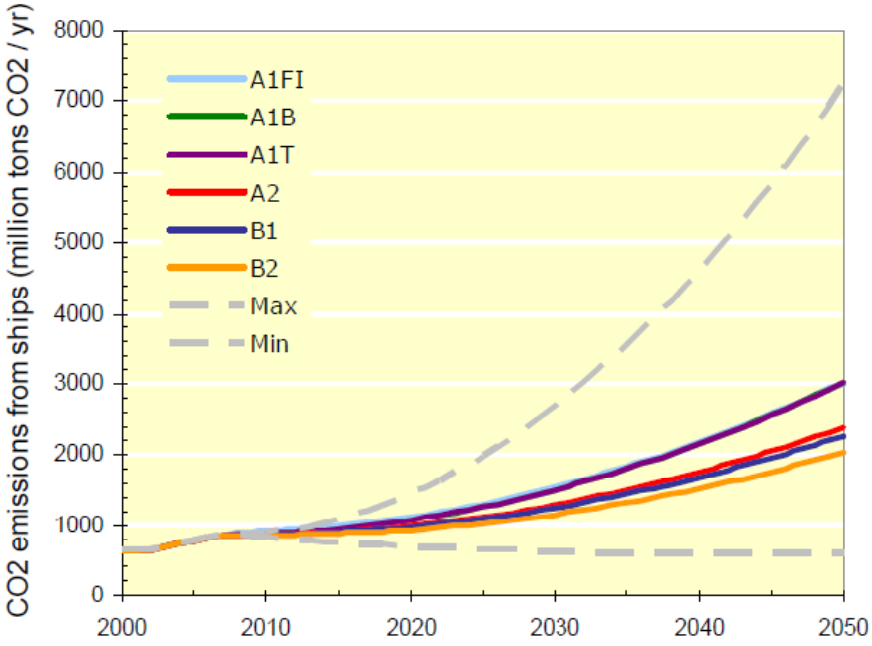
The Second IMO GHG Study 2009

International shipping emitted 870 million tonnes (approx. 2.7% of the global total.

Technical and operational measures has the potential to reduce the emissions rate by 25% to 75% below the current levels.

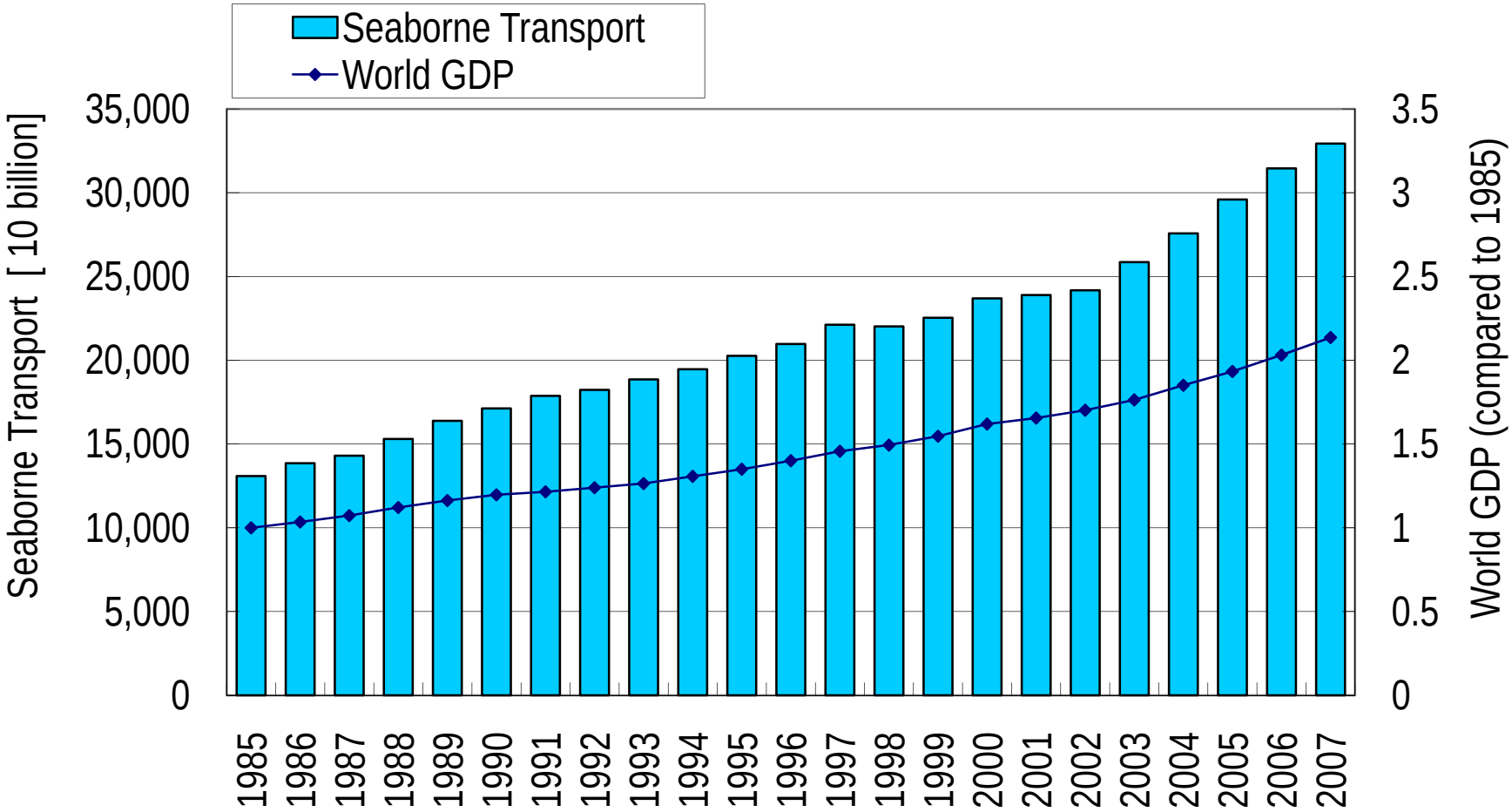
In the absence of global policies to control GHG emissions, the emissions could increase between 150% to 250% by the year 2050 due to the expected growth in international trade.





Source: IMO MEPC59/INF.10

Seaborne Transport & World GDP



- **Outline of CO_2 Emissions Regulation Measures in IMOs**

Outline of CO_2 Emissions Regulation Measures in IMO

CO_2 Emission (g) = Transportation (ton-mile) x Emission Efficiency (g /ton-mile)

How to Reduce ?

