

# Implications of GHG reduction targets and a mandatory IMO CO<sub>2</sub> data collection system for international shipping



**Dr. Park. Han-Seon**

**Research Fellow / Maritime Safety Division**

**- Korea Maritime Institute -**



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◇ **IMO GHG Regulations and Issues**

◇ **UNFCCC Issues and Paris Agreement**

◇ **Target Management System of ROK**

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# IMO GHG Issues(emission from shipping sector)

## Emissions from ships

### Third IMO GHG Study 2014 approved

Study found that for international shipping, the CO<sub>2</sub> estimate dropped from **2.8% in 2007** to **2.2% in 2012**.

Year	Global CO <sub>2</sub> <sup>1</sup>	IMO GHG Study 2014 CO <sub>2</sub>			
		Total shipping	Percent of global	International shipping	Percent of global
2007	31,409	1,100	3.5%	885	2.8%
2008	32,204	1,135	3.5%	921	2.9%
2009	32,047	978	3.1%	855	2.7%
2010	33,612	915	2.7%	771	2.3%
2011	34,723	1,022	2.9%	850	2.4%
2012	35,640	938	2.6%	796	2.2%
<b>Average</b>	<b>33,273</b>	<b>1,015</b>	<b>3.1%</b>	<b>846</b>	<b>2.6%</b>

