

EEDI, Other Regulations to Come, and Their Implications for Ship Design

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Now in charge of **industrial policy on shipbuilding and ship machinery**. (challenging time for Japanese shipbuilding industry....not today's topic)

From 2008 to 2011, as the Director for International Regulations, Maritime Bureau, MLIT, and the Head Delegation of Japan to IMO's **Marine Environment Protection Committee (MEPC)**,

led the discussion in issues of **CO₂, NO_x, ballast water management and ship recycling**.

For CO₂ issues, in this period, drafted 37 Japanese submissions to MEPC and its WGs.

EEDI, in Annex VI to MARPOL Convention, be calculated, be verified by the third-party, and be less than the pre-set threshold value.

Unbelievable achievement from climate change (UNFCCC) negotiators, i.e., IMO outsiders

Why? We broke the spell of **CBDR (Common but Differentiated Responsibility)** principle in UNFCCC

- “developed” and “developing” countries divide

Uniform and flag-neutral application to any ocean-going ships.

Believe or not,

EEDI regulations were developed by carefully taking into account the technical expertise of shipping and shipbuilding communities.

Unlike some of environmental regulations developed “emotionally”, lacking thorough consideration of costs and benefits.

Industry players would be better-off by understanding:

- in what principle and rationale the regulations were developed,
- what kind of future regulations are being developed

Players could properly consider future business strategies including the direction of ship design.

This paper tries to **answer FAQs** to give **insights on what will come next**, and **what maritime players should do proactively**.

Is the international shipping “evil” in climate change?

- Currently, 3% share. In future, major league.

Why IMO, not UNFCCC?

(United Nations Framework Convention on Climate Change)

Are we in a stable regime, or in chaos?

Shift of policy paradigm

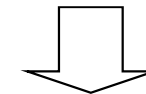
1997: Kyoto Protocol delegated work to IMO

No substantial action at IMO: except some studies on emission volume, and suggestions on voluntary environment indexing

Public and other forum (UNFCCC) **unsatisfied**

Dec.2007: Bali Action Plan at UNFCCC COP13
Roadmap for post-Kyoto framework

Establishment of policy ideas



From May 2008: Policy ideas on mandatory regime on **efficiency indices developed**. Policy ideas on **MBM (Market-Based Measures) proposed**.

Institutionalization of policy ideas

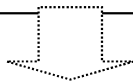
July 2011: **EEDI/SEEMP regulation agreed**, amendments to the Convention **adopted**. MBMs are still under discussion.

January 2013: **EEDI/SEEMP regulation applied**.
Little progress for MBMs. Interim solution (MRV: **Monitoring, Reporting and Verification**) emerged.

Present: EEDI regulation moves from Phase 0 to Phase 1 (more stringent requirement)

Discussion of technical guidelines (e.g., minimum power requirement) continues, and may have negative effects.

MRV not agreed yet. Regional (EU) regulation eminent.



Stability of policy paradigm?

OR

Accumulation of in consequence again? **Collapse** of policy paradigm?

Many regulatory tools....confusing!

Are they just fragmented ideas by bureaucrats?

EEDI is not a stand-alone tool.

Need to see the entire picture.

$$\text{CO}_2 \text{ emissions} = (\text{Activity}) (\text{Efficiency})$$

Activity = Transported cargo volume (**ton mile**);

Efficiency = CO₂ Emissions per unit transported cargo (**gramme /ton mile**)

• Option A: **Transport Volume Reduction**

This is not a feasible option!

• Option B: **Efficiency Improvement**

✓ B-1 Technical Measures

Alter the configuration of a ship

✓ B-2 Operational Measures

Operate a ship “wisely” at sea

REDUCTION MEASURES

Emission Reduction =

A Transport volume reduction
and/or;

B Efficiency improvement

B-1 Technical measures

B-2 Operational measures

2ND GENERATION REG. PACKAGE

Induce any reduction measures

(A, B-1, B-2)

Market-Based Measures (MBM)

METS, Bunker Fuel Levy

Monitoring, Reporting and Verification System (MRV)

interim solution prior to MBM

Induce technical measures (B-1)

EEDI (Energy Efficiency Design Index) - mandatory for new ships

Efficiency of a ship at design and construction stage

Require EEDI to be below a certain standard

Induce operational Measures (B-2)

SEEMP (Ship Energy Efficiency Management Plan) - mandatory for new and existing ships

To declare operational measures

Monitor the ship's performance at sea

1ST GENERATION REG. PACKAGE

EEOI (Energy Efficiency Operational Indicator) -Voluntary application-

Efficiency actually achieved

Why do EEDI and EEOI use the same unit, gramme/ton mile?

- Reduction Option A is of no help.
- Policy instruments should guide the industry to pursue Option B-1 (technical measures) and Option B-2 (operational measures)
- Both have **efficiency-based goal**. **Quantitative indicators for their achievement** should be provided.

Here comes EEDI and EEOI.

EEDI (Energy Efficiency Design Index)

EEDI indicates the efficiency that is expected for a ship to achieve, based on the ship specifications, and is calculated by “SFC* X Engine Output”, and divided by “DWT”, and “Speed”.

$$\text{EEDI} \begin{matrix} \text{(g/ton mile)} \\ \text{=} \end{matrix} \frac{\text{Engine Power} \times \text{SFC}^* \times C_F^*}{\text{Capacity(dwt)} \times \text{Speed}}$$

Efficiency
“potential”

SFC: Specific Fuel Consumption

C_F : Carbon Factor

EEOI (Energy Efficiency Operational Indicator)

