IMO's work to address GHG emissions from international shipping focusing on technical cooperation and capacity building work to support the implementation of international regulations on energy efficiency for ships

UNFCCC Technical Experts Meeting, May 2016



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International Maritime Organization

- A specialized agency of the UN
- The IMO Convention adopted in 1948 and IMO first met in 1959
- 171 Member States
- Develop and maintain a comprehensive regulatory framework for shipping
- Safety, environment, legal matters, technical co-operation, security and the efficiency of shipping

Safe, secure and efficient shipping on cleaner oceans

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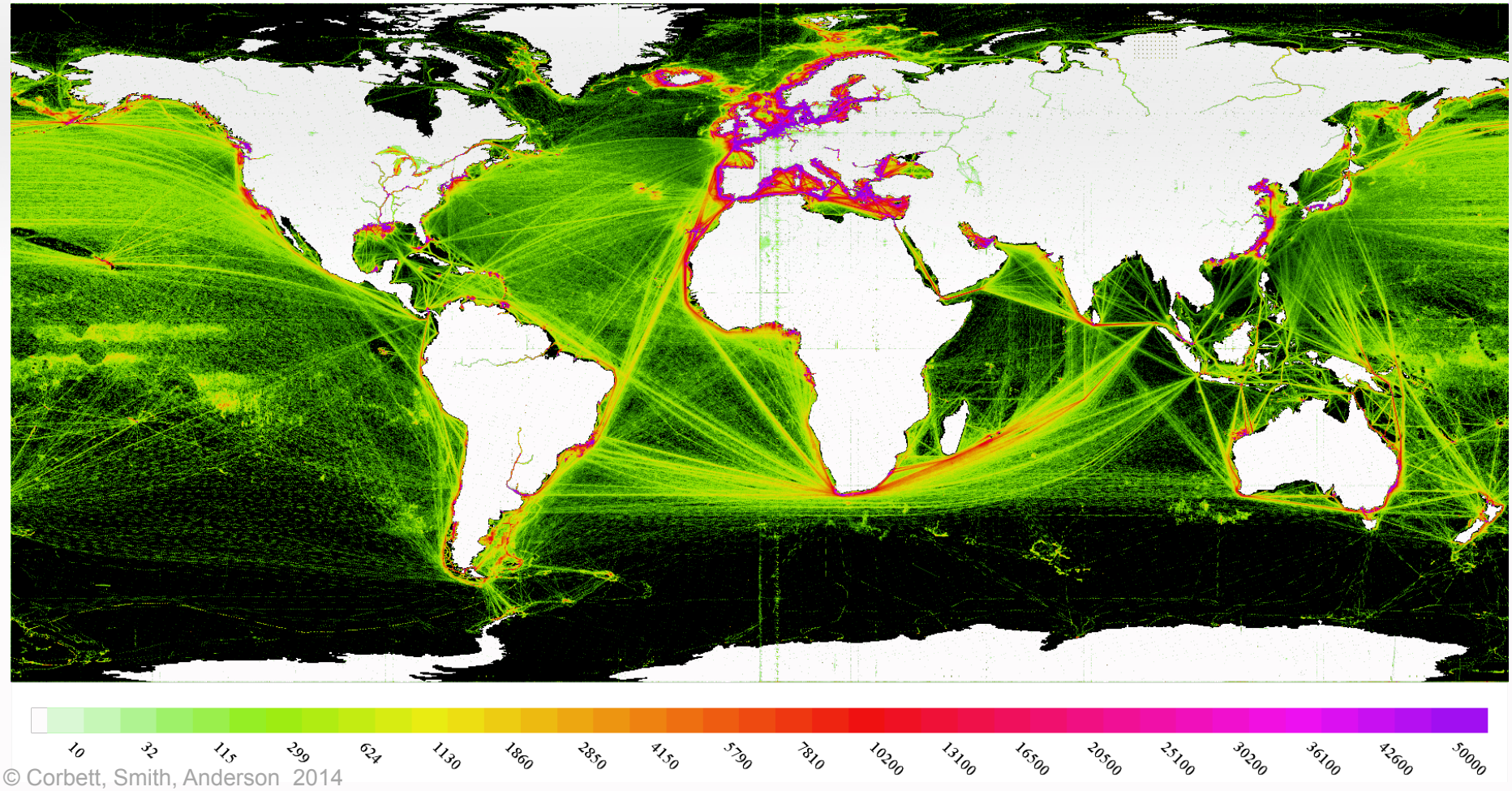
Global ship traffic patterns

ILMATIETEEN LAITOS
METEOROLOGISKA INSTITUTET
FINNISH METEOROLOGICAL INSTITUTE



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Source: Third IMO GHG Study 2014

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Possible trade growth

- Food, energy, raw materials and finished products
- Around 90 % of global trade by volume

