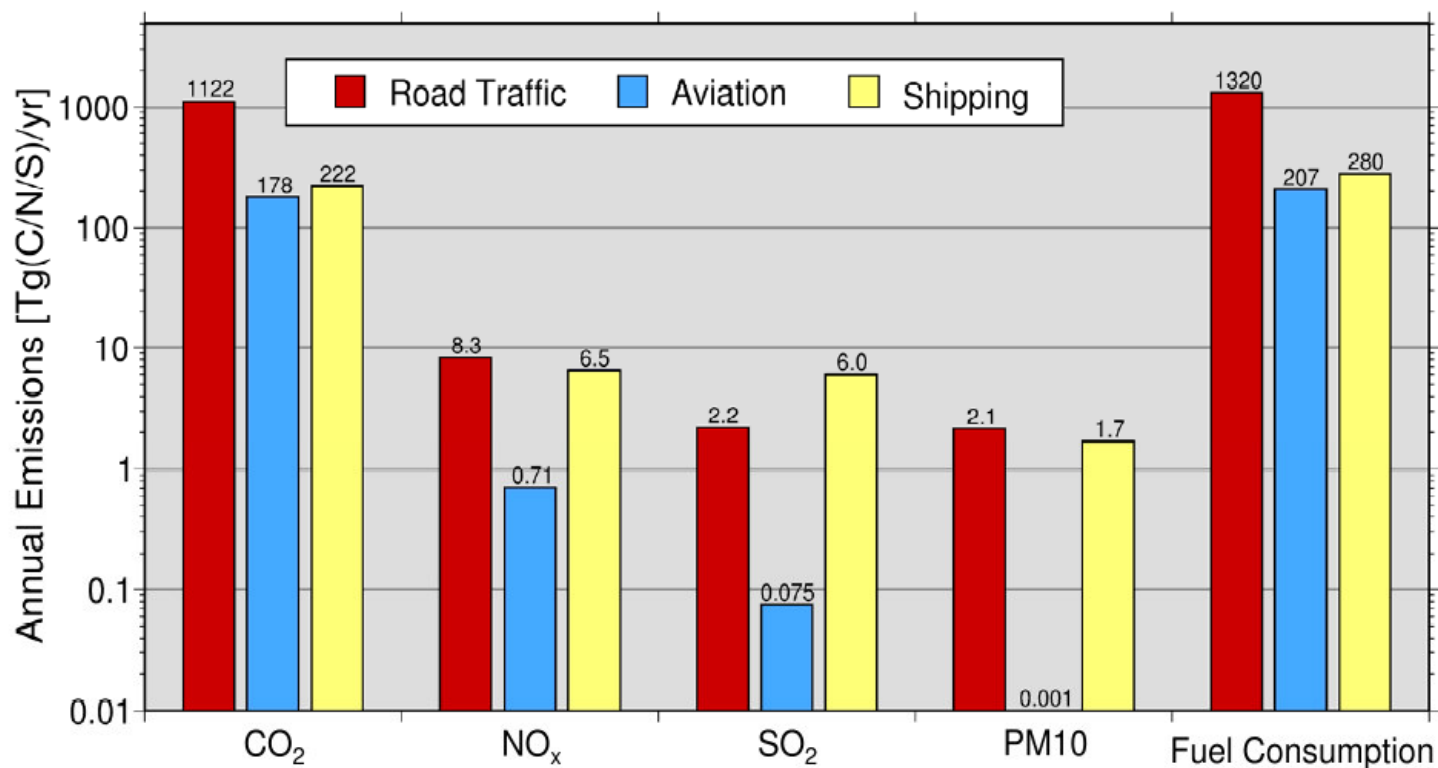


Comparison between transport modes

Global emissions

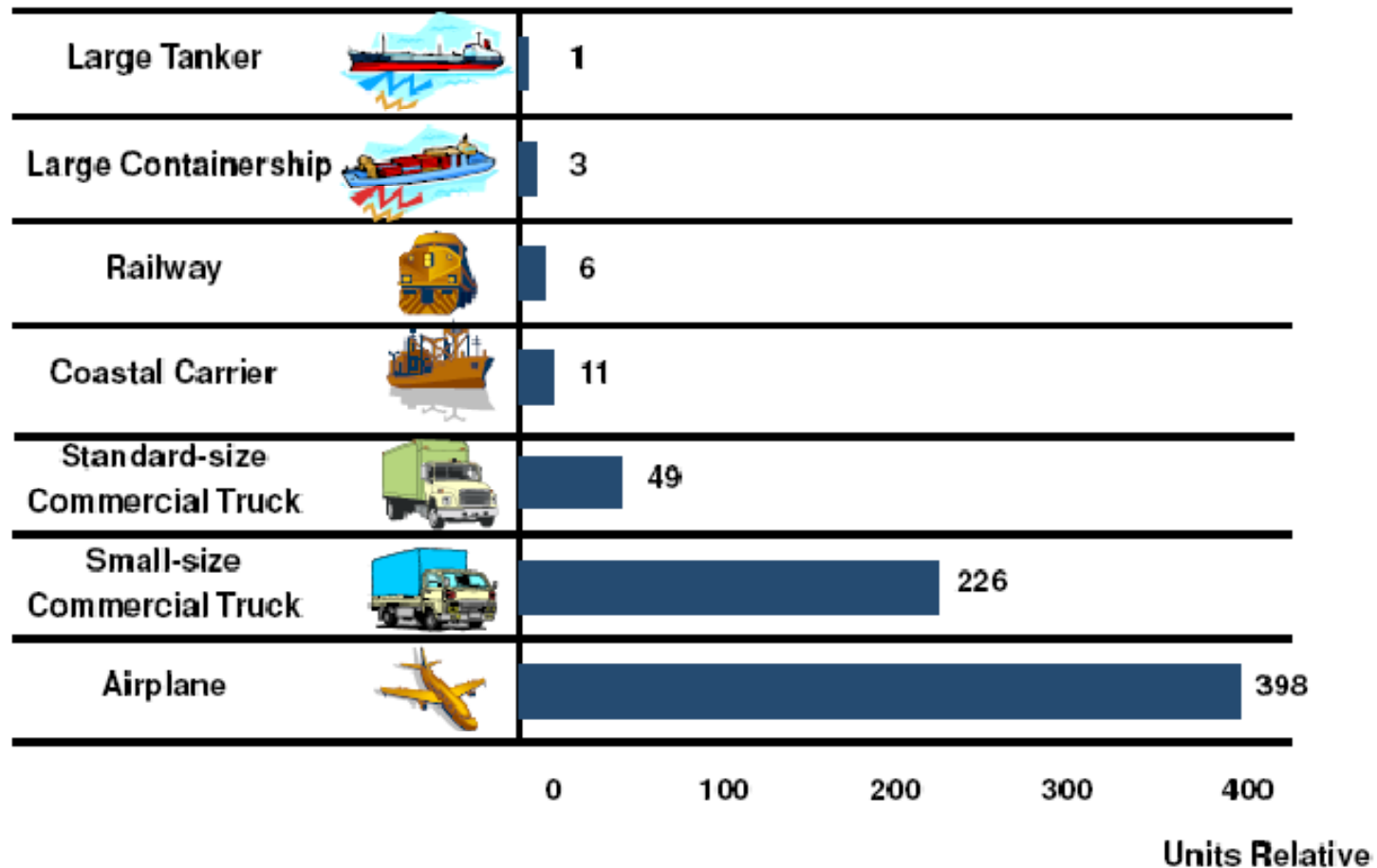


Eyring et al., J Geophys Res 110 (2005)