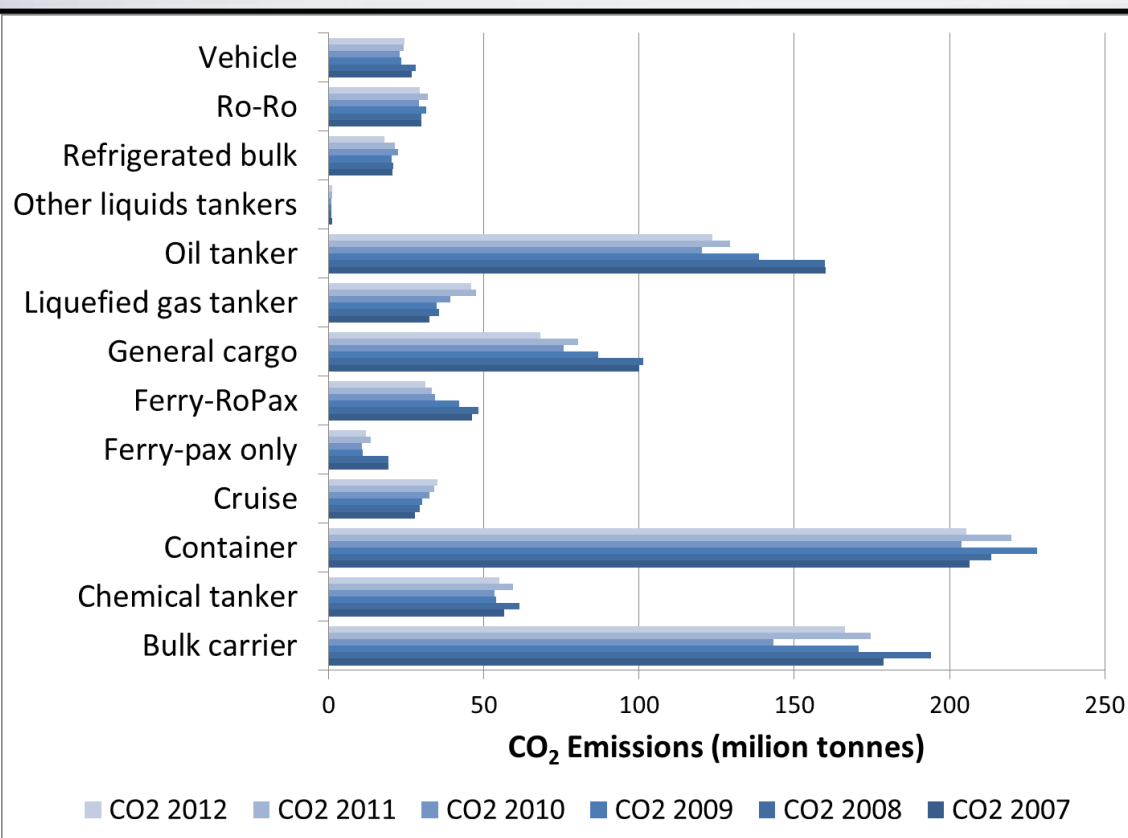
Source : 2014 The third IMO GHG Study





# IMO GHG Issues(emissions from shipping sector)

## CO<sub>2</sub> emissions, international shipping, 2007-2012 (bottom-up method)

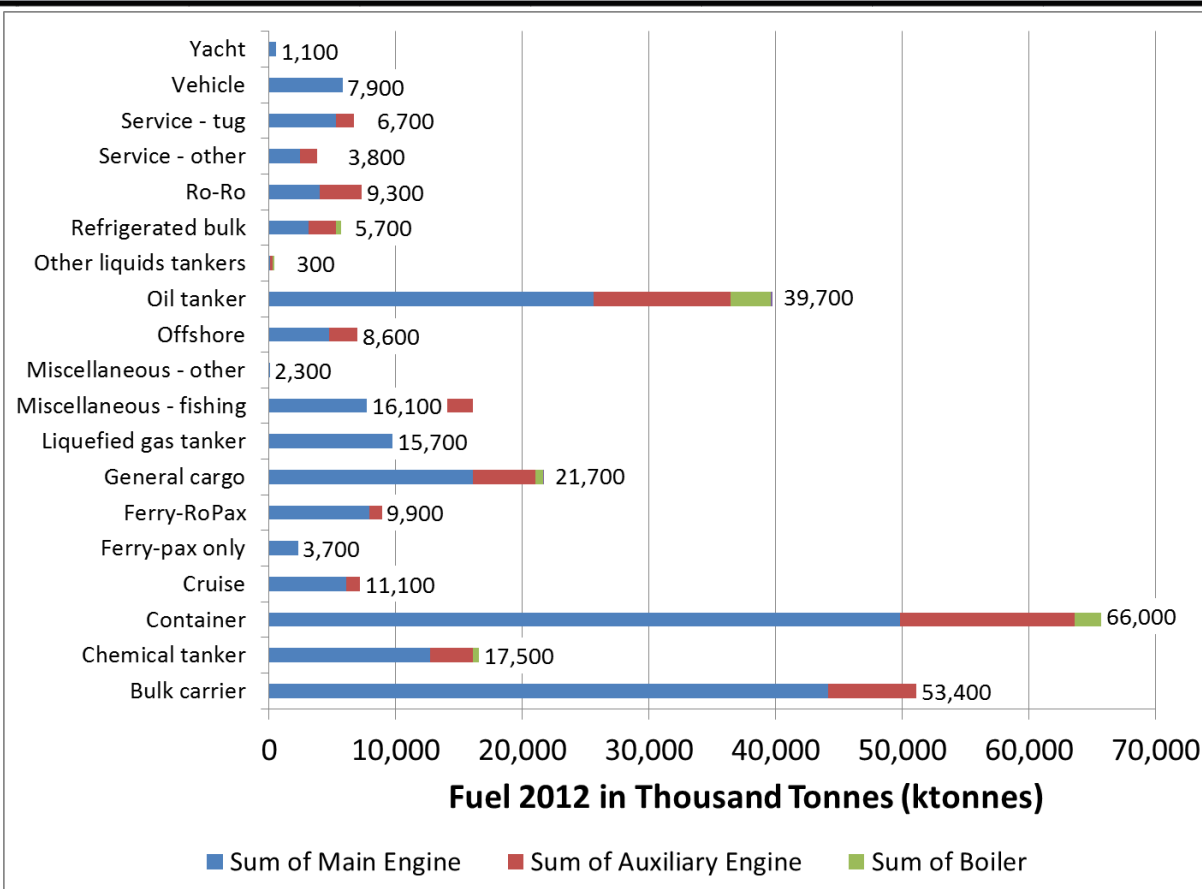


Source : 2014 The third IMO GHG Study



# IMO GHG Issues(emissions from shipping sector)

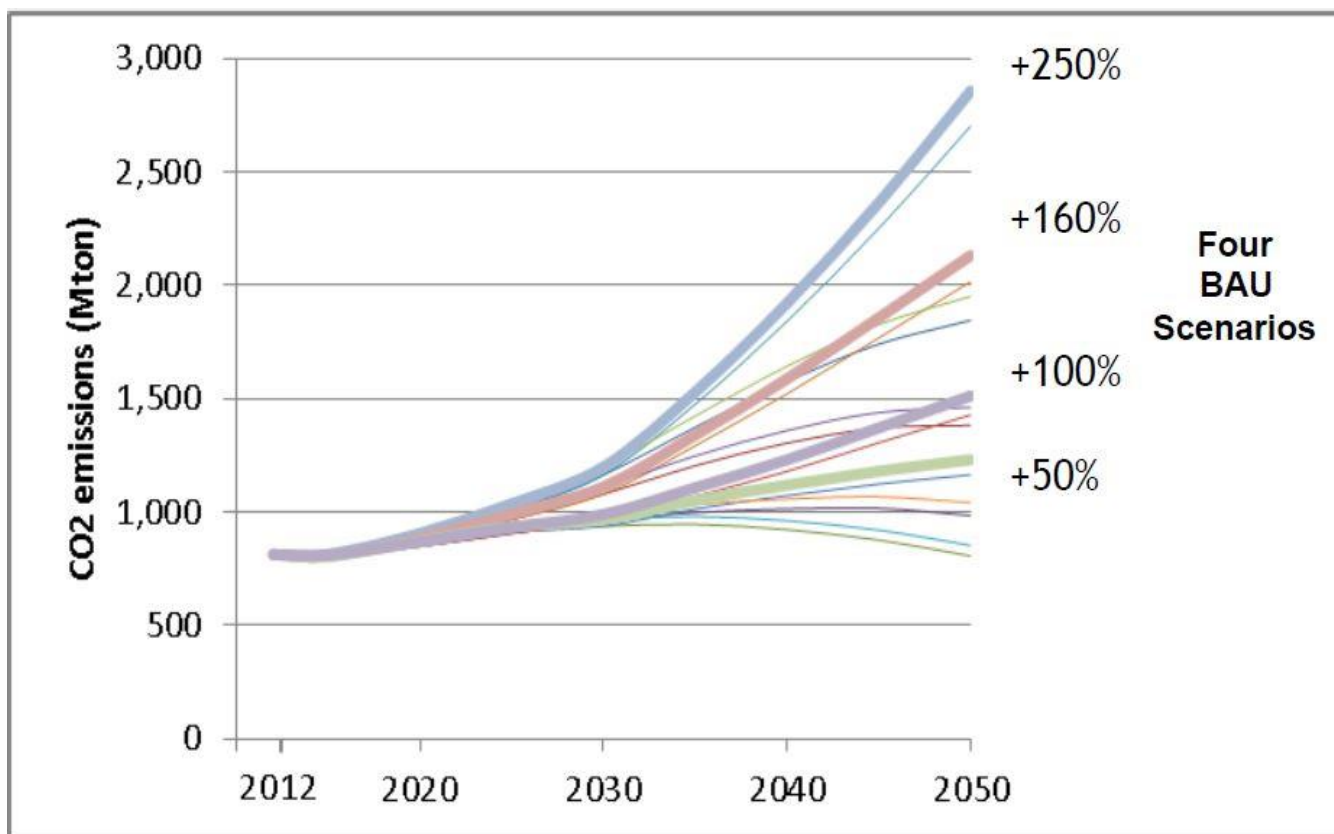
## Fuel consumption, all ship types by engine/boiler, 2012 (bottom-up method)





# IMO GHG Issues(emissions from shipping sector)

Shipping CO<sub>2</sub> emissions are projected to increase by 50% to 250% in the period to 2050, despite fleet average efficiency improvements of about 40%

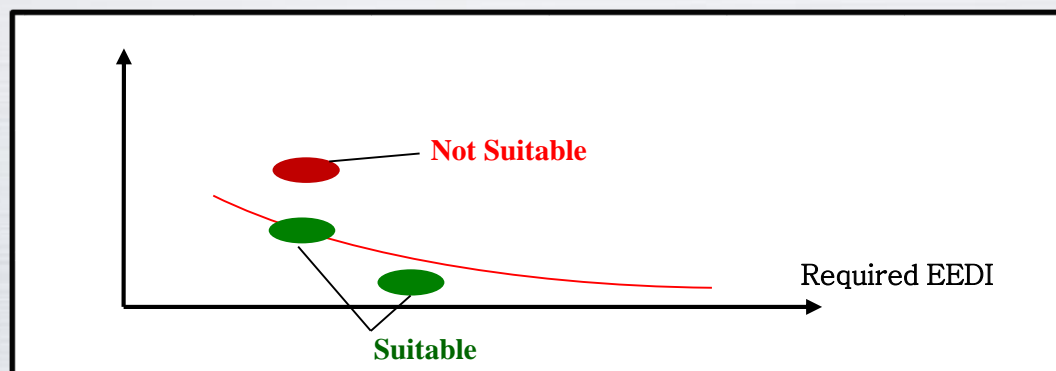




# IMO GHG Regulations

## EEDI (Energy Efficiency Design Index)

$g(\text{CO}_2)/\text{ton}\cdot\text{m}$



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

**Main Engine**

**Aux. Engine**

$f_i \cdot \text{Capacity} V_{ref} \cdot f_w$

**Innovative Energy Saving Technology**

**Shaft Motor(for Elec. Propulsion Ships), Waste Heat Recovery System**

**The maximum Transportation Quantity of Design Standard Vessel(mile-ton)**



# IMO GHG Regulations

## EEOI (Energy Efficiency Operational Indicator)

### Indicator = CO<sub>2</sub>/transport work

- The Basic expression for a voyage is :