Source: "Global Marine Trends 2030", Lloyd's Register/ QinetiQ/University of Strathclyde, 2013

GHG emissions from ships

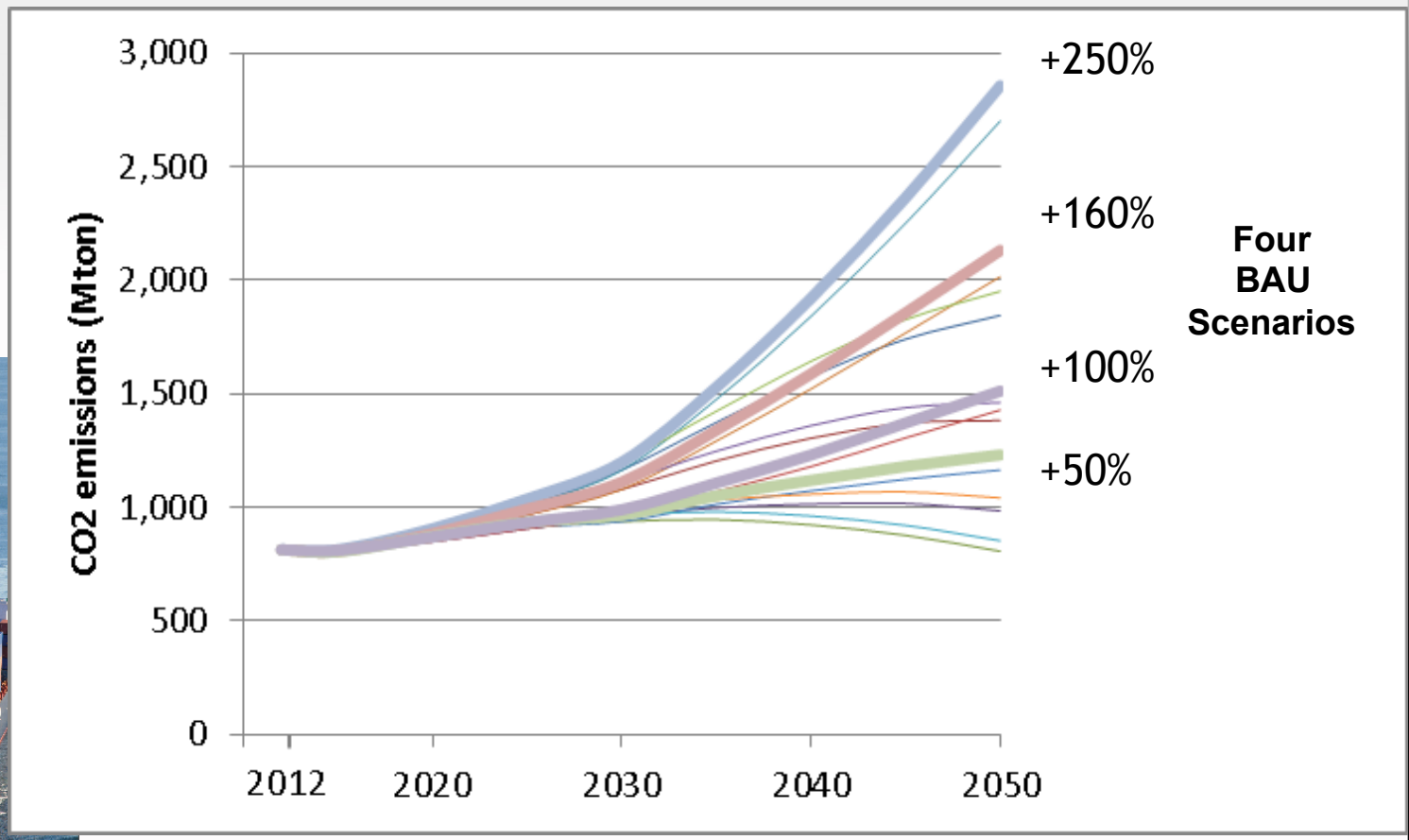
Third IMO GHG Study 2014

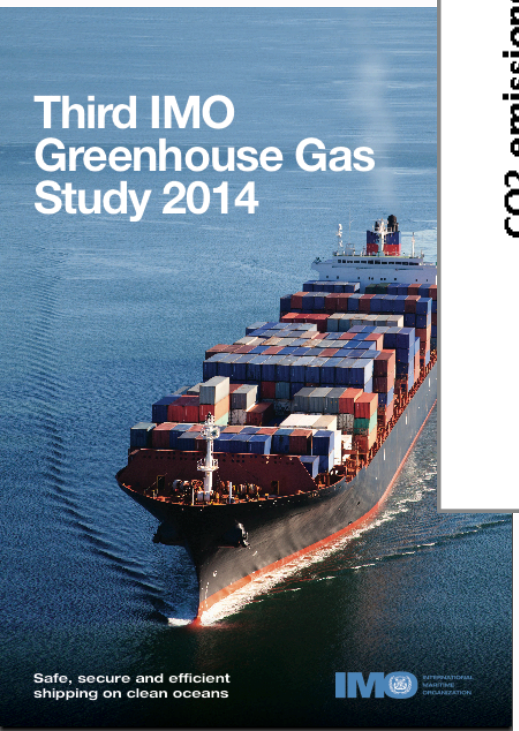
Study found that for international shipping, the CO_2 estimate dropped from **2.8% in 2007** to **2.2% in 2012**.

