Sustainable shipping: to be or not to be

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Main reference i

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Decarbonization of maritime transport: to be or not to be?

Harilaos N. Psaraftis¹

• (published a few months before the Initial IMO Strategy)

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Main reference ii

• More than 10 years of research on ship emissions & logistics tradeoffs
• Involvement at the IMO, EU, etc

• Central focus of talk: Greenhouse gas (GHG) emissions
The Initial IMO Strategy

ANNEX 11

RESOLUTION MEPC.304(72)  
(adopted on 13 April 2018)

INITIAL IMO STRATEGY ON REDUCTION OF GHG EMISSIONS FROM SHIPS
Central ambition

• Reduce annual GHG emissions by ≥ 50% by 2050 (vs 2008 levels)

• Reduce annual CO2 emissions per transport work by ≥ 40% by 2030, pursuing efforts towards 70% by 2050 (vs 2008 levels)
This talk

• Where do we stand?
• How did we come here?
• Where will we go from here?
IMO: the GHG track

Subtrack I
- EEDI

Subtrack II
- MBMs
IMO: the GHG track

Subtrack I  
• EEDI

Subtrack II  
• MBMs

The **IMO Roadmap** (2016), including the **Initial IMO Strategy** (2018)
Subtrack I: Energy Efficiency Design Index (EEDI): thus far the only mandated measure to reduce GHGs

- **Adopted in July 2011**
- **Adopted as an amendment to MARPOL’s Annex VI**
- **Fierce resistance by China, India, Brazil, Saudi Arabia and other developing countries**
- **Matter highly political**

\[
\left( \prod_{j=1}^{M} f_j \right) \left( \sum_{i=1}^{n_{ME}} P_{ME(i)} C_{FME(i)} \cdot SFC_{ME(i)} \right) + \left( P_{AE(i)} C_{FAE(i)} \cdot SFC_{AE(i)} \right) + \left( \sum_{i=1}^{n_{PTI}} P_{PTI(i)} - \sum_{i=1}^{n_{eff}} f_{eff(i)} P_{AEff(i)} \right) C_{FAE(i)} \cdot SFC_{AE(i)} \right) - \left( \sum_{i=1}^{n_{eff}} f_{eff(i)} P_{eff(i)} C_{FME(i)} \cdot SFC_{ME(i)} \right)
\]

- \( f_j \): Capacity
- \( V_{ref} \cdot f_w \)
Energy Efficiency Design Index (EEDI)

- Defined as

\[
\left( \prod_{j=1}^{M} f_i \right) \left( \frac{\sum_{i=1}^{nME} P_{ME(i)} C_{FME(i)} \cdot SFC_{ME(i)}}{\sum_{i=1}^{nPTI} P_{PTI(i)} \cdot f_{i} \cdot P_{AE(i)} C_{FAE(i)} \cdot SFC_{AE(i)}} \right) + \left( \frac{\prod_{j=1}^{M} f_i \cdot \sum_{i=1}^{nPTI} P_{PTI(i)} - \sum_{i=1}^{nPTI} f_{i} \cdot P_{AE(i)} P_{AE(i)} C_{FAE(i)} \cdot SFC_{AE(i)} - \sum_{i=1}^{nPTI} f_{i} \cdot P_{AE(i)} C_{FME(i)} \cdot SFC_{ME(i)}}{\sum_{i=1}^{nPTI} f_{i} \cdot P_{AE(i)} C_{FME(i)} \cdot SFC_{ME(i)}} \right)
\]

\( f_i \): Capacity, \( V_{ref} \), \( f_w \)

- Numerator: Ship’s CO2 emissions
- Denominator: Ship’s transport work

- Units: Grams of CO2 per ton-mile
EEDI contd

• Mandatory for newbuildings as of 2013
• Attained EEDI ≤ Required EEDI
• Required EEDI = \((1 - X/100) aDWT\)

- \(X=0\%\) for ships built from 2013-2015
- \(X=10\%\) for ships built from 2016-2020
- \(X=20\%\) for ships built from 2020-2025 and
- \(X=30\%\) for ships built from 2025-2030.
Coefs $a$ and $c$: 
determined by regression from world fleet database

<table>
<thead>
<tr>
<th>Ship type</th>
<th>$a$</th>
<th>$c$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bulk carrier</td>
<td>961.79</td>
<td>0.477</td>
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<tr>
<td>Gas carrier</td>
<td>1120.00</td>
<td>0.456</td>
</tr>
<tr>
<td>Tanker</td>
<td>1218.80</td>
<td>0.488</td>
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<tr>
<td>Container ship</td>
<td>174.22</td>
<td>0.201</td>
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<tr>
<td>General cargo ship</td>
<td>107.48</td>
<td>0.216</td>
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<tr>
<td>Reefer</td>
<td>227.01</td>
<td>0.244</td>
</tr>
<tr>
<td>Combination carrier</td>
<td>1219.0</td>
<td>0.488</td>
</tr>
</tbody>
</table>

Note the absence of RoRo ferries in the Table!
Reference line EEDI

Figure 1: Dry bulk carriers
All data: 2,259 ships. Without outliers (shown in blue): 2,218 ships
EEDI for RoRo ferries

- EEDI formulation is more complex
- Coefficients in the formula are NOT constant
- Big discussion on how to fix the formula
Can EEDI drastically reduce CO2 emissions?