Category	No of ships	tdw million ton	consumption HFO+MDO million ton	emission CO2 million ton
<u>Dry Cargo.</u>				
Dry bulk	7002	366.7	55.8	168.8
Gen.cargo	13600	75	27.2	82.7
<u>Comb.carr.</u>	<u>110</u>	<u>5.8</u>	<u>0.7</u>	<u>2.4</u>
Total	20712	447.5	83.7	253.9
<u>Liquid.</u>				
Chem/dest.	1649	21.8	10	30.5
Chem.	1195	6.2	5.4	16.3
<u>Crude</u>	<u>1945</u>	<u>150.8</u>	<u>43.8</u>	<u>132.3</u>
Total	4789	178.8	59.2	179.1
<u>Liner.</u>				
Container	3991	113.3	104	314.5
Ro/pax	3759	30.2	39.6	120.5
Ro/ro	2131	38.2	12.2	57.4
<u>Reefer</u>	<u>2132</u>	<u>9.1</u>	<u>18.9</u>	<u>37.1</u>
Total	12013	190.8	174.7	529.5
<u>Misc.</u>				
Fiskeftg.etc.	11902	16.8	17.7	54.5
Off shore	4326	10.7	24	73.4
<u>Bunker.ftg</u>	<u>1723</u>	<u>15.6</u>	<u>4.2</u>	<u>12.8</u>
Total	17951	43.1	45.9	140.7

CO₂ Emissions per Unit Load by Transport Mode



Source: Ministry of Land, Infrastructure and Transport (Japan): The Survey on Transport Energy 2001/2002
 MOL (Japan): Environmental and Social Report 2004

Energy consumption expressed as kWh/TEU.



	Panamax	Post Panamax	Super Post Panamax
Capacity	3.300 teu	6.900 teu	13.000 teu
Speed	24 knots	24 knots	24 knots
CSR	27.000 kW	46.000 kW	68.000 kW

Assuming a distance between Göteborg to Shanghai via Suez of 12.500 Nm, the steaming time with 24 knots is 520 hrs.

Consumed energy	14 milj kWh	23milj kWh	35 milj kWh
45% of teu capacity	1.485 teu	3.105 teu	5.850 teu
Consumed energy/teu	9.400 kWh/teu	7.400 kWh/teu	5.980 kWh/teu
95% of teu capacity	3.300 teu	6.555 teu	12.350 teu
Consumed energy/teu	4.465 kWh/teu	3.500 kWh/teu	2.800 kWh/teu

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Fuel Consumption Reduction

- Hydrodynamic
 - Hull
 - Propeller
 - Other fuel saving measures
- Mechanical
 - Main engine
- System integration
- Energy recovery

Fuel Consumption Reduction



Hullform

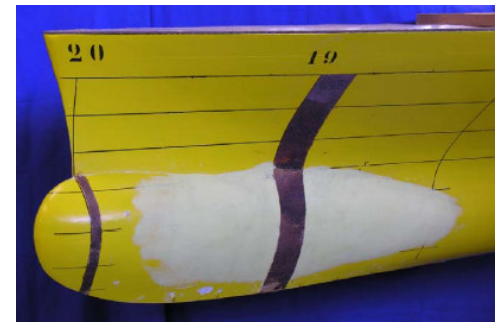
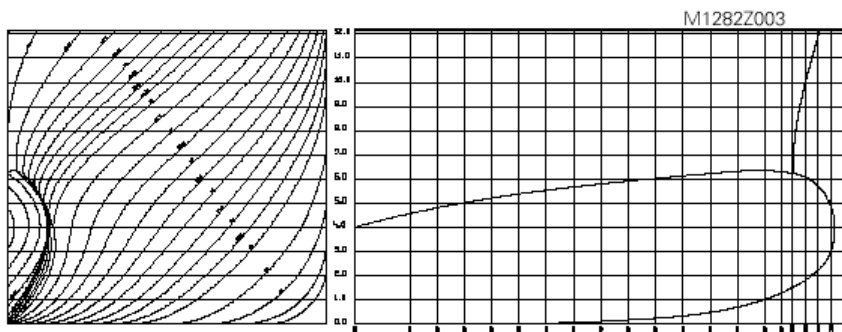
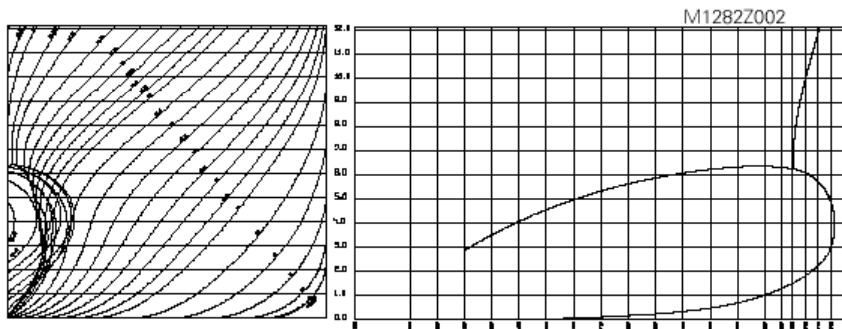
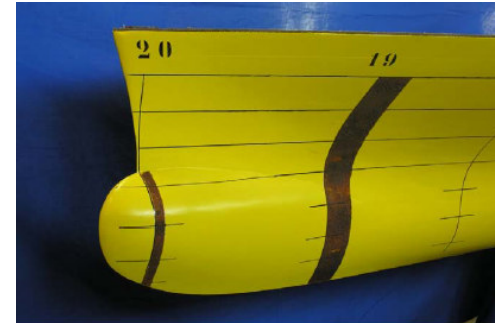
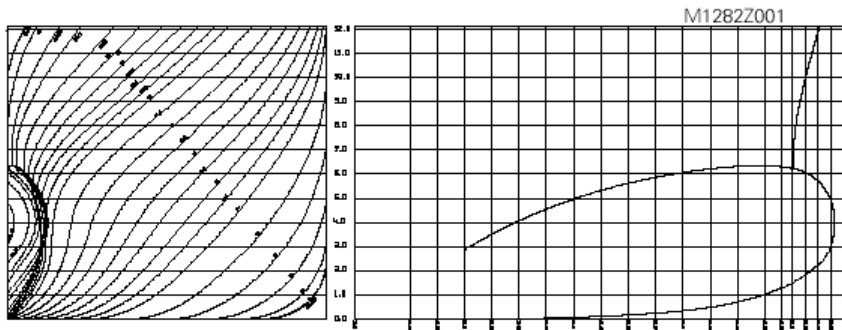