A Reduce the amount of Transportation → Affect Sea trade

B Improve Efficiency

B-1 TECHNICAL

B-2 OPERATIONAL

Market Based Measures

MBI: Market-Based Instrument

- Global Emission Trading Scheme (ETS)
- Global Contribution Scheme (Levy)
- Other

B-1 TECHNICAL

EEDI

(Energy Efficiency Design Index)

Performance at the stage of design and construction by ;

- Calculating attained EEDI
- Verifying EEDI
- Reduce Required EEDI step by step

B-2 OPERATIONAL

SEEMP

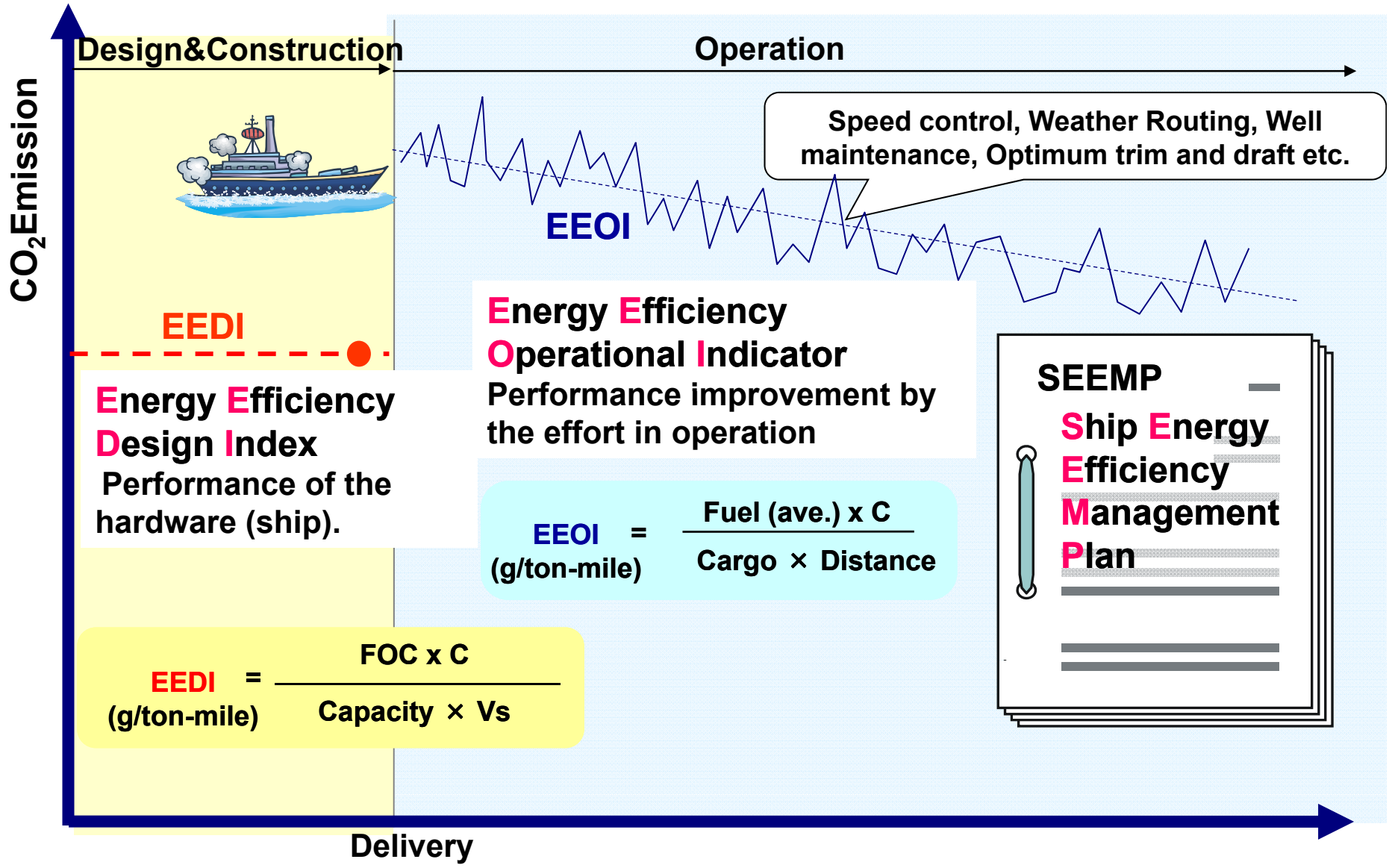
(Ship Energy Efficiency Management Plan)

Performance improvement in operation by ;

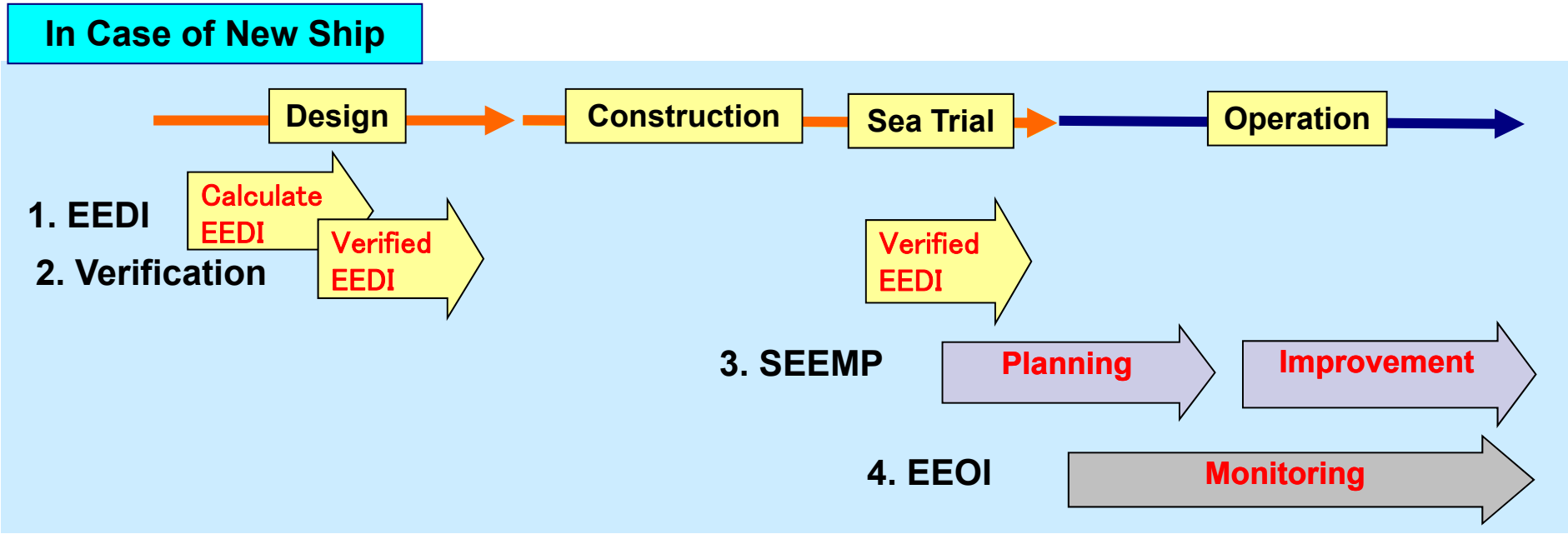
- Onboard Management plan
- Monitoring EEOI (Energy Efficiency Operational Indicator)