- From UMAS (2016) study

Figure 9: CO2 emissions scenario EEDI and no-EEDI

Scenario EEDI has 3% emissions reduction of scenario no-EEDI

Cumulative emissions reduction = 1214 million tonnes
The horsepower limit deficiency

- To be EEDI compliant, **the correct solution** would be to **optimize hull, engine and propeller**

- **The easy solution** would be to **reduce installed power** (or, equivalently, **design speed**)
The horsepower limit deficiency ii

- ANY energy inefficient design can be made EEDI compliant by **reducing installed power**
- The existence of this easy way out is hardly an incentive for more fuel efficient ships

- This could also lead to **underpowered ships**
- More CO2 to maintain speed in bad weather
Compromise on safety?

• A ship needs to have adequate power to maintain speed in bad weather, manoeuvering, etc.
• Big discussion at the IMO, how to reconcile these 2 issues
• Issue STILL UNRESOLVED
Subtrack II: Market Based Measures (MBMs)

- 11 MBM proposals at MEPC 60 (March 2010)
- Expert Group formed by IMO Sec. General
- Feasibility study (300-page report)
- Work: May- August 2010
- Report presented at MEPC 61 (Sep. 2010)
- Various discussions since then
How does an MBM work?

• It induces operators and investors to adopt measures that will reduce CO2 emissions

• These measures can be
  – **Operational** (short run): speed reduction
  – **Technological** (long run): build ships that are more energy efficient
What else can an MBM do?

• Collect money to be used for various purposes (even to reduce GHG emissions)
In-sector vs out-of-sector

**In-sector**

- **Direct** reduction of emissions (eg, reduce speed due to a fuel tax)

**Out-of-sector**

- **Indirect** reduction of emissions (eg, use the money to build a wind farm in New Zealand)
MBM proposal groups

- International GHG Fund (Denmark et al) (LEVY)
- 4 distinct Emissions Trading Schemes (ETS) (Norway, UK, France, Germany)
- Various hybrids, based on EEDI (Japan, USA, WSC)
- Port-based (Jamaica)
- Rebate mechanism (IUCN)
- Bahamas proposal
# Emission reductions in 2030

Modelled emission reductions across various scenarios

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

* Included if the mandatory EEDI is adopted by the committee
Assumptions, assumptions, & more assumptions!

- 300-page report
- No recommendation!
Greece’s proposal

- Keep on table only Levy and ETS proposals
- Put on hold hybrid MBMs* (US, Japan, WSC)
- Discard all others (Bahamas, Jamaica, IUCN)

*MBMs embedding EEDI
Greece’s proposal

- Keep on table EU Levy and ETS proposals
- Put on hold hybrid MBMs (US, Jap., WSC)
- Discard all others (Bahamas, IUCN)

• KEEP ALL ON THE TABLE
Another proposal

• Draft Resolution on Technical Co-operation and Transfer of Technology

• Brought forward by developing countries (China, India, Brazil, etc)
Another proposal

- Draft Resolution on Cooperation and Transfer of Technology
- Brought forward by developing countries (China, India, Brazil, etc)

**NO CONSENSUS**
Yet another proposal

- Proposal for an Impact Assessment Study on MBMs
- Brought forward by the Chairman of MEPC
- Supported by developed countries
Yet another proposal

- Proposal for an Impact Assessment Study on MBMs
- Brought forward by the Chairman of the MEPC
- Supported by developed countries

- NO CONSENSUS
MBMs

• Some proposals merged (Japan, WSC)
• Bahamas proposal reformulated and then withdrawn
• US proposal reformulated
• Basically, no real progress since 2010
MBMs

• Some proposals merged (Japan, WSC)
• Bahamas proposal reformulated and then withdrawn
• US proposal reformulated
• Basically, no real progress since 2010

MEPC 65 (May 2013):

• MBM DISCUSSION SUSPENDED!
Main reason for failure?