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Fuel Consumption Reduction



Hullform

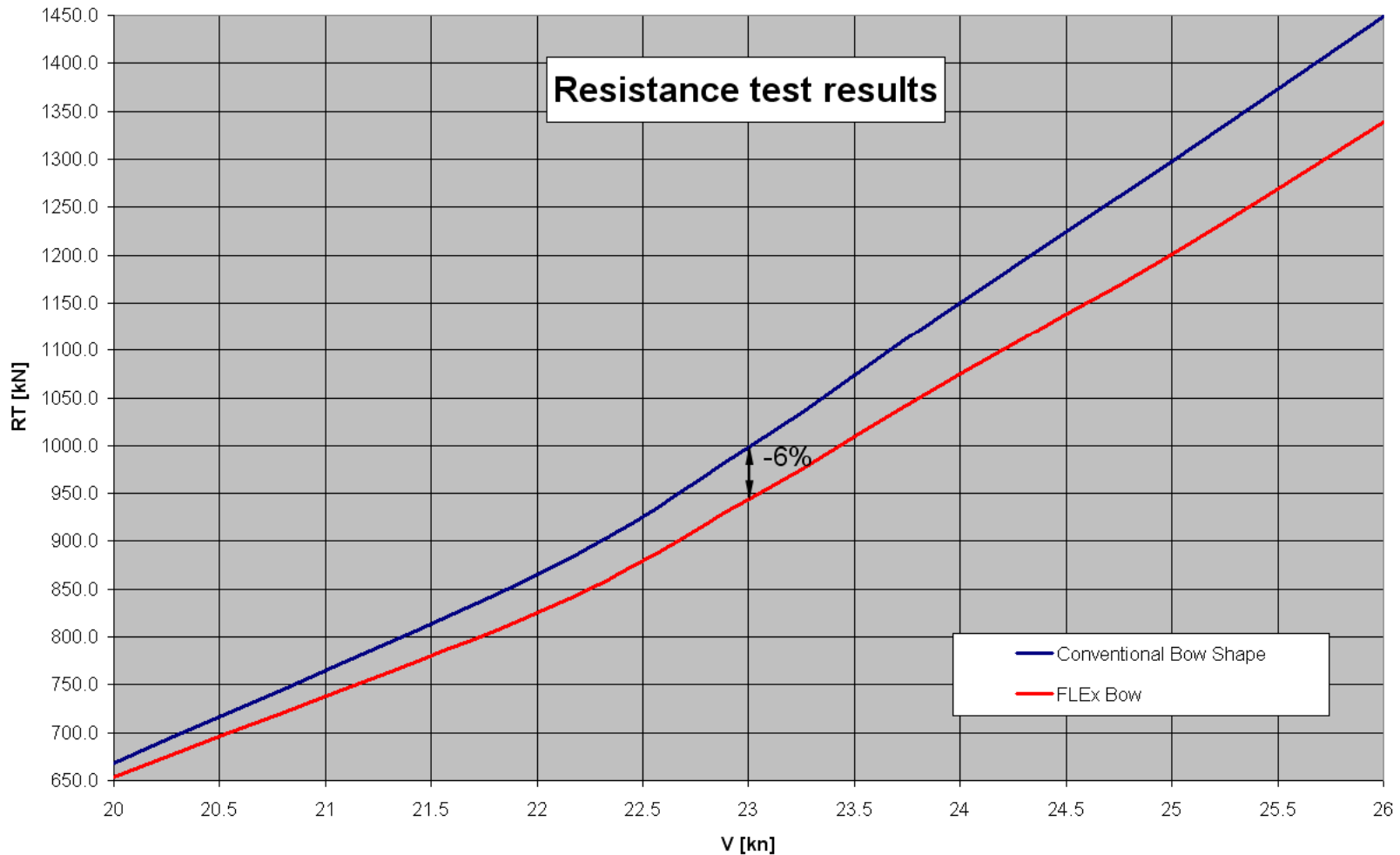


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Fuel Consumption Reduction



Hullform

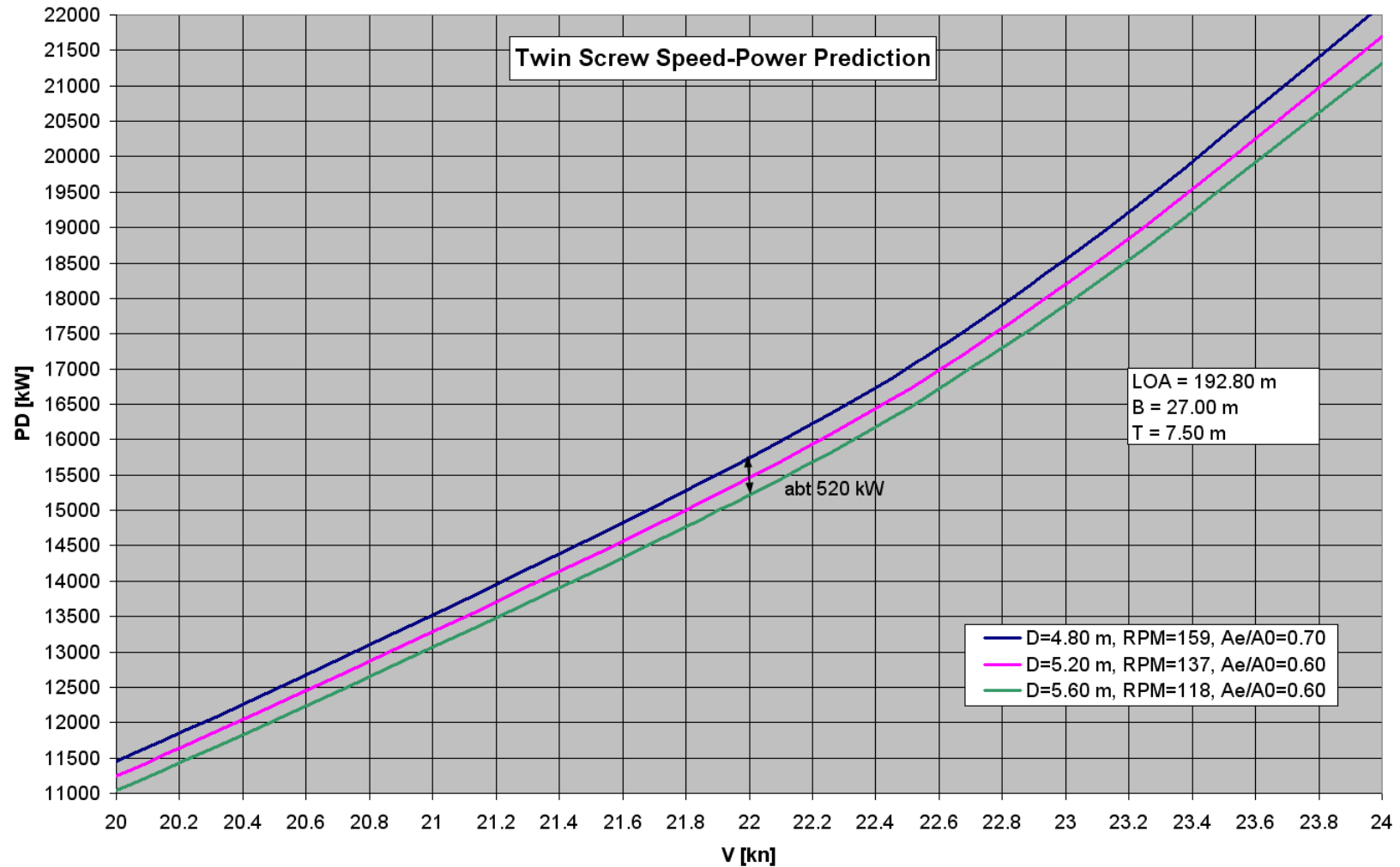


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Fuel Consumption Reduction



Propeller large diameter



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Potential

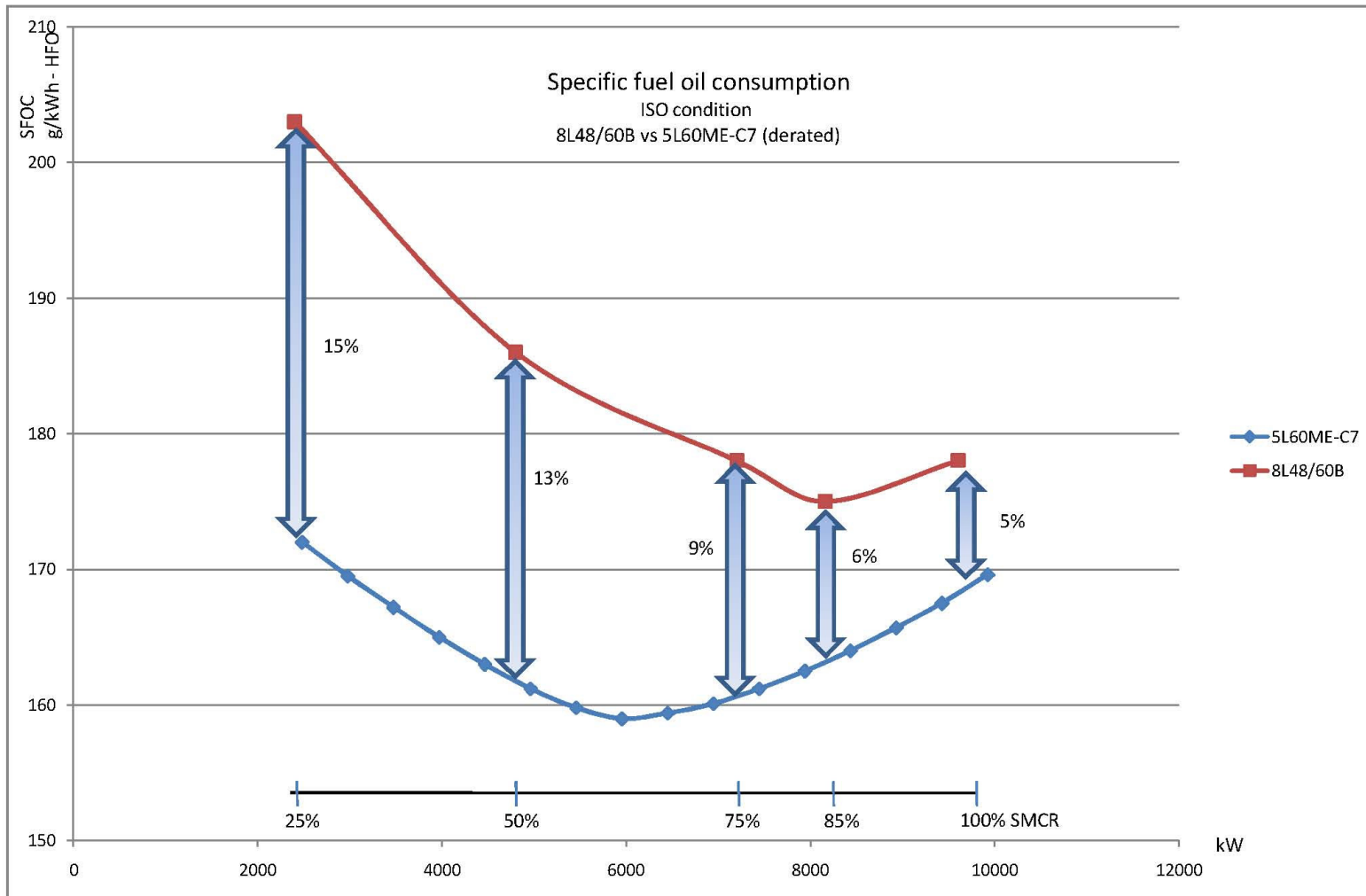


		4 Stroke			2 Stroke			2 Stroke larger propeller			2 Stroke larger propeller			2 Stroke larger propeller		
Lower heating value			20000 kW			20000 kW		20000 kW		20000 kW		20000 kW		20000 kW		
Thrust power delivered	PT	26,4%	5286 kW		29,8%	5970 kW		30,9%	6176 kW		31,8%	6367 kW		32,7%	6540 kW	
			100%			113%			117%			120%			124%	

