IMO activities on reduction GHG emissions from ships

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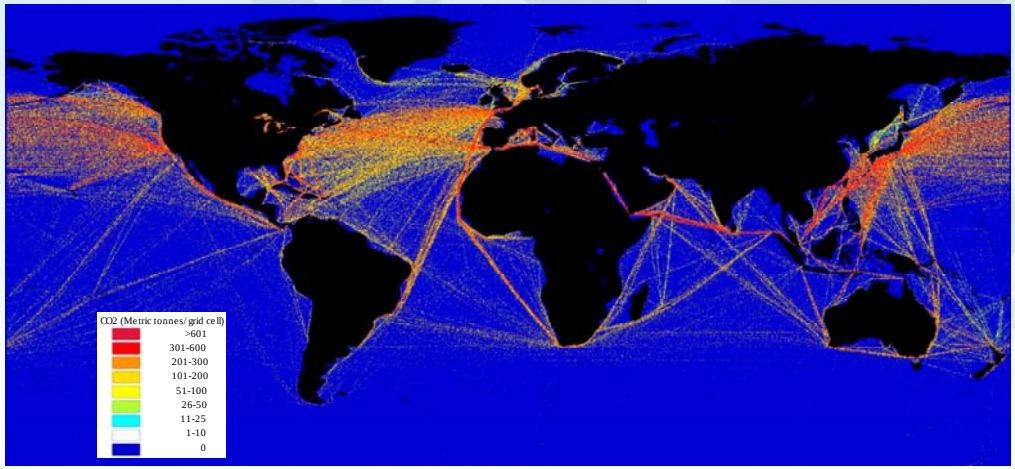
Ship emissions one of the last major ship pollutants to be regulated

Work started at IMO in the 1980's

Annex VI adopted in 1997, in force in May 2005, revised 2005 - 2008



- Prohibits ODS in line with the Montreal Protocol
- Regulates exhaust gas emissions: NOx & SOx and cargo vapours (VOC)

Greenhouse gases not covered

UNFCCC debate on allocation of ship emissions 1992 - 1997

1 No allocation
2 Proportional to national emissions
3 Fuel sales
4 Nationality of company
5 Flag
6 Route of vessel
7 Route of cargo
8 Country of origin of cargo
9 Emissions in territorial waters