• Or: Name ONE (number=1) MAJOR obstacle in all these GHG discussions
• (hint: it is a 4-letter word)

• A: CBDR!
CBDR: **Common** But **Differentiated** Responsibilities

- Widely accepted principle after the Kyoto Protocol.
- Has two aspects. The first is **common responsibility**, which is raised from the concept of common heritage and common concern of humankind and reflects the duty of countries to equally share the burden of environmental protection for common resources.
- The second is **differentiated responsibility**, which addresses different social and economic situations across countries.

**DIRECTLY INCOMPATIBLE WITH PRINCIPLE OF NO MORE FAVOURABLE TREATMENT**
The IMO roadmap

OCTOBER 2016

• Adoption of an initial strategy in 2018 to meet the targets of COP21, which entered into force in November 2016.

• The strategy will be validated by actual emission figures gathered through the IMO’s fuel data collection system as of 2019.

• This will then lead to a final agreement on targets and measures, including an implementation plan, by 2023.
IMO Roadmap progress

- MEPC 71 (June 17)
- MEPC 72 (Apr. 18)
- MEPC 73 (Oct. 18)

- 13 April 2018 decision (Initial IMO Strategy)
Key elements (selected)

• **Vision:** IMO remains committed to reducing GHG emissions from international shipping and, as a matter of urgency, to phasing them out as soon as possible.

• **Levels of ambition:**
  – total GHG emissions from international shipping should peak as soon as possible and **total annual GHG emissions should be reduced by at least 50% by 2050** compared to 2008, while, at the same time, pursuing efforts towards phasing them out entirely.
  – **reduce CO2 emissions per transport work**, as an average across international shipping, **by at least 40% by 2030, pursuing efforts towards 70% by 2050**, compared to 2008;
Key elements (selected)

GUIDING PRINCIPLES

• the principle of non-discrimination and the principle of no more favourable treatment, enshrined in MARPOL and other IMO conventions;

• the principle of Common But Differentiated Responsibilities and respective capabilities, in the light of different national circumstances, enshrined in UNFCCC, its Kyoto Protocol and the Paris Agreement;
LONG LIST OF CANDIDATE MEASURES

HIERARCHY

• SHORT TERM (2018-2023)

• MEDIUM TERM (2023-2030)

• LONG TERM (2030 on)

EXAMPLES

• Speed reduction

• Market based measures

• Low carbon fuels
Which countries opposed it the most?
Which countries opposed it the most?
Also!

- Chile and Peru objected to "speed reduction" as a measure.
- Argued that sending cherries to China would suffer.
- Suggested using "speed optimization" instead
Also!

- Chile and Peru objected to "speed reduction" as a measure.
- Argued that sending cherries to China would suffer.
- Suggested using "speed optimization" instead

Compromise solution

- Both "speed optimization" and "speed reduction" were included in the text!
- No one really sure what is meant by "speed optimization!"
Speed reduction

• Was proposed as a key measure

• Advocates said it can have an immediate impact in reducing CO2

• Can be used as a bridge until more permanent measures are in place (eg, low carbon fuels)
Speed reduction (rationale)

- Pay less for fuel
- Reduce emissions
- Help sustain a volatile market

- Win-win-win?
- (killing 3 birds with one stone?)
Build more ships to match demand throughput

- More emissions due to shipbuilding and scrapping (life cycle analysis)
More ships also means

- More maritime traffic
- Implications on safety!
Yet another side-effect

• Cargo may shift to land-based modes, if these are available
• This may result in more CO2

• European short-sea shipping
• Even in deep-sea shipping

The speed limiters lobby

- **Speed limits** have been proposed by some NGOs
- **Clean Shipping Coalition**

- These NGOs have been lobbying the IMO and the EU for years
Tried before in 2010

MEPC 61

- CSC: “speed reduction should be pursued as a regulatory option in its own right and not only as possible consequences of market-based instruments or the EEDI.”

- RESULT: REJECTED
CE Delft study 2017

• Speed limits as functions of ship type and size
On the table in 2018!

SET OF SHORT-TERM MEASURES (2018-2023)

4. Consider and analyse the use of speed optimization and speed reduction as a measure, taking into account safety issues, distance travelled, distortion of the market or trade and that such measure does not impact on shipping's capability to serve remote geographic areas;
Project ShipCLEAN findings
(joint project with Chalmers Univ.)

- Vessels deployed on a TransPacific service

- EASTBOUND: Xiamen, Ningbo, Shanghai, Manzanillo, Buenaventura, Callao, San Antonio

- WESTBOUND: Callao, Manzanillo, Kaohsiung, Yantian, Hong Kong, Xiamen

- Slow steaming BIG TIME (with no speed limits)
Central question

In IMO lingo

• Speed reduction, or speed optimization?

Substance-wise

• Reduce speed via speed limits, or via a bunker levy?

• Both measures would reduce speed, hence emissions
Question

• Which is better, a bunker levy or a speed limit?