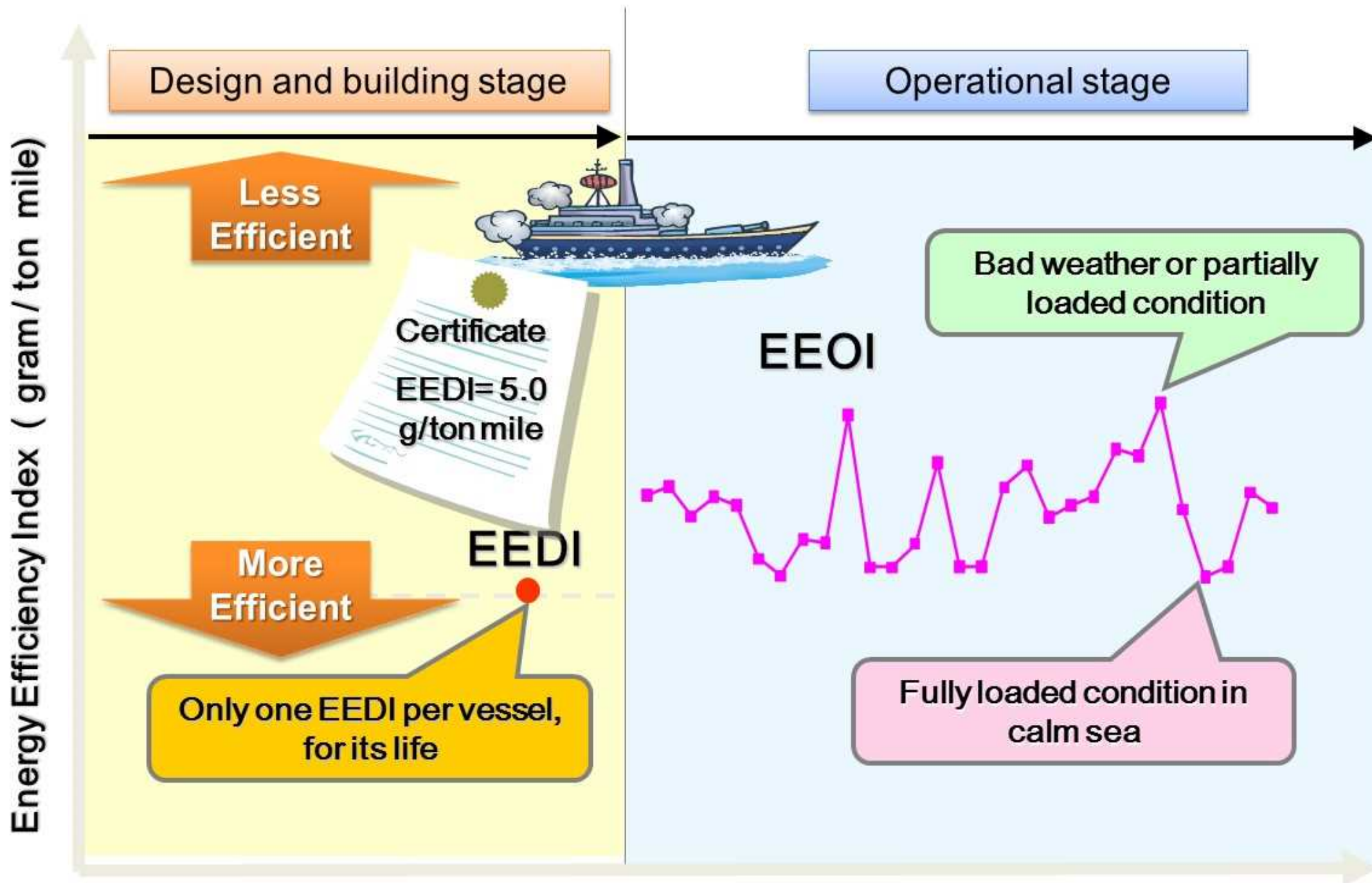
EEOI indicates the efficiency that was achieved in actual operation, calculated by “Fuel Consumption”, “Cargo Mass”, and “Sailed Distance”.

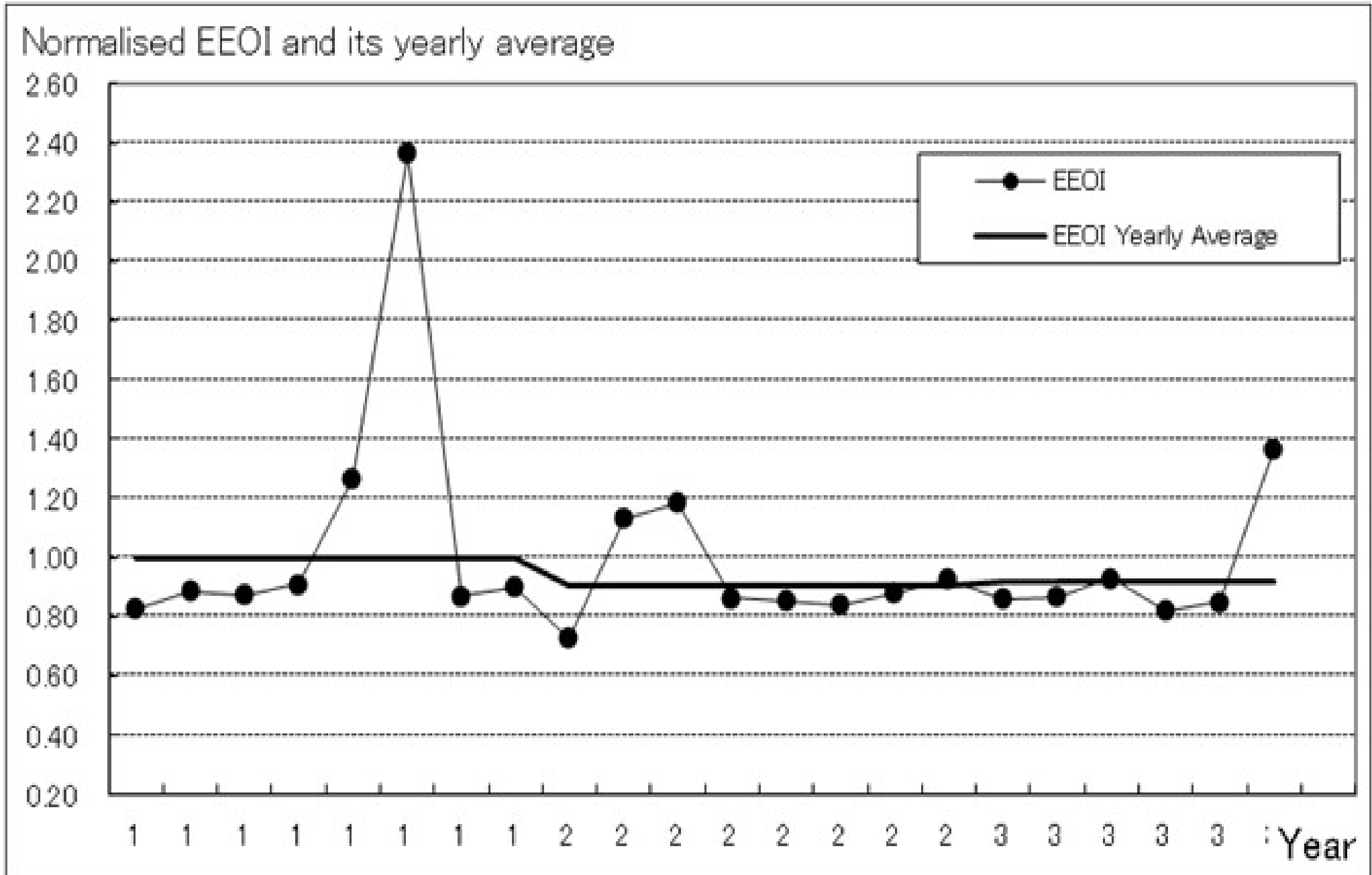
$$\text{EEOI (g/ton mile)} = \frac{\text{Actual Fuel Consumption} \times C_F^*}{\text{Cargo Mass} \times \text{Sailed Distance}}$$

