

6<sup>th</sup> ASEF 2012



### **Recent Technology Trend on Green Ships**

2012 11 22 Suak Ho Van, MOERI



## Contents

- **1. Introduction of MOERI**
- 2. Green Growth and Greenship
- 3. IMO EEDI
- 4. Greenship: Powering performance
- 5. Greenship Project
- 6. Summary

### **Introduction of MOERI**

Maritime and Ocean Engineering Research Institute (KRISO), Korea Institute of Ocean Science and Technology(KIOST)



## **MOERI** Facilities



# Status of evaluation tools (MOERI)

### • EFD

- Extrapolation
- Geosim Test(KVLCC, KCS, KLNG)

### • CFD

- Qualitative comparison
- WAVIS 2.x : Quantitative: Self-propulsion (CFD 2010)
- Seakeeping(CFD 2010), Maneuvering (SIMMAN '09)
- Local Flow
- Pitot-tube, SPIV (2010)

## DSME (6<sup>th</sup> SIMF, 2012. 10)

#### What is Green Ship?

- Fuel Energy shall be consumed for the ship operation, and ship also inevitably emits various kinds of **Pollutants** to the environment.
- Green ship is the ship that can Reduce Fuel Energy Consumption and/or Lessen Generation of Pollutants during operation.



### **MARPOL 73/78**

#### **Green Ship**

- The International Convention for the Prevention of Pollution From Ships, 1973 as modified by the Protocol of 1978.
  ("Marpol" is short for marine pollution and 73/78 short for the years 1973 and 1978.)
- Annex I Oil
- Annex II Noxious Liquid Substances carried in Bulk
- Annex III Harmful Substances carried in Packaged Form
- Annex IV Sewage
- Annex V Garbage
- Annex VI Air Pollution



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### **Green Growth Policy, KOREA**

## Green Growth in Korea

#### • Global Warming

- Kyoto Protocol: 2012
- Post-2012: COP-15 meeting (2009.12, Copenhagen)
- Green Growth Policy: GDP 2%

#### - Effort to reduce GHG from ships : IMO

- Conference of the Parties to the UN Framework Convention on Climate Change

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# GHG from Ships/shipbuilding



Greenships are built by **green shipyards** and operated by **green shipping companies** in Korea



# CO2 from ships (2007)

| CO2 emission(Mton)     | Low<br>bound | Consensus<br>estimate | High<br>bound | Global CO2<br>emissions(%) |
|------------------------|--------------|-----------------------|---------------|----------------------------|
| Total ship emission    | 854          | 1,019                 | 1,224         | 3.3                        |
| International shipping | 685          | 843                   | 1,039         | 2.7                        |

IMO MEPC, 58<sup>th</sup> session, 2009 Korea total: 610Mton, 2% (Shipbuilding about 2.0Mton) (2007)

# CO2 / ton-km (gram)



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# CO2 emission for ship types (2007)



2012-12-10

## CO<sub>2</sub> Emissions from transport (2005)



### Estimation up to 2050 (2<sup>nd</sup> IMO GHG Study 2009)



### IMO Policy options: reduction of emissions

- **EEDI** : Energy Efficiency Design Index
- **SEEMP** : Ship Energy Efficiency Management Plan
  - EEOI : Energy Efficiency Operational Indicator

### MBM

- METS : Maritime Emissions Trading Scheme
- ICF : International Compensation Fund

## Reduction ratio

| Ship type                  | Size<br>(DWT)              | Staart      | 1 phase     | 2 phase                  | 3 phase                  |
|----------------------------|----------------------------|-------------|-------------|--------------------------|--------------------------|
|                            |                            | 2013 ~ 2014 | 2015~2019   | 2020 ~ 2024              | 2025 after               |
| Bulk Carrier               | >20,000<br>10,000 ~ 20,000 |             |             |                          |                          |
| Gas Tanker                 | >10,000<br>2,000 ~ 10,000  |             |             |                          |                          |
| Tanker                     | >20,000<br>4,000 ~ 20,000  |             | 10<br>0-10* | <mark>20</mark><br>0-20* | <mark>30</mark><br>0-30* |
| Containership              | >15,000<br>10,000 ~ 15,000 |             |             | 0 20                     |                          |
| Combination<br>Carrier     | .>20,000<br>4,000 ~ 20,000 |             |             |                          |                          |
| Refrigerated<br>Cargo      | .>5,000<br>3,000 ~ 5,000   |             |             | 15                       | 30                       |
| General Cargo              | >15,000<br>3,000 ~ 15,000  |             | 0-10*       | 0-15*                    | 0-30*                    |
| * Reduction ratio linearly | proportional to ship       | cizo        |             |                          |                          |

\* Reduction ratio linearly proportional to ship size 2012-12-10

## **Green Shipping**

### Total Lifetime Shipping Cost Share (DNV)



## SHIPBUILDINGTRIBUNE.COM 2012 July 23

• On July 18th 2012, Scorpio Tankers Inc took delivery of the STI Amber, the first of eight 52,000 DWT product tankers that are being built by Hyundai Mipo Dockyard of South Korea.



### Scorpio Tankers Seeks Growth Through Fuel Efficient Newbuilds

 Emanuele Lauro, chief executive officer and chairman of the board, commented, "The previous few months have been very exciting for us with the deliveries of our first five newbuildings. These vessels are performing as we expected on their voyages from the Far East to the Atlantic Basin. The following table illustrates the difference in main engine fuel oil consumption, assuming similar operating conditions, between the first newbuilding, STI Amber, and that of a comparable MR product tanker that the Company recently sold, STI Coral. The table provides evidence of the material savings (worldwide marine fuel oil prices exceed \$600 per ton) and environmental benefits of our newbuildings:

| Main Engine Consumption in Metric Tons of Fuel per day | STI Amber | STI Coral | Savings in<br>Metric Tons | Variance % |
|--|-----------|-----------|---------------------------|------------|
| 13.5 Knots Ballast                                     | 18.0      | 25.0      | 7.0                       | 28.0%      |
| 13.5 Knots Laden                                       | 20.5      | 29.5      | 9.0                       | 30.5%      |

• Scorpio Tankers Inc. Announces Financial Results for the Third Quarter of 2012, Oct. 29 2012

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### **NYK Line**: Super Eco Ship 2030 Not a joke, not a toy, not only a dream!



### MAERSK (6<sup>th</sup> SIMF, Oct. 2012)

"We want to be a profitable, responsible and sustainable business. It is in line with our values, and is expected by our shareholders, customers, employees and society in general."

Nils S. Andersen CEO of the A.P. Moller - Maersk Group



# Hanjin Shipping (6<sup>th</sup> SIMF, Oct. 2012)

#### IV. Green Ship Technology

HANJIN SHIPPING Beyond the Ocean



**Green Shipbuilding** 

### **DSME** (6<sup>th</sup> SIMF, Oct. 2012)

#### **Better Future with the Green Ship Technology**

With Green Ship Technologies and Strategies DSME does not just fulfill all regulations and > requirements but push the boundary even further.



**Challenging Goals** 

Continuous R&D

Back to the Basic



## Samsung Heavy Industry

#### SHI GF (Green Future) Ship



2012-12-10

## STX Europe : EOSEAS









#### 2012-12-10

# Korean Shipyards (Newsletter)

#### Hyundai Heavy Industry Thrust Fin, 4~6%



Samsung Heavy Industry Saver Fin, 4~6%





DSME

**Pre-swirl stator**, 5%

# Hybrid CRP

- Hybrid contra-rotating pod propulsion
- POW, Resistance & Self-propulsion test(container ship)
  - Sasaki(2009)





# Efficiency Improvements

- Inflow duct/stators
  - Scaling effect issues with low Reynolds
- Overlapping Propellers
  - Challenges traditional powering and sc
- Rudder bulbs
  - Affects ITTC wake scaling procedure







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### **Greenship Project**

#### 2011 Key Technology Development Program

### Energy Saving Hull Form and Propulsion System for Green Ship

**Five Sub-Projects** 

2011. 07 ~ 2016. 06 Project Manager : Suak Ho Van Research Project Consortium

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# Project Summary

#### 1. Purpose

Effort to reduce GHG for Global Warming

Develop the key Technologies to reduce CO<sub>2</sub> from Ships

2. Period

2011. 7. ~ 2016. 6. (5years)

3. Budget

Total : about \$70M

4. Sub-Projects

**Five sub-projects** 

5. Consortium

2 Research Institutes, 10 Industries, 7 Universities

## Sub-projects and research topics



2012-12-10

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# Energy distribution Shaft 50% : Exhaust 50% ( 2<sup>nd</sup> IMO GHG Study 2009 )



**Figure A2.1** Use of propulsion energy on board a small cargo ship, head sea, Beaufort 6

## Pre-swirl Stator





# Trim Variation Test

- +1~-1m in full scale
- 3~5%, <0.5knots



## Micro Bubble Injection



## Preliminary results



U=3.5m/s



#### **Upstream Sensor**

## Other Efforts

- Hull form/propeller optimization
- Pod: vertical/longitudinal angle
- Polymer/micro bubble injection
- Air-cavity drag reduction
- LNG Pump + vortex generator

. . . . . .

# Economy for Energy Saving

• Engine – RPM – Speed : Fuel saving  $\rightarrow$  CO2

| Ship           | VLCC      | Container |
|----------------|-----------|-----------|
| DFC (ton)      | 100       | 300       |
| Fuel cost/year | \$18M     | \$54M     |
| 1% saving      | \$180,000 | \$540,000 |

\* Bunker C : \$600/ton, operation 300days/year

\* Thrust Fin, Saver Fin, Pre-swirl Stator (3~5%)



## Improvement Measures

| Energy Efficiency Improvement    | Energy Saving/<br>GHG Reduction | Cost     |
|----------------------------------|---------------------------------|----------|
| Slow Steaming                    | •                               | •        |
| Optimum Trim                     | Ο                               | •        |
| Weather Route                    | $\Delta$                        | -        |
| Energy Saving Devices            | Ο                               | -        |
| Propeller & Rudder               | Ο                               | -        |
| Hull Surface Treatment           | Ο                               | -        |
| Alternative Fuel                 | $\Delta$                        | -        |
| Main Engine Derating             | $\Delta$                        | -        |
| WHRS(Waste Heat Recovery System) | igodot                          | <b>—</b> |
| LNG Conversion                   | O                               |          |

#### $\odot$ > $\bigcirc$ > $\bigcirc$ > $\bigcirc$ > $\bigcirc$

### Summary

### KMI (Korea Maritime Institute)

- Four players
- Shipper, Shipping, Shipbuilding, Financial



# **Green Ship Technology**



# **Green Ship Technology**



30%

## Thank you! 謝謝