Fuel Consumption Reduction

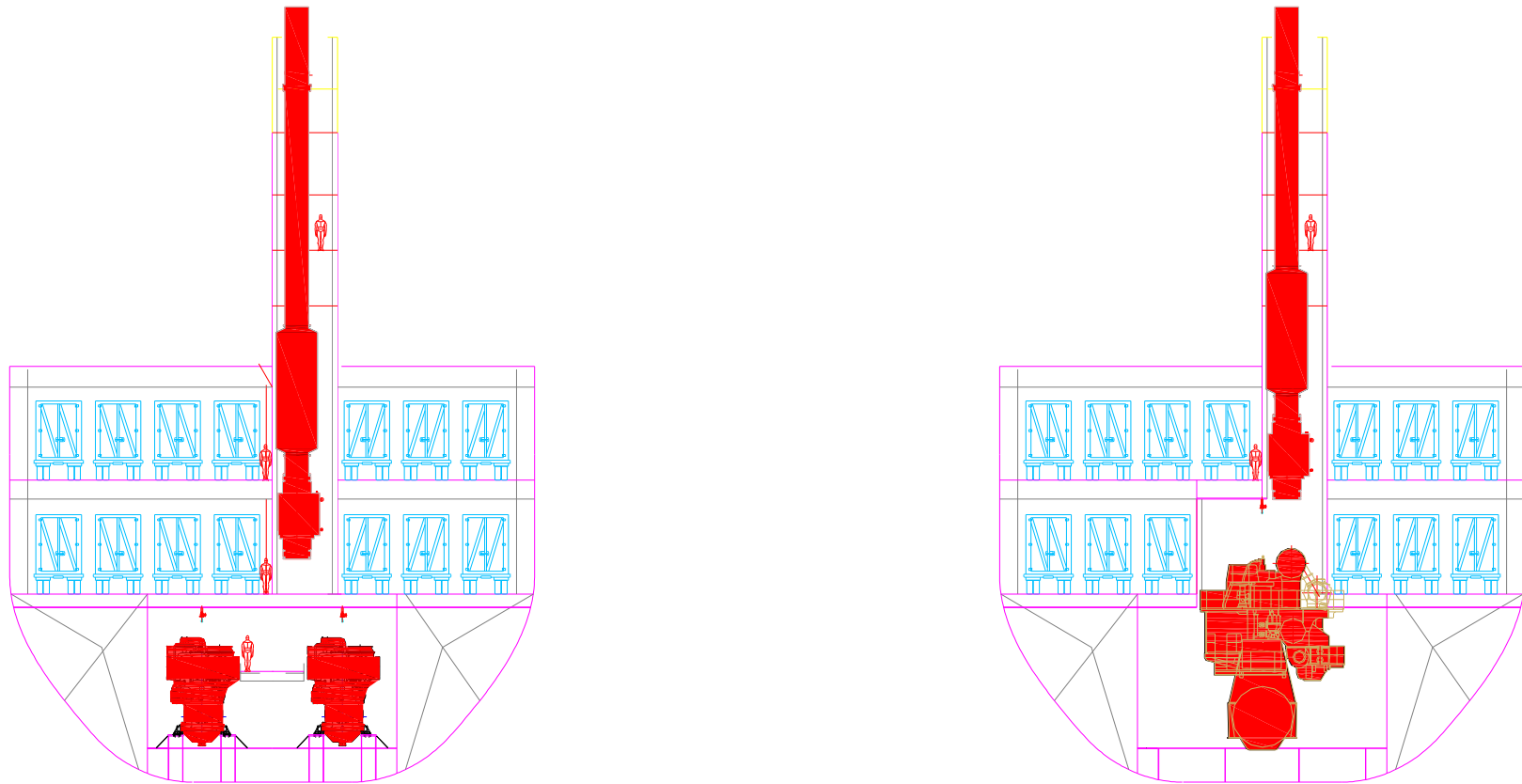


Engine Selection

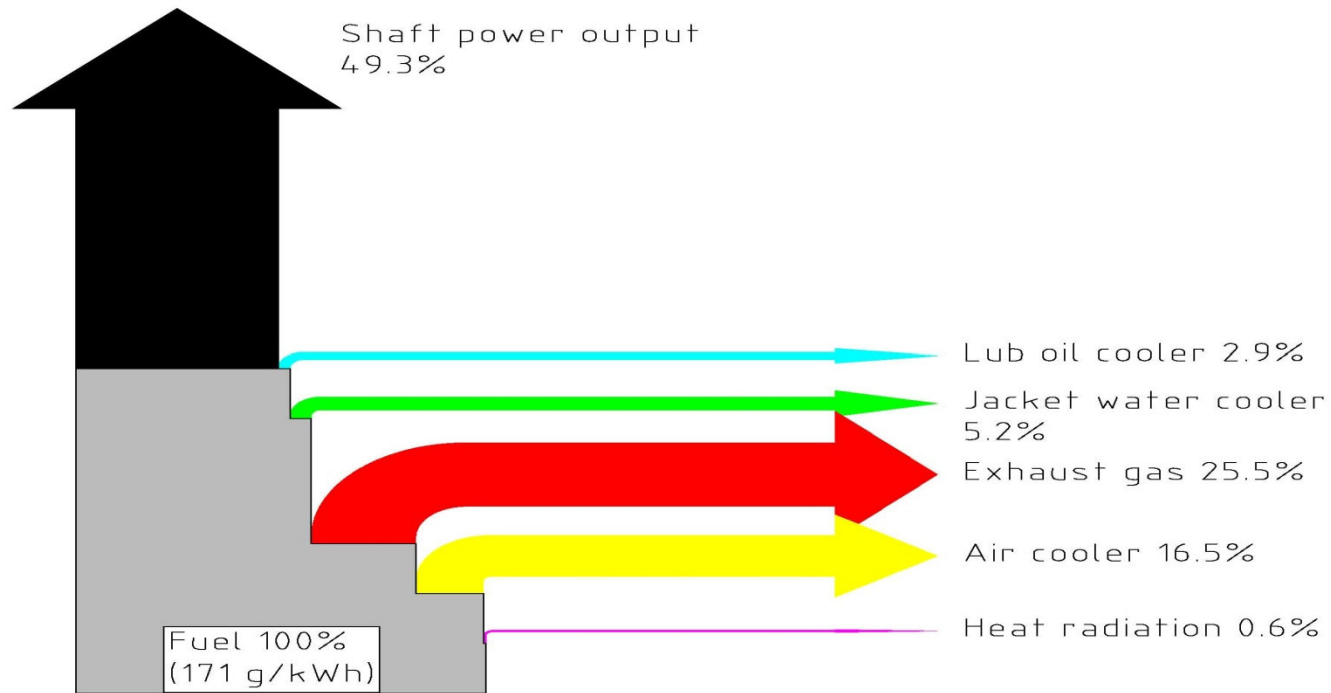


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Are you ready for two-stroke?