Technical & Operational Measures → MEPC Circulars

Technical & Operational Measures ; EEDI, EEOI & SEEMP



How to use Technical & Operational Measures



Technical and operational measures ; developed in MEPC.59

→ Trial purposes or Voluntary Implementation

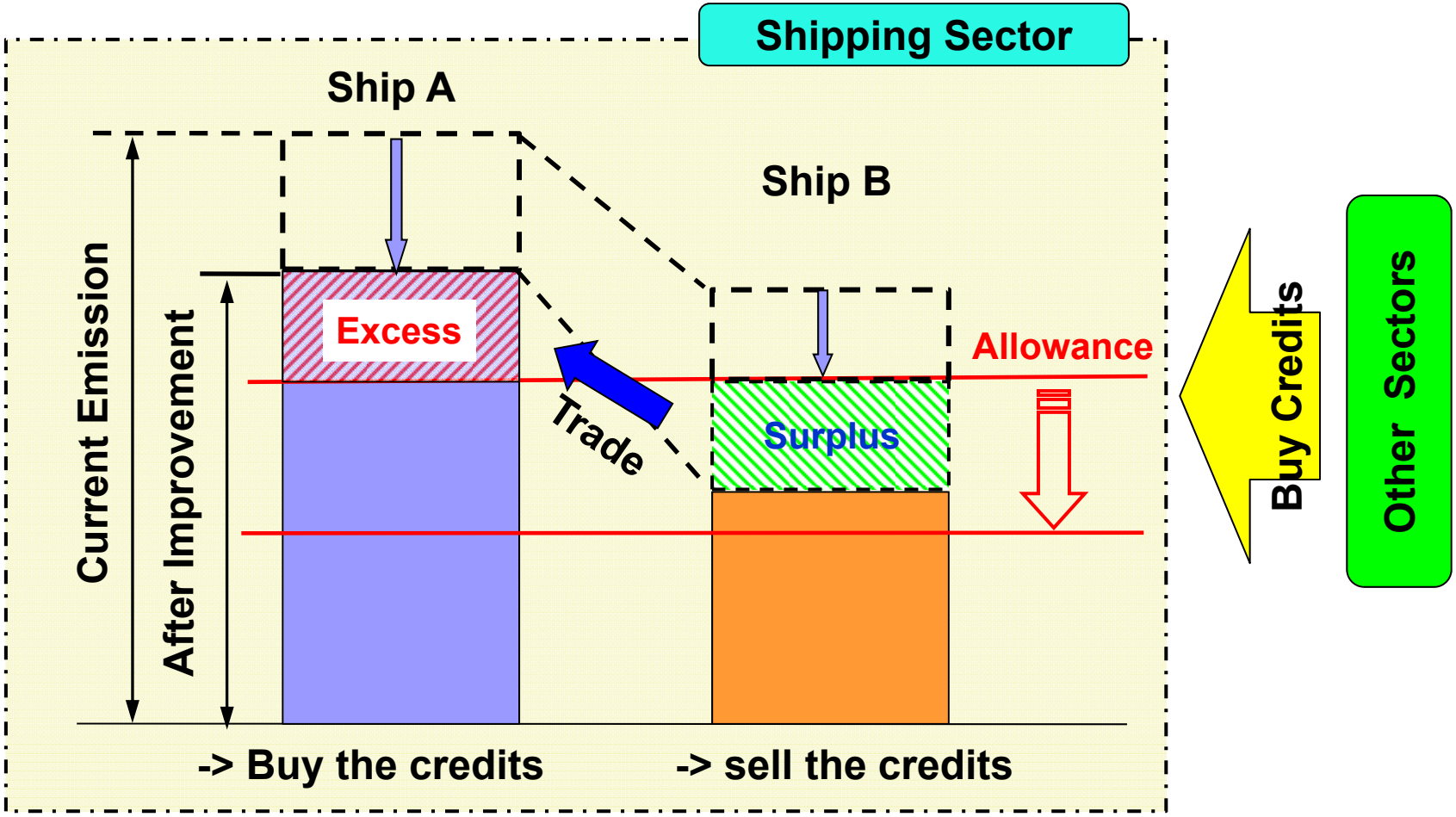
1. Interim Guidelines on the method of calculation of the EEDI (MEPC.1/Circ.681)

2. Interim Guidelines for voluntary verification of the EEDI (MEPC.1/Circ. 682)

3. Guidance for the development of a SEEMP (MEPC.1/Circ. 683)

4. Guidelines for voluntary use of the EEOI (MEPC.1/Circ.684)

Concept of Maritime Emission Trading Scheme (ETS)



If total allowance for the shipping sector total is small, Shipping Sector should purchase credits continuously !