$$EEOI = \frac{\sum_j FC_j \times C_{Fj}}{m_{cargo} \times D} \quad \text{Equation 1}$$

- Where average of the indicator for a period or for a number of voyage is obtained, the Indicator is :

$$\text{Average EEOI} = \frac{\sum_i \sum_j (FC_{ij} \times C_{Fj})}{\sum_i (m_{cargo,i} \times D_i)} \quad \text{Equation 2}$$

*j : the fuel type*

*i : the voyage number*

*FC<sub>ij</sub> : the mass of consumed fuel j at voyage i*

*C<sub>Fj</sub> : the fuel mass to CO<sub>2</sub> mass conversion factor for fuel j*

*m<sub>cargo</sub> : cargo carried (tonnes) of work done(number of TEU or passengers) or gross tonnes or passenger ships*

*D : the distance in nautical miles corresponding to the cargo carried or work done*





# IMO GHG Regulations

## SEEMP (Ship Energy Efficiency Management Plan)

- **Planning**
  - ✓ The most appropriate, effective and implementable plan shall be developed
- **Implementation**
  - ✓ A ship and a company identify the measures to be implemented, and the planned measures should be carried out
- **Monitoring**
  - ✓ The energy efficiency of a ship should be monitored quantitatively, preferably by an international standard such as EEOI(MEPC.1/Circ.684)
- **Self-evaluation and improvement**
  - ✓ This phase should produce meaningful feedback for the coming first stage
- **Voluntary reporting/review**
  - ✓ Not mandated but it can be a number of benefits for shipowners/operators.



# IMO GHG Regulations

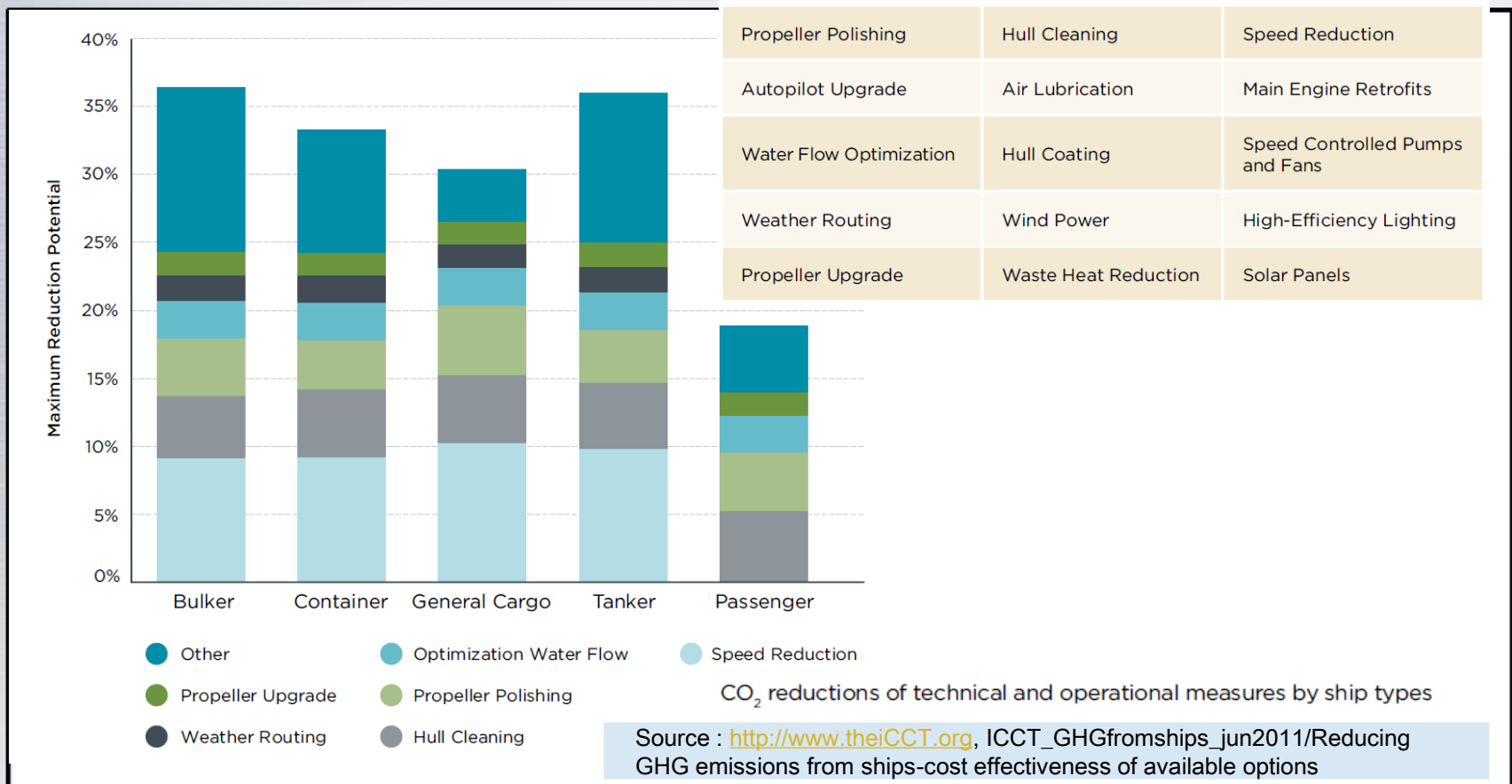
## Reduction Phase 0 ~ 4 (1 Jan 2013 ~ 1 Jan 2025)