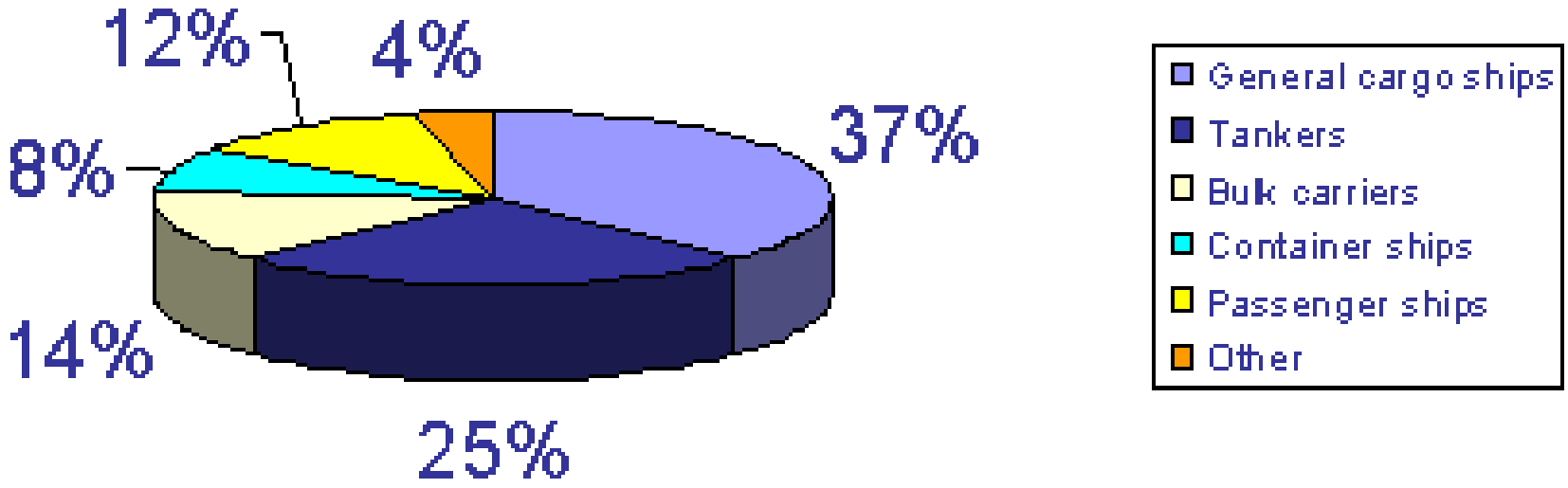
Kyoto Protocol Article 2.2

"The Parties included in Annex I shall pursue limitation or reduction of emissions of greenhouse gases not controlled by the Montreal Protocol from … marine bunkers fuels, working through … the International Maritime Organization, …"

Distribution of the world fleet March 2008

ships above 400 GT

	Number of ships	GT	DW
Annex I flag States	20,872 (33.42%)	209,015,681 (26.08%)	263,820,104 (22.82%)
Non-Annex I flag States	41,119 (66.58%)	593,330,359 (73.92%)	892,384,249 (77.18%)
Total	61,862	801,346,040	1,156,204,353



Top ten ship registers

Flag of registration	Number of ships	Total tonnage (1000 DWT)	Share of world total DWT (%)	% dwt growth 2008/07
Panama	7616	252 564	22.6	8.8
Liberia	2173	117 519	10.5	11.7
Greece	1477	61 384	5.5	11.3
Bahamas	1422	59 744	5.3	8.2
Marshall Islands	1097	59 600	5.3	9.1
Hong Kong, China	1238	59 210	5.3	9.0
Singapore	2243	55 550	5.0	8.8
Malta	1442	45 218	4.1	12.5
China	3816	37 124	3.3	6.3
Cyprus	982	29 431	2.6	−0.7

Top ten controlling interests by domicile

Controlling interest's country of domicile	Number of ships	Total tonnage (1000 dwt)	Share of world total dwt (%)	% Dwt growth 2008/2007	% Share of dwt in national registry
Greece	3115	174 570	16.8	−0.6	31.9
Japan	3515	161 747	15.6	0.5	7.2
Germany	3208	94 222	9.1	0.4	15.5
China	3303	84 881	8.2	1.0	40.5
Norway	1827	46 872	4.5	−0.5	30.3
United States	1769	39 828	3.8	−1.1	51.0
Korea, Republic of	1140	37 703	3.6	0.3	50.7
Hong Kong, China	657	33 424	3.2	−1.4	54.5
Singapore	869	28 632	2.8	0.1	57.4
Denmark	861	27 434	2.6	0.4	38.2

Resolution A.963(23)

CLIMATE CHANGE:
A CHALLENGE FOR IMO TOO!

IMO Policies and Practices Related to the Reduction of Greenhouse Gas Emissions from Ships, adopted on 5 December 2003

