EEDI review for phase 2 under Regulation 21.6 of MARPOL Annex VI

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Energy Efficiency Regulations in MARPOL ANNEX VI

Jul. 2011 Adoption of the amendments to MARPOL Annex VI

Jan.2013 Entry into force of the amendments

- **For new ships**
  Energy Efficiency Design Index (EEDI)

- For all ships including existing ships
  Ship Energy Efficiency Management Plan (SEEMP)

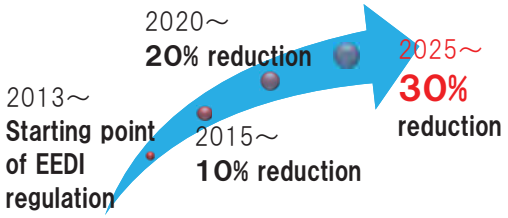
Energy Efficiency Regulations in MARPOL ANNEX VI

EEDI regulations

- Attained EEDI shall be less than or equal to Required EEDI.

  Attained EEDI ≤ Required EEDI

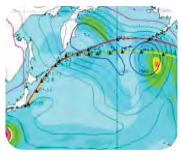
- Required EEDI will be stepwisely strengthened.



Energy Efficiency Regulations in MARPOL ANNEX VI

SEEMP

- SEEMP shall be kept on board.
- SEEMP is to indicate ship-specific practices for the fuel efficient operation of ships, such as:
  - Weather routing;
  - Speed optimization etc.

