The IMO Convention adopted in 1948 and IMO first met in 1959

A specialized agency of the UN

170 Member States

Role is to develop and maintain a comprehensive regulatory framework for shipping: safety, environment, legal, technical cooperation, security

“Art.1(b) To encourage the removal of discriminatory action and unnecessary restrictions by Governments affecting shipping engaged in international trade so as to promote the availability of shipping services to the commerce of the world without discrimination.”

Safe, secure and efficient shipping on clean oceans
Key factors for international maritime transport emissions:

1. World economy / trade volumes
2. Economics of shipbuilding / ship operation
3. Changes to trades / types of vessels needed
4. Cost of fuel / energy efficiency
5. Charter rates
6. Regulatory drivers e.g. emission limits
7. Scrutiny by stakeholders e.g., carbon footprint
Direct impact of a lower global fuel oil price:
1. Bunker fuel oil price drops
2. Ship operational costs decrease
3. Less incentive to adopt costly energy efficiency measures? Split incentive margin grows?

Indirect impact of lower global fuel oil price:
1. Increase demand for certain ship types e.g. tankers
2. Increase charter rate
3. Less incentive for slow steaming? Market overcapacity?
“Shipping can thank OPEC for US$29 billion saving”
Bloomberg, 4 December 2014
Trade is growing

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

Source: Royal Academy of Engineering, Future Ship powering options, Exploring alternative methods of ship propulsion, July 2013

World merchandise trade volumes expanded by 2.2% in 2013 to 9.6 billion tonnes (UNCTAD, 2014)
Growth in major trade routes

Source: UNCTAD Review of Maritime Transport 2014
Energy efficiency of shipping

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

Triple EEE

1 gramme of fuel to transport 1 tonne of cargo 1 kilometre
IMO work to address GHG emissions from international shipping

IMO’s work to address GHG emissions has investigated three distinct routes:

- **Technical**
  Mainly applicable to new ships - EEDI

- **Operational**
  Applicable to all ships in operation – SEEMP (EEOI – voluntary)

- **Market-based Measures (MBM)**
  carbon price, incentive, may generate funds
  - consideration suspended at MEPC 65 (May 2013)
Potential energy efficiency improvements

**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%

Source: ICCT, 2013
Regulations on energy efficiency for ships

- New chapter 4 added to MARPOL Annex VI (regulations 19 to 23)
- Entered into force on 1 January 2013
- First ever global and legally binding CO₂ reduction regime for an international industry sector or transport mode
- Apply to internationally trading ships of ≥ 400 GT

RESOLUTION MEPC.203(62)
Adopted on 15 July 2011

(Inclusion of regulations on energy efficiency for ships in MARPOL Annex VI)
Energy Efficiency Design Index

\[
EEDI = \frac{\text{Impact to environment}}{\text{Benefit to society}} = \frac{\text{Power} \times \text{fuel consumption} \times \text{CO}_2 \text{ emission factor}}{\text{Capacity} \times \text{ship speed}}
\]

- The EEDI is likely to promote innovation at the design stage of ships for a reduction of their energy consumption at full load.
- The EEDI is applicable to ship types responsible for 85% of CO\(_2\) emissions from international shipping.
EEDI – applicable ship types

Attained EEDI: For ships over 400 GT:
- Bulk carrier
- Gas carrier
- Tanker
- Container ship
- General cargo ship
- Refrigerated cargo carrier
- Combination carrier
- Passenger ships
- Ro-ro cargo ship (vehicle carrier)
- Ro-ro cargo ship
- Ro-ro passenger ship
- LNG Carrier*
- Cruise passenger ship having non-conventional propulsion*

Required EEDI: For ships above a given size (regulation 21, Table 1):
- Bulk carrier
- Gas carrier
- Tanker
- Container ship
- General cargo ship
- Refrigerated cargo carrier
- Combination carrier
- Ro-ro cargo ship (vehicle carrier)*
- Ro-ro cargo ship*
- Ro-ro passenger ship*
- LNG carrier*
- Cruise passenger ship having non-conventional propulsion*

*MEPC 66 (April 2014) adopted amendments to MARPOL Annex VI to add these ship types to regulation 20 and 21 respectively. These amendments are expected to enter into force on 1 September 2015.
SEEMP – operational management tool to include:

- All ships 400 gross tonnage and above
- Improved voyage planning (Weather routeing/Just in time arrival at port)
- Speed and power optimization
- Optimized ship handling (ballast/trim/use of rudder and autopilot)
- Improved fleet management
- Improved cargo handling
- Energy management
- Monitoring tools
  - EEOI (MEPC.1/Circ.684)
MEPC 65 (May 2013) considered US proposal for a phased approach to implementation of further measures for existing ships.

Phases proposed include:
- data collection and analysis – development of “baseline curves” and identification of “attained energy efficiency standard”
- pilot phase – ships evaluated and rated against “attained energy efficiency standard”
- full implementation

MEPC 66 focused on data collection phase only and MEPC 67 agreed, in principle, to develop a data collection system for ships.

Core elements:
- ship data collection
- flag State functions
- centralized database
Key issues for data collection

- Data – what to report, when reported, data collection method, how reported, data “holder”, confidentiality
- Administrative burden – ship, company, flag, IMO
- Application
  - tonnage threshold? 400GT…5000GT
  - voluntary or mandatory
- Ship energy efficiency
  - Should data on transport work be collected?
  - Reference level – EEOI? Time period?
Energy efficiency metric for ships

- Transportation Work?
  - Tonne-mile (EEDI metric for transport work)
  - Distance travelled
  - Service Days
  - Joules of energy used
  - DWT/GT/PAX/TEU

- Different for ship types?

- Ballast voyages?