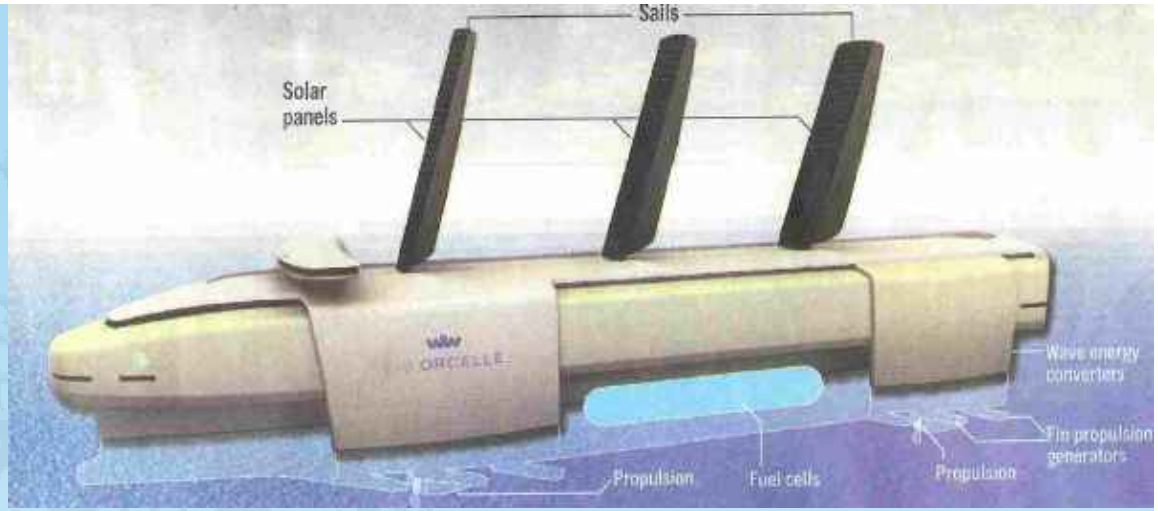
Requests MEPC to:

- develop a work plan with timetable
- establishment of GHG baseline
- develop CO2 indexing methodology

Requests the IMO Secretariat to continue the co-operation with UNFCCC and ICAO

MEPC 58

Developed further a range of measures that will form part of the package of technical and operational measures to be adopted by MEPC 59:



- Energy Efficiency Design Index for new ships and associated guidelines approved for use in trials

- Energy Efficiency Operational Index for all ships

- Ship Energy Efficiency Management Plan

- Guidance on Best Practices for energy efficient operation of ships for the entire maritime sector

MEPC 58 agreed to continue the debate on market-based measures at MEPC 59

Energy Efficiency Design Index

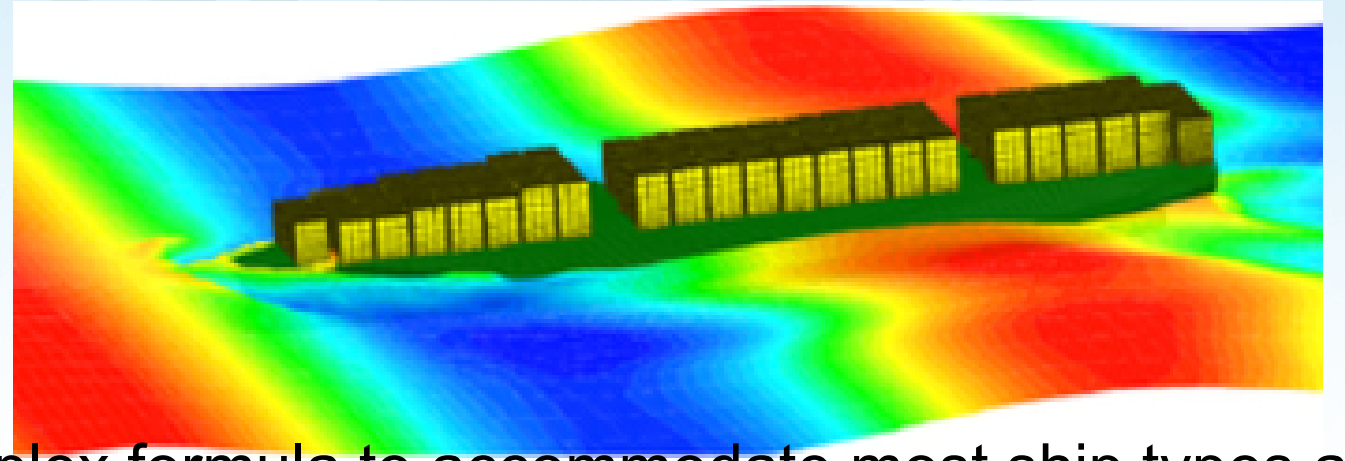
$$Attained\ design\ CO_2\ index = \frac{Environmental\ cost}{Benefit\ for\ society}$$