Energy recovery

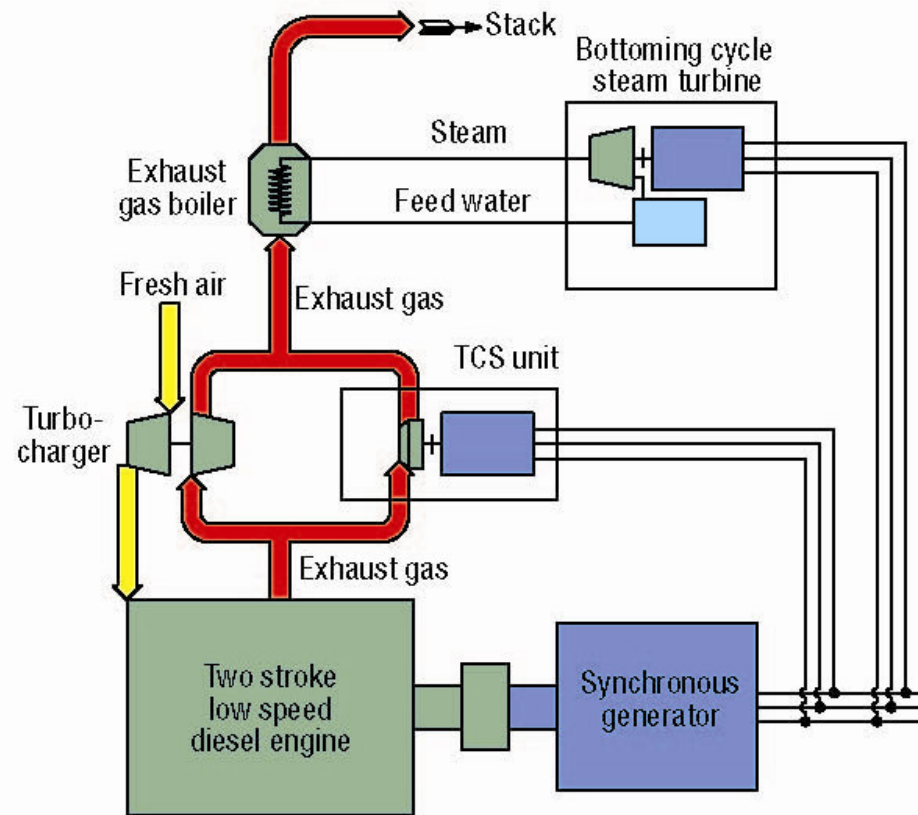


Turbo compound system

MAN B&W

General Information

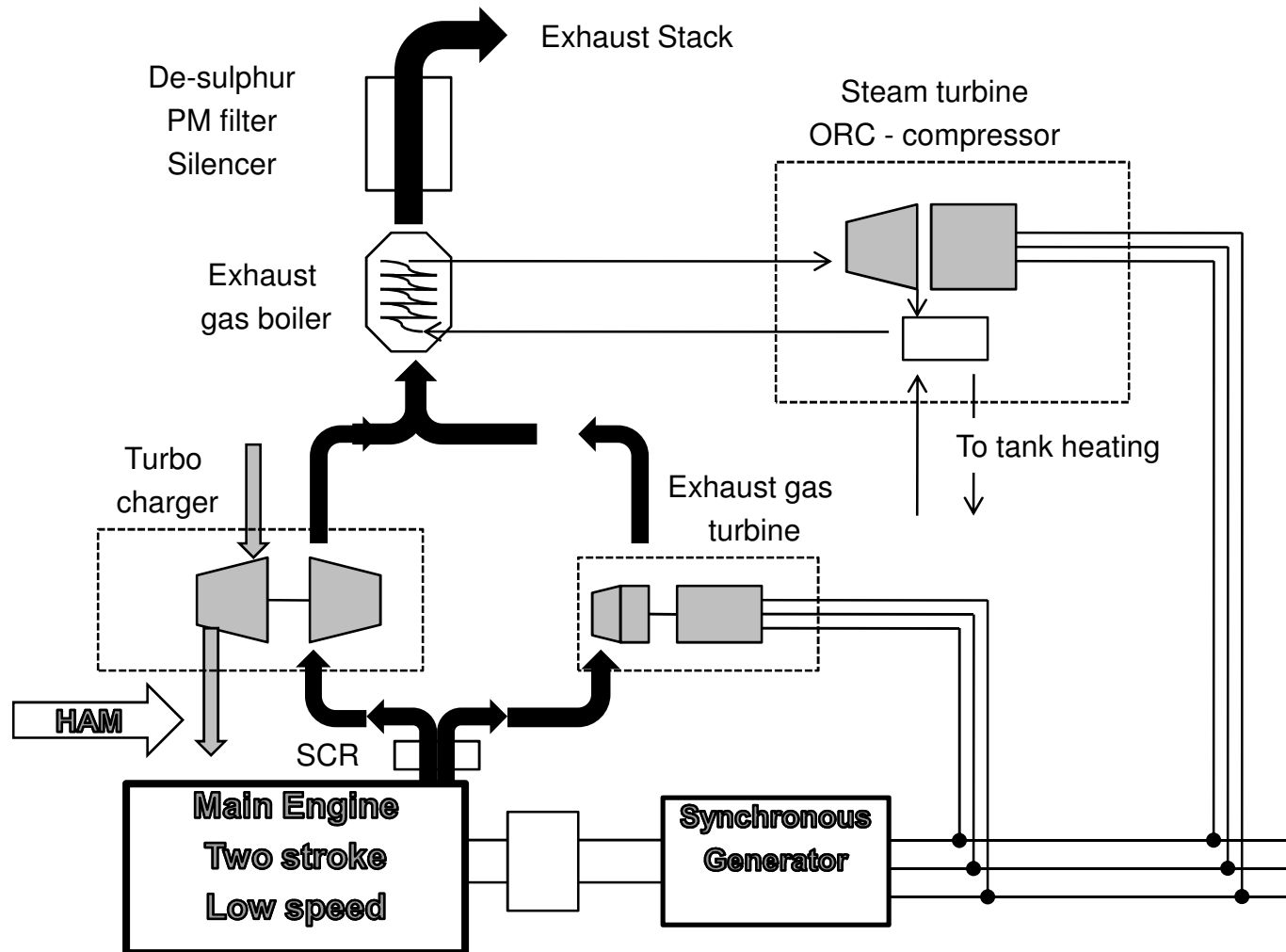
**Two-stroke Low Speed Diesel Engine of MAN B&W Design
in Combined Cycle**