Actually achieved Efficiency

C_F : Carbon Factor

EEDI and EEOI, their relation





MBM or MBI (Market-Based Instruments)?

REDUCTION MEASURES

Emission Reduction =

A Transport volume reduction
and/or;

B Efficiency improvement

B-1 Technical **measures**

B-2 Operational **measures**

2ND GENERATION REG. PACKAGE

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Efficiency actually achieved

Optimum way was the **two-step approach**.

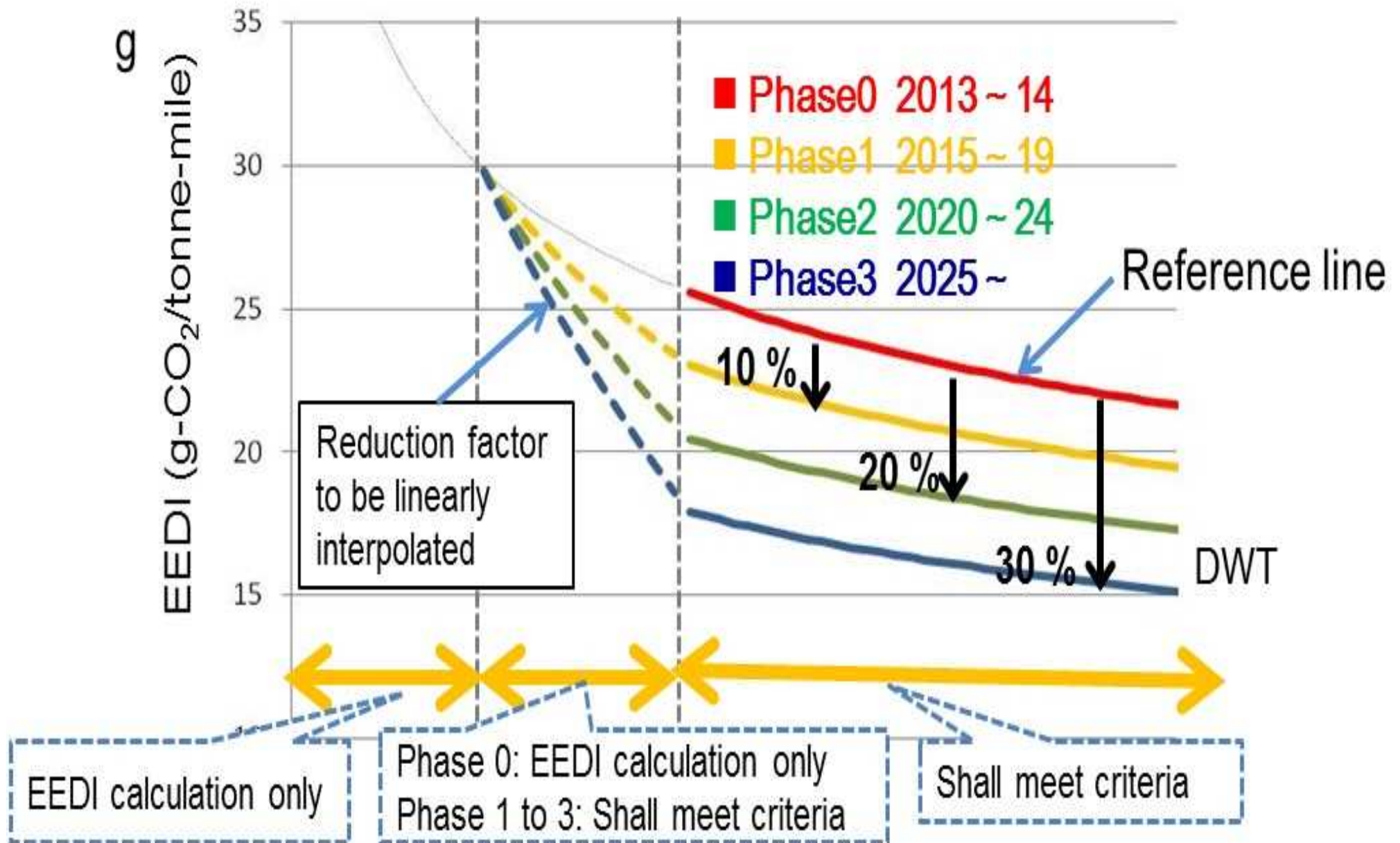
1st generation: quick, relatively easy to implement, effective, **but not perfect in isolation**.

