Multi-year Expert Meeting
On Transport and Trade Facilitation:

Maritime Transport and the Climate Change Challenge

16-18 February 2009

GHG emissions from international shipping and the potential for control and reduction

by

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Expert Meeting on Transport and Trade Facilitation:
Maritime Transport and the Climate change Challenge
Palais des Nations, Geneva
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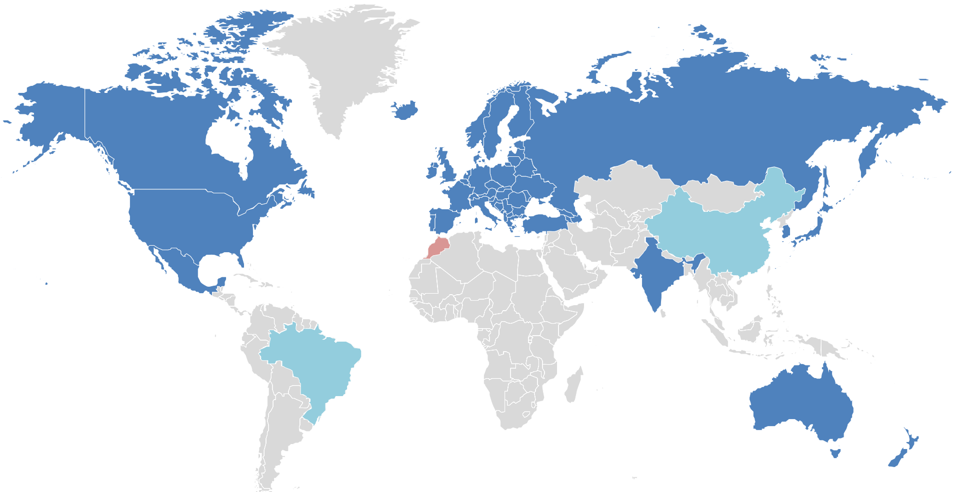
- **Established by Transport Ministers as a platform to work on transport issues of global significance**
- **A successor institution to the European Conference of Ministers of Transport (ECMT)**
- **Part of the OECD family**
- **28-30 May 2008: "Transport & Energy, the Challenge of Climate Change"**
- **27-29 May 2009: "Transport & Globalisation**



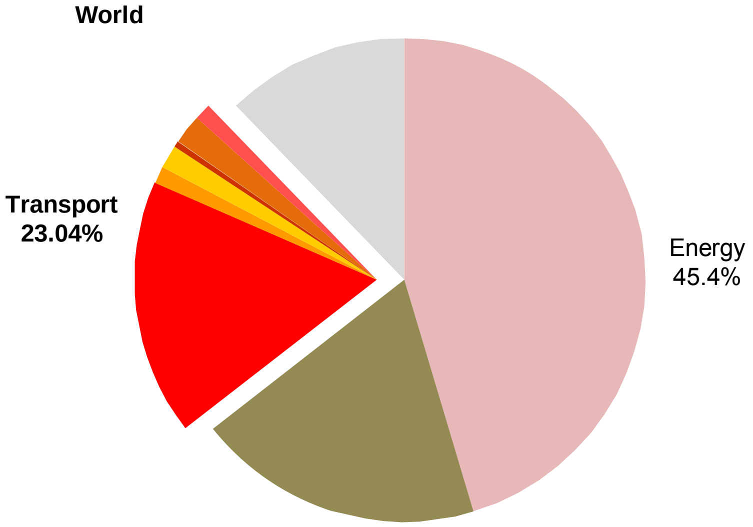
52 Member Countries worldwide

Outline

- 🟥 Background and Context
- 🟦 Maritime CO2 Emissions
- 🟦 Maritime CO2 Reduction Potential
- 🟦 Factors that Impact Maritime CO2 Reduction Potential

Transport's Share of CO2 emissions from fuel combustion

(2006 IEA data, *including* international aviation and maritime)



