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**An integrated approach towards cost-effective operation of ships
with reduced GHG emissions**

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Maersk Maritime Technology

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Who we are

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