Year	Global CO_2[1]	IMO GHG Study 2014 CO_2 Total shipping	Percent of global	International shipping	Percent of global
2007	31,409	1,100	3.5%	885	**2.8%**
2008	32,204	1,135	3.5%	921	2.9%
2009	32,047	978	3.1%	855	2.7%
2010	33,612	915	2.7%	771	2.3%
2011	34,723	1,022	2.9%	850	2.4%
2012	35,640	938	2.6%	796	**2.2%**
Average	**33,273**	**1,015**	**3.1%**	**846**	**2.6%**

GHG emissions from ships

- Shipping CO_2 emissions are projected to increase by 50% to 250% in the period to 2050, despite fleet average efficiency improvements of about 40%





Download Third IMO GHG Study 2014 as free ebook from: www.imo.org

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MEPC 57 (April 2008) Fundamental principles as a basis for future regulations on GHG emissions from ships*

.1 effective in contributing to the reduction of total global GHG emissions;

.2 binding and equally applicable to all flag States in order to avoid evasion;

.3 cost-effective;

.4 able to limit, or at least, effectively minimize competitive distortion;

.5 based on sustainable environmental development without penalizing global trade and growth;

.6 based on a goal-based approach and not prescribe specific methods;

.7 supportive of promoting and facilitating technical innovation and R&D in the entire shipping sector;

.8 accommodating to leading technologies in the field of energy efficiency; and

.9 practical, transparent, fraud free and easy to administer.

* Brazil and China reserved their position

IMO work to address GHG emissions

- **IMO Resolution A.963(23) "IMO Policies and Practices Related to the Reduction of Greenhouse Gas Emissions from Ships", adopted by Assembly 23 in December 2003**
- **IMOs work to address GHG emissions has considered:**
  - Technical, Operational and Market-based Measures (MBM)

Energy Efficiency of Ships

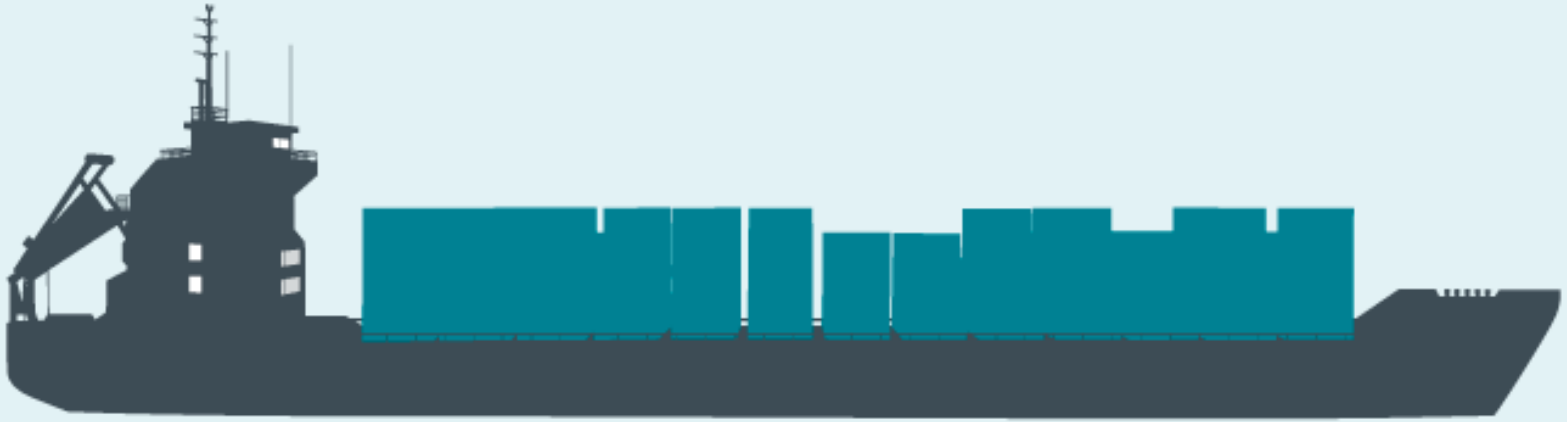
- **Energy Efficiency Design Index (EEDI)**
  - Applicable to all ships 400 gross tonnage and above
- **Ship Energy Efficiency Management Plan (SEEMP)**
  - Applicable to all ships in operation
- **Energy Efficiency Operational Indicator (EEOI) – voluntary**
- **Data collection system (approved at MEPC 69 – April 2016)**

