IMO’s GHG work
Mandatory energy efficiency measures for ships
- continued work on market-based measures

Eivind S. Vagslid
Deputy director/ Head
Air Pollution and Climate Change Section
Marine Environment Division
IMO
Cyprus side event at COP 17 - Durban 3 December 2011
IMO – specialised UN agency

- 170 Member States
- IGOs and NGOs
- London headquarters
- Annual budget £30+ M
- Secretariat: 300+ staff
- 50+ Nationalities
- Secretary-General: E. E. Mitropoulos, Greece

53 treaties covering all aspects of international shipping
Design – Construction - Equipment – Operation – Maintenance – Manning

Prevention – Response – Liability - Compensation

Safe, secure and efficient shipping on clean oceans!
World seaborne trade 1968-2008

Baseline efficiency improvement in historic perspective

Efficiency improvements

Fuel Consumption World Fleet

This study
IMO Expert Group (Freight Trend), 2007
Endresen et al., JGR, 2007
Endresen et al (Freight Trend), JGR, 2007
EIA Total marine fuel sales
Point Estimates from the Studies
This study (Freight trend)
IMO’s work on GHG control and improved energy efficiency

Work on prevention of air pollution from ships from late 1980s
1991 the IMO Assembly called for the development of MARPOL Annex VI
The 1997 MARPOL Conference’s resolution 8 calling for GHG action by IMO
First IMO GHG Study on emissions from ships published in 2000
IMO’s GHG policy adopted by Assembly 23 in December 2003
Development of T&O measures, including EEOI, EEDI, SEEMP: 2000 – 2009
Voluntary application and testing by administrations and industry 2005 - 2011
Regulatory text developed/refined 2009 - 2011
Basic principles adopted by MEPC 57 in April 2008
Second IMO GHG Study 2009 published and presented to MEPC 59 in July 2009
Development of MBM from 2007, Expert Group reported to MEPC 61 in 2010
2011 Adoption of new chapter 4 to MARPOL Annex VI; mandatory T&O measures
2012 Further MBM work (e.g. impacts)

Technical - mainly applicable to new ships - EEDI
Operational - all ships in operation – SEEMP & EEOI
Market-based Measures (MBM) – carbon price for shipping: incentive, offsetting, may generate funds
CO2 emissions from international shipping:

- Large reduction potential: 25 – 75% if all known measures are taken
- Significant increase predicted: 200 - 300% by 2050 in the absence of regulations
- Demand is the primary driver, both for volume and speed
- Technical and operational efficiency measures will provide significant reductions but will not be able to provide an absolute reduction if demand continues.
Examples of efficiency measures:

Technical:
- Larger ships, reduced ballast legs, combination carriers
- Improved hull design and engine efficiency
- More efficient propellers and rudders
- Reduce installed power (speed)
- Wind and solar power
- Alternative fuels

Operational:
- Speed and energy management
- Improved routeing & less waiting
- Enhanced fleet management and better utilization
Breakthrough at IMO
MEPC 62 (11 – 14 July 2011)

Mandatory technical and operational Energy efficiency measures adopted

Mandatory measures (EEDI and SEEMP) in new chapter 4 of MARPOL Annex VI

Further development of supporting guidelines on:
- Calculation of EEDI
- EEDI Reference Lines (average of ships built 1999 – 2009)
- EEDI Survey and Certification
- Development and implementation of SEEMP
- EEOI - Energy Efficiency Operational Indicator (MRV tool and benchmark)

Work on EEDI formulas for ship types not yet covered

Intersessional meeting January 2012 to prepare guidelines for adoption at MEPC 63 in February/March 2012
New Chapter 4 to Annex VI

- **Regulation 19 – Application**
  - Ship types: bulk carriers, tankers, container ships, general cargo ships, gas carriers, reefers and combination carriers
  - Covers 71% of international shipping CO2
  - 4 years waiver clause for Administrations in need of more time

- **Regulation 20** Attained EEDI
- **Regulation 21** Required EEDI
- **Regulation 22** SEEMP for all ships (400 GT)
- **Regulation 23** Promotion of technical co-operation and transfer of technology relating to the improvement of energy efficiency of ships
### Energy Efficiency Design Index - EEDI