- Cost: Emission of CO_2
- Benefit: Cargo capacity & transport work
- Efficiency standard at the design stage
- Efficiency rating

Energy Efficiency Design Index (2)

$$\frac{\left(\prod_{j=1}^{M} f_j\right)\left(\sum_{i=1}^{nME} C_{FMEi}\ SFC_{MEi}\ P_{MEi}\right) + P_{AE}C_{FAE}SFC^{*}_{AE} + \left(\sum_{i=1}^{nPTI} P_{PTIi} - \sum_{i=1}^{nWHR} P_{WHRi}\right)C_{FAE}SFC_{AE} - \left(\sum_{i=1}^{neff} f_{eff}\,P_{eff}\,C_{FMEi}SFC_{MEi}\right)}{f_i \quad Capacity \quad V_{ref} \quad f_W}$$

MEPC 58 approved the use of the draft Interim Guidelines on the method of calculation of the Energy Efficiency Design Index for new ships, for calculation/trial purposes with a view to further refinement and improvement



Complex formula to accommodate most ship types and sizes

Ship Energy Efficiency Management Plan

Under development by coalition of maritime industry organization, will include:

- **Improved voyage planning** (Weather routeing/Just in time)
- **Speed and power optimization**
- **Optimized ship handling** (ballast/use of rudder and autopilot)
- **Improved fleet management**
- **Improved cargo handling**
- **Energy management**

Energy Efficiency Operational Indicator

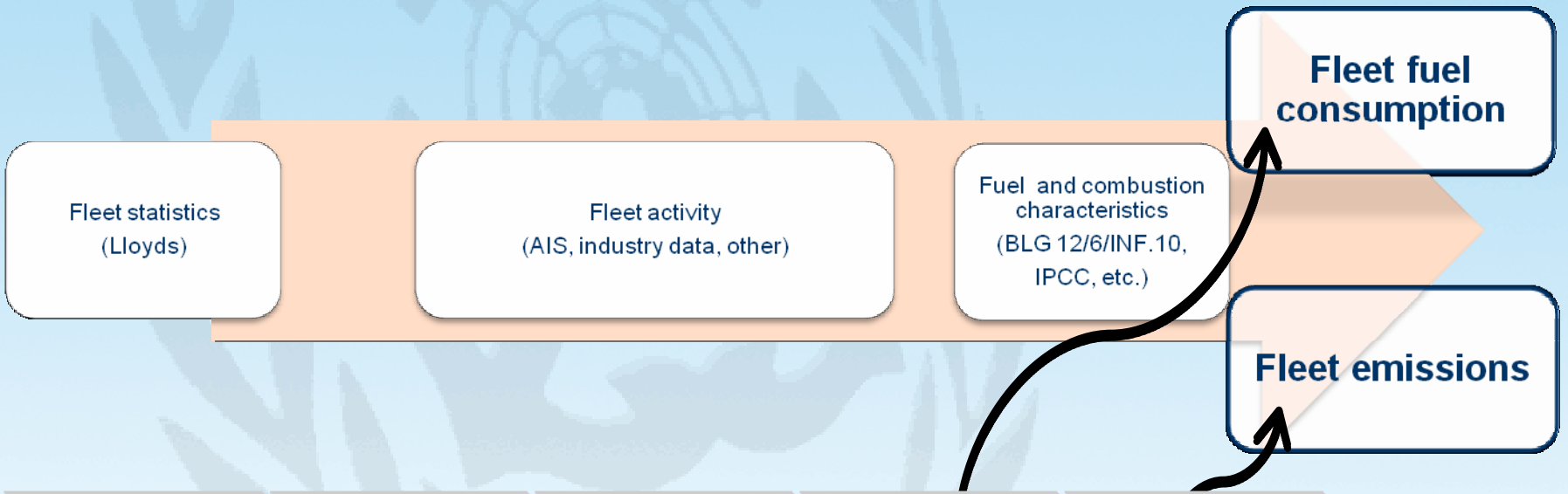
- Energy Efficiency Operational Indicator for all ships (new/existing) obtained from fuel consumption, voyage and cargo data

$$\text{Actual Fuel Consumption Index} = \frac{\text{Fuel Consumption in Operation}}{\text{Cargo Onboard} \times \text{(Distance traveled)}}$$