Potential energy efficiency improvement

Operational
Weather routing **1-4%**
Autopilot upgrade **1-3%**
Speed reduction **10-30%**

Auxiliary power
Efficient pumps, fans **0-1%**
High efficiency lighting **0-1%**
Solar panel **0-3%**

Aerodynamics
Air lubrication **5-15%**
Wind engine **3-12%**
Kite **2-10%**



Thrust efficiency
Propeller polishing **3-8%**
Propeller upgrade **1-3%**
Prop/rudder retrofit **2-6%**

Engine efficiency
Waste heat recovery **6-8%**
Engine controls **0-1%**
Engine common rail **0-1%**
Engine speed de-rating **10-30%**

Hydrodynamics
Hull cleaning **1-10%**
Hull coating **1-5%**
Water flow optimization **1-4%**

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Source: International Council on Clean Transportation (ICCT), Long-term potential for increased shipping efficiency through the adoption of industry-leading practices, Wang & Lutsey, 2013

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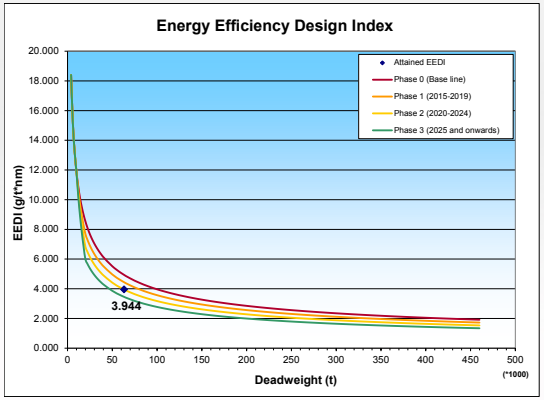
Regulatory framework – MARPOL Annex VI

Chapter 4 – Regulations on energy efficiency for ships

- **Adopted in July 2011**
- **Entered into force 1 January 2013**
- **First mandatory global energy efficiency standard for one industry sector**



Application	Reg.19
Attained Energy Efficiency Design Index (EEDI)	Reg.20
Required EEDI	Reg.21
Ship Energy Efficiency Management Plan (SEEMP)	Reg.22
Technical co-operation and technology transfer	Reg.23

IEE Certificate International Energy Efficiency Certificate

Energy Efficiency Design Index (EEDI)

$$EEDI = \frac{\text{Impact to environment}}{\text{Benefit to society}} = \frac{\text{Power} \times \text{fuel consumption} \times CO_2 \text{ emission factor}}{\text{Capacity} \times \text{ship speed}}$$

(transportation work)

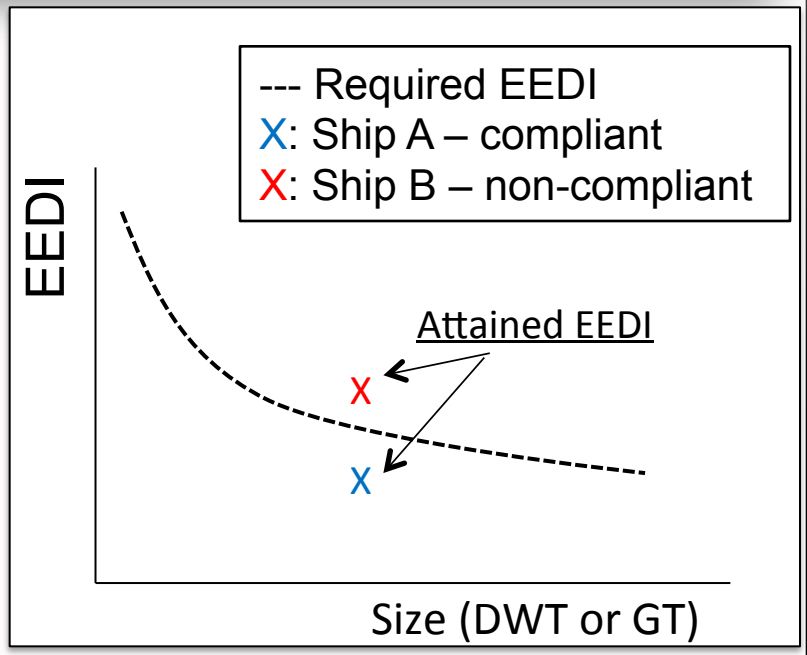
- **Attained EEDI**

  For applicable new ships, attained EEDI value shall be calculated

- **Required EEDI**

  For applicable new ships, the attained EEDI value shall be less than or equal to the required EEDI value