#### Main Engine(s)

#### Auxiliary Engine(s)

**Energy Saving Technologies**

**Auxiliary Power**

**Main Power**

\[
\begin{align*}
\prod_{j=1}^{M} f_j \left( \sum_{i=1}^{nME} P_{ME(i)} \cdot C_{F ME(i)} \cdot S_{F C ME(i)} \right) + \left( \prod_{j=1}^{M} f_j \sum_{i=1}^{nPIT} P_{PIT(i)} - \sum_{i=1}^{nEFF} f_{EFF(i)} \cdot P_{AE(i)} \cdot C_{FAE} \cdot S_{FCAE} \right) - \left( \sum_{i=1}^{nEFF} f_{EFF(i)} \cdot P_{EFF(i)} \cdot C_{FME} \cdot S_{FCME} \right) \\
\end{align*}
\]

\[fi \cdot \text{Capacity} \cdot V_{ref} \cdot f_w\]

**g of CO₂ emitted**

**cargo capacity x speed**

-10% ships built between 2015 – 2020
-20% ships built between 2020 – 2025
-30% ships built between 2025 – [2030]

**Attained EEDI \( \leq \) Required EEDI values**
Ship Energy Efficiency Management Plan (SEEMP) - Onboard management tool

- Monitoring of emissions and energy performance of individual ships and encouraging continuous improvement, using the operational indicator (EEOI) as monitoring tool and benchmarking.
- Improved voyage planning/execution (Weather routing/Just in time).
- Speed and power optimization (single most important issue).
- Optimized ship handling (ballast/trim/use of rudder and autopilot).
- Improved fleet and ship management - utilization.
- Improved cargo handling.
- Energy management.
Energy Efficiency Operational Indicator - EEOI

- MRV tool and benchmark for individual ships
  - A ship specific efficiency indicator to be used by all ships in operation (new and existing) obtained from fuel consumption, voyage (miles) and cargo data (tonnes)

\[
\text{Actual Fuel Consumption Index} = \frac{\text{Fuel Consumption in Operation}}{\text{Cargo Onboard} \times (\text{Distance traveled})}
\]
Effects of amendments

Following the adoption, IMO commissioned a study from LR/DNV to estimate the effects, document MEPC 63/INF.2

• **2020** – effects of EEDI and SEEMP
  103 - 200 million tonnes of CO2 reduction
  10 – 17% reduction over BAU
  US$ 20 – 80 billion annual fuel cost savings

• **2030**
  237 - 423 million tonnes of CO2
  18 – 26% over BAU
  US$ 90 – 310 fuel cost savings

• **2050**
  706 – 1320 million tonnes of CO2
  35 – 41% reduction over BAU
World fleet effects of mandatory EEDI and SEEMP

- 71% of the emission targeted by EEDI
- Significant reductions
- Low cost of compliance in Phase 1
- Massive fuel cost savings will make the overall life cycle fuel cost positive also in phases 2 and 3

<table>
<thead>
<tr>
<th>Year</th>
<th>BAU Mt</th>
<th>Reduction Mt</th>
<th>Reduction %</th>
<th>New level Mt</th>
</tr>
</thead>
<tbody>
<tr>
<td>2020</td>
<td>1103</td>
<td>152</td>
<td>14%</td>
<td>951</td>
</tr>
<tr>
<td>2030</td>
<td>1435</td>
<td>330</td>
<td>23%</td>
<td>1105</td>
</tr>
<tr>
<td>2040</td>
<td>1913</td>
<td>615</td>
<td>32%</td>
<td>1299</td>
</tr>
<tr>
<td>2050</td>
<td>2615</td>
<td>1013</td>
<td>39%</td>
<td>1602</td>
</tr>
</tbody>
</table>

SEEMP reduction will be more significant in the short run, while the effect of EEDI will have a large effect in the long term.
Breakthrough at IMO

Adopted by majority as full consensus could not be reached despite strenuous efforts, however no division between developing and developed countries (Non-Annex I/Annex I).

The majority of developing countries eligible to vote supported the adoption, including all LDC and SIDS.

<table>
<thead>
<tr>
<th></th>
<th>Number of countries</th>
<th>Gross tonnage</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>49</td>
<td>757,412,533</td>
<td>79.06%</td>
</tr>
<tr>
<td>No</td>
<td>5</td>
<td>97,083,482</td>
<td>10.13%</td>
</tr>
<tr>
<td>Abstain</td>
<td>2</td>
<td>4,877,396</td>
<td>0.51%</td>
</tr>
<tr>
<td>Not present</td>
<td>8</td>
<td>4,448,076</td>
<td>0.46%</td>
</tr>
<tr>
<td>Non-Annex VI countries</td>
<td>98</td>
<td>96,506,909</td>
<td>10.04%</td>
</tr>
<tr>
<td>World total</td>
<td>162</td>
<td>957,981,010</td>
<td>100%</td>
</tr>
</tbody>
</table>
**Breakthrough at IMO**

“This is a landmark for the Organization, which has now made a positive contribution to worldwide efforts to stem climate change and, indeed, a landmark for the international community since, for the first time in history, it has been possible to legislate GHG emission reductions for an entire industry sector”

E.E. Mitropoulos
IMO Secretary-General

“…..this underscores the fact that IMO is best positioned to play a leadership role in addressing greenhouse gas emissions from international shipping.”