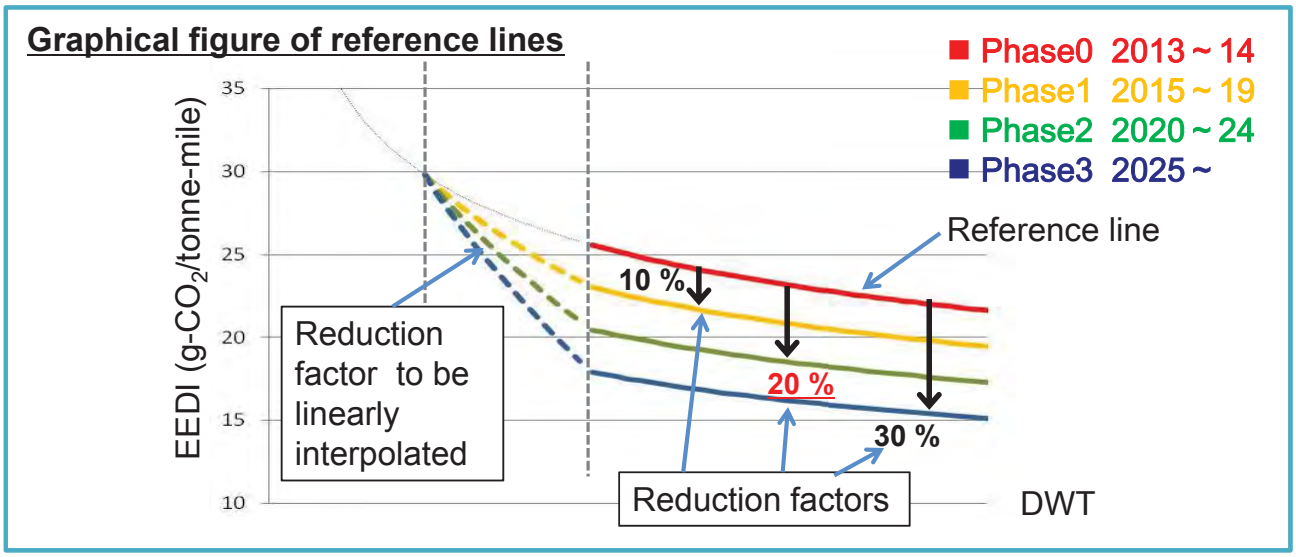


Outline of EEDI Regulations

Attained EEDI ≤ Required EEDI

Required EEDI = (1-X/100) x reference line value

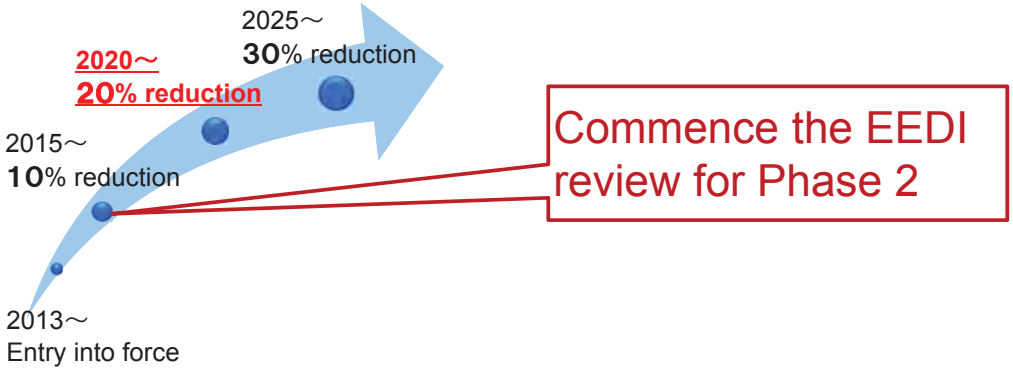
where X is the reduction factor



EEDI review for phase 2

Regulation 21.6 of MARPOL Annex VI

*'**At the beginning of Phase 1** and at the midpoint of Phase 2, the Organization shall **review the status of technological developments** and, if proven necessary, amend the time periods, the EEDI reference line parameters for relevant ship types and reduction rates set out in this regulation.'*



Correspondence Group on EEDI review for phase 2

- Establishment October 2014
- Coordinator Japan
- Participants
  - 36 Member States
  - 1 Intergovernmental Organization (IGO)
  - 19 Non-governmental Organization (NGO)
- Objective of the CG
  - Assess the achievability of phase 2 requirement to recommend whether the time periods, the EEDI reference line parameters for relevant types and the reduction rates set out in regulation 21 (Required EEDI) should be retained or, if proven necessary, should be amended as appropriate.