• ANSWER:

• Depends. A speed limit can cause higher, lower, or the same CO2 reductions as a bunker levy.
Result: CO2 can be reduced two ways

Bunker levy

Speed limit
Main problems i

• Speed limit will provide no incentive to build & operate energy efficient ships

• Speed limit will penalize energy efficient ships, forcing them to sail at same speed as their energy inefficient competitors

• Implementing and enforcing it will be an administrative nightmare
The way to 2023 (MEPC 80)

<table>
<thead>
<tr>
<th>Streams of activity</th>
<th>2018 (MEPC 73)</th>
<th>2019 (MEPC 74)</th>
<th>2020 (MEPC 75)</th>
<th>2021 (MEPC 76)</th>
<th>2022 (MEPC 77)</th>
<th>2023 (MEPC 80)</th>
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<tbody>
<tr>
<td>Candidate short-term measures (Group A) that can be considered and addressed under existing IMO instruments①</td>
<td>Invite concrete proposals</td>
<td>Consideration of proposals</td>
<td>Consideration and decisions on candidate short-term measures that can be considered and addressed under existing IMO instruments e.g. further improvement of the existing energy efficiency framework with a focus on EEDI and SEEMP, ITCP②</td>
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<tr>
<td>Candidate short-term measures (Group B) that are not work in progress and are subject to data analysis</td>
<td>Invite concrete proposals</td>
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<td>Consideration and decisions on candidate short-term measures that are not work in progress and are subject to data analysis, consistent with the Roadmap③</td>
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<tr>
<td>Candidate mid-/long-term measures and action to address the identified barriers</td>
<td>Invite concrete proposals</td>
<td>Consideration of proposals including identification of barriers and action to address</td>
<td>Progress made and timelines agreed on the development of mid- and long-term measures</td>
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<tr>
<td>Impacts on States④</td>
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<td>Finalization of procedure</td>
<td>Measure-specific impact assessment, as appropriate, consistent with the Initial Strategy, in particular paragraphs 4.10 to 4.13</td>
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<tr>
<td>Fourth IMO GHG Study</td>
<td>Scope</td>
<td>Initiation of the Study</td>
<td>Progress report</td>
<td>Final report</td>
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<td>Capacity-building, technical cooperation, research and development</td>
<td>Development and implementation of actions including support for assessment of impacts and support for implementation of measures</td>
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<tr>
<td>Follow-up actions towards the development of the revised Strategy</td>
<td>Ship fuel oil consumption data collection pursuant to regulation 22A of MARPOL Annex VI (DCS)</td>
<td>Initiation of revision of the Initial Strategy taking into account IMO DCS data and other relevant information</td>
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</tbody>
</table>

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① Includes ongoing work pursuant to regulation 21.6 of MARPOL Annex VI.

② In aiming for early action, the timeline for short-term measures should prioritize potential early measures that the Organization could develop, while recognizing those already adopted, including MARPOL Annex VI requirements relevant for climate change, with a view to achieve further reduction of GHG emissions from international shipping before 2023 (paragraph 4.2 of the Initial Strategy).

③ Assessment of impacts on States to be undertaken in accordance with the procedure to be developed by the Organization.
AFTER A FIERCE DEBATE: "prioritization" changed to "consideration"

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<td>Data analysis, in particular from IMO Fuel Oil Consumption DCS</td>
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</tbody>
</table>
Q: Any measure that might work?

• A: A significant bunker levy
  – SHORT RUN: reduce speed
  – LONG RUN: incentivize technologies or low carbon fuels that would reduce GHG emissions

(if fossil fuels are cheap, people will use them)
VLCC emissions

- Gkonis and Psaraftis (2012)
• Who was for a Levy in the IMO MBM discussion?
Important note!

• MBMs are NOT explicitly included in the set of measures currently considered by the IMO

• Only *obliquely* included under **medium term measures (2023-2030):**

new/innovative emission reduction mechanism(s), possibly including Market-based Measures (MBMs), to incentivize GHG emission reduction;
CONCLUSIONS

• The road to 2050 is a long one
• Process is rather slow, at least to identify a credible pathway
• Politics seems to be the main obstacle
• Need to move on, to avoid unilateral action by the EU
Enter the EU!

FEBRUARY 2017

• Decision of EU Parliament to include shipping in EU ETS!

• Industry: A bad idea!
However!

After negotiations between the EP and the EU Council of Ministers, it was agreed to align the EU with the IMO process.

Essentially refrain from taking action on ETS before seeing what the IMO intends to do on GHGs.

The European Commission will closely monitor the IMO process, starting from what is agreed on the initial strategy in 2018 and all the way to 2023.
• (just out)
THANK YOU

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