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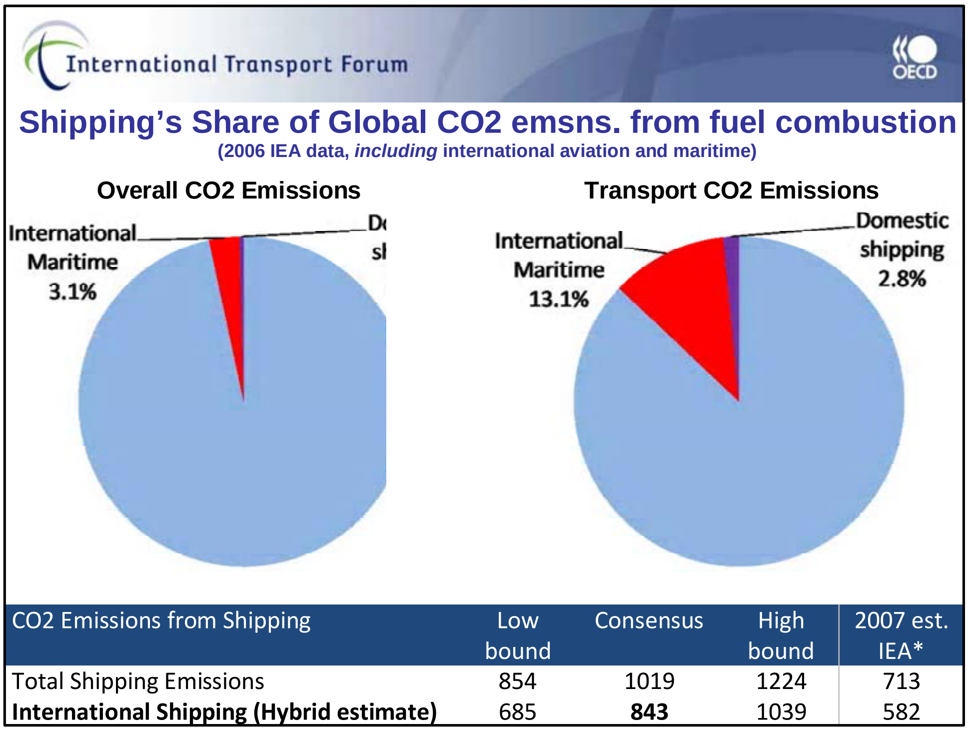
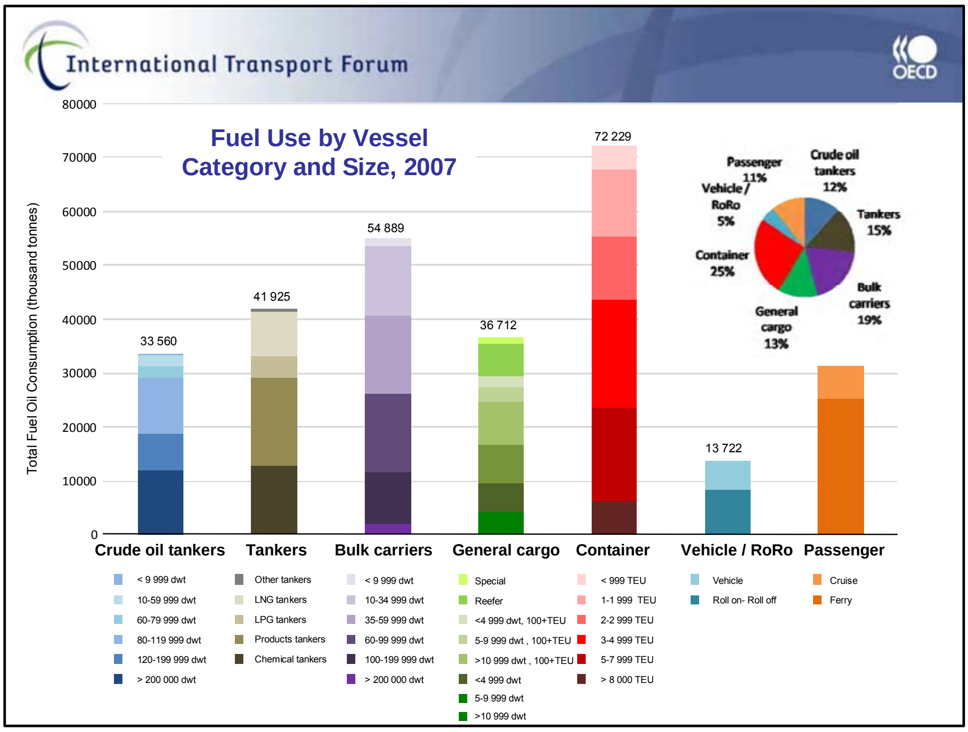


Shipping's Share of Global CO2 emsns. from fuel combustion

(2006 IEA data, *including* international aviation and maritime)

CO2 Emissions from Shipping	Low bound	Consensus	High bound	2007 est. IEA*
Total Shipping Emissions	854	1019	1224	713
International Shipping (Hybrid estimate)	685	**843**	1039	582



Fuel Use by Vessel Category and Size, 2007

What about the Future?