Save time, ease the external pressure (“*shipping is evil, doing nothing!*”), then the **2nd generation**

MBM, theoretically correct tool, but challenging.

MRV, interim solution, similar effects to MBM, but to weaker degree.

EEDI regulations at a glance



Developing EEDI in 2008 to 2011 at IMO-MEPC,
we had a battle on:

Setting 1. **Reference Lines** (**average EEDI of existing ships**) and

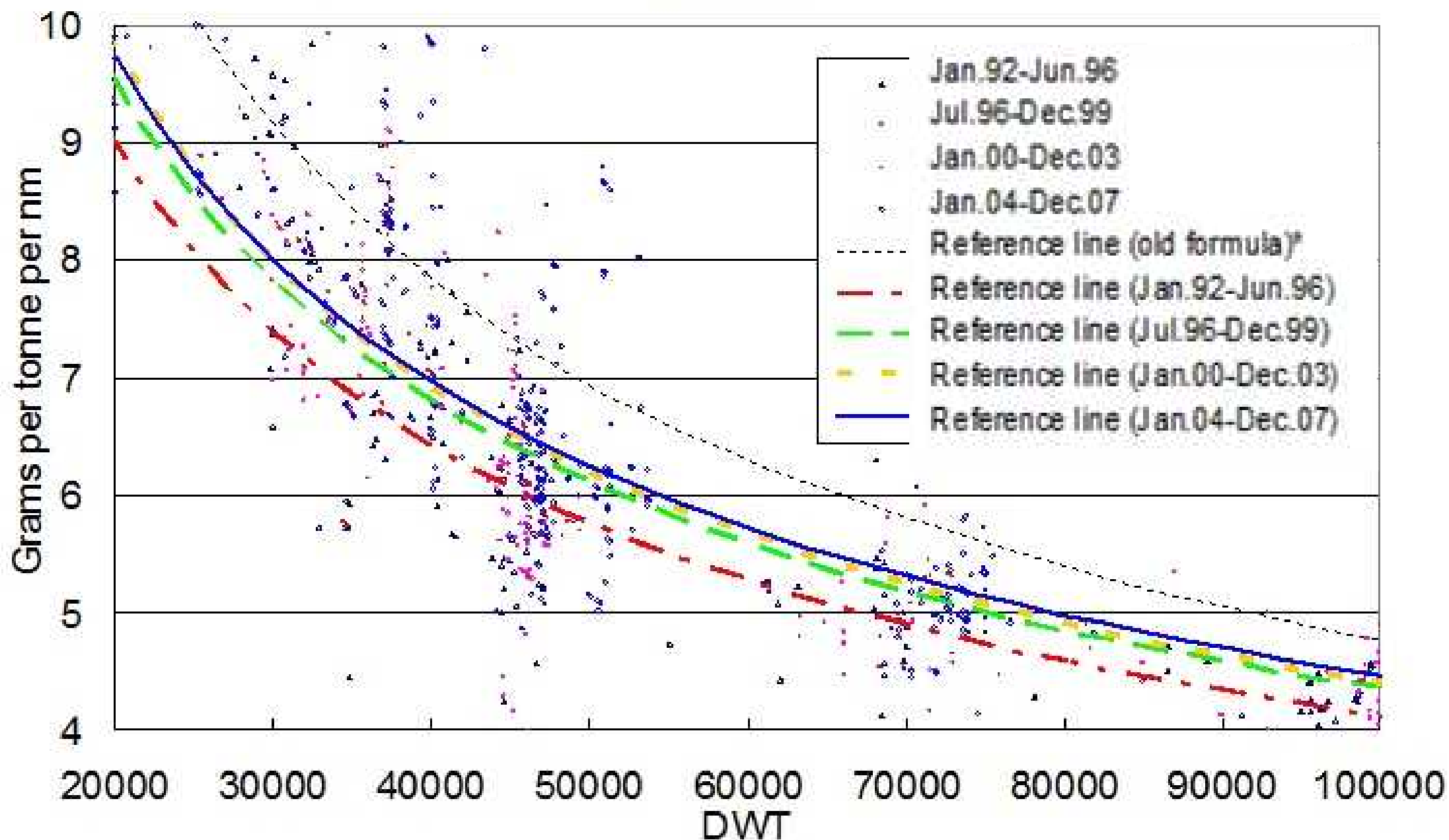
2. **Reduction Factors:**

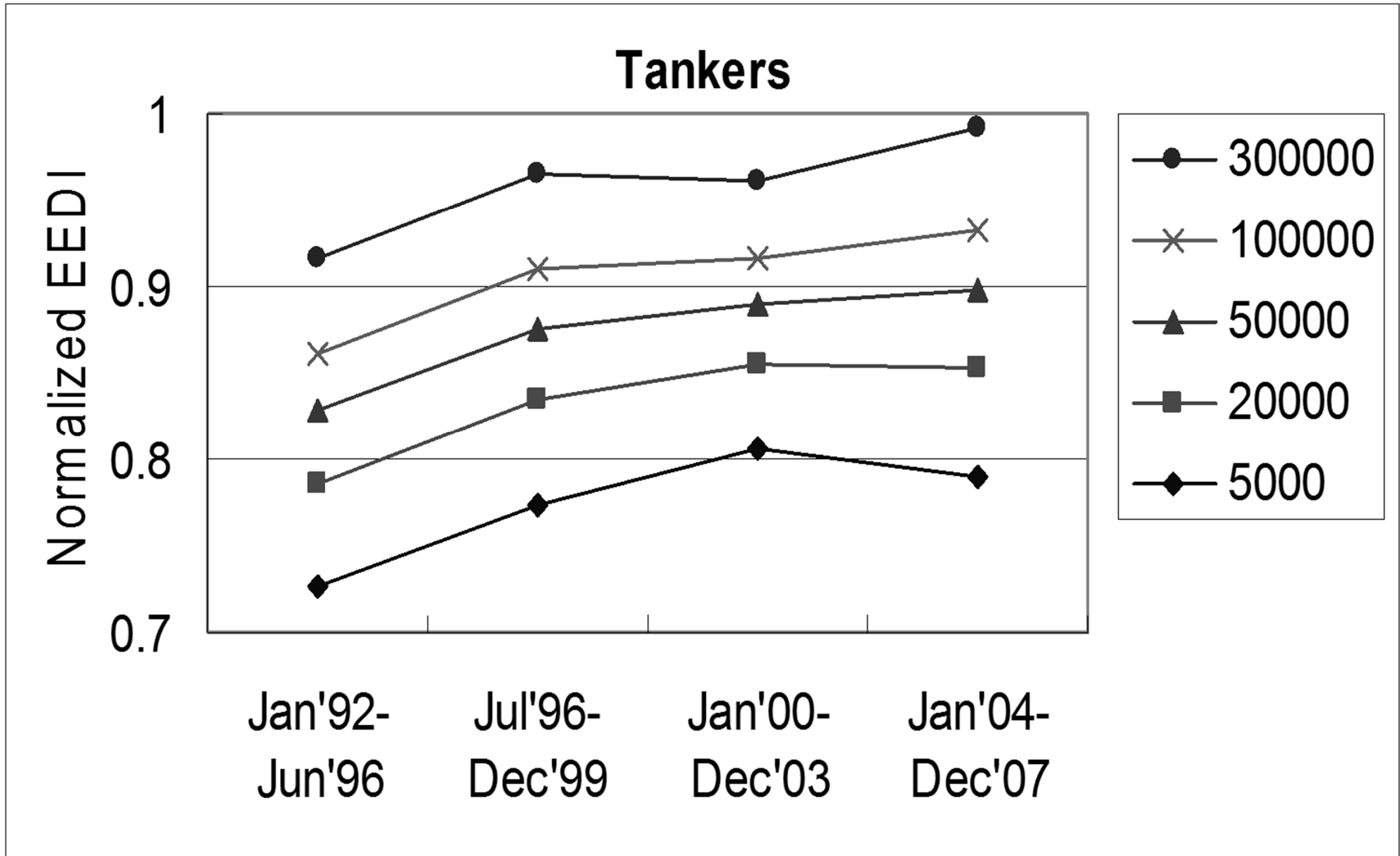
They determine the stringency (painful) level

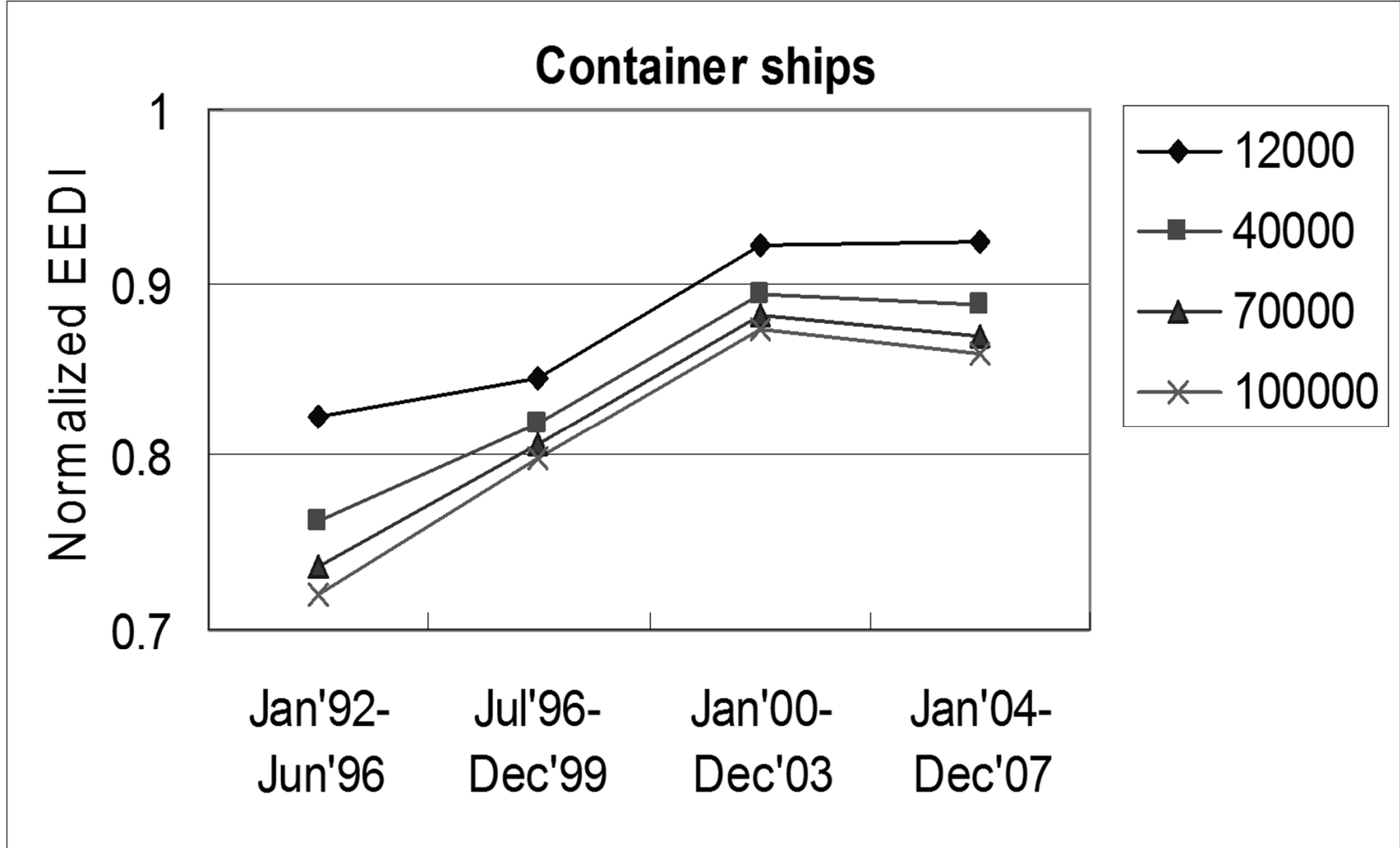
Position of the Reference Line was appropriately set, **or it is too “slack”?**