Attained EEDI ≤ Required EEDI

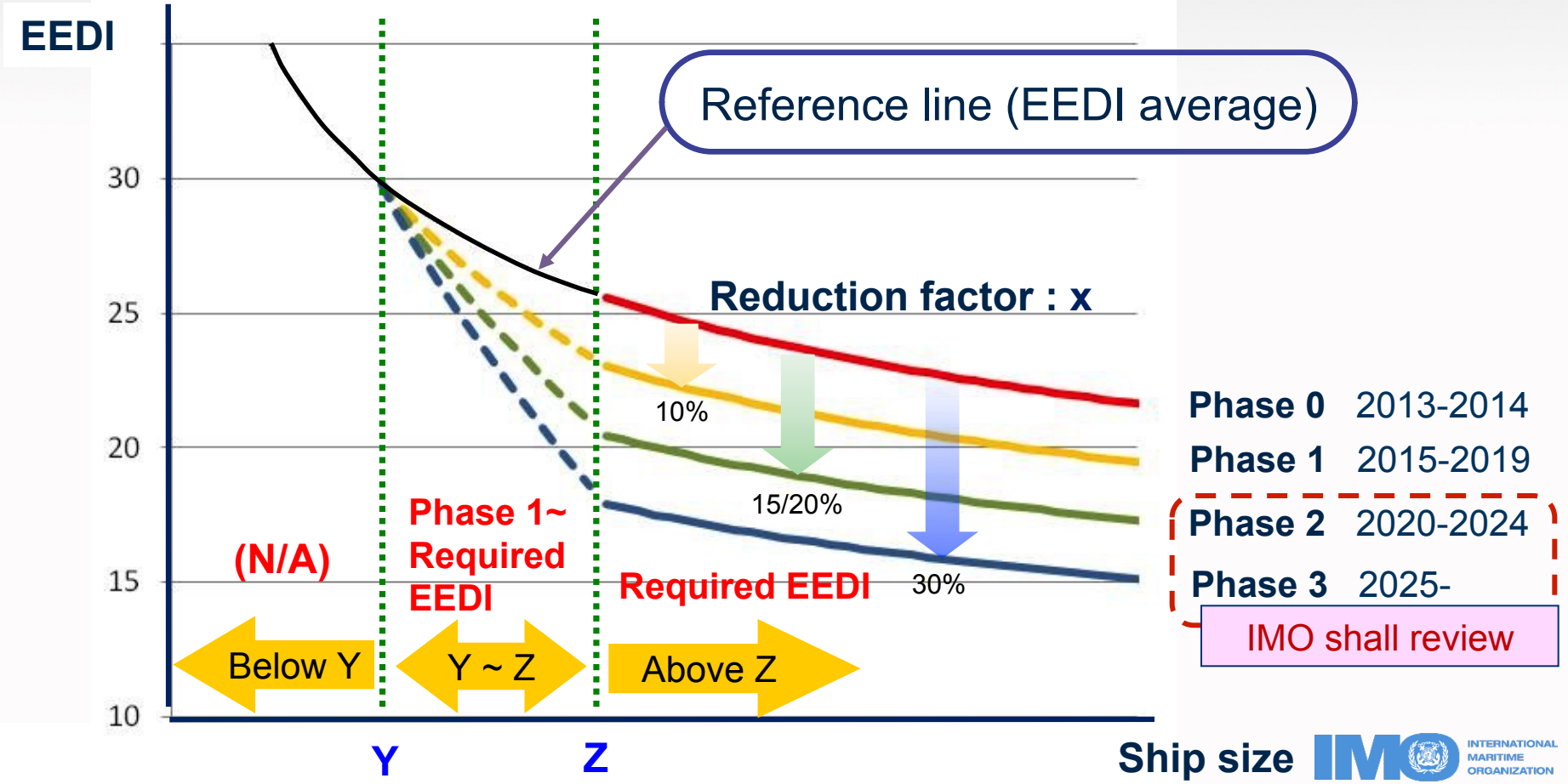


Regulatory framework – MARPOL Annex VI

Required EEDI = (1-x/100) * Reference line value

x: reduction factor set out in regulation 21, Table 1

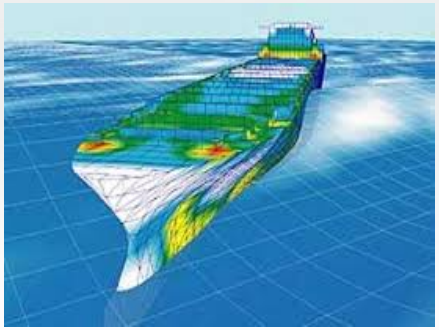
Reference line value = $a * b^{-c}$ Parameters a, b, c set out in regulation 21, Table 2