- Trade growth – albeit at a slowed pace
- Continued efficiency improvements
- Energy Prices will trend inexorably upwards – important implications
- CO2 emissions continue to rise from shipping
- Business-as-Usual: 10-26% more CO2 by 2020 and 126-218% by 2050
- Stabilisation at 2007 levels possible but will require technical and operational changes much beyond BAU.

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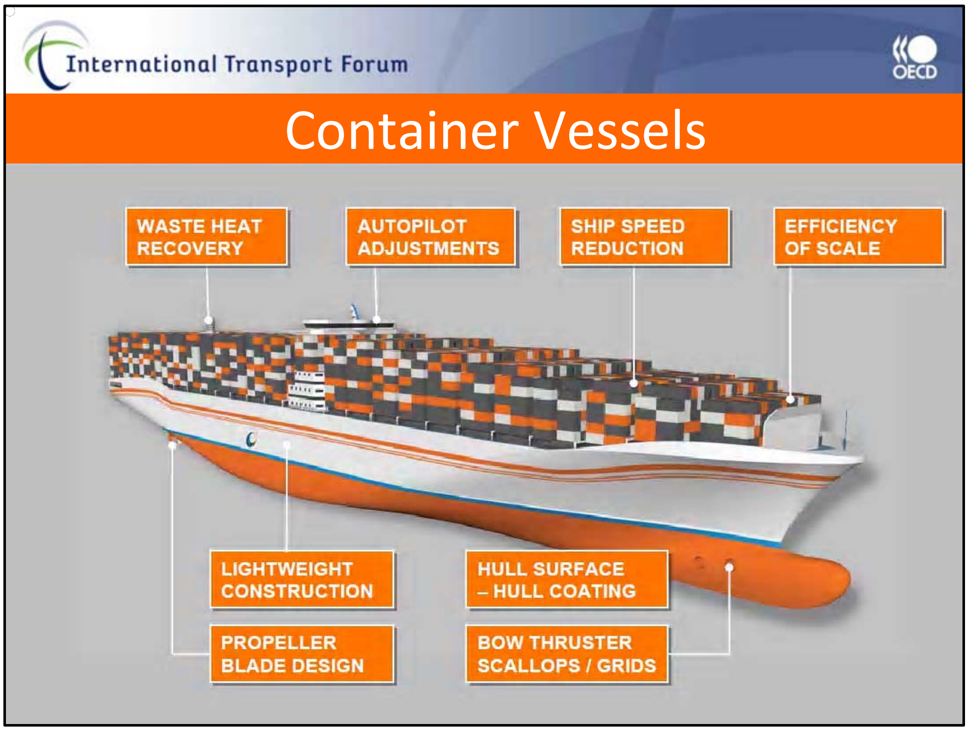
Maritime CO2 Reduction: How? How Much? How Fast?

- Technical and Operational opportunities
- Vessel Duty Cycles not uniform and are a critical element
- 4 broad categories: Hull and vessel design, engines, propulsion systems and other on-board energy-using systems.
- Operational changes – speed reduction foremost – can also significantly contribute
- Technical measures: 5-30% newbuilds today, additional retro-fit and maintenance can add 4-20% and operational strategies can reduce fuel use by as much as 40%. Overall potential 43% and 63% by tkm in 2020 and 2050 respectively.
- Crucially, most cost-effective gains are to be had through existing technologies and operational improvements – not from alternative energy propulsion sources.