MEPC 58 established a correspondence group coordinated by Japan to finalize the review of the operational index based on outcomes of trials

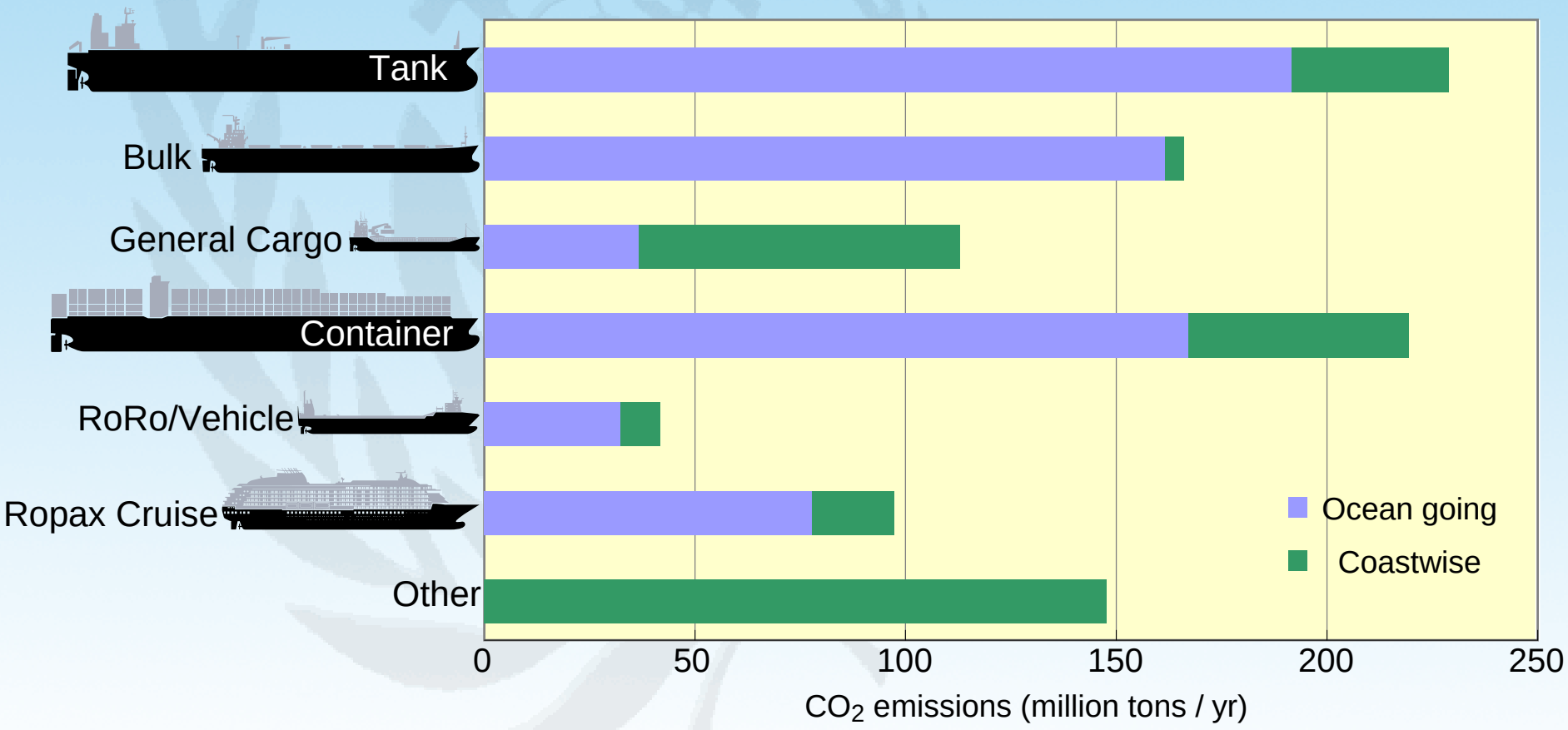
Second IMO GHG Study 2009

Activity-based methodology data confidence summary



Average installed power	Average operating time	Average engine load	Average SFOC	Average Carbon content