<u>Ship Type</u>	<u>Size</u>	<u>Phase 0</u> [1 Jan 2013 ~ 31 Dec 2014]	<u>Phase 1</u> [1 Jan 2015 ~ 31 Dec 2019]	<u>Phase 2</u> [1 Jan 2020 ~ 31 Dec 2024]	<u>Phase 3</u> [1 Jan 2025 and onwards]
<u>Bulk Carrier</u>	20,000 DWT and above	0	10	20	30
	10,000 – 20,000 DWT	n/a	0-10*	0-20*	0-30*
<u>Gas tanker</u>	10,000 DWT and above	0	10	20	30
	2,000 – 10,000 DWT	n/a	0-10*	0-20*	0-30*
<u>Tanker</u>	20,000 DWT and above	0	10	20	30
	4,000 – 20,000 DWT	n/a	0-10*	0-20*	0-30*
<u>Container ship</u>	15,000 DWT and above	0	10	20	30
	10,000 – 15,000 DWT	n/a	0-10*	0-20*	0-30*
<u>General Cargo ships</u>	15,000 DWT and above	0	10	15	30
	3,000 – 15,000 DWT	n/a	0-10*	0-15*	0-30*
<u>Refrigerated cargo carrier</u>	5,000 DWT and above	0	10	15	30
	3,000 – 5,000 DWT	n/a	0-10*	0-15*	0-30*
<u>Combination carrier</u>	20,000 DWT and above	0	10	20	30
	4,000 – 20,000 DWT	n/a	0-10*	0-20*	0-30*



# IMO GHG Regulations(Technical & Operational Measures)

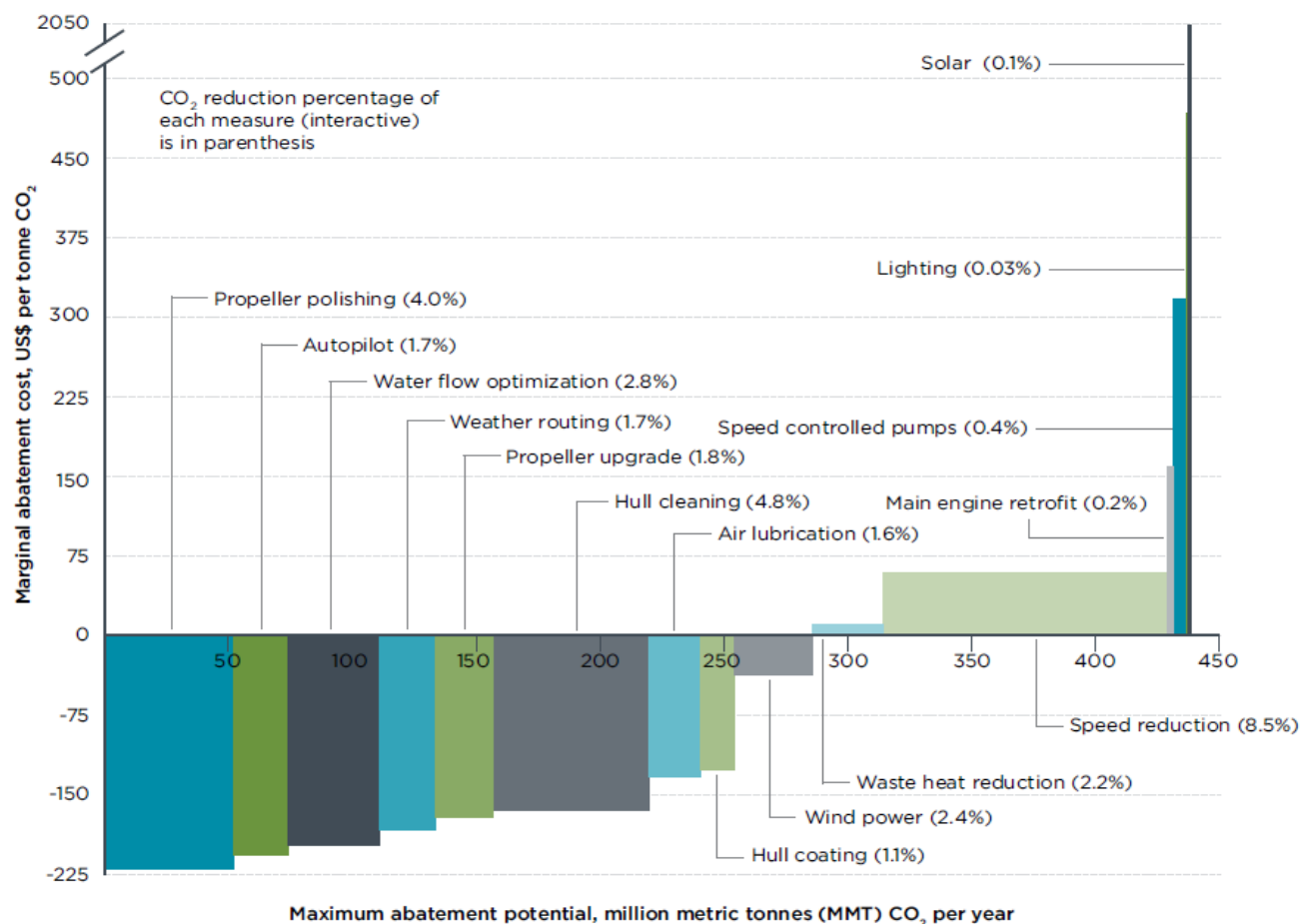
## Technologies and operations strategies to reduce GHG emissions from ships