Tankers and Bulkers



Container Vessels

WASTE HEAT RECOVERY

AUTOPILOT ADJUSTMENTS

SHIP SPEED REDUCTION

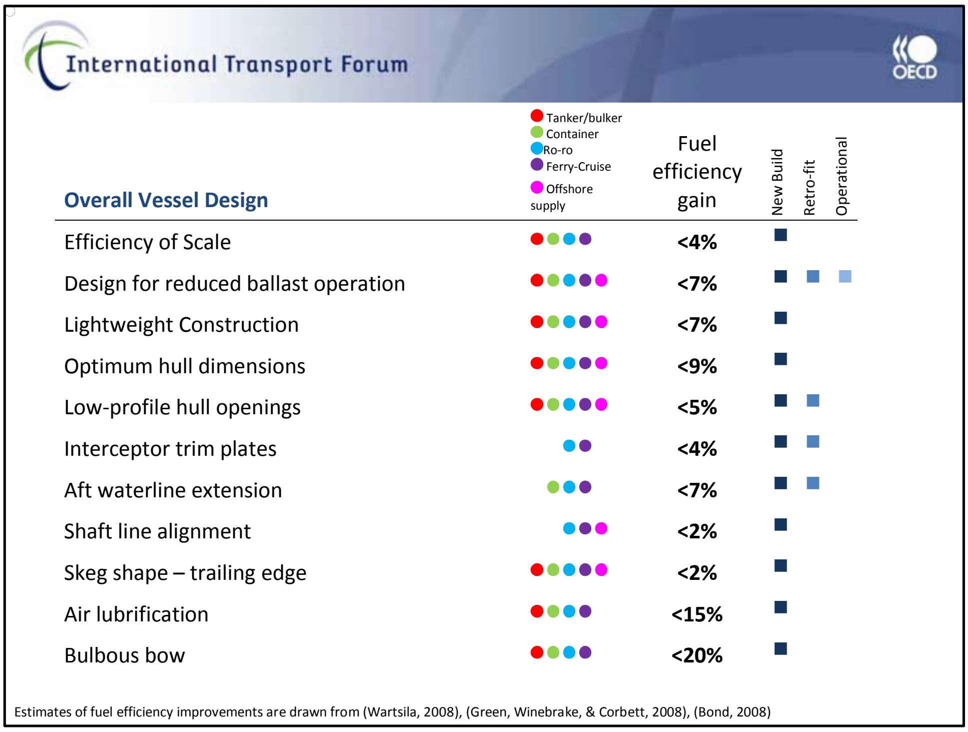
EFFICIENCY OF SCALE

LIGHTWEIGHT CONSTRUCTION

HULL SURFACE – HULL COATING

PROPELLER BLADE DESIGN

BOW THRUSTER SCALLOPS / GRIDS



Overall Vessel Design	🔴 Tanker/bulker 🟢 Container 🔵 Ro-ro 🟣 Ferry-Cruise 🩷 Offshore supply	Fuel efficiency gain	New Build	Retro-fit	Operational
Efficiency of Scale	🔴🟢🔵🟣	**<4%**	■		
Design for reduced ballast operation	🔴🟢🔵🟣🩷	**<7%**	■	■	■
Lightweight Construction	🔴🟢🔵🟣🩷	**<7%**	■		
Optimum hull dimensions	🔴🟢🔵🟣🩷	**<9%**	■		
Low-profile hull openings	🔴🟢🔵🟣🩷	**<5%**	■	■	
Interceptor trim plates	🔵🟣	**<4%**	■	■	
Aft waterline extension	🟢🔵🟣	**<7%**	■	■	
Shaft line alignment	🔵🟣🩷	**<2%**	■		
Skeg shape – trailing edge	🔴🟢🔵🟣🩷	**<2%**	■		
Air lubrication	🔴🟢🔵🟣	**<15%**	■		
Bulbous bow	🔴🟢🔵🟣	**<20%**	■		

Estimates of fuel efficiency improvements are drawn from (Wartsila, 2008), (Green, Winebrake, & Corbett, 2008), (Bond, 2008)

Engine Design	🔴 Tanker/bulker 🟢 Container 🔵 Ro-ro 🟣 Ferry-Cruise 🩷 Offshore supply	Fuel efficiency gain	New Build	Retro-fit	Operational
Engine derating	🔴🟢🔵🟣	**<3.5%**	■	■	
Diesel electric drives	🔵🟣🩷	**5-30%**	■		
Combined diesel-electric and diesel-mechanical drives	🟣🩷	**<4%**	■		
Waste heat recovery	🔴🟢🔵🟣	**<10%**	■	■	
Enhanced engine tuning and part-load operation	🔴🟢🔵	**<4%**	■	■	
Common rail engine	🔴🟢🔵🟣🩷	**<1%**	■	■	