How to assess the achievability of phase 2 requirement

Two methods

Method A

By using data of already built ships

Method B

By conducting numerical case study

How to assess the achievability of phase 2 requirement

Method A

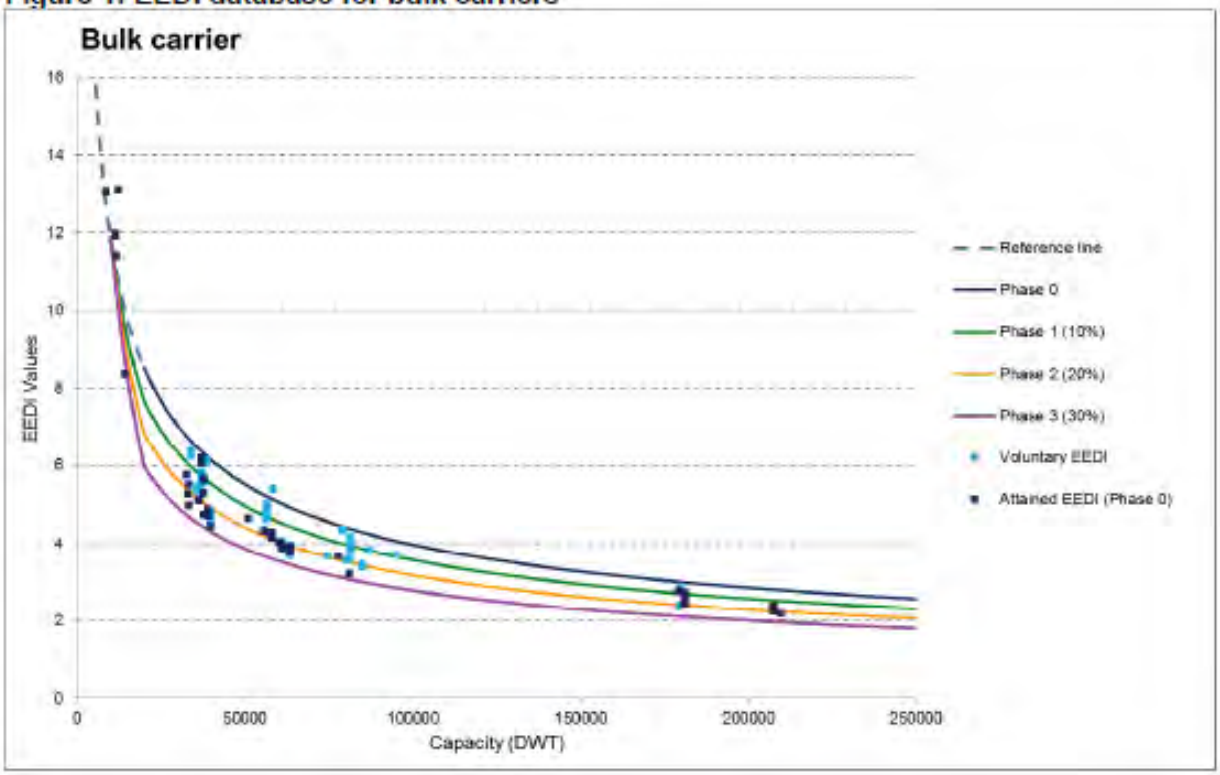
By using data of already built ships

① Using data in the **IMO's EEDI database** (Currently 573 datasets)

② Plotting **attained EEDI** of each data on the graph with **reference lines for Phase 2**

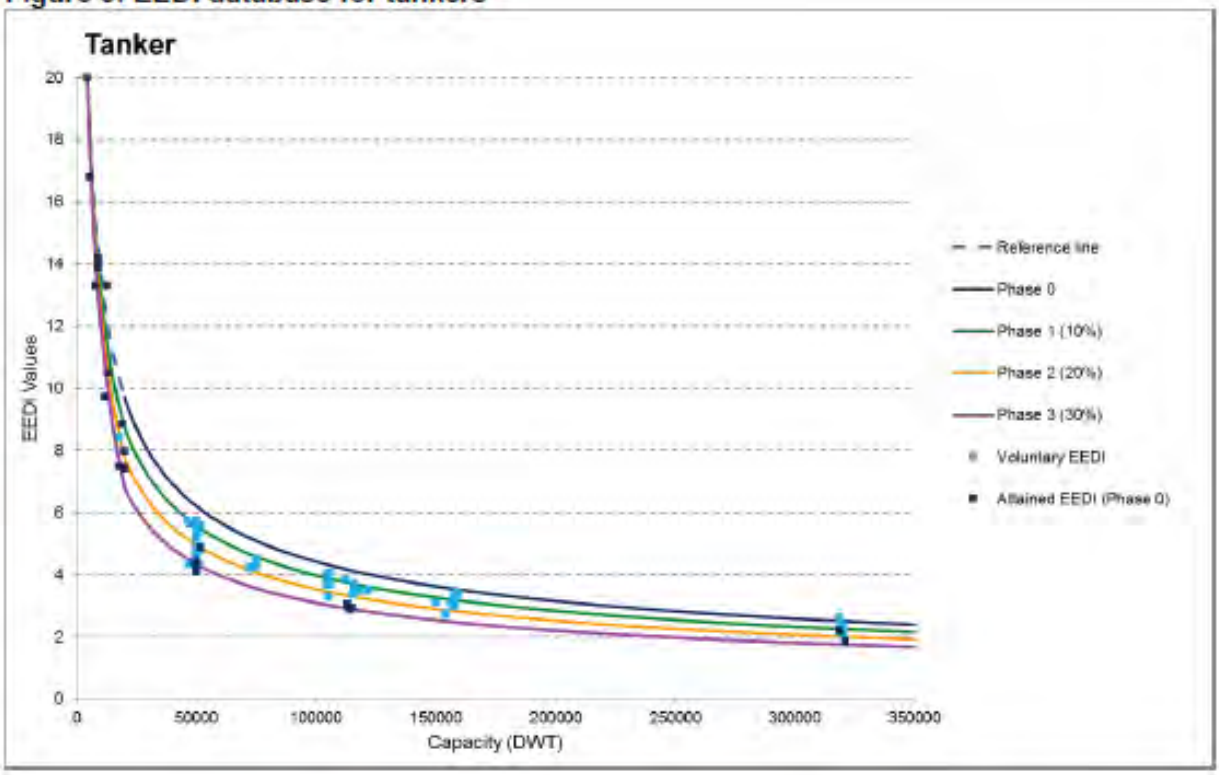
Result of Method A (Bulk carriers)