# IMO GHG Regulations(Abatement Cost)

Technologies and operations strategies to reduce GHG emissions from ships







# CO<sub>2</sub> Data Collection System(MRV)

## "Annual" EEOI concept

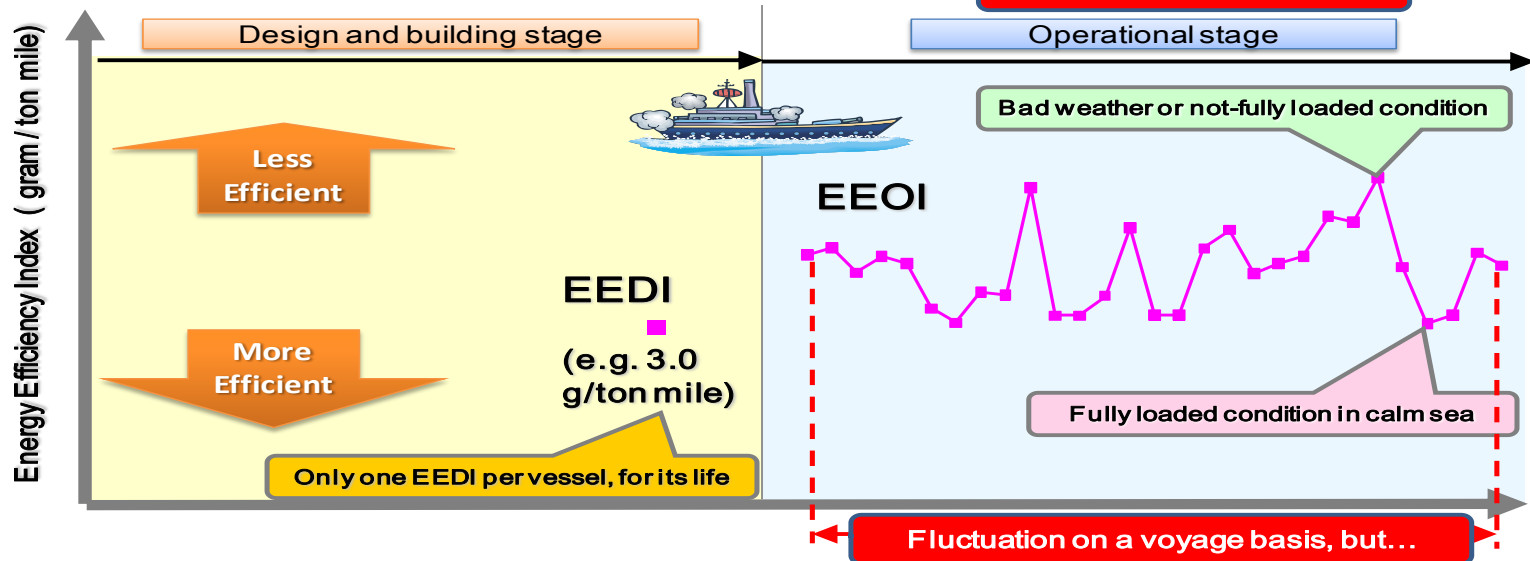
$$\text{EEDI} = \frac{\text{Engine Power} \times \text{SFC} \times C_F}{\text{Capacity(dwt)} \times \text{Speed}}$$

(g/ton mile)

$$\text{EEOI} = \frac{\text{Fuel Consumption} \times C_F}{\text{Cargo Mass} \times \text{Sailed Distance}}$$

(g/ton mile)

Same units are used!

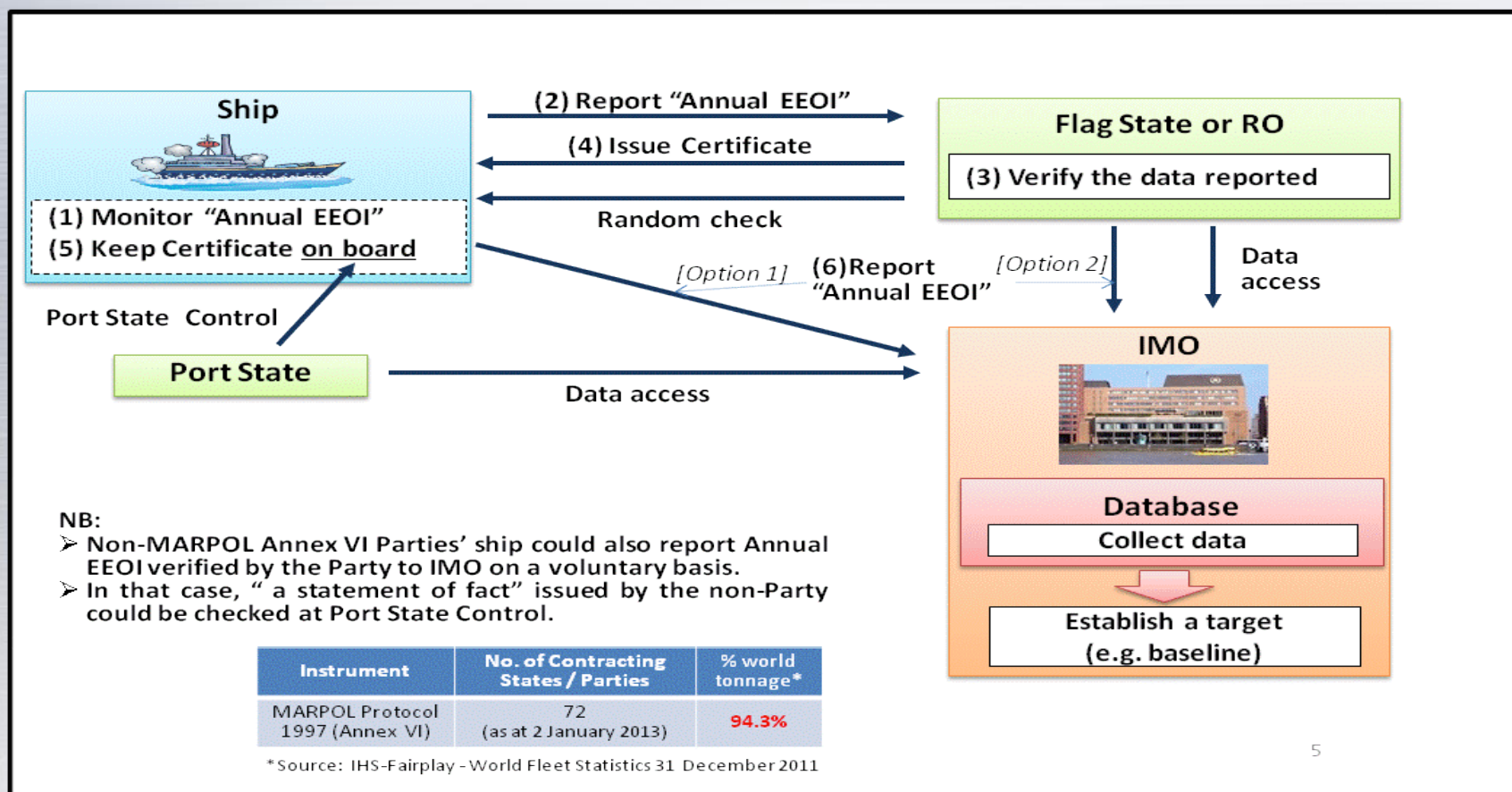


Yearly average EEOI, i.e. **Annual EEOI** represents a fairer tendency of actual performance of ships!