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Energy recovery – exhaust gas



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Potential energy savings

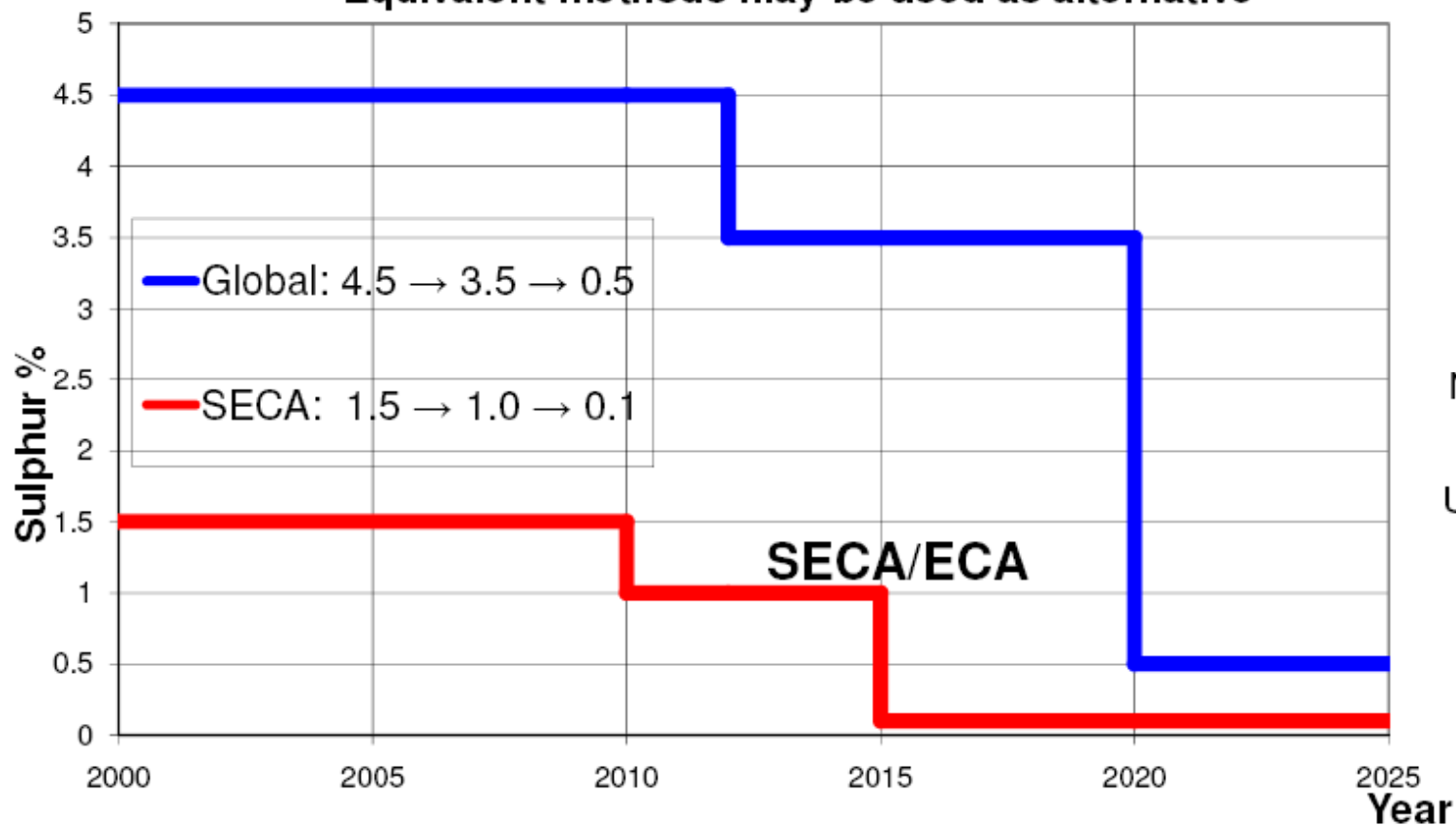
<u>Category</u>	<u>Potential saving</u>	<u>Reason</u>
<u>Dry bulk & liquid</u>	10% à 20%	Operation, scale of economy
	10% à 12%	Efficient engine systems
	<u>5% à 10%</u>	Hull and propulsion
	Totally	25% à 42%
<u>Container & Ro/ro</u>	30% à 50%	Operation, scale of economy
	10% à 12%	Efficient engine systems
	<u>10% à 15%</u>	Hull and propulsion
	Totally	50% à 77%
<u>Misc.</u>	5% à 10%	Operation
	5% à 12%	Efficient engine systems
	<u>10% à 15%</u>	Hull and propulsion
	Totally	20% à 37%

It is not unrealistic to achieve a 50% reduction of energy consumption for the maritime transports – and thus CO2 emissions – within a 20 year period of time.

And in addition also achieve better transport economy and capacity.