A recent study says that efficiency deteriorated after 90s. **Of course, we knew.** Japan showed the analysis at the IMO, and we had full debate on it.

Tankers







Chose the **existing ships of relatively new (past 10 years)** as data samples for the regression line.

Reference Line is rather generous for the industries.

On the other hand, **the height of the bar does not take into account the latest regulations (NOx Tier III, BWMS, H-CSR)** having negative impacts on EEDI.

Overall, not too slack, not too tight, but balanced.



EEDI estimates the ship performance **under the calm sea condition**, is that enough?

Would everybody seek speed reduction (engine-downsizing) only, to satisfy EEDI?

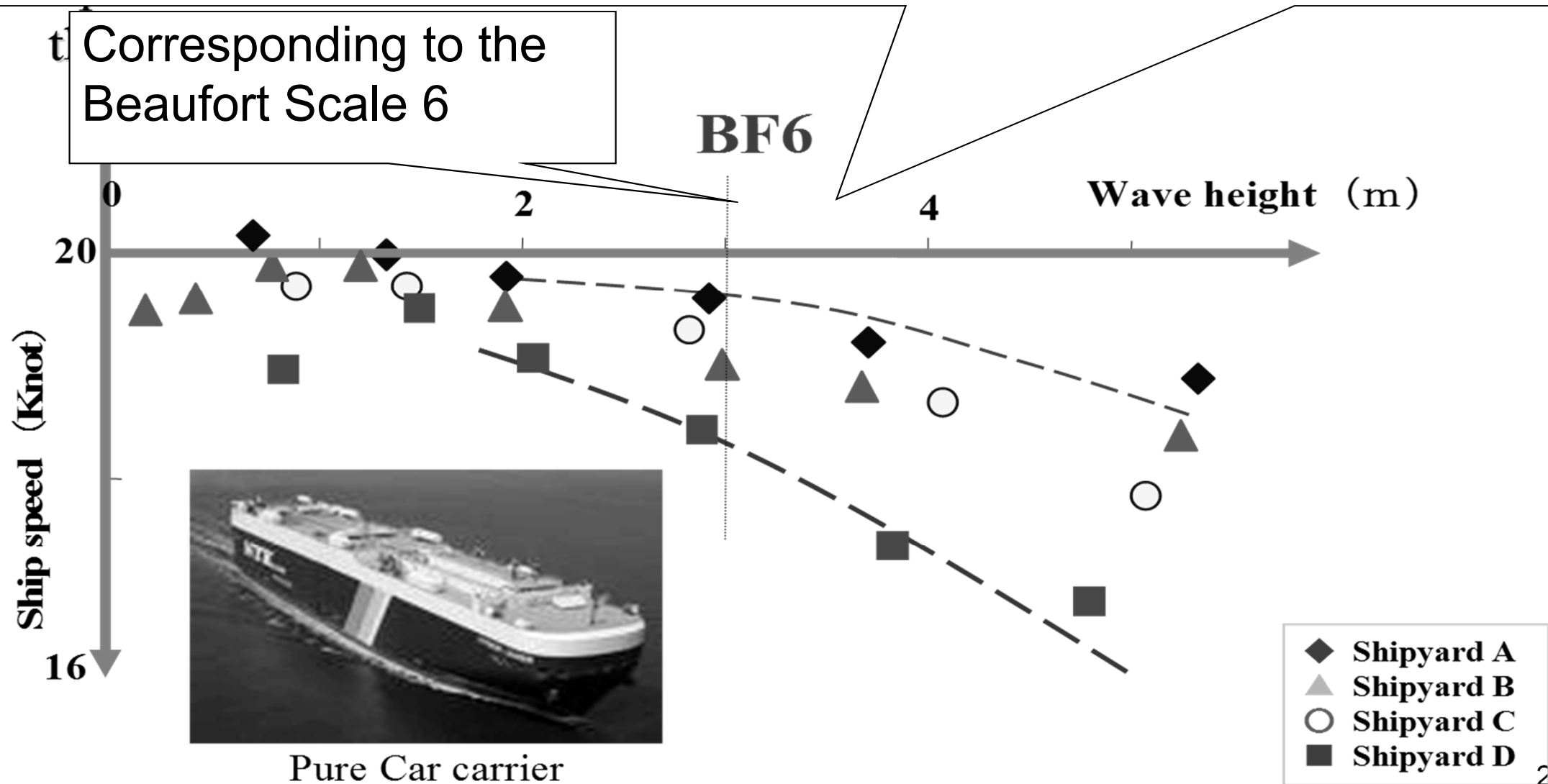
Are we so stupid not to care for safety?

How to cope with ship operators' concern?

Will the strict requirement on minimum propulsion power help?

Observed Speed Reduction in North Pacific

These 4 ships (PCC) are operated by the same shipping company on the same route, and have similar specifications. However, they are designed and built by different shipyards A, B, C and D, thus they may have different hull configuration.



The 1st generation package is weak to induce further efforts by the existing ships.

MRV (Monitoring, Reporting and Verification), and Data Collection system

Ship's CO₂ emission performance to be **monitored, recorded, verified and reported as the ship is engaged in actual voyages.**

An appropriate indicator (“metric”) to show

- to what extent the ship is designed and constructed in energy efficient way; and
- the ship is operated, in energy-efficient manner.