Concept of Global Contribution Scheme (Levy)

Contributions
(per unit fuel)

GHG Fund

Refund

Labeling
Evaluated by EEOI records

- **Mitigation and Adaptation projects**
- **R&D on low emission ships**
- **IMO – Technical Cooperation**
- **Human resource development**
- **Investment on Infrastructure**
- **Development of ship recycling capability**

Leveraged Incentive for Efficiency Improvement
The effort will be rewarded by refund

Contributing to the adaptation of developing countries and to investment to reduce CO_2 emission

(MEPC 59/4/34)

Current Status (MEPC59) and Future Plan

Legal Instrument ; Defer consideration of all documents addressing the type of legal instrument and application issues, when the issues could be discussed in light of the outcome of COP 15 (Dec., 2009 in Copenhagen)

Market-based measures ; agreed work plan;

- **MEPC 60 to consider, on the basis of further detailed outlines of possible market-based measures, the methodology and criteria for feasibility studies and impact assessments.**
- **MEPC 61 to clearly indicate which market-based measure the Committee wishes to evaluate further**
- **MEPC 62 to report its progress to the 27th Assembly**

Position of IMO ; Any regulatory scheme should be developed and enacted by IMO

Mitigation and Adaptation ; Greater part of any funds by MBI to be used for climate change purposes in developing countries (general preference)

- **Development of Technical and Operational measures**

EEDI; Energy Efficiency Design Index

Formula of EEDI ; Interim Guidelines for New Ships(MEPC.1/Circ.681)

Emission

Reduction due to innovative technology

from M/E

from Aux. Engine

from Shaft Motor

$$\frac{\left(\prod_{j=1}^{M} fj\right)\left(\sum_{i=1}^{nME} P_{ME(i)} \cdot C_{FME(i)} \cdot SFC_{ME(i)}\right) + \left(P_{AE} \cdot C_{FAE} \cdot SFC_{AE}{}^{*}\right) + \left(\left(\prod_{j=1}^{M} fj\right)\sum_{i=1}^{nPTI} P_{PTI(i)} - \sum_{i=1}^{neff} f_{eff(i)} \cdot P_{AEeff(i)}\right) C_{FAE} \cdot SFC_{AE} - \left(\sum_{i=1}^{neff} f_{eff(i)} \cdot P_{eff(i)} \cdot C_{FME} \cdot SFC_{ME}\right)}{fi \cdot Capacity \cdot V_{ref} \cdot f_w}$$

P_{ME}, P_{AE} : Power of main and auxiliary engines

P_{PTI} : Power consumption of each shaft motor

P_{AEeff} : Main engine power reduction due to innovative mechanical energy efficient technology

P_{eff} : Auxiliary power reduction due to innovative electrical energy efficient technology

C_{FME}, C_{FAE} : non-dimensional conversion factor between fuel consumption and CO_2 emission based on carbon content. (Table given)

SFC_{ME}, SFC_{AE} : certified specific fuel consumption of main and auxiliary engines

fj : correction factor to account for ship specific design elements (for ice-class, table given)

fi : the capacity factor for any technical/regulatory limitation on capacity (for ice-class, table given)

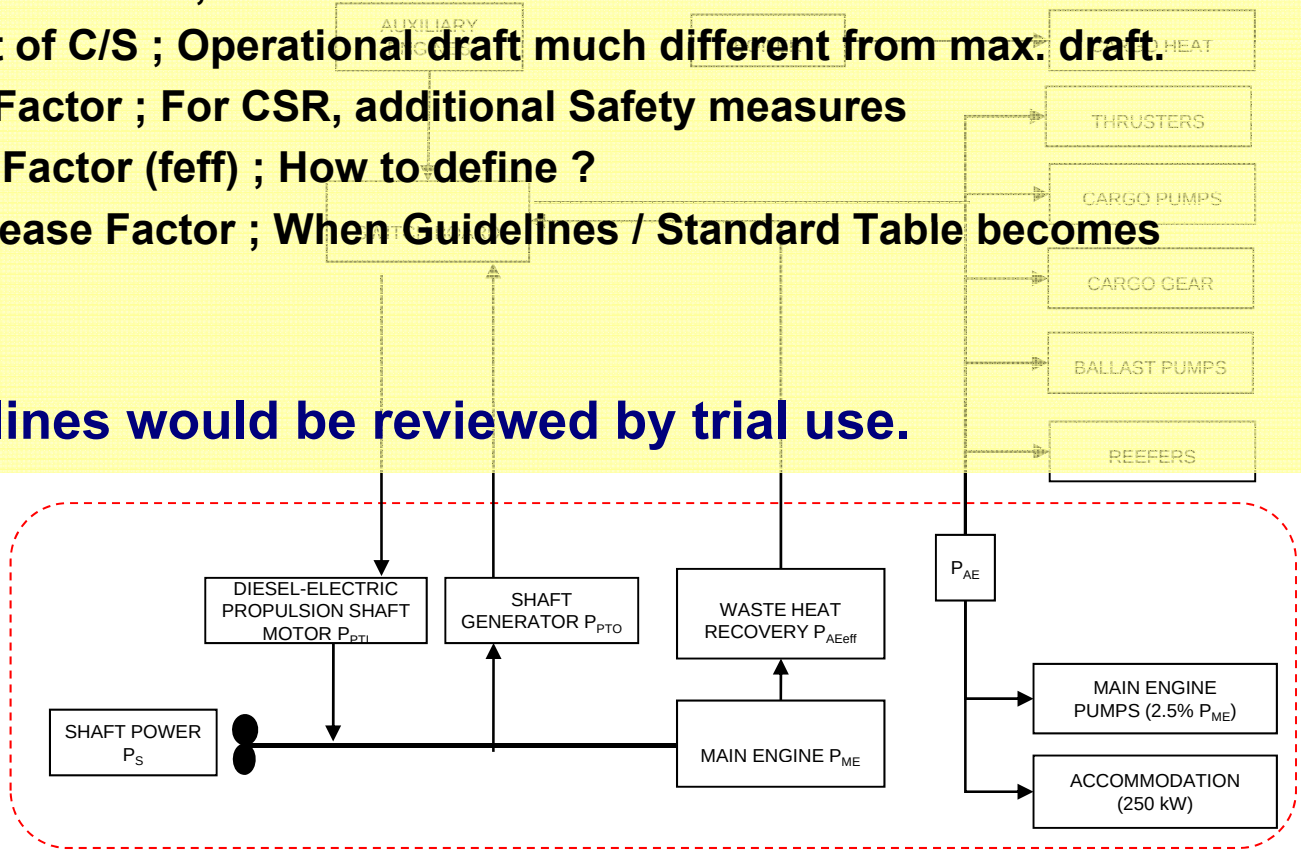
fw : non-dimensional coefficient indicating the decrease of speed in BF6. (=1.0)

feff : availability factor of each innovative energy efficiency technology.(=1.0 for waste energy recovery system)

Major Outstanding issues on EEDI

- Formulation ; Still matured ?
- Type of the vessel ; Dominant Ship Type Only ?
- Non-Conventional Type of the Vessel ; How to treat ?
  Turbine Propulsion, Diesel – Electric Propulsion , Hybrid Propulsion
- Electric Power Table ; Can be verified ?
- Deadweight of C/S ; Operational draft much different from max. draft.
- Correction Factor ; For CSR, additional Safety measures
- Availability Factor (feff) ; How to define ?
- Speed Decrease Factor ; When Guidelines / Standard Table becomes available ?