MEPC 57 IMO Fuel-sulphur Content

Equivalent methods may be used as alternative

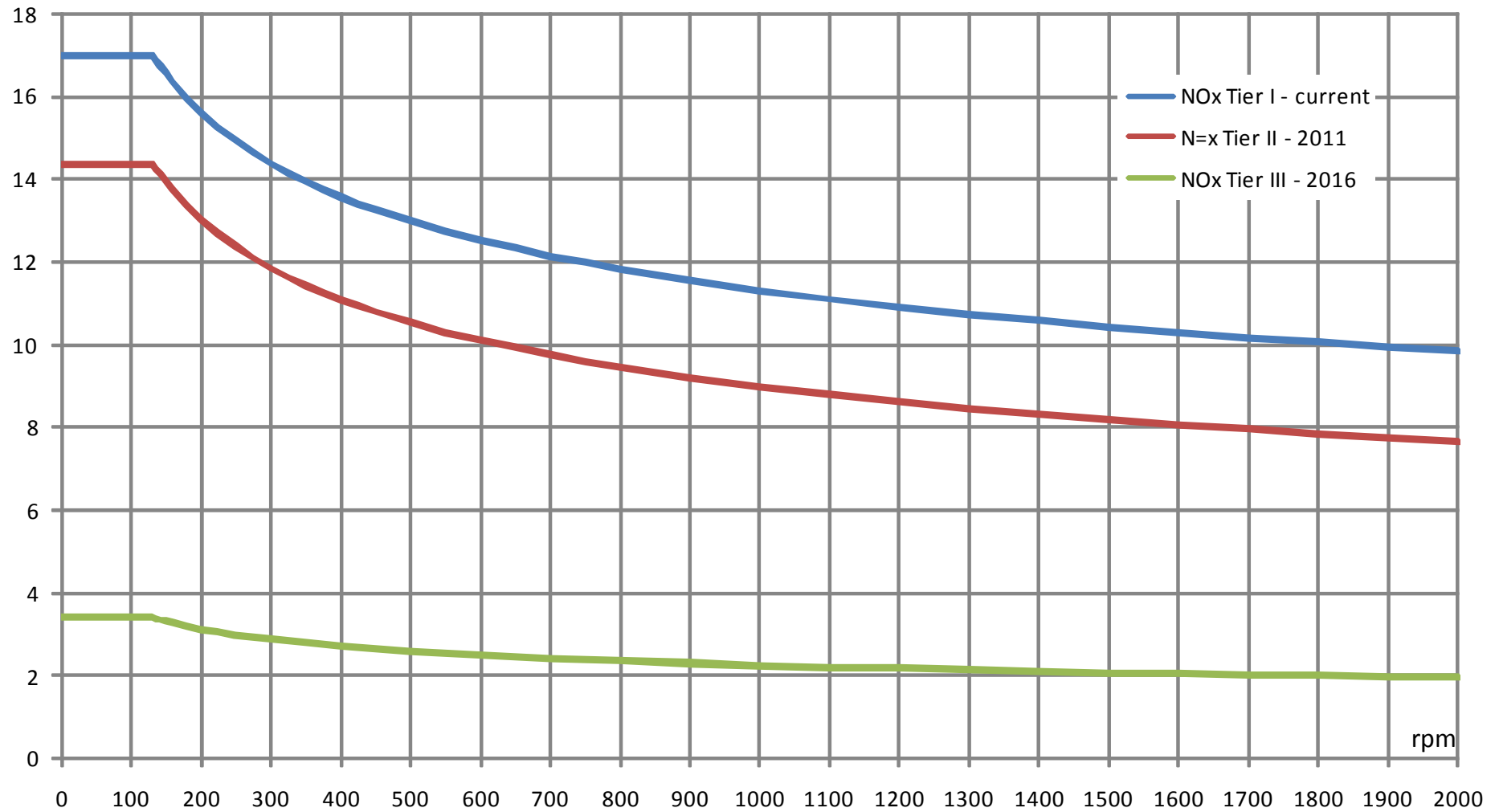


New ECA areas
could be?:
USA West Coast
Mediterranean
Others?

Particulate matter regulated by the sulphur content of the fuel or by scrubber technology

IMO NOx Technical code

g NO_x/kWh



Emission reduction



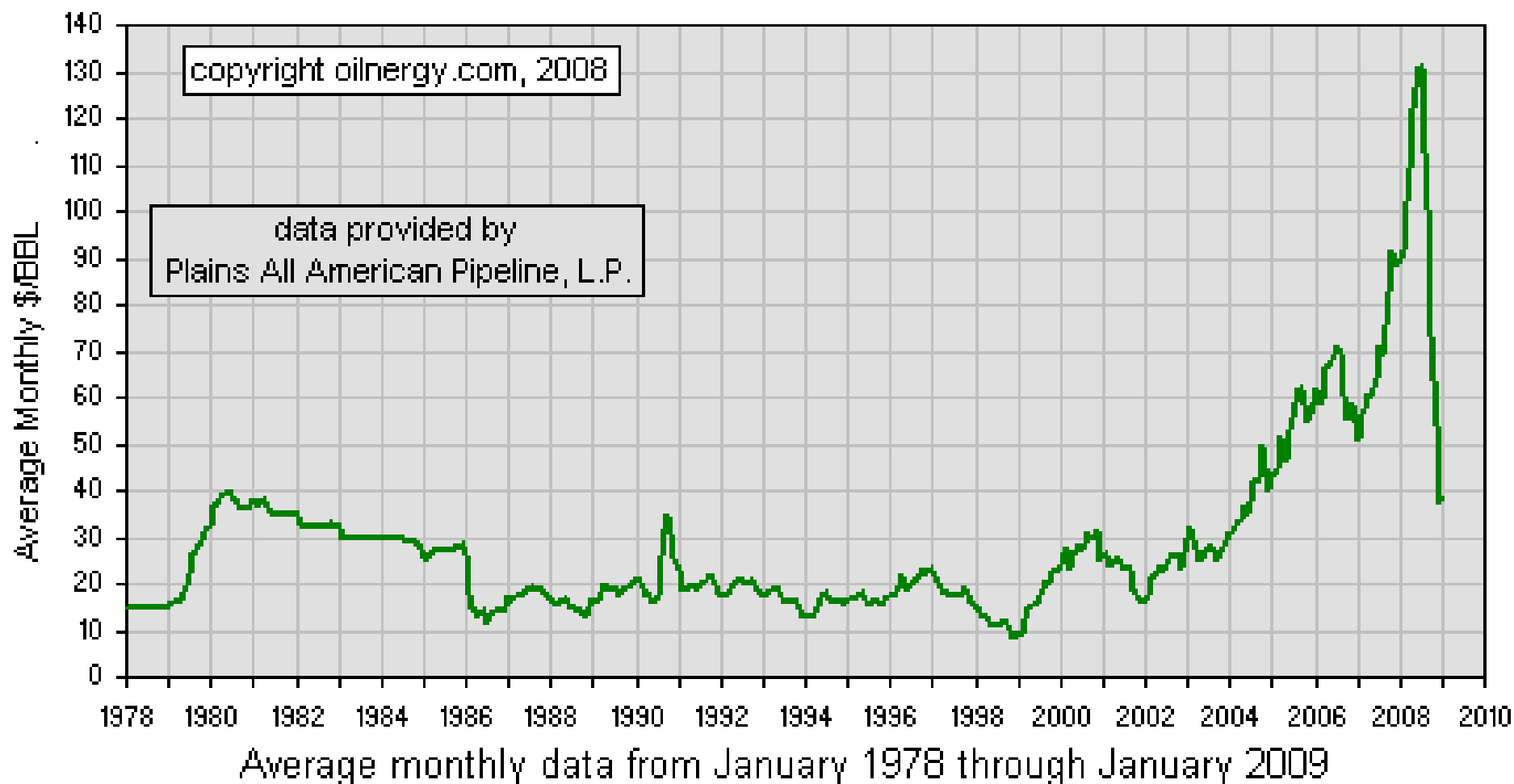
- NO_x – reduction requirements are well defined and various technologies are available today
- SO_x reduction requirements are well defined. Alternative fuels will be part of the solution. Scrubbers might be a competitive solution.
- Sea transport is already CO₂ efficient. Fuel efficiency goes hand in hand with CO₂ reduction