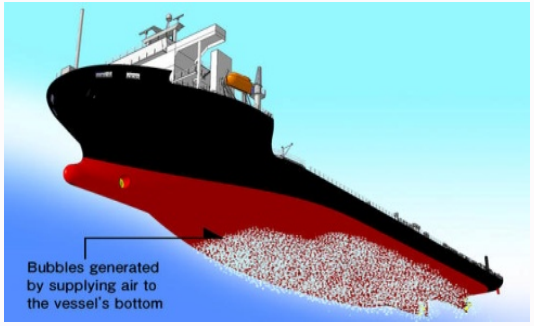


Technical Measures

- **Energy efficiency Improvement by enhanced hardware**

- Improvement of hull form/hydrodynamics (reduction of propulsion resistance)
- Improvement of engine/propeller (improvement in propulsion efficiency)
- Hull appendage for energy saving
- Waste Heat Recovery
- Utilization of renewable energy, etc.





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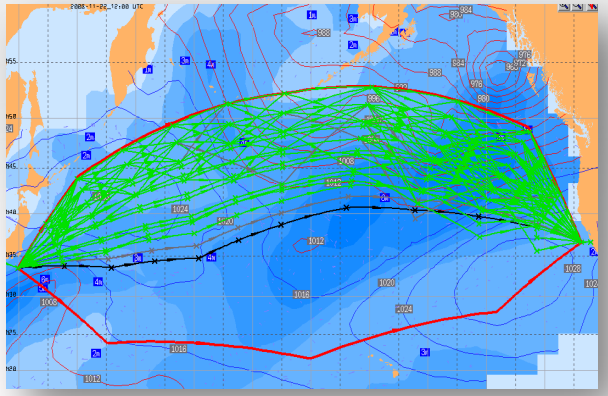
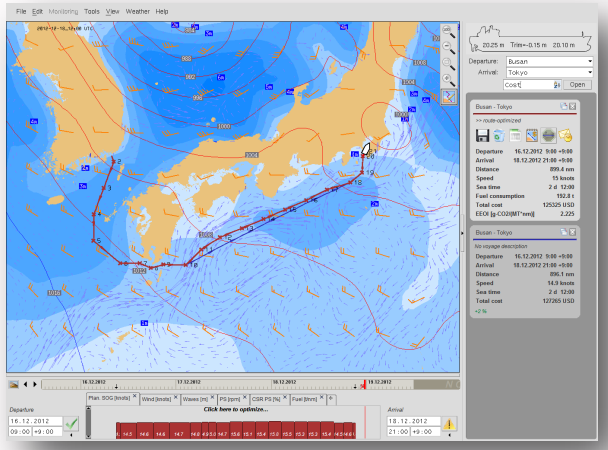
Operational Measures

- **Energy efficiency improvement by operational efforts**

  - Optimization of operating plan for each ship or fleet
  - Speed Reduction
  - Weather Routing
  - Just in Time arrival in Port
  - Hull cleaning
  - Propeller polishing
  - Maintenance of engine





Computer tool for appraisal of technical and operational measures

- **IMO project using funds donated by Transport Canada**
- **Appraisal tool developed by DNV GL (based on their experience and analysis)**

Output data calculated based on the input values provided

Input data to change vessel segment, vessel size and fuel price

Cost efficiency curves for each measure evaluated in the model (ranked from left to right). Each bar represents a measure (color coded and numbered) represented in the table below.

The height of the bar indicates the cost efficiency of the measure [$/ton CO_2] over the lifetime of the vessel while the width represents the effect measured in ΔEEDI (left) and ΔEEOI (right)

Energy Efficiency Appraisal Tool

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Input data

Select vessel type:	Crude oil tanker
Select vessel size:	>200000 Dwt
Fuel price [$/ton]:	600

Output data — Before / Optimal / All

EEOI [g CO_2/ton nm]:	7,9 / 6,7 / 6,1
EEDI [g CO_2/ton nm]:	2,5 / 2,4 / 2,2
Fuel [tonnes/year]:	9186 / 7799 / 7065

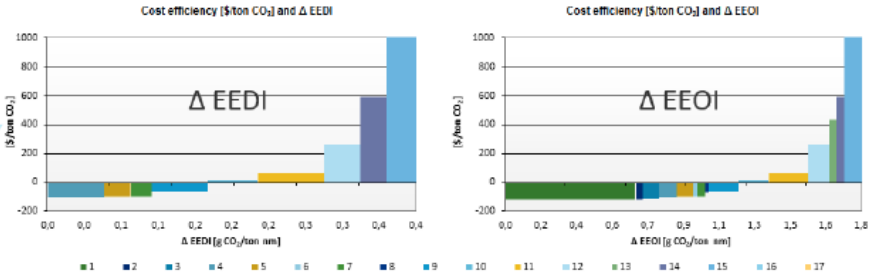
Reference values

TW [million tons x nm/year]:	3 652
Sailed distance [nm/year]:	97 398

Instructions

1. Select vessel type/size from the drop down menus and enter fuel price
2. Apply measures from the drop down menus or measure buttons.
3. Press "Calculate" to run the model