Figure 1: EEDI database for bulk carriers



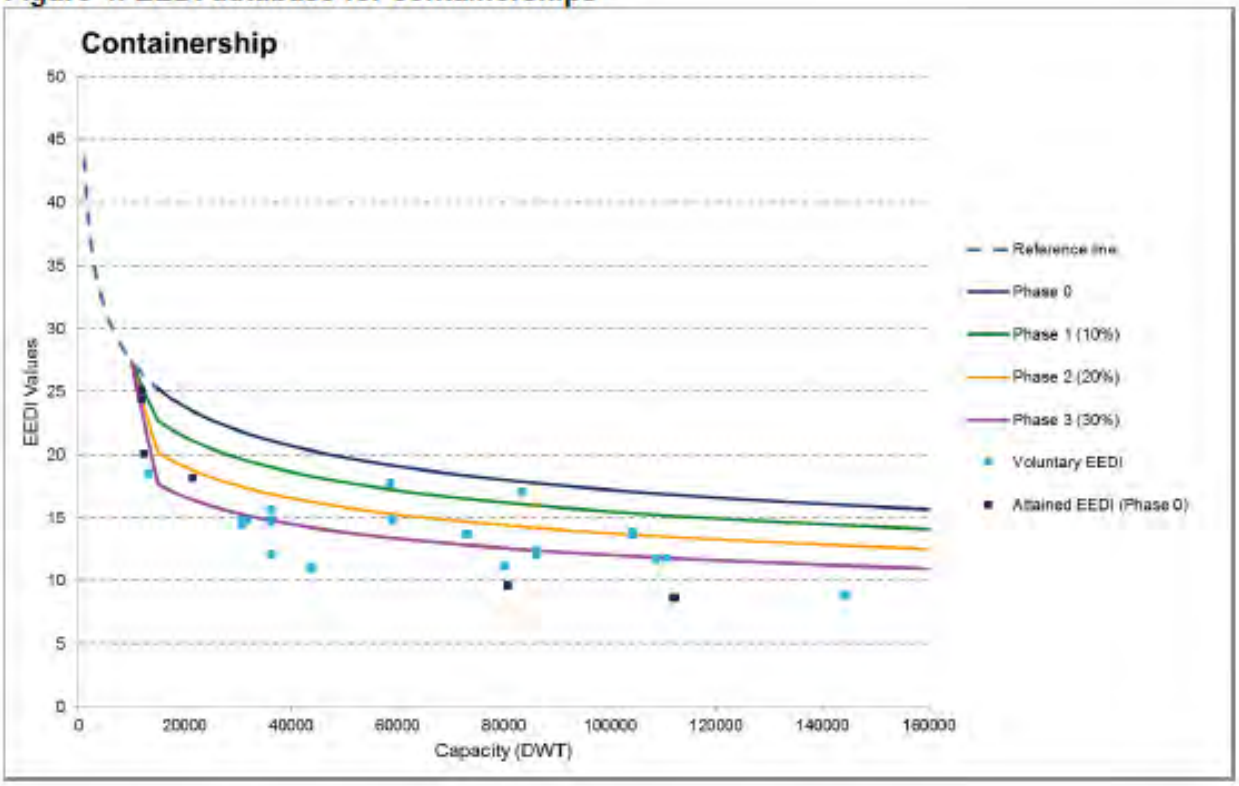
Result of Method A (Tankers)

Figure 3: EEDI database for tankers



Result of Method A (Container ships)

Figure 4: EEDI database for containerships



From the results of method A

- The graphical data show that significant number of ships already built has complied with phase 2 requirement.
- Currently, views of the CG participants are anticipated.

How to assess the achievability of phase 2 requirement

Method B

By conducting numerical case study

① Updating the information on energy saving technologies
② Selecting a ship (type and size)
③ Selecting energy saving technologies to be applied for the ship
④ Calculating energy efficiency improvement ratio by using numerical simulation

Information on energy saving technologies

(Example)

Categorization / Type of technologies	Improvement ratio (%)	The year expected for in-use of that technology
1 Design improvement		
(1) Optimization of hull	2-10%	Already available
(2) Optimization of superstructure	Approximately 1-2% reduction of power consumption, which corresponds to about 30% reduction of wind resistance. For some type of ships, 3% reduction of the power consumption has been achieved.)	available by 2020 (partly already achieved)
(3) Optimization of propeller	4-5% (The Contracted Loaded Tip (CLT) propeller shows the higher improvement ratio, which depends on the ship type, the propeller loading coefficient etc.)	Already available
(4) Podded (azipod) drives	Similar to the effect of conventional propeller.	In use
2 Recovery of propeller energy		
(1) Coaxial contra-rotating propeller	8% (The improvement ratio decreases to about 5% depending on the types of ships and propellers.)	Already available
(2) Free rotating vane wheel	10% of power consumption	
(3) Ducted propeller	10% of power consumption (The improvement ratio depends on the thrust loading condition.)	
(4) Pre-swirl devices	4% improvement of the power consumption (8% improvement would be achievable in case post-swirl device in 2.(5)) is used together)	
(5) Post-swirl devices	4% improvement of the power consumption (8% improvement would be achievable in case pre-swirl device in 2(4) is used together) Improve propulsion efficiency by 4%	Already available
(6) Split stern (Twin skeg)	4-6%	Already available
3 Alternative propulsion systems		
(1) Alternative propulsion systems		
4 Engine energy recovery		
(1) for low-speed engine	Waste Heat Recovery System could recover 6-12% reduction of power consumption.	Already achieved.