Ban Ki-Moon
UN Secretary-General

“I would like to congratulate IMO on this outstanding result….The adoption of mandatory efficiency standards for international shipping is a major step and a substantial contribution….“

Christiana Figueres
UNFCCC Executive Secretary
Market-based reduction measures – MBM

An MBM under IMO to serve two purposes

- Economic incentive for enhanced energy efficiency both through design and operation (in-sector reductions)
- Off-setting in other sectors (out-of-sector reduction)

10 MBM proposals by governments and NGOs under review

- Charges, ETS, Efficiency based, Incentive Schemes, Rebate Mechanism

Three main streams:

GHG Fund: Offsetting above a target line

ETS: 100% auctioning (global/national)

- remaining proceeds: R&D, TC, improve port/maritime infrastructure in developing countries, Climate Finance

Efficiency based (EEDI): Closed trading of credits
Developed methodology to assess, *inter alia*, possible impacts on end consumers and selected industries, in particular in developing countries, and analyzed 10 MBMs proposed by Governments/NGOs.

**Selected commodities and trades:**

Iron ore (Dirty Bulk) – Crude oil (Tankers) – Grains (Clean Bulk) – Clothing and furniture (Container)

**Assumptions and growth scenarios:**

Size and composition of world fleet – growth scenarios (IPCC A1B: 1.65% and B2: 2.8%) – fuel and carbon prices – uptake of technology – etc.

**Elasticity estimates of freight rate to fuel price increase:**

<table>
<thead>
<tr>
<th>Source</th>
<th>Clean Bulk</th>
<th>Dirty Bulk</th>
<th>Tanker</th>
<th>Container</th>
</tr>
</thead>
<tbody>
<tr>
<td>IMO (MBM-EG)</td>
<td>0.25</td>
<td>0.959</td>
<td>0.324</td>
<td>0.116</td>
</tr>
<tr>
<td>UNCTAD</td>
<td>-</td>
<td>1.0</td>
<td>0.28</td>
<td>0.19 – 0.36</td>
</tr>
<tr>
<td>OECD</td>
<td>0.28</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
Nautical distance weighted by bilateral trade

MBM-EG concluded that those countries most affected would be those furthest away from their trading partners.

Ad valorem maritime transport cost **Australia**

<table>
<thead>
<tr>
<th></th>
<th>Cereals</th>
<th>Ores</th>
<th>Crude Oil</th>
<th>Manufactured</th>
<th>Impact 0.16%</th>
</tr>
</thead>
<tbody>
<tr>
<td>11%</td>
<td>20%</td>
<td>13%</td>
<td>5%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Ad valorem maritime transport costs for **Chile**

<table>
<thead>
<tr>
<th></th>
<th>Cereals</th>
<th>Ores</th>
<th>Crude Oil</th>
<th>Manufactured</th>
<th>Impact 0.26%</th>
</tr>
</thead>
<tbody>
<tr>
<td>27%</td>
<td>20%</td>
<td>6%</td>
<td>5%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Average global increase in freight costs equal to a 10% fuel price increase by introducing MBM

<table>
<thead>
<tr>
<th></th>
<th>Clean Bulk</th>
<th>Dirty Bulk</th>
<th>Tanker</th>
<th>Container</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2.7%</td>
<td>9.8%</td>
<td>3.0%</td>
<td>2.0%</td>
</tr>
</tbody>
</table>
# Emission reductions in 2030

Modelled emission reductions across various scenarios

<table>
<thead>
<tr>
<th></th>
<th>SECT (Mt)</th>
<th>VES (Mt)</th>
<th>Bahamas (Mt)</th>
<th>GHG Fund</th>
<th>LIS (Mt)</th>
<th>PSL (Mt)</th>
<th>ETS (Norway France)</th>
<th>ETS (UK)</th>
<th>RM (Mt)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mandatory EEDI</strong></td>
<td>123 - 299</td>
<td>123 - 299</td>
<td>123 - 299*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>MBM In sector</strong></td>
<td>106 - 142</td>
<td>14 - 45</td>
<td></td>
<td>1 - 31</td>
<td>32 - 153</td>
<td>29 - 119</td>
<td>27 - 114</td>
<td>27 - 114</td>
<td>29 - 68</td>
</tr>
<tr>
<td><strong>MBM Out of Sector</strong></td>
<td></td>
<td></td>
<td></td>
<td>152 - 584</td>
<td></td>
<td></td>
<td>190 - 539</td>
<td>190 - 539</td>
<td>124 - 345</td>
</tr>
<tr>
<td><strong>Total reductions</strong></td>
<td>19 - 31%</td>
<td>13 - 23%</td>
<td>10 - 20%</td>
<td>13 - 40%</td>
<td>3 - 10%</td>
<td>2 - 8%</td>
<td>13 - 40%</td>
<td>13 - 40%</td>
<td>13 - 28%</td>
</tr>
<tr>
<td><strong>Potential supplementary reductions</strong></td>
<td>45 - 454</td>
<td></td>
<td></td>
<td>104 - 143</td>
<td>232 - 919</td>
<td>917 - 1232</td>
<td>696 - 870</td>
<td></td>
<td>187 - 517</td>
</tr>
</tbody>
</table>