Cost abatement curves



Measure	Include?
Kite	Yes
Fixed Sails or Wings	Yes
Solar Panels	Yes
Electronic Engine Control	Yes
Waste Heat Recovery	Yes
Hull Coating	Yes
Air Cavity Lubrication	Yes
Contra-Rotating Propeller	Yes
Propulsion Efficiency Devices	Yes
Frequency Converters	Yes
Exhaust Gas Boilers	Yes
Efficient Lighting System	Yes
Trim/Draft Optimization	Yes
Weather Routing	Yes
Voyage Execution	Yes
Steam Plant Improvements	Yes
Propeller Condition	Yes

Select all measures | Select no measures

Calculate

Abatement summary

ID	Measure	Uncertainty [%]	Type of measure [T/O]	Cost efficiency [$/ton CO_2]	Fuel reduction [%]	Δ EEDI [%]	Δ EEOI [%]	CAPEX [$]	Accumulated CAPEX [$]	Payback period [years]	Accumulated payback period [years]
1	Steam Plant Improvements	< 10 %	O	-122	8,4 %	n/a	8,4 %	0	0	1,0	1,0
2	Trim/Draft Optimization	< 10 %	O	-118	0,5 %	n/a	0,5 %	25 000	25 000	1,0	1,0
3	Voyage Execution	10-30 %	O	-114	1,1 %	n/a	1,1 %	10 000	35 000	1,0	1,0
4	Propulsion Efficiency Devices	< 10 %	T*	-106	1,3 %	2,5 %	1,3 %	133 000	168 000	3,0	1,0
5	Exhaust Gas Boilers	< 10 %	T	-101	1,2 %	1,2 %	1,2 %	75 000	243 000	2,0	1,0
6	Weather Routing	10-30 %	O	-99	0,3 %	n/a	0,3 %	15 000	258 000	2,0	1,0
7	Efficient Lighting System	< 10 %	T	-98	0,6 %	0,9 %	0,6 %	100 000	358 000	4,0	1,0
8	Propeller Condition	< 10 %	O	-67	0,3 %	n/a	0,3 %	8 000	366 000	1,0	1,0
9	Frequency Converters	10-30 %	T	-64	2,3 %	2,6 %	2,3 %	810 000	1 176 000	10,0	2,0
10	Contra-Rotating Propeller	10-30 %	T	15	2,5 %	2,3 %	2,3 %	1 333 000	2 509 000	25+	4,0
11	Air Cavity Lubrication	10-30 %	T	63	3,1 %	3,2 %	3,1 %	5 384 000	5 893 000	25+	7,0
12	Kite	> 30 %	T	264	1,7 %	1,8 %	1,7 %	1 887 000	7 780 000	25+	10,0
13	Hull Coating	< 10 %	O	431	0,5 %	n/a	0,5 %	651 000	8 431 000	25+	12,0
14	Fixed Sails or Wings	> 30 %	T	589	0,7 %	1,3 %	0,7 %	1 000 000	9 431 000	25+	15,0
15	Waste Heat Recovery	< 10 %	T	1 176	1,3 %	1,3 %	1,3 %	9 500 000	18 931 000	25+	25+
16	Solar Panels	> 30 %	T	2 799	0,1 %	0,1 %	0,1 %	1 370 000	20 301 000	25+	25+
17	Electronic Engine Control	< 10 %	T	0	0,0 %	0,0 %	0,0 %	544 000	20 846 000	25+	25+

Version 1.0: Normal mode

Reference values based on the vessel type and size segment applied

Instructions providing guidance on how to use the model.

Measure selection chosing what measure to include in the model

Resulting table with more detailed information on each measure evaluated in the model

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Further measures to enhance the energy efficiency of ships

- three-step approach: i) data collection, ii) data analysis, iii) decide on what further measures, if any, are required
- Purpose of the data collection system is to analyse energy efficiency and for this analysis to be effective some transport work data needs to be included
- application to ships of 5,000 GT and above
- data to be collected includes ship identification number, technical characteristics, total annual fuel consumption, by fuel type, in metric tons, and transport work and/or proxies data as yet to be defined e.g. distance travelled, time not at berth
- methodology for collecting the data would be outlined in the ship specific Ship Energy Efficiency Management Plan (SEEMP)
- data to be aggregated and reported by the shipowner/operator to the Administration (flag State), which would then submit the data to IMO for inclusion in a database. Access to the database would be restricted to State Parties only and that any data provided would be anonymized to the extent that identification of a specific ship will not be possible

IMO's response path to promote technology transfer and capacity building

Reg. 23, MARPOL Annex VI, MEPC Resolution, TT-EG

ITCP: Awareness raising and capacity building tools

Major Projects: Capacity building & private sector partnerships

Global network to promote technology cooperation and transfer?