# CO<sub>2</sub> Data Collection System(MRV)

## Overall MRV Framework





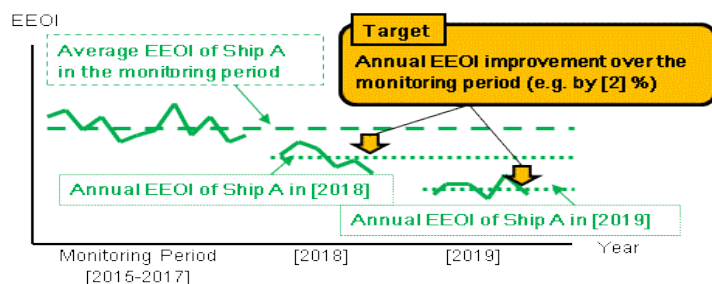
# CO<sub>2</sub> Data Collection System(MRV)

## Energy Efficiency Target (three options)

*Setting an Energy Efficiency Target: three options at this stage...*

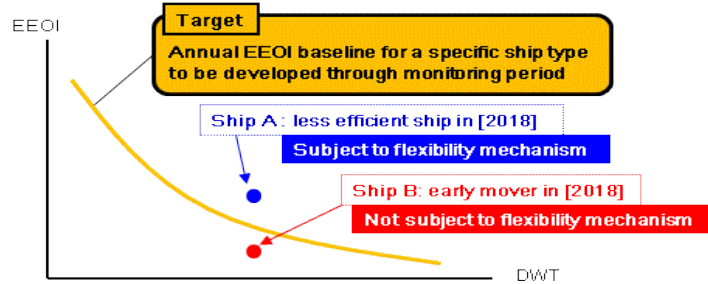
### (Option 1)

*Compare the present and past value of individual ship's annual EEOI on its own*



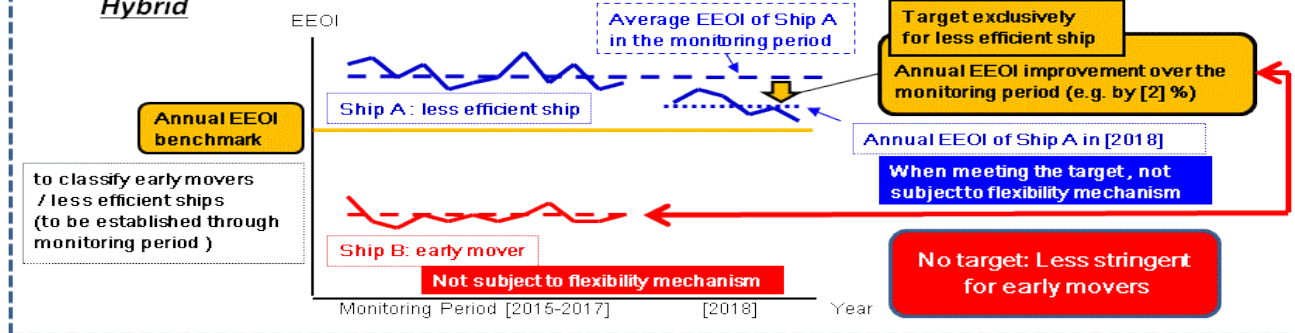
### (Option 2)

*Compare the annual EEOI value with the average of a specific ship type/size category*



### (Option 3)

*Hybrid*





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# PARIS AGREEMENT

## 7 Key Tasks to Implement the Paris Agreement after COP 21

1. Provide Guidance for Countries to Increase their Ambition
2. Ensure Transparency and Accountability
3. Track Climate Finance
4. Create an Adaptation Cycle of Ambition
5. Design the First Dedicated Committee for Capacity Building
6. Decide How Countries Can Achieve their Mitigation Targets Cooperatively
7. Create a New Technology Framework



# PARIS AGREEMENT

## 7 Key Tasks to Implement the Paris Agreement

### Post Paris: Key Tasks to Complete Before the First Meeting of the Parties to the Paris Agreement

WHEN	WHAT
February 2016 – May 2016	<div>Update INDC synthesis report (Secretariat)</div> <div>Create interim Public Registry (Secretariat)</div> <div>Initiate clearinghouse for risk transfer (WIM)</div> <div>Initiate task force for displacement (WIM)</div> <div>Start work on new Technology Framework (SBSTA)</div> <div>Initiate assessment of effectiveness and adequacy of support provided by the Technology Mechanism (SBI)</div>
COP22 2016	<div>Identify how IPCC assessments can inform the Global Stocktake (SBSTA)</div> <div>Review the WIM (COP)</div> <div>Initiate work on identifying information to be provided on public finance provided, mobilized, and intended (COP)</div> <div>Adopt terms of reference for the PCCB (COP)</div>
COP23 2017	<div>Review institutional arrangements for adaptation (AC)</div>

Source : <http://www.wri.org/blog/2016/03/after-cop21-7-key-tasks-implement-paris-agreement>



# PARIS AGREEMENT

## 7 Key Tasks to Implement the Paris Agreement

COP24 2018	Convene facilitative dialogue to take stock of collective efforts toward the long-term goal of the Paris Agreement (COP)	Provide a special report on impacts of global warming of 1.5C (IPCC)	Consider the recommendations of the APA on the modalities, procedures and guidelines for the transparency of action and support (COP)	Develop modalities for the accounting of public finance for consideration at COP24 (SBSTA)	Develop recommendations on transparency of action and support for consideration at COP24 (APA)
COP25 2019	Re-communicate or update INDCs (Parties)	Communicate long-term low GHG development strategies (Parties)	Adopt the scope and modalities for the periodic assessment of support provided to the Technology Mechanism (COP)	Review the progress, need for extension, effectiveness and enhancement of the PCCB (COP)	

**KEY:**

- Ambition Mechanism
- Transparency and Accountability
- Adaptation and Loss & Damage
- Finance
- Capacity Building
- Cooperative Action
- Technology





# PARIS AGREEMENT

## 7 Key Tasks to Implement the Paris Agreement

For adoption by the CMA at the first meeting of the Parties to the Paris Agreement

(Date of first meeting dependant on timing of entry into force of Paris Agreement)

Guidance on the features of and information to be provided in future NDCs (APA)

Guidance for accounting of NDCs (APA)

Modalities and procedures for Public Registry (SBI)

Forum on the Impact of Implementation of Response Measures (SBSTA and SBI)

Modalities, procedures and guidelines for the transparency of action and support (APA)

Modalities for the Global Stocktake (APA)

Sources of input for the Global Stocktake (APA)

Modalities and procedures for the compliance committee (APA)

Modalities to recognise the adaptation efforts of developing country Parties (AC and LEG)

Methodologies to mobilize support for adaptation in developing countries and review the adequacy and effectiveness of support for adaptation (AC, LEG and SCF).