→ Guidelines would be reviewed by trial use.

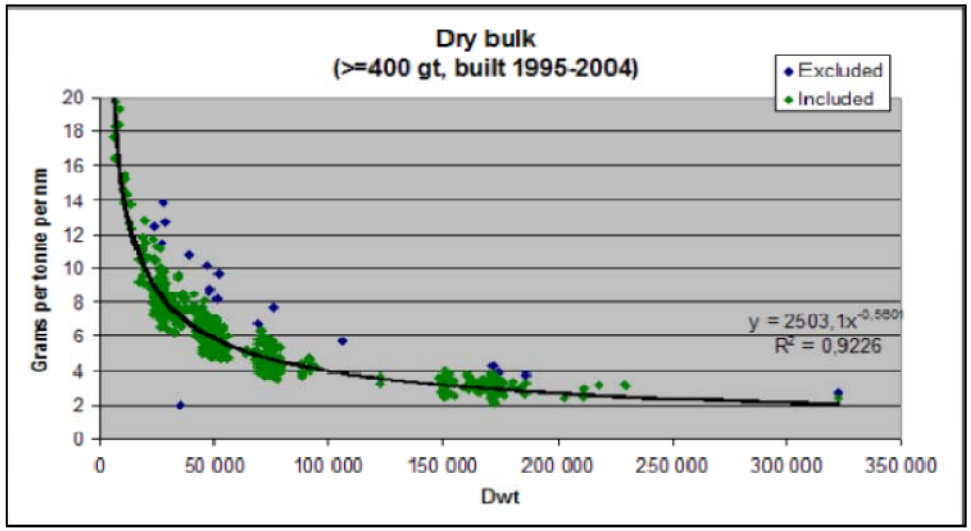


Formula for Establishing EEDI Baseline

- Basic Concept of Regression Formula (Proposed by Denmark MEPC58/4/8)
- Exponential Regression to be applied for new vessels built in last 10 years

$$Baseline\ value = a \cdot Capacity^{-c}$$

- Lloyd's Register Fairplay's database is used currently
- However, comments are raised regarding computation method, database accessibility, integrity and interpretation, etc.
- Concerns are expressed about the effect of new rules (CSR, NOx Tier2), penalization of safety equipment / facilities in excess of rule requirement, voluntarily
- Ships which has Non-Conventional propulsion system (Steam Turbine, Electric-Diesel) need further consideration
- Parameters should be decided in transparent manner within IMO



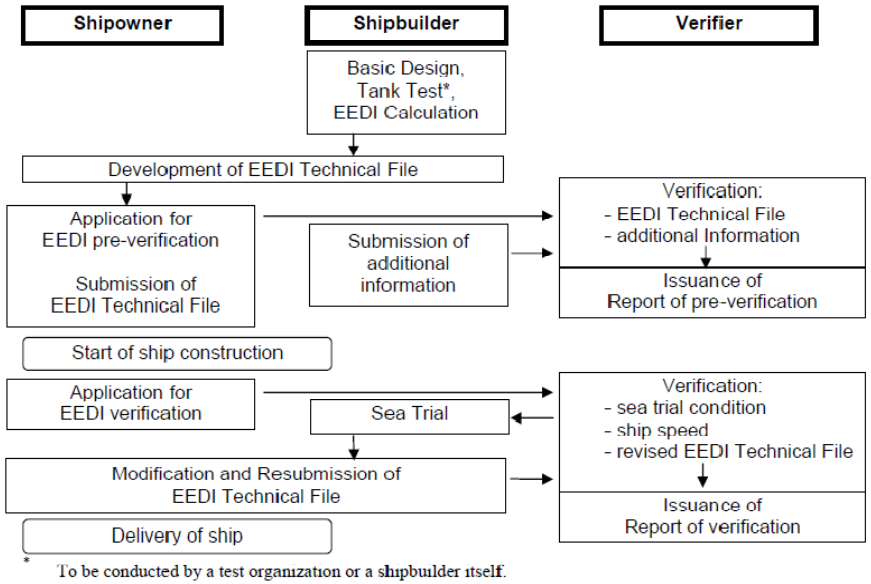
Source: IMO MEPC58/4/8

Verification of EEDI

- Interim Guidelines for Voluntary Verification (MEPC.1/Circ.682) ;
- Two stages ; Preliminary at design, and Final at Sea Trial
- Technical File ; DWT, MCR, SFC, Power Curve, etc.
- Speed ; verified by Model Test at design stage and by Sea Trial in final

➔In a long history of Shipbuilding Industry, Speed has never been verified by 3rd party.

- Additional Information ; Detail Report of model test, Lines, Calculation Process, Model-Ship correlation, Lightweight (To protect shipbuilders' confidential information, it should be provided directly to the verifier).
- Sea Trial ; Verifier attend. Measurement and Analysis method should be verified by attending verifier and document.
- Guidelines would be reviewed by trial use.



Basic Flow of Verification Process

EEOI ; Energy Efficiency Operating Indicator

Guidelines for Voluntary use(MEPC.1/Circ.684);

EEOI = [Mass of CO_2] (t) / [Transportation Work] (ton-mile)

→Represents Operation Efficiency over a consistent period (trading pattern)

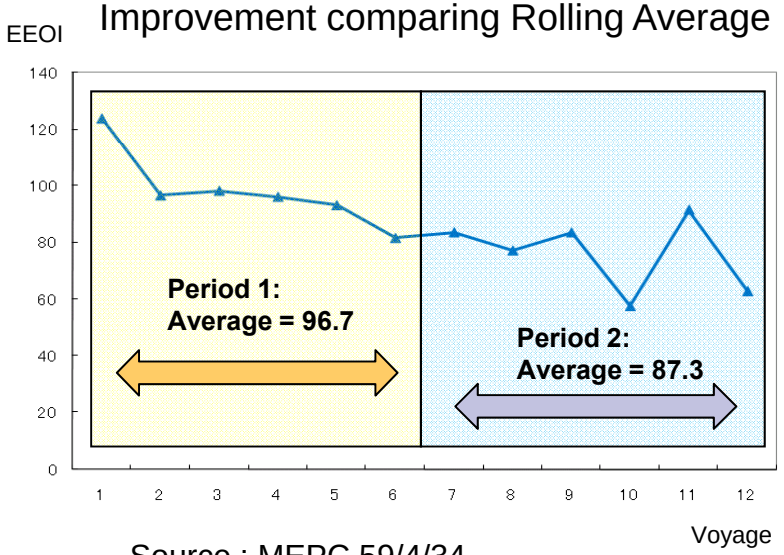
When it applies voyages in some period, it gives average EEOI (Rolling Average)