Catalyze institutions and financing for sustainable marine transport

Regulation 23 MARPOL Annex VI

Promotion of technical co-operation and transfer of technology relating to the improvement of energy efficiency of ships

1 Administrations shall, in co-operation with the Organization and other international bodies, promote and provide, as appropriate, support directly or through the Organization to States, especially developing States, that request technical assistance.

2 The Administration of a Party shall co-operate actively with other Parties, subject to its national laws, regulations and policies, to promote the development and transfer of technology and exchange of information to States which request technical assistance, particularly developing States, in respect of the implementation of measures to fulfil the requirements of chapter 4 of this annex, in particular regulations 19.4 to 19.6.

Resolution MEPC.229 (65)
May 2015

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Resolution MEPC.229(65)

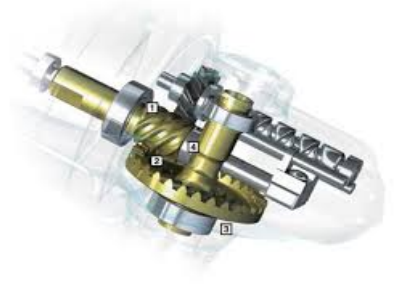
- Technical cooperation and capacity building
- Contributions and support for implementation of energy efficiency measures
- Establishment of an Ad hoc Expert Working Group on facilitation of Transfer of Technology for ships (TT-EG)
- Promotion of provision of:
  - transfer of energy efficiency technologies for ships;
  - research and development for the improvement of energy efficiency of ships;
  - training of personnel, for the effective implementation and enforcement of the regulations in chapter 4 of MARPOL Annex VI; and
  - the exchange of information and technical co-operation relating to the improvement of energy efficiency for ships;

Transfer of technology for ships

Work plan tasks for Technology Transfer – Expert Group (MEPC.229(65))

Task 1 - Assess the potential implications and impacts of the implementation of the regulations in chapter 4 of MARPOL Annex VI, in particular, on developing States, as a means to identify their technology transfer and financial needs, if any

Task 2 - Develop an inventory of energy efficiency technologies for ships (currently under development expected Summer 2016)



Task 3 - Identify barriers to transfer of technology, in particular to developing States, including associated costs, and possible sources of funding

Task 4 - Make recommendations including the development of a model agreement enabling the transfer of financial and technological resources and capacity-building between Parties, for the implementation of the regulations in chapter 4 of MARPOL Annex VI

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➢ **Reported to MEPC 69 (April 2016)**

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Activities for technical cooperation and capacity building

- **Integrated Technical Cooperation Programme**
  - Includes funding for the training and capacity-building activities in ship energy efficiency
- **Major Projects on Capacity Building**
  - IMO-KOICA Project on “Building Capacities in East Asian Countries to Address GHG Emissions from Ships”
- **Global Maritime Energy Efficiency Partnerships Project (GloMEEP)**
  - GEF-UNDP-IMO partnership to support increased uptake and implementation of energy efficiency measures for shipping
- **Maritime Technology Cooperation Centres (MTCC)**
  - Establish five regional centres
  - Global network to provide regional outreach, capacity building, and information exchange

Global partnerships and networks

- **UNDP-GEF-IMO Global Maritime Energy Efficiency Partnerships Project (GloMEEP Project) launched in September 2015**
  - focus in particular on building capacity to implement technical and operational measures in developing countries, where shipping is increasingly concentrated
  - 10 Lead Pilot Countries – support provided to enable governments to pursue legal, policy and institutional reforms
  - create global, regional and national partnerships to build the capacity to address maritime energy efficiency and for countries to mainstream this issue within their own development policies, programmes and dialogues
  - US$13.7 million budget (US$2million cash)
  - Global Industry Alliance to support industry innovation to support the effective implementation
- **Global network of Maritime Technology Cooperation Centres (MTCC)**
  - Euro10 million funding from European Union
  - Network to act as a sustainable institutional framework to catalyze capacity building and transfer of technology for shipping

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IMO-Singapore Future Ready Shipping conference on Maritime Technology Transfer and Capacity Building, September 2015

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IMO-Singapore Future Ready Shipping conference, September 2015

- highlighted need for enabling environments to be developed
- current status of maritime technology and future trends highlighted
  - smarter, data driven, greener ships
  - fully connected wireless onboard & digitally connected via satellite
  - new cleaner fuels
  - new flexible propulsion technologies
  - new materials
- knowledge gap and readiness of maritime companies to effectively deploy new technologies could be addressed through the use of testing facilities, e.g. "Maritime Energy Test Bed" at Singapore's Nanyang Technological University
- beyond the “hardware” aspect, the role of the seafarer needs greater consideration without which technology cannot be effectively utilised

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