• **Confidence High**	• **Confidence moderate** • Known variability high • Dominates output range	• **Confidence moderate** • Known variability moderate • Second most influential to output range	• **Confidence high**	• **Confidence high** • Some variability due to fuel characteristics

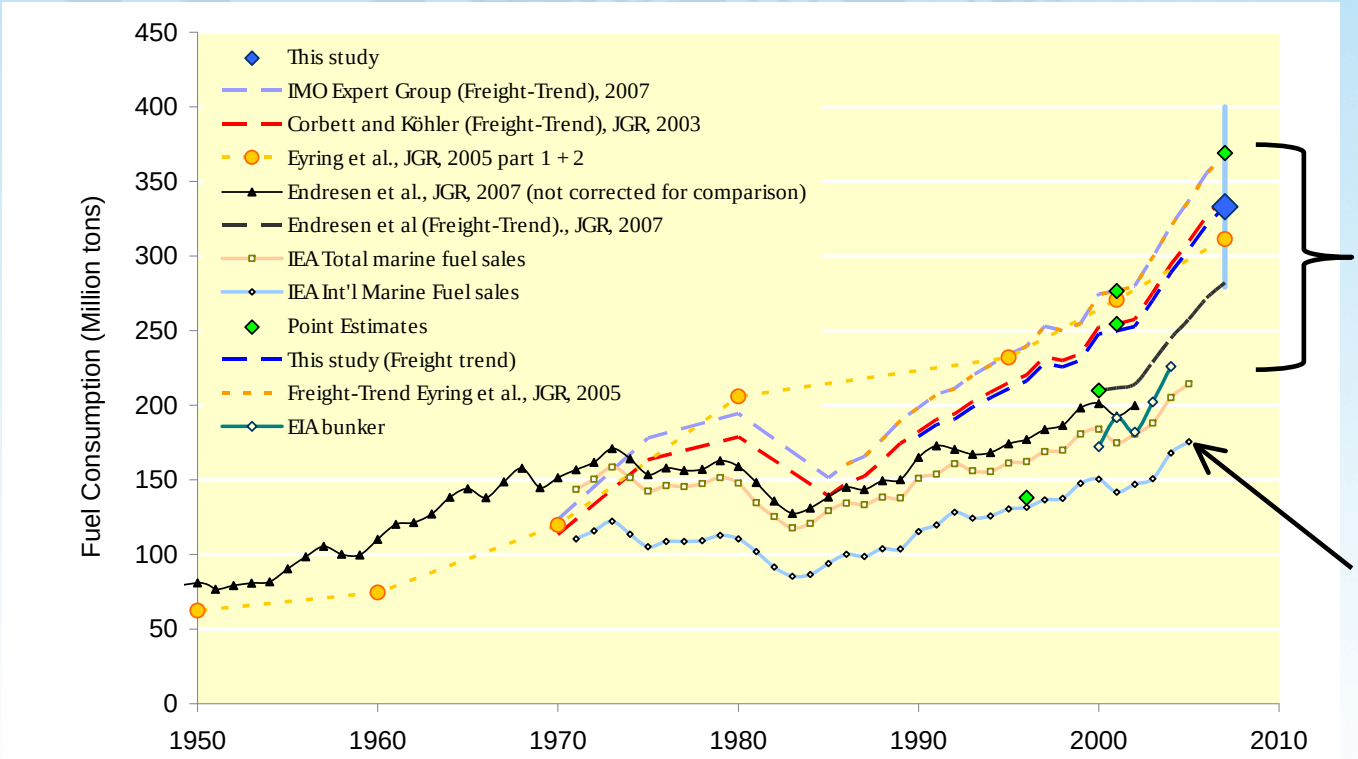
CO_2 emissions divided by main ship categories and assumed typical type of operation