CO_2 Indicator Report (example)

NAME AND TYPE OF SHIP						
Voyage or day (i)	Fuel consumption (FC) at sea and in port in tonnes				Voyage or time period data	
	Fuel type (HFO)	Fuel type (LFO)	Fuel type ( )		Cargo (m) (tonnes or units)	Distance (D) (NM)
1	20	5			25,000	300
2	20	5			0	300
3	50	10			25,000	750
	10	3			15,000	150

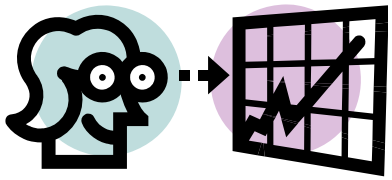
$$EEOI = \frac{100 \times 3.114 + 23 \times 3.151}{(25{,}000 \times 300) + (0 \times 300) + (25{,}000 \times 750) + (15{,}000 \times 150)} = 13.47 \times 10^{-6}$$

Improvement comparing Rolling Average



Source ; MEPC 59/4/34

Monitoring on a regular basis and verified by internal audits under ISM Code.



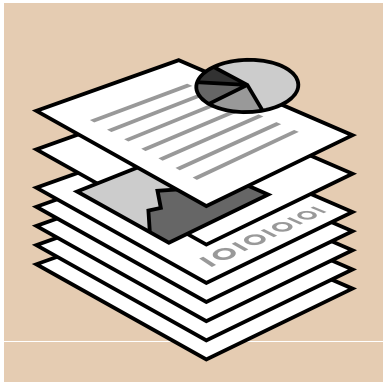
SEEMP ; Ship Energy Efficiency Management Plan

Guidance for the Development of SSEMP(MEPC.1/Circ.683);

- Documentation for establish internal mechanism to improve Energy Efficiency
- Linked to Corporate Energy Management Policy (EMS)
- 4-Steps;
  - 1. Planning
  - 2. Implementation
  - 3. Monitoring
  - 4. Self-Evaluation and Improvement
- Goal Setting ; voluntary (no need to announce to the public)
- Best Practice for Energy Efficient Operation could be selected

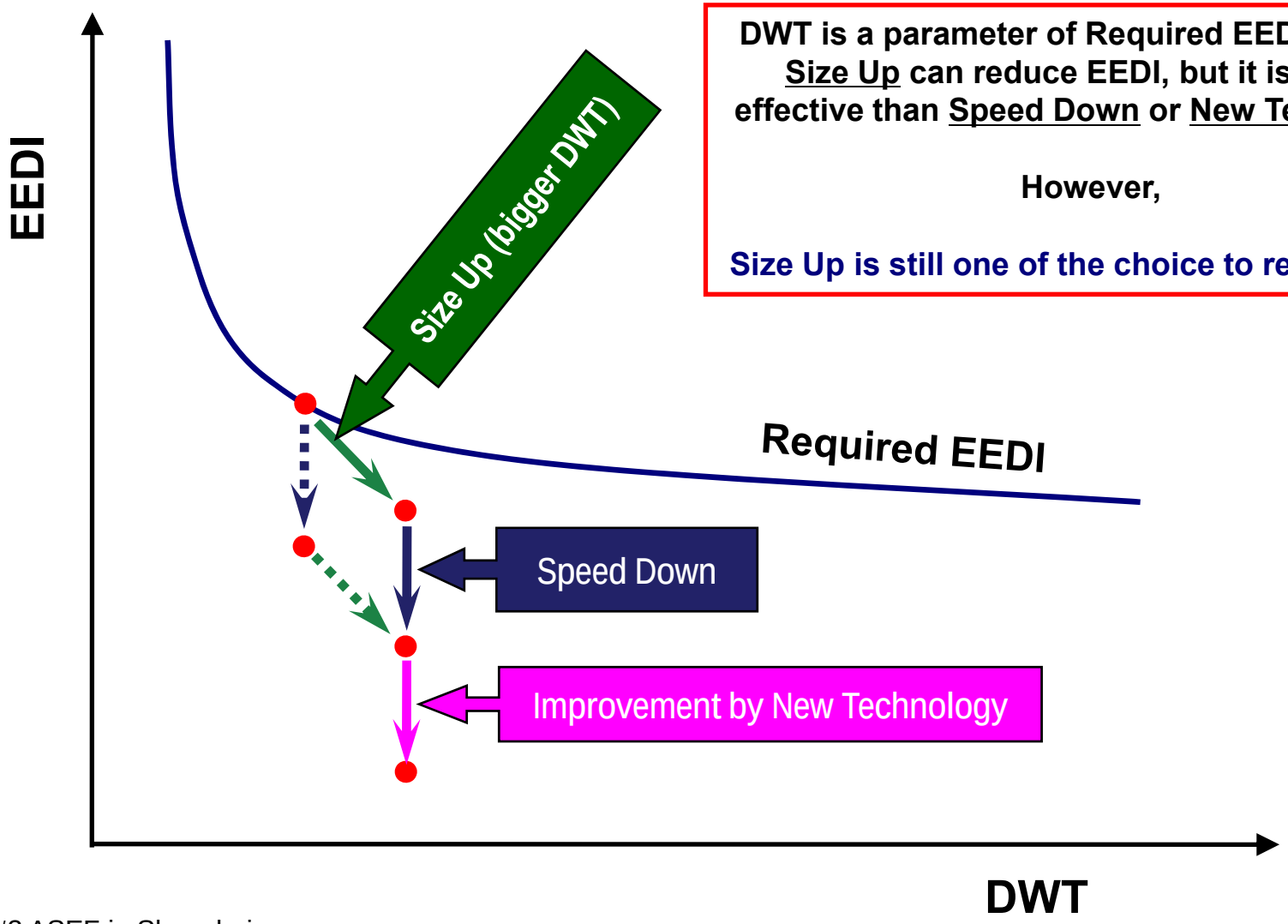
Information on Described on SSEMP

1. Measures to improve Energy Efficiency
2. Method / Tools of Monitoring
3. Goal (measurable)
4. Procedures of Evaluation



- **CO_2 Emission Reduction Technologies**

Reduction Measures of EEDI



DWT is a parameter of Required EEDI formula. Size Up can reduce EEDI, but it is not so effective than Speed Down or New Technology.