Japanese proposal for MRV– Concept of AER

$$\text{Annual Efficiency Ratio (AER)} = \frac{\sum_j FC_j \times C_{Fj}}{DWT \times D} \quad [\text{g-CO}_2 / \text{ton-mile}]$$

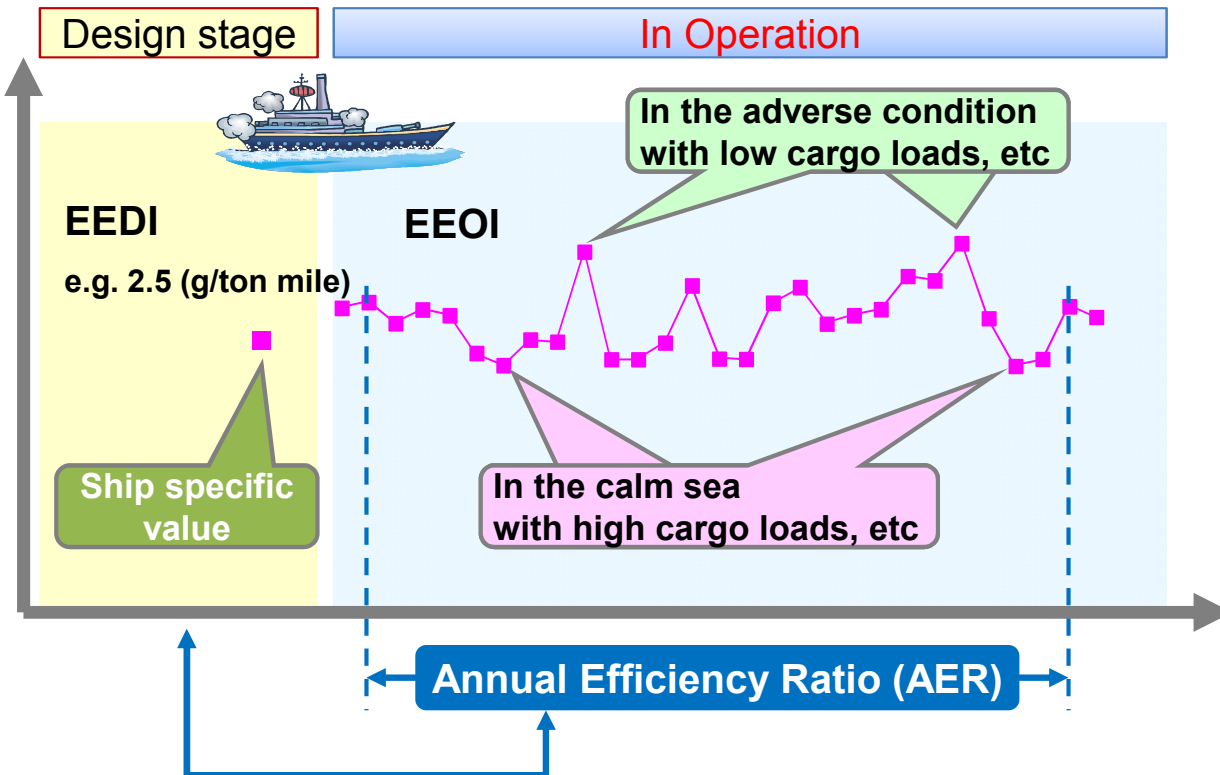
j : the fuel type;

DWT : the deadweight;

FC_j : the annual mass of consumed fuel j ;

D : the annual distance sailed in nautical miles;

C_{Fj} : the fuel mass to CO₂ mass conversion factor for fuel j ;



Example of calculation of the AER

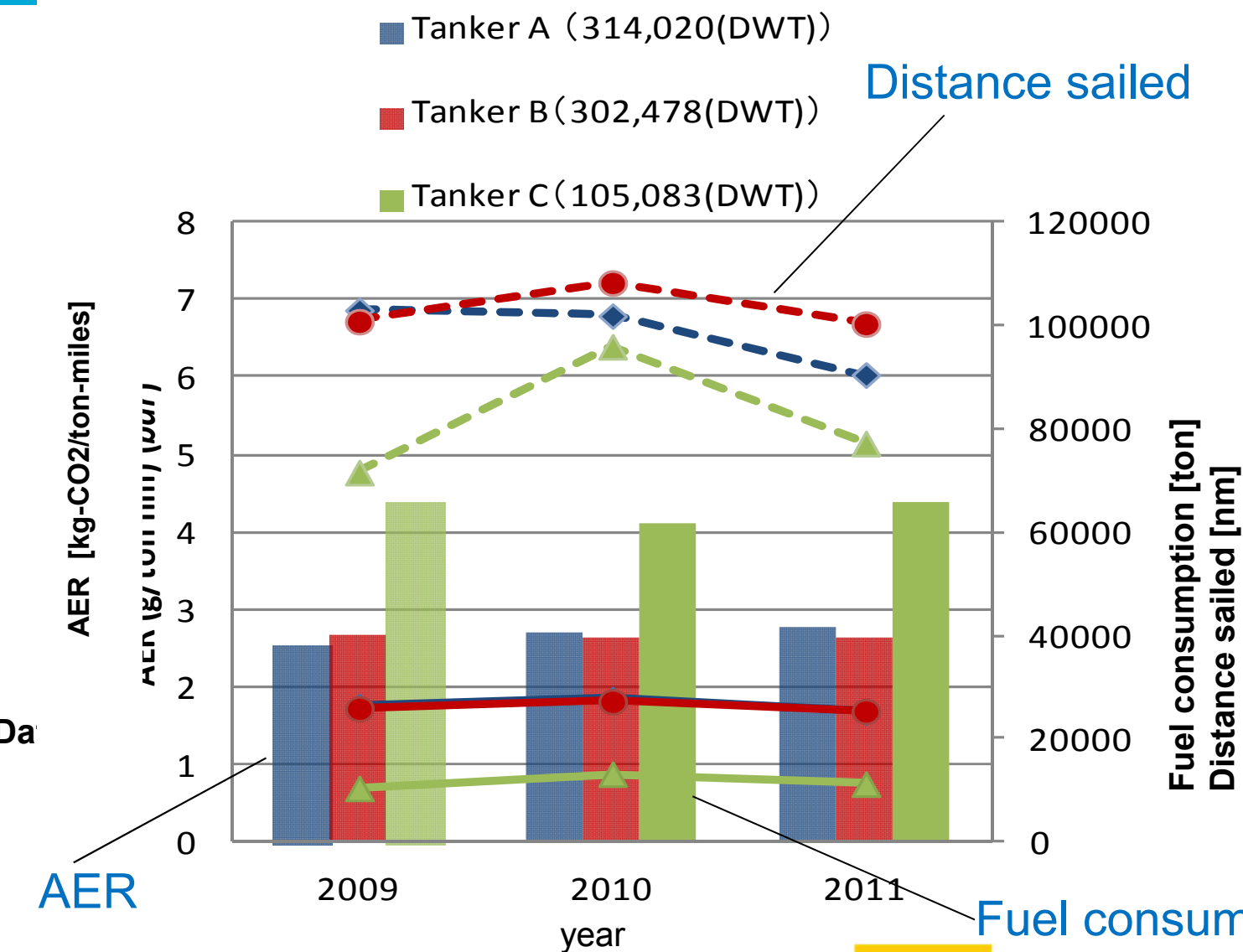
$$\begin{aligned} \text{AER} &= \frac{17,381 \times 10^6 \times 3.114}{230,000 \times 81,984} \\ &= 2.87 \text{ (g-CO}_2/\text{ton mile)} \end{aligned}$$