* Included if the mandatory EEDI is adopted by the committee
## Potential climate change financing*

Modelled “remaining proceeds” across various scenarios

<table>
<thead>
<tr>
<th>MBM</th>
<th>2020 ($ billion)</th>
<th>2030 ($ billion)</th>
</tr>
</thead>
<tbody>
<tr>
<td>GHG Fund</td>
<td>2 - 5</td>
<td>4 - 14</td>
</tr>
<tr>
<td>LIS</td>
<td>6 - 32</td>
<td>10 - 87</td>
</tr>
<tr>
<td>PSL</td>
<td>24 - 43</td>
<td>40 - 118</td>
</tr>
<tr>
<td>SECT</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>VES</td>
<td>8 - 41</td>
<td>5 - 18</td>
</tr>
<tr>
<td>ETS (Norway, France)</td>
<td>17 - 35</td>
<td>28 - 87</td>
</tr>
<tr>
<td>ETS (UK)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Bahamas</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>RM</td>
<td>10 - 13</td>
<td>17 - 23</td>
</tr>
</tbody>
</table>

*Excludes financing of out-of-sector emission reductions
Impacts of an MBM – Conclusions:

Impacts on consumers depend on stringency of MBM, e.g. the carbon price, if it is equal to a 10% increase in fuel price, it translates into a 2 – 10% increase in transport costs and means an increase of 0.0 – 0.2% on end prices and 0.02 – 0.8% of GDP:

Trading distances - Market share

Domestic production - Value-to-weight ratio

**Impacts on developing countries:**

Will vary by country independent of level of economic development

As a result, developing countries, especially SIDS and LDCs, should not be treated as a collective bloc in assessing impacts

Those that are closer to their trading partners or have large exporters will, in general, be less affected than countries that are further away or have many small exporters
IMO’s MBM impact study to continue

MEPC 63 (March 2012) to continue work on MBMs and to agree on further impacts studies

Impact on import costs = 10% fuel price

<table>
<thead>
<tr>
<th></th>
<th>Australia</th>
<th>Chile</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.16%</td>
<td>0.26%</td>
<td></td>
</tr>
</tbody>
</table>

MBM cost in relation to world imports

<table>
<thead>
<tr>
<th>Emissions (Mt)</th>
<th>Costs ($billion)</th>
<th>Seaborne Imports ($billion)</th>
<th>Costs/Imports (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>870</td>
<td>17.4</td>
<td>9.393</td>
<td>0.19%</td>
</tr>
</tbody>
</table>
Links with and effects on UNFCCC negotiations

As the EE regulations address ships and not States, and as they do not impose any reduction obligations, quantified or otherwise, on States, as well as the fact that the cost of introducing EEDI/SEEMP will be borne by the industry, there are no incompatibility issues with UNFCCC.

KP 2.2 are still interpreted differently by Parties.

Adoption of mandatory T&O at MEPC 62 in July 2011 clarified how the world community chose to deal with this issue.

Disbursement of revenues from an MBM for international shipping under IMO is seen by many IMO member States as a way to accommodate or reconcile the two sets of principles under the two conventions:
- CBDR under UNFCCC and non-discrimination under IMO

An MBM for international shipping could be a predictable source to the Green Climate Fund and thereby facilitate the UNFCCC negotiations.
Summary - IMO’s GHG Work

- Mandatory technical and operational measures adopted in July 2011 – in force 1 January 2013
  Important step - Energy efficiency standard for new ships, operational measures for all ships - Significant reductions

- MBM for international shipping under IMO
  Continues development - Possible adoption of treaty 2014 – 2015

- Climate Finance and the Green Climate Fund may be the key to unlock the UNFCCC/IMO deadlock
  Application to all ships via IMO is the only way to raise revenues from international maritime transport (precedence in IOPC)

www.imo.org