However,

Size Up is still one of the choice to reduce CO2!

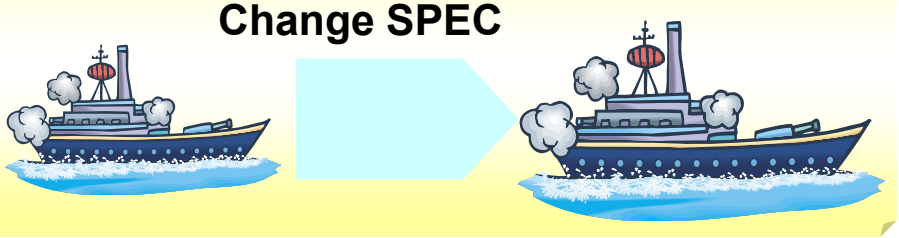
Efficiency Improvement Scenario

New ship

(MEPC 59/INF.27)

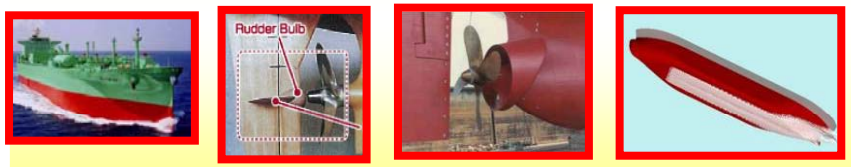
Speed reduction/Enlargement

Change SPEC



Application of New technology

Introduce New technologies



Implementation of case study

Efficiency Improvement Scenario of New ships

Contract	2012-2016	2017-2021	2022-2026	2027-2031	2032-2036
Delivery	2015-2019	2020-2024	2025-2029	2030-2034	2035-2039
Bulk/General Cargo	25%	40%	45%	50%	50%
Tanker	35%	40%	55%	55%	55%
VLCC	40%	50%	60%	60%	60%
Container	35%	45%	55%	65%	70%

Existing ship

10% speed reduction (as to container ships, 15% speed reduction)

Estimated Efficiency Improvement for new ships

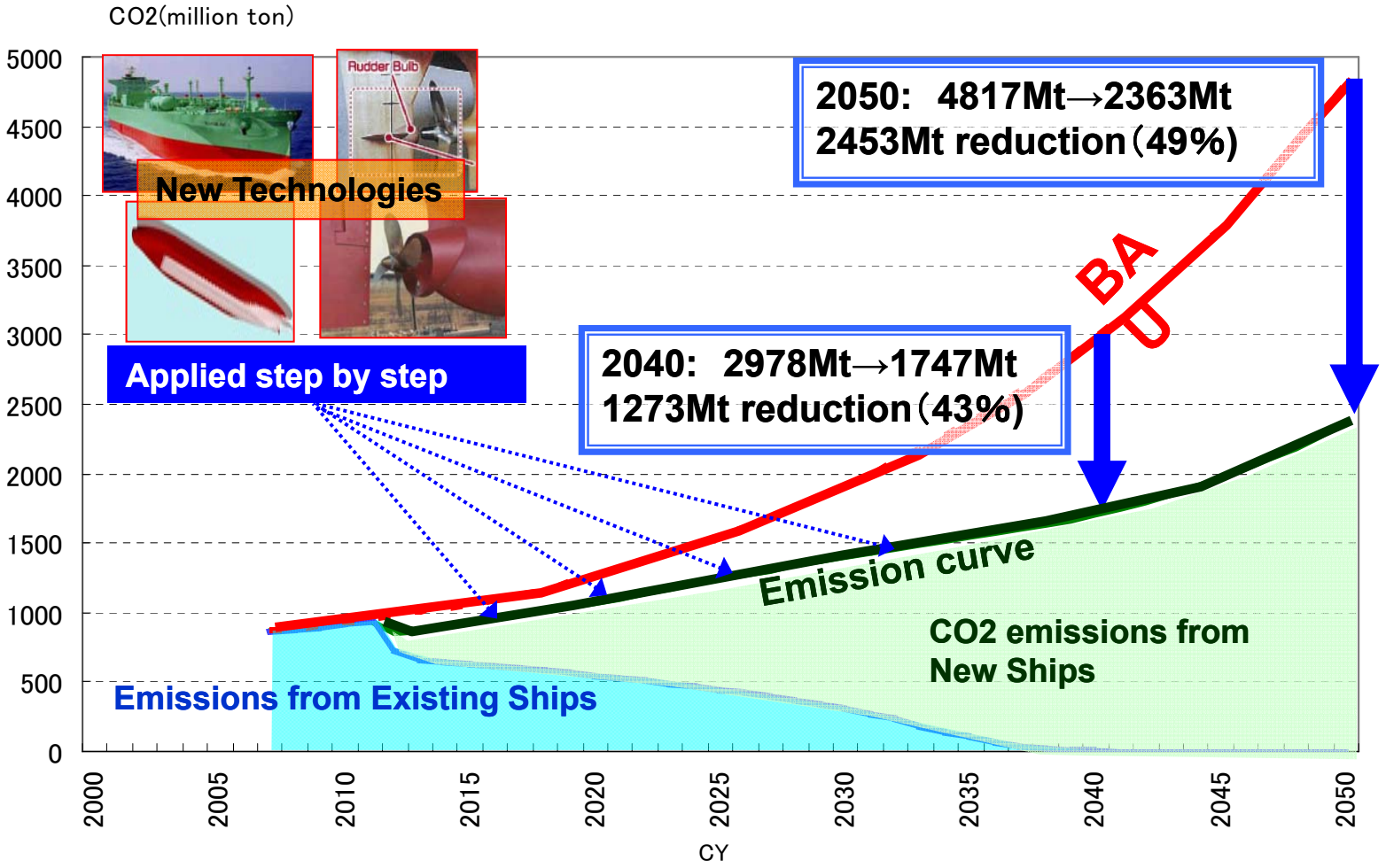
- in the case of Panamax Bulker

		Present	2012-2017 2015-2020	2022-2027 2025-2030	Note
Speed & Size	Speed (kt)	14.0	12.6 (10.0%dwn)	12.5 (10.7%dwn)	Min.12.5kt
	DWT	83,000	91,300 (15.0%up)	99,500 (20.0%up)	
	EEDI	3.72	2.94 (- 21.0%)	2.81 (-24.5%)	
New Tech.	wave making resistance	—	○	○	
	CRP	—	○	○	
	Low Resistance Rudder	—	N/A	○	
	Stern Shape	—	N/A	○	
	Spray Prevention	—	N/A	○	
	Air Lubrication	—	N/A	○	
	Multi Shafts	—	N/A	○	
	Improvement	—	9.95%	31.44%	
EEDI		3.72	2.65 (- 28.8%)	1.93 (-48.2%)	