Where:

Fuel consumption: 17,381 ton/year
 $C_F = 3.114$
 Distance sailed: 81,984 mile/year
 DWT: 230,000

Same units: Could be compared !

Monitoring Results: Appropriateness of AER



- ✓ Tanker B consumed larger fuels than Tanker C. But...
- ✓ Tanker B achieved a longer distance, carried larger cargoes than Tanker C.
- ✓ Calculated AER value of Tanker B shows a better efficiency ratio than that of Tanker C.

AER is that could appropriate capture energy efficiencies of individual existing ships, taking well into account “transport work”.

EU regional MRV regulation will start to be applied from January 2018.

Covers **ships calling at EU ports, no matter they are EU-flagged or not.**

Mandatory with the penalty clause.

As a matter of principle, regional approach should be avoided.

EU regulation will be positive or negative?

Depends on whether such EU action will accelerate or deter the IMO negotiation process.

Governments always come up with costly regulations. No financial incentives to reward curbing CO₂ emission?

EEDI regulation is “pass or fail” exam; no incentive for top-runners.

Meanwhile, **OECD sets the rules on officially supported ship finance.**

SSU (Sector Understanding on Export Credits for Ships) regulates - minimum down payment, interest rates and repayment period.

International Frameworks

IMO

EEDI for new ships

- Sets minimum standard
- No reward for excellence
- No economic perspective

OECD

SSU for new ships

- Sets common rules for officially supported export credits
- No environmental perspective

Need to establish
“Reward for Excellence”
in environmental performance

Incorporate environmental factors (e.g., EEDI) into the SSU

- Encourage excellence by creating economic incentives
- Remove financial obstacles for investing in more efficient but expensive ships

Japan proposed at the OECD to **relax the export loan rules to benefit “*low CO₂ emission ships*”**:

- Down payment: **reduced to 15 %**, as compared to 20% for ordinary ships
- Maximum repayment terms: **extended to 18 years**, as compared to 12 years for ordinary ships

“*Low CO₂ emission ship*”: attained EEDI is lower than required EEDI by more than 20%: about 5% of existing ships already satisfy this criterion.

In longer term, environmental performance of ship will influence financial terms of newbuilding or other commercial transaction (such as the 2nd hand sales).

Regulations started rather generously, but will become more stringent.

We cared for the **acceptance level** by the industry, and there was the time constraint to obtain wider support.

General trend will not be reversed.

Severer selection inevitable

Ship designers/builders with higher credibility of delivering the ships with the expected performance will survive.

Importance of ship performance at actual sea conditions, and its transparency

Operators are more conscious of performance at actual sea.

MRV, no matter it is regional or global, will put further pressure on ship owners/operators to use superior ships.

While f_w and $EEDI_{weather}$ is an optional indication of the IEEC, **Ship designers/builders can utilize f_w and $EEDI_{weather}$ as a marketing tools.**

Differentiation of financial conditions in favor of more efficient ships may help such efforts.

Regulations should be balanced one: reduce emission, without damaging maritime transport activities.

External pressure comes to IMO, its Member States and industry players to bring tangible outcome.

Politics in UNFCCC may lead to top-down approach, causing disproportionate financial burden.



Scenario 1: The 1st package goes smoothly, and the goal for higher efficiency is achieved: stability is kept.

Scenario 2: Modification of the 1st package, - unnecessary strengthening of the minimum power requirement, significant alleviation of the EEDI requirement levels in Phase 2 and 3 - the discussion on the 2nd generation package would stagnate.

Accumulation of inconsequence is dangerous

Scenario 2: “accumulation of inconsequence” might lead to the “collapse of policy paradigm”.

New policy ideas will emerge, not deliberate and well thought, leading to **regulatory confusion**.

Designers/builders should continue to improve the energy efficiency of ship, be proactive in dialogue with owner/operator to share the merits of eco-ships.

The industry's efforts should be visual in the form of the total emission volume vis-à-vis transport activity. **Visibility will be the best defense** to the policy instability.

Stability or Collapse?

It is up to YOU, industry players.

Thank you for your attention.