Information to be provided on public finance (COP)

Decision on how to enhance the institutional arrangements for capacity building (COP)

Ways to enhance the coherence of adaptation-related institutional arrangements under the UNFCCC (AC)

Methodologies for assessing adaptation needs of developing country Parties (AC)

Modalities for the accounting of public finance (COP)

Guidance to ensure double counting is avoided for emissions by sources and removals by sinks (SBSTA)

Decision on the work programme under the framework for non-market approaches to sustainable development (SBSTA)

Rules, modalities and procedures for the mechanism to contribute to the mitigation of GHG emissions and support sustainable development (SBSTA)

New Technology Framework (SBSTA)





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# TMS of ROK

## Targets Management System of Republic of Korea

- **Announced ‘Low Carbon, Green Growth’ as its vision for mid-to long-term development in 2008**
- **Established the national target of 30% reduction of GHG emissions from business as usual(BAU) scenario by 2020 in 2009**
- **To achieve the reduction goal, the 『Framework Act on Low Carbon, Green Growth』 was enacted in 2010**
- **To reduce GHG and Control the energy quantity to be used for developing industries is to implement Act on Low Carbon, Green Growth**



# TMS of ROK

## Targets Management System of Republic of Korea

- The scheme is a system to set the goals of greenhouse gas emissions and energy consumption to Controlled Entities for reducing
  - Companies or facilities that emit GHG emissions and consume energy above a certain threshold are designated as Controlled Entities
- They should establish implementation plans and management systems aimed at reaching the target in an efficient manner
- The government encourages Controlled Entities to achieve targets by utilizing incentives and penalties such as improvement orders and fines.



# TMS of ROK

## Shipping sector (Criteria of application)

- Designated companies as Controlled Entities
  - Coastal passenger and cargo transport services(corporate bodies) registered as the Marine Transport Act that record GHG emissions and energy consumption above a certain threshold set in the Guidelines

**Table 1 : Criteria for the Designation of Controlled Entities**

Year	GHG Emission (t-CO <sub>2</sub> )	Energy Consumption (Terajoules)
2011	125,000	500
2012~2013	87,500	350
2014~	50,000	200





# TMS of ROK

## Calculation formula for the GHG emissions and energy consumption

### ➤ Formula for CO<sub>2</sub> emission

$$\text{CO}_2 \text{ emission} = \text{Fuel consumption (t)} \times \text{CO}_2 \text{ mass conversion factor for type of fuel (C}_F\text{)}$$

**Table 2 : Fuel mass to CO<sub>2</sub> mass conversion factors(C<sub>F</sub>)**

Type of fuel	Diesel/Gas Oil	Residual Fuel Oil
C <sub>F</sub> (t-CO <sub>2</sub> /t-Fuel)	3.206	3.1144

- \* The calculation formula set out in MEPC.1/Circ.684
- \*\* After designation as Controlled Entity, GHG emissions shall be calculated according to the IPCC guideline to manage the target



# TMS of ROK

## Calculation formula for the GHG emissions and energy consumption

### ➤ Formula for Energy consumption

Energy consumption = Fuel consumption (t) × Gross calorific values  
for type of fuel(MJ/ℓ)

**Table 3 : Gross calorific values for type of fuel**

Type of fuel	Diesel/Gas Oil	Residual Fuel Oil
Gross calorific Values (MJ/ℓ)	37.7	41.6

**\* According to country-specific gross calorific values for type fuel(addendum of the Enforcement Rules for the Energy Act) mentioned in Table 19 of the Guidelines for the Operation of Target Management Scheme**



# TMS of ROK

## Example calculation

- In case that a ship has used up 100,000 ℓ of MF-30

Table 4 : Calculation

Type of fuel		Diesel Oil	Residual Fuel Oil
Quantity(ℓ) * Diesel : Residual Fuel = 0.3903 : 0.6097		$100,000 \text{ ℓ} \times 0.3903(\%)$ $= 39,030 \text{ ℓ}$	$100,000 \text{ ℓ} \times 0.6097(\%)$ $= 60,970 \text{ ℓ}$
GHG Emission (t-CO <sub>2</sub> )	Cal.	$39,030 \text{ ℓ} \times 1 \text{ m}^3/1000 \text{ ℓ} \times$ $0.86^* \times 3.206 \text{ t-CO}_2/\text{t-Fuel}$ $= 107.6 \text{ t-CO}_2$	$60,970 \text{ ℓ} \times 1 \text{ m}^3/1000 \text{ ℓ} \times$ $0.95^* \times 3.1144 \text{ t-CO}_2/\text{t-Fuel}$ $= 180.4 \text{ t-CO}_2$
	Total	$107.6 \text{ t-CO}_2 + 180.4 \text{ t-CO}_2 = 288 \text{ t-CO}_2$	
Energy Consumption (TJ)	Cal.	$39,030 \text{ ℓ} \times (37.7 \text{ MJ/ℓ} \times \text{TJ}/10^6 \text{ MJ})$ $= 1.47 \text{ TJ}$	$60,970 \text{ ℓ} \times (41.6 \text{ MJ/ℓ} \times \text{TJ}/10^6 \text{ MJ})$ $= 2.54 \text{ TJ}$
	Total	$1.47 \text{ TJ} + 2.54 \text{ TJ} = 4.01 \text{ TJ}$	

\* Volume to weight conversion factor (m<sup>3</sup> → t) = Diesel/Gas Oil: 0.86, Residual Fuel Oil: 0.95



# TMS of ROK

## Pilot program – Procedure and contents

Procedure	Contents	Schedule
Status check	Emissions of greenhouse gases and consumption of energy during the latest three years	~ 2 month
Verification	Verification by designate verifying institutes	~ 5 month
Target establishment	Establishment of the reduction target of greenhouse gases and consumption of energy	~ 6 month
Implementation plan check	Establishment and check of implementation plan	~ 6 month
Implementation	Improvement of fuel efficiency	7 ~ 15 month
Evaluation	Evaluation of Implementation	~ 16 month





# TMS of ROK

## Pilot program – 1<sup>st</sup>

### ❖ Verification statement and report



Signing MOU



Verified vessel



Verification

No. AS\_PRUG-482360-2013-CCS-KOR\_E



#### DNV ASSURANCE STATEMENT 쌍용해운주식회사 SsangYong Shipping Co., Ltd.

##### < Introduction >

DNV Certification, Ltd. ("DNV") was commissioned by SsangYong Shipping Co., Ltd. ("SsangYong Shipping") to verify the SsangYong Shipping's Greenhouse Gas Inventory Report for the calendar year 2009-2011 ("the report") based upon a limited level of assurance. SsangYong Shipping is responsible for the preparation of the GHG emissions data on the basis set out within the guidelines on the operation of greenhouse gas and energy target management scheme (Notification No. 2012-211, Korean Ministry of Environment) and the principles set out in ISO 14064-1:2006. Our responsibility in performing this work is to the management of SsangYong Shipping only and in accordance with terms of reference agreed with them. DNV expressly disclaims any liability or responsibility for any decisions, whether investment or otherwise, based upon this assurance statement.