(Coastwise shipping is mainly ships < 15000 dwt, RoPax, Cruise, Service and Fishing)

World fleet fuel consumption

2007	Low bound	Best	High bound
Total fuel consumption (Mtonnes yr^{-1})	279	333	400
CO_2(Mtonnes yr^{-1})	876	1,046	1,256



Bottom-up (Activity-based) estimates

Top-down (Fuel-sales) data

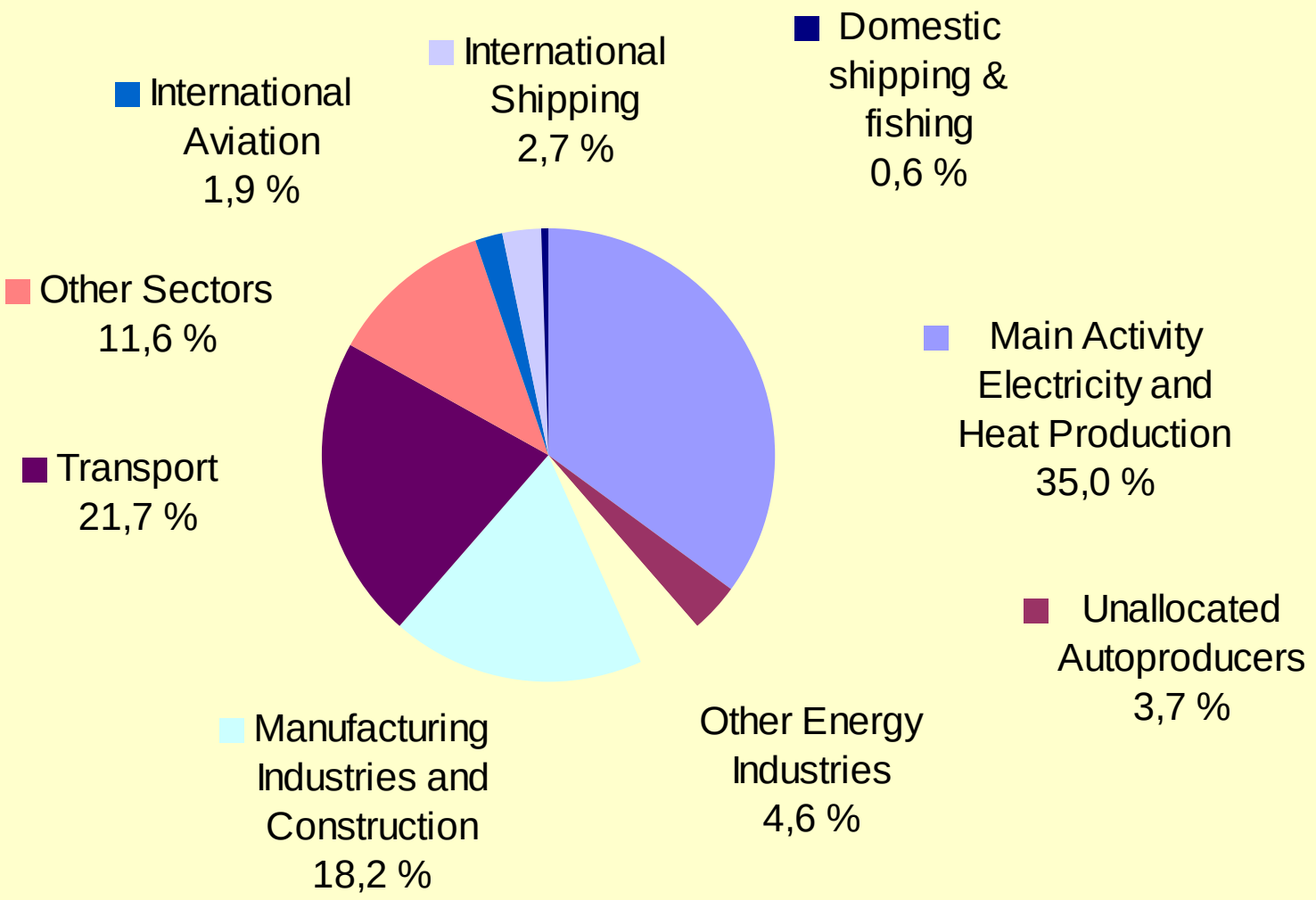
Second IMO GHG Study 2009

2007 CO_2 emissions for international shipping in million tonnes CO_2

	Low bound	Consensus	High bound
Total shipping emissions (activity based)	854	1019	1224
Total less fishing (activity based)	796	954	1150
IEA domestic shipping (statistical data)	111	111	111
International shipping (hybrid estimate)	685	843	1039

[1] **All non-military vessels larger than 100 GT**

Share of Global Emissions



Key Driving Variables

Category	Variable	Related Elements
Economy	Shipping transport demand (tonne-miles/year)	Population, global and regional economic growth, modal shifts, sectoral demand shifts.
Transport efficiency	Transport efficiency (MJ/tonne-mile) – depends on fleet *composition*, ship *technology* and *operation*	Ship design, propulsion advancements, vessel speed, regulation aimed at achieving other objectives but that have a GHG emissions consequence.
Energy	Shipping fuel carbon fraction (gC/MJ fuel energy)	Cost and availability of fuels (e.g., use of residual fuel, distillates, LNG, biofuels, or other fuels).

Different values applied to three categories of ships:

- Coastwise shipping - Ships used in regional (short sea) shipping;