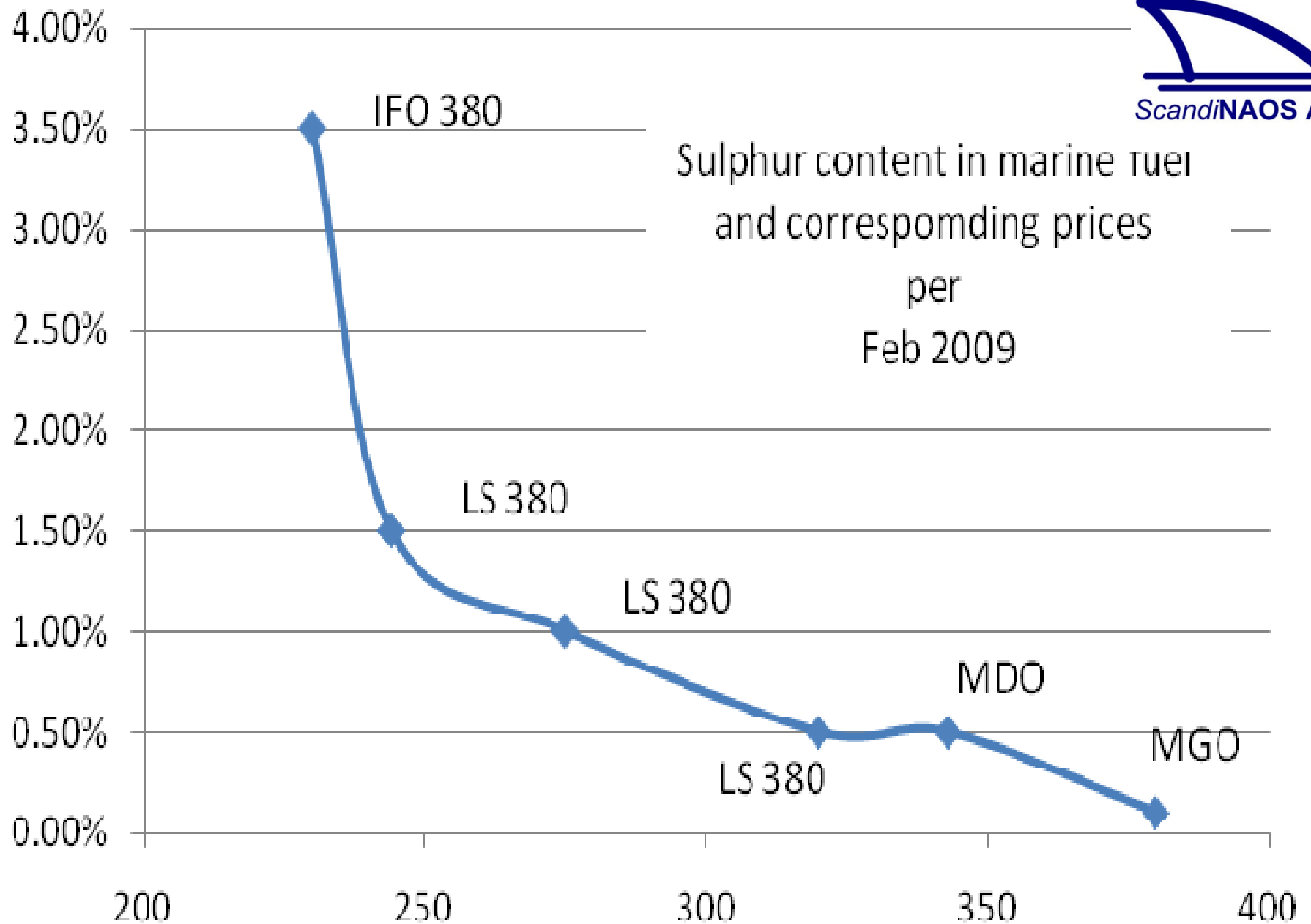
SOx reduction

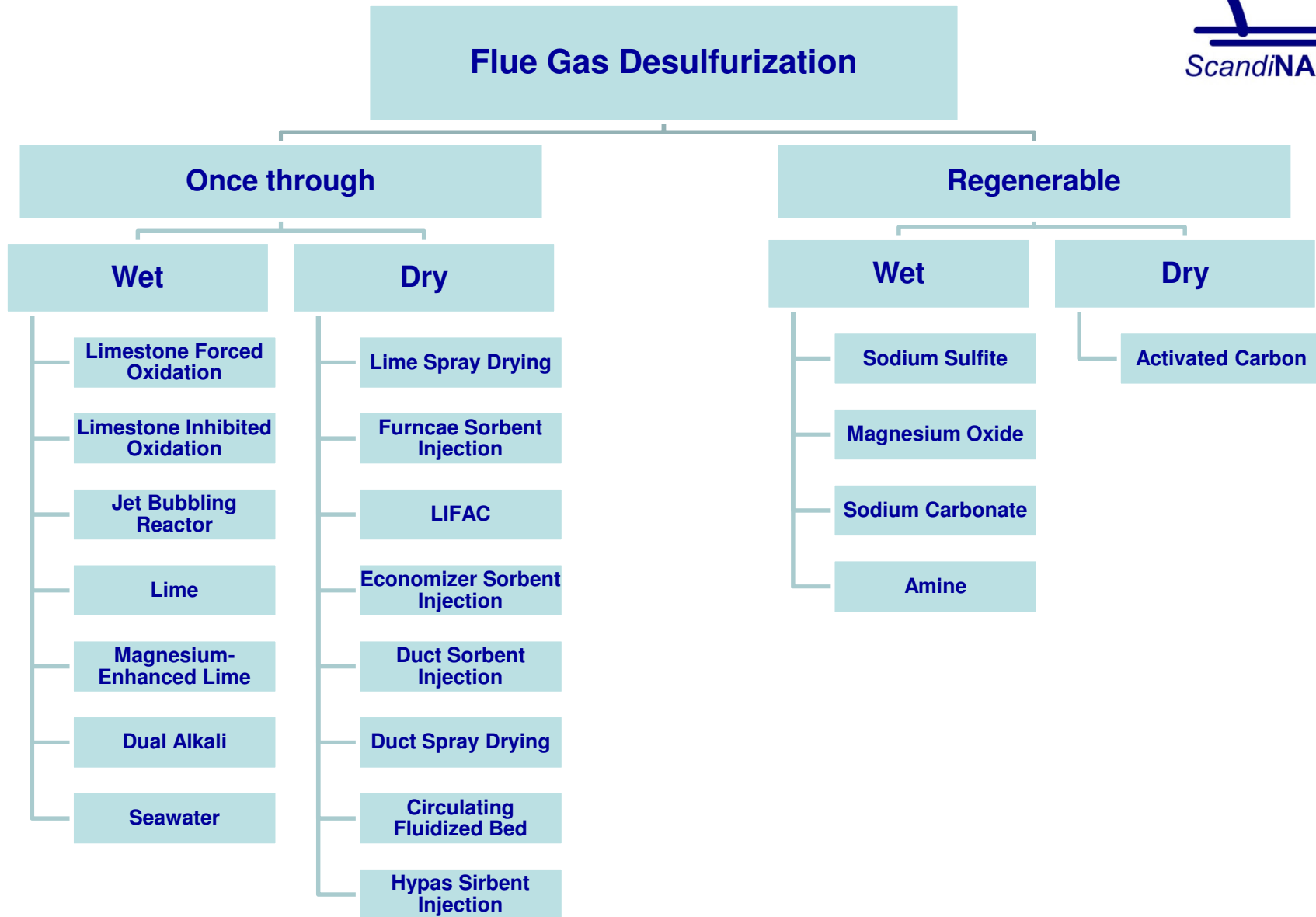
- Low sulphur distillates (refineries)
 - Residuals (HFO) will be available in at least 20 years
- LNG (Oil- and gas companies)
 - Solves some problems, creates some new
- Scrubbers
 - Further development required. Land based technologies need to be adopted for marine use

Implementation date	SOx Emission Control Areas	SOx Global	Scrubbers
Existing	1.5%	4.5%	Only in SECAS
1 March 2010	1.0%		3.5% Review of 2020 fuel situation
2012			
2015			
2018	0.1%	0.5% (HFO allowed) Alternative 0.5% intro date	
2020			
2025			

Plains All American L.P.'s WTI Crude - Posted Price









Tank you for your attention!