Selection of ships

① 91,000 DWT Container ship

Length L [m]	abt. 316.0
Width B [m]	abt. 45.0
Draft d [m]	abt. 13.0
Speed V_{ref} [knot]	abt. 25.0

② 52,000 DWT Bulk carrier

Length L [m]	abt. 196.0
Width B [m]	abt. 37.0
Draft d [m]	abt. 10.0
Speed V_{ref} [knot]	abt. 14.5

Selection of applicable energy saving technology

① 91,000 DWT Container ship

Energy saving technology	Element	Improvement ratio agreed by the CG	Improvement ratio applied
Optimization of hull	Power	2-10% reduction	2% reduction
Optimization of superstructure	Wind resistance	30% reduction	30% reduction
Optimization of propeller	Propeller efficiency	4-5% improvement	4% improvement
Split stern & Post-swirl devices	Propulsive efficiency	Sprit stern 4-6% Post-swirl 4%	6% improvement(*)
Engine energy recovery for low speed engine	Fuel consumption	6-12% reduction	6% reduction
Selection of coatings /Polymers and air lubrication	Viscous resistance	5% reduction	5% reduction

Minimum values of the improve ratio agreed by the CG are applied.
(*) interaction between split stern & post-swirl devices are taken into account.

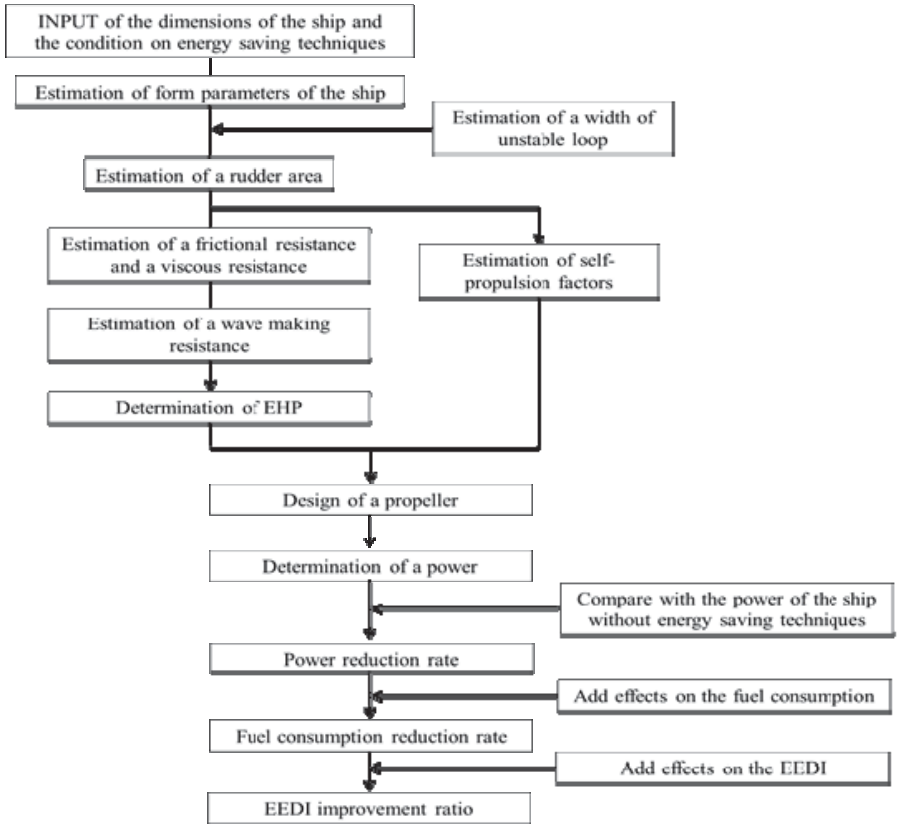
Selection of applicable energy saving technology