##### < Scope of Assurance >

The GHG emissions and energy consumption data covered by our examination comprise Direct emissions (Scope 1 emissions), Energy indirect emissions (Scope 2 emissions) and Fuel, Electricity Energy consumption.

- Reporting period under verification : Calendar Year 2009-2011
- Organizational boundary for reporting : 13 domestic vessels owned by SsangYong Shipping Co., Ltd.

Organizational Boundaries	Remark(name of vessel)	Verification activity
13 domestic vessels owned by SsangYong Shipping	Gyeong, Talyang, Dragon Star, Dragon Star, Dragon Sky, Jayang, Changyang, Duryang, Koryang, Changyang, Morning Sun, Suyang, Anyang	Desk Review, data & Site visit verification

##### < Verification Approach >

The verification has been conducted by DNV from 2<sup>nd</sup> May through 25<sup>th</sup> September 2013 and performed in accordance with the verification principles and tasks outlined in the guidelines on the operation of greenhouse gas and energy target management scheme (Notification No. 2012-211, Korean Ministry of Environment). We planned and performed our work so as to obtain all the information and explanations deemed necessary to provide us with sufficient evidence to provide a limited verification opinion concerning the completeness of the emission inventory as well as the reported emission figures in ton CO<sub>2</sub> equivalent. As part of the verification process:

- We have reviewed and verified the SsangYong Shipping's greenhouse gas report for the calendar year 2009-2011
- We have reviewed the greenhouse gas emissions and energy consumption for the calendar year 2009-2011
- We have reviewed and verified the process to generate, aggregate and report the emissions and energy data

##### < Conclusions >

As a result of the work described above, in our opinion nothing has come to our attention that would cause us to believe that the greenhouse emissions and energy consumption set out in SsangYong Shipping's report are not fairly stated. The greenhouse gas emissions and energy consumption of SsangYong Shipping for the year 2009-2011 were confirmed as below.

#### Greenhouse Gas Emissions and Energy Consumption of SsangYong Shipping Co., Ltd. from Yr 2009-2011

Operational Boundary (Period)	Direct emissions (Scope 1)	Indirect emissions (Scope 2)	Total GHG emissions	Fuel Energy	Electricity Energy	Total Energy
Year 2009						
Year 2010						
Year 2011						

\* In order to report the GHG emissions as an integer, the rounded number on the statement might be different from the number on the system with ± 1 tCO<sub>2</sub>.

25<sup>th</sup> September 2013

Tae-Ho Kim  
Lead Verifier

In-Kyoon Ahn  
Country Manager  
DNV Certification, Ltd.

"This Assurance Statement is valid as of the date of the issuance (25<sup>th</sup> September 2013). Please note that this Assurance statement would be revised if any material discrepancy which may impact on the Greenhouse Gas Emissions of SsangYong Shipping Co., Ltd. is subsequently brought to our attention. In the event of ambiguity or contradiction in this statement between English version and Korean version, Korean shall be given precedence."

# TMS of ROK

## Pilot program – 2<sup>nd</sup>

## Verification statement and report



## Kickoff meeting



### Verified vessel



## Verification

[illegible]



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◇ Introduction of Climate Change

◇ IMO GHG Regulations

◇ UNFCCC Issues

◇ Conclusion



# Conclusion

## Findings and conclusion of TMS

- **Mitigating GHG emissions in domestic shipping other than international shipping**
- **Collecting data from domestic shipping (Enabling to attain the inventory)**
- **Acquiring outcomes and analysis on application of GHG reduction technology into vessels**
- **Contribution to the energy efficiency of domestic vessels**
- **Contribution to INDCs of UNFCCC**





# Conclusion

## Findings and conclusion of TMS

- **Collecting statistical information on fuel and energy consumption of vessels to establish a base of MBM**
- **Empowering R&D about monitoring devices to emission of GHG from ships, applying IT technology**
- **Contributing sustainable growth of national transport and logistics through modal shift from land to maritime transportation**



# Conclusion

## MBM related to the CO2 data collection system

- The EU MRV many readers will be aware that the EU adopted a mandatory MRV regulation on 29 April 2015. This creates an EU-wide legal framework for the monitoring, reporting and verification of CO2 emissions from maritime transport
- **The EU MRV regulation requires operators of large ships(only those over 5,000 G/T) calling at EU ports**(irrespective of where they are registered) from 1 January 2018 to : Monitor and annually report the verified amount of CO2 emitted on journeys to, from and between EU ports and also when in EU ports



# Conclusion

## MBM related to the CO2 data collection system

- When visiting EU ports, ships will need to carry a document of compliance issued by an accredited MRV verifier.
- With regard to the data collection system, no decision was taken as to whether the system should be mandatory or voluntary, **whether the data collected would be made publically available to create transparency**, or whether in addition to fuel data the system should also incorporate the collection of energy efficiency information, such as overall supply chain emissions



# Conclusion

## Key questions related to the CO2 data collection system

- IMO member States proposes the development of an “intended IMO Determined Contribution” to CO2 reduction for international shipping, echoing the INDC language of the Paris Agreement. It need to be rapid finalization of an IMO MRV system
- **Key questions to be determined on MRV** – Q1. when the scheme will start, Q2. Whether the scheme will be mandatory or voluntary, Q3. whether MRV data will be made public, Q4. What information will need to be collected beyond mere fuel use, Q5. Methodology for data collection/calculation, Q6. Responsibility(ship owner/operator), Q7. Enforcement/penalties for non-compliance





# Conclusion

## Accelerating to implementation

- Instrument is continuously going to **be made** and **entered into force**

## Expanding to more ships for reducing GHG

- **All ships** are to be participated the regulations

## Mobilizing the fund from International Bunkering

- It is considered to mobilize **the fund** from MBM, etc. for **Promotion of Technical Co-operation and Transfer of Technology** relating to the **improvement of energy efficiency of ships**
- The fund might be used for **GCF** or **other purpose**

# THANK YOU!



*Thank you*