- MEPC 68 (May 2015) will consider report of CG
Methodology

- Calculations of activity, fuel consumption (per engine) and emissions (per GHG and pollutant substances) for each in-service ship during each hour of each of the years 2007-2012
- Aggregation to find totals of each fleet
- Aggregation to find total shipping (international, domestic, and fishing) and international shipping only

Advantages:

- Approach removes any uncertainty attributable to use of average values
- Substantial improvement in resolution of shipping activity, energy demand and emissions data
### CO₂ emissions estimate 2007-2012

- **Consensus CO₂ emissions estimate (tonnes) and shipping as a % share of global CO₂ emissions**

<table>
<thead>
<tr>
<th>Year</th>
<th>Global CO₂¹</th>
<th>Total shipping</th>
<th>IMO GHG Study 2014 CO₂</th>
<th>International shipping</th>
<th>Percent of global</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td>31,409</td>
<td>1,100</td>
<td>3.5%</td>
<td>885</td>
<td>2.8%</td>
</tr>
<tr>
<td>2008</td>
<td>32,204</td>
<td>1,135</td>
<td>3.5%</td>
<td>921</td>
<td>2.9%</td>
</tr>
<tr>
<td>2009</td>
<td>32,047</td>
<td>978</td>
<td>3.1%</td>
<td>855</td>
<td>2.7%</td>
</tr>
<tr>
<td>2010</td>
<td>33,612</td>
<td>915</td>
<td>2.7%</td>
<td>771</td>
<td>2.3%</td>
</tr>
<tr>
<td>2011</td>
<td>34,723</td>
<td>1,022</td>
<td>2.9%</td>
<td>850</td>
<td>2.4%</td>
</tr>
<tr>
<td>2012</td>
<td>35,640</td>
<td>949</td>
<td>2.7%</td>
<td>796</td>
<td>2.2%</td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td><strong>33,273</strong></td>
<td><strong>1,016</strong></td>
<td><strong>3.1%</strong></td>
<td><strong>846</strong></td>
<td><strong>2.6%</strong></td>
</tr>
</tbody>
</table>

- **From 2007 to 2012 study estimates a reduction in CO₂ emissions from international shipping in both absolute terms and as a percentage of global CO₂ emissions**
Consensus CO₂e emissions estimate (tonnes) and shipping as a % share of global CO₂e emissions

<table>
<thead>
<tr>
<th>Year</th>
<th>Global CO₂e²</th>
<th>Total shipping</th>
<th>IMO GHG Study 2014 CO₂e</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>International shipping</td>
</tr>
<tr>
<td>2007</td>
<td>34,881</td>
<td>1,121</td>
<td>903</td>
</tr>
<tr>
<td>2008</td>
<td>35,677</td>
<td>1,157</td>
<td>940</td>
</tr>
<tr>
<td>2009</td>
<td>35,519</td>
<td>998</td>
<td>873</td>
</tr>
<tr>
<td>2010</td>
<td>37,085</td>
<td>935</td>
<td>790</td>
</tr>
<tr>
<td>2011</td>
<td>38,196</td>
<td>1,045</td>
<td>871</td>
</tr>
<tr>
<td>2012</td>
<td>39,113</td>
<td>972</td>
<td>816</td>
</tr>
<tr>
<td>Average</td>
<td>36,745</td>
<td>1,038</td>
<td>866</td>
</tr>
</tbody>
</table>

From 2007 to 2012 study estimates a reduction in equivalent CO₂ emissions from international shipping in both absolute terms and as a percentage of global equivalent CO₂ emissions.
Fuel consumption 2012 by ship type (bottom-up method)

- Yacht: 1,100
- Vehicle: 7,900
- Service - tug: 6,700
- Service - other: 3,800
- Ro-Ro: 9,300
- Refrigerated bulk: 5,700
- Other liquids tankers: 300
- Oil tanker: 39,700
- Offshore: 8,600
- Miscellaneous - other: 2,300
- Miscellaneous - fishing: 16,100
- Liquefied gas tanker: 15,700
- General cargo: 21,700
- Ferry-RoPax: 9,900
- Ferry-pax only: 3,700
- Cruise: 11,100
- Container: 66,000
- Chemical tanker: 17,500
- Bulk carrier: 53,400

Fuel 2012 in Thousand Tonnes (ktonnes)

- Sum of Main Engine
- Sum of Auxiliary Engine
- Sum of Boiler
0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1

2007 2012

5000-7999 TEU container 60000-99999 dwt bulker 80000-119999 dwt tanker
5000-7999 TEU container 60000-99999 dwt bulker 80000-119999 dwt tanker

ratio of operating to design speed (%) main engine output (%MCR)

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2nd IMO GHG Study 2009 projected rapid emissions increase, but since publication:

- new set of long-term socio-economic scenarios has been developed by IPCC
- larger & more efficient container ships have entered market
- new emission projection methods have been developed:
  - based on transport work activity, rather than tonnes of cargo
  - taking into account non-linear relations between activity drivers (e.g. GDP) and activity (i.e., transport work)

3rd Third IMO Study 2014 has developed new projections
CO₂ emissions projections

- Shipping CO₂ emissions are projected to increase by 50% to 250% in the period to 2050, despite fleet average efficiency improvements of about 40%
Future scenarios (2012 – 2050)

- Maritime CO₂ emissions are projected to increase significantly in the coming decades
- Depending on future economic and energy developments, BAU scenarios project increase by 50% to 250% in the period to 2050
- Further action on efficiency and emissions can mitigate emissions growth, although all scenarios but one project emissions in 2050 to be higher than 2012
- Demand for transport of unitized cargoes projected to increase most rapidly in all scenarios
Thank you for your attention

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