- Ocean-going shipping - Larger ships suitable for intercontinental trade; and,
- Container ships (all sizes).

Future Emissions

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2020

Predicted growth by a factor of 1.1 – 1.3

= 927 - 1,095 mill tonnes of CO2

2050

Predicted growth by a factor of 2.4 – 3.0

= 2,023 - 2,529 mill tonnes of CO2

The way ahead

Before COP 15 in Copenhagen:

- MEPC 59 agrees to package of technical and operational measures in July
- MEPC 59 draws clear plan to develop a market-based mechanism
- MEPC 59 adopts a resolution setting out a calendar for regulatory action
- Whole package is submitted to COP 15

After COP 15:

- Regulatory action undertaken by MEPC 60 (March 2010) and MEPC 61 (October 2010)

COP 15 Outcome

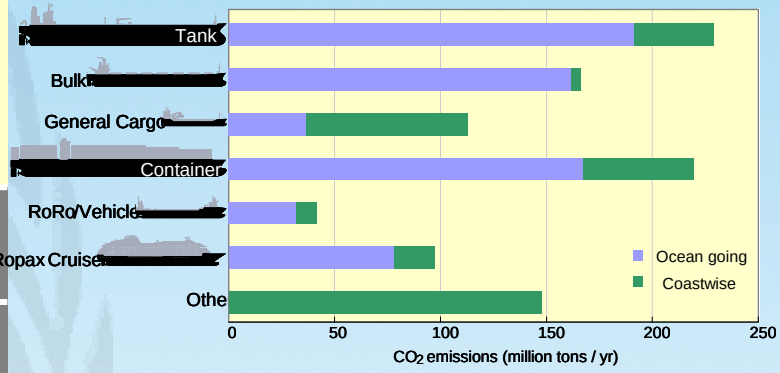
Three main IMO objectives:

- IMO continues to be entrusted to develop and enact global regulations to limit or reduce GHG emissions from ships engaged in international trade
- The regulations are applied to ships according to the non-discriminatory principle on which the IMO regulatory framework is based
- The interests of developing countries are fully taken into account

Summary

2007 shipping CO2 emissions

2007 shipping CO_2 emissions	Low bound	Consensus estimate	High bound
Total	854	1019	1224
International	685	843	1039



Future CO2 emissions:

- Significant increase predicted
- Demand is the primary driver
- Technical and operational efficiency measures can provide significant improvements