Estimates of fuel efficiency improvements are drawn from (Wartsila, 2008), (Green, Winebrake, & Corbett, 2008), (Bond, 2008)

Propulsion Systems	🔴 Tanker/bulker 🟢 Container 🔵 Ro-ro 🟣 Ferry-Cruise 🩷 Offshore supply	Fuel efficiency gain	New Build	Retro-fit	Operational
Wing thrusters	🔵🟣🩷	**<10%**	■		
Counter-rotating propellers	🔴🟢🔵🟣🩷	**<12%**	■		
Optimised propeller-hull interface	🔴🟢🔵🟣🩷	**<4%**	■		
Propeller-rudder Unit	🔴🟢🔵	**<4%**	■	■	
Optimised propeller blade sections	🔴🟢🔵🟣🩷	**<2%**	■	■	
Propeller tip Winglets	🔴🟢	**<4%**	■	■	
Propeller nozzle	🔴🩷	**<5%**	■	■	
Propeller Efficiency Monitoring	🔴🟢🔵🟣	**<4%**	■	■	■
Efficient Propeller Speed Modulation	🟢🔵🟣🩷	**<5%**	■	■	■
Pulling Thruster	🔵🟣🩷	**<10%**	■		
Wind power: Flettner rotor	🔴🔵	**<30%**	■	■	
Wind Power: Kites and Sails	🔴🟢🔵🟣	**<20%**	■	■	

Estimates of fuel efficiency improvements are drawn from (Wartsila, 2008), (Green, Winebrake, & Corbett, 2008), (Bond, 2008)

Other technology strategies	Tanker/bulker	Container	Ro-ro	Ferry-Cruise	Offshore supply	Fuel efficiency gain	New Build	Retro-fit	Operational
Low-loss electric drive			●	●	●	<2%	■		
Hybrid auxiliary power generation	●	●	●	●	●	<2%	■		
Variable speed electric power generation				●	●	<3%	■		
Energy saving lighting				●		<1%	■	■	
Enhanced power management	●	●	●	●	●	<5%	■		■
Solar power	●		●	●		<4%	■	■	
Variable speed pumps	●	●	●	●	●	<1%	■	■	
Automation	●	●	●	●	●	<10%	■	■	■

Estimates of fuel efficiency improvements are drawn from (Wartsila, 2008), (Green, Winebrake, & Corbett, 2008), (Bond, 2008)

Operational Strategies	Tanker/bulker	Container	Ro-ro	Ferry-Cruise	Offshore supply	Fuel efficiency gain	New Build	Retro-fit	Operational
Fuel additives	●	●	●	●	●	<2%			■
Port turn-around time	●	●	●	●	●	<10%	■	■	■
Propeller surface maintenance	●	●	●	●	●	<10%			■
Hull coating	●	●	●	●	●	<5%	■	■	■
Hull cleaning	●	●	●	●	●	<3%			■
Ship speed reduction	●	●	●	●	●	<23%			■
Voyage planning and weather routing	●	●	●	●	●	<10%			■
Optimised vessel trim	●	●	●	●	●	<5%			■
Optimised autopilot	●	●	●	●	●	<4%		■	■
Overall energy awareness	●	●	●	●	●	<10%			■
Condition-based maintenance	●	●	●	●	●	<5%		■	■
Optimal berthing, mooring and anchoring	●	●	●	●	●				

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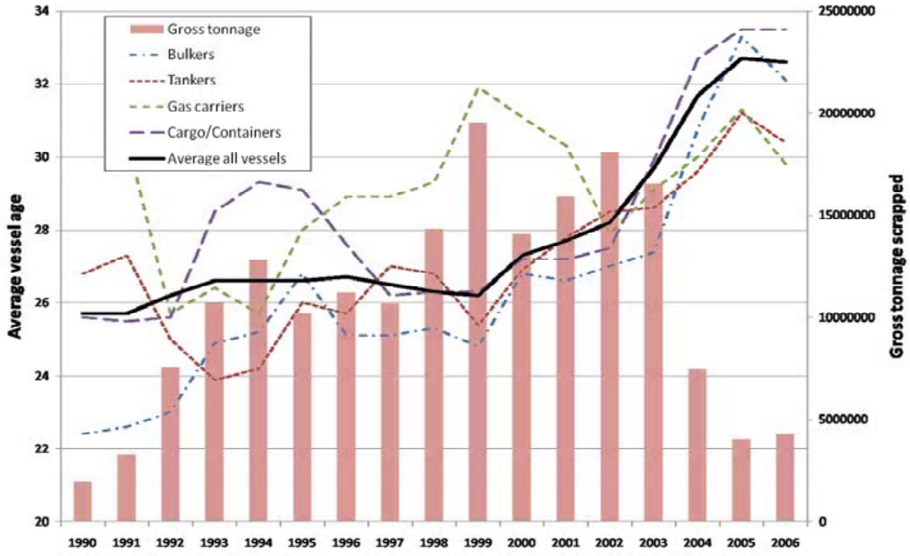
Factors impacting Maritime CO2 Intensity