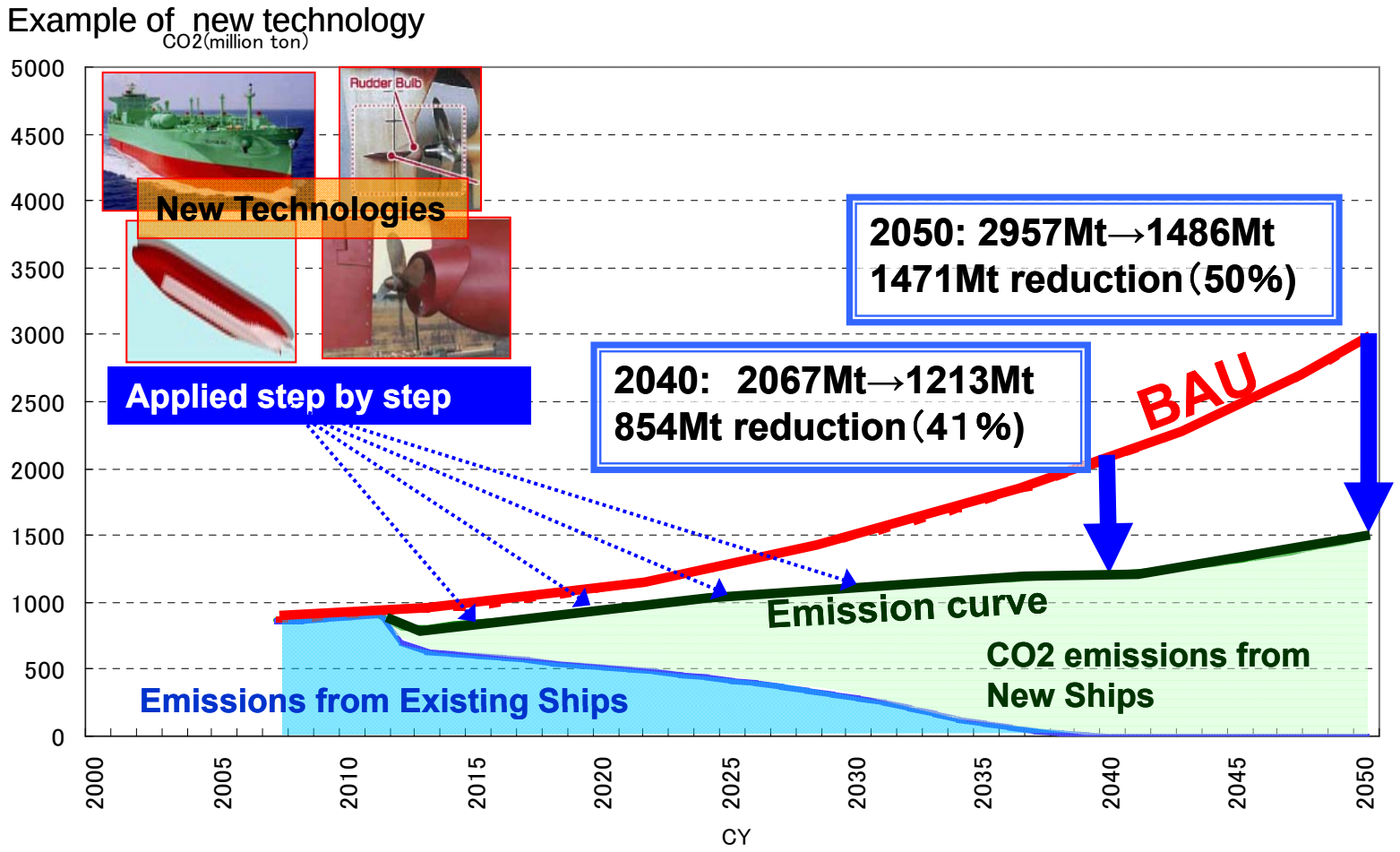
(Details in MEPC 59/INF.27)

New technologies indicated above are examples.

Projection of CO2 Emission（A1B Base)



Projection of CO2 Emission（B2 Base)



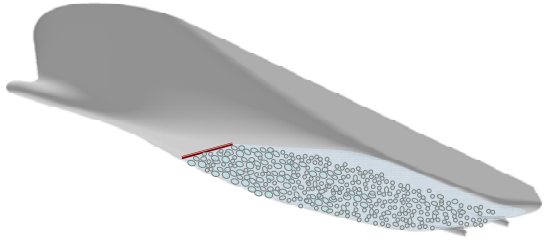
Conclusion ; Impact on Shipbuilding Industry

- Development of CO_2 Emissions Regulation Measures is still in progress. and it should be managed by IMO. Regulations should be transparent and eliminate escape route.
- Energy Efficient Technologies is effective not only against Global Warming but also Shipping Economy.
- Near Future, when Shipping Sector face the lack of Bunker Oil and its price increase, operator will easily recover initial investment of Energy Efficient Technologies. Also, the price must be pushed by the demand for Low Sulfur Fuel (1,000$/t ?).
- Cost Effective Technical Measures to reduce CO_2 emissions would be a lot and it is not a dream to achieve 50% reduction.
- It is obvious that Shipping is the most energy efficient transportation mode in the world.
- Shipbuilding industry should continue the efforts to develop new technologies to reduce /eliminate CO_2, which support sustainable growth of shipping industry.

NYK Super ECO SHIP 2030 http://www.nyk.com/english/csr/envi/ecoship.htm

Solar Panel

Hybrid CRP POD Propulsion



Air Lubrication System