② 52,000 DWT Bulk carrier

Energy saving technology	Element	Improvement ratio agreed by the CG	Improvement ratio applied
Optimization of hull	Power	2-10% reduction	2% reduction
Optimization of superstructure	Wind resistance	30% reduction	30% reduction
Coaxial contra-rotating propeller	Propeller efficiency	8% improvement	8% improvement
Pre-swirl devices	Propulsive efficiency	4% improvement	4% improvement
Engine energy recovery for low speed engine	Fuel consumption	6-12% reduction	6% reduction
Selection of coatings /Polymers and air lubrication	Viscous resistance	5% reduction	5% reduction

Minimum values of the improve ratio agreed by the CG are applied

Calculation using a numerical simulation by NMRI



Results of numerical simulations

① 91,000 DWT Container ship

➡ EEDI improvement ratio is 21.1%

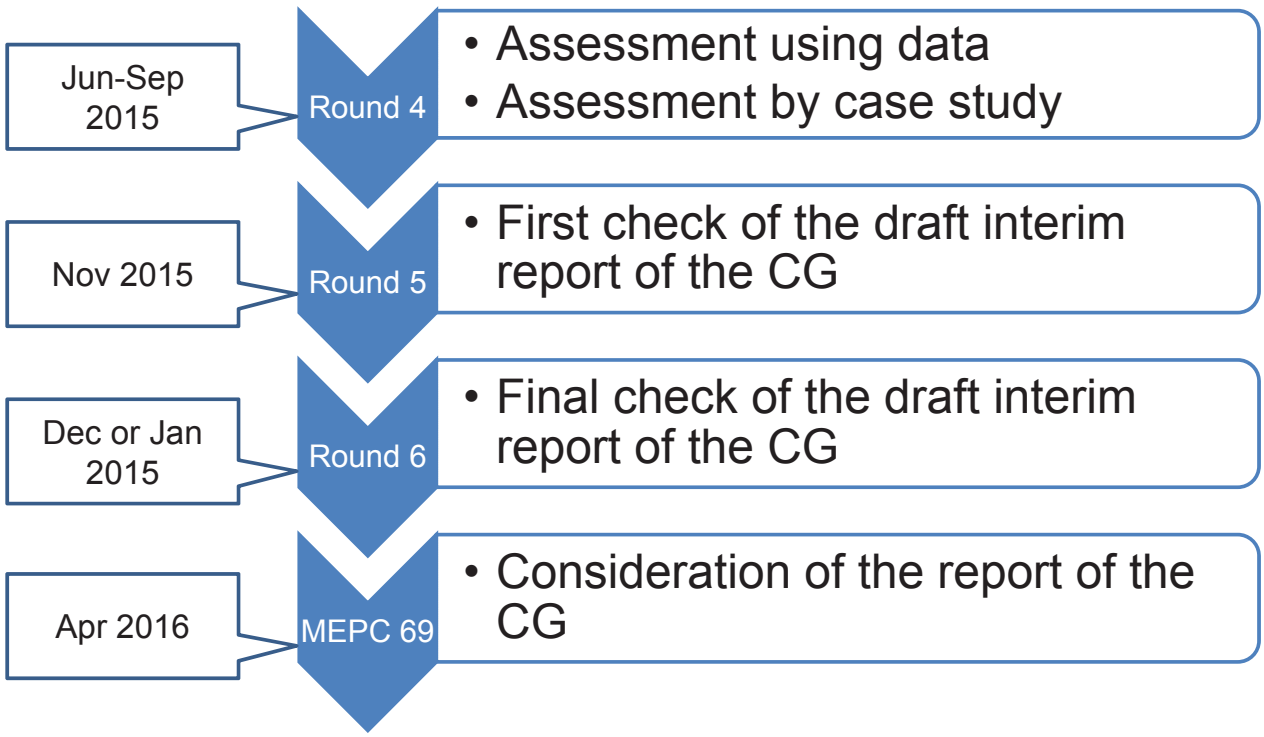
② 52,000 DWT Bulk carrier

➡ EEDI improvement ratio is 22.8%

From the results of method B

- Both case studies (91,000 DWT Container ship and 52,000 DWT Bulk carrier) show good results.
- Currently, more input of the results of the case studies from the CG participants are anticipated.

Future work towards MEPC 69



Thank you very much for your kind attention.