•Load factors – imbalances in trade

•Market reactivity – but principal agent problems for newbuilds and operational strategies – (commercial and chartering practices)

•Fleet turnover (avg. vessel age was increasing)



Factors impacting Maritime CO2 Intensity

- Load factors – imbalances in trade
- Market reactivity – but principal agent problems for newbuilds and operational strategies – (commercial and chartering practices)
- Fleet turnover (avg. vessel age was increasing)
- Capital constraints and market outlook

BALDRY $1,989.00 ⇩ $66.00 (3.21%)

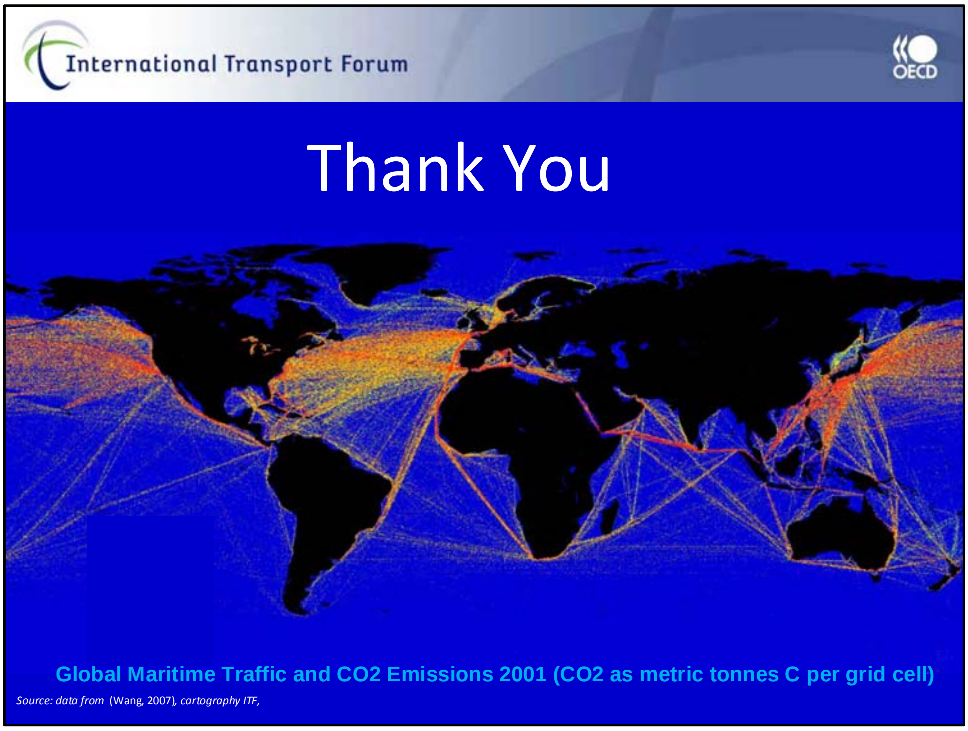
quotes delayed

Day range **$0.00 - $0.00**
52wk range **$663.00 - $11,77...**
Volume **0.0k**
Mkt Cap **N/A**
P/E Ratio **N/A**
EPS **N/A**

06/15/07 Price: 5,258.00 Vol:

Factors impacting Maritime CO2 Intensity

- Load factors – imbalances in trade
- Market reactivity – but principal agent problems for newbuilds and operational strategies – (commercial and chartering practices)
- Fleet turnover (avg. vessel age was increasing)
- Capital constraints and market outlook
- Impact of recession?



Thank You

Global Maritime Traffic and CO2 Emissions 2001 (CO2 as metric tonnes C per grid cell)

Source: data from (Wang, 2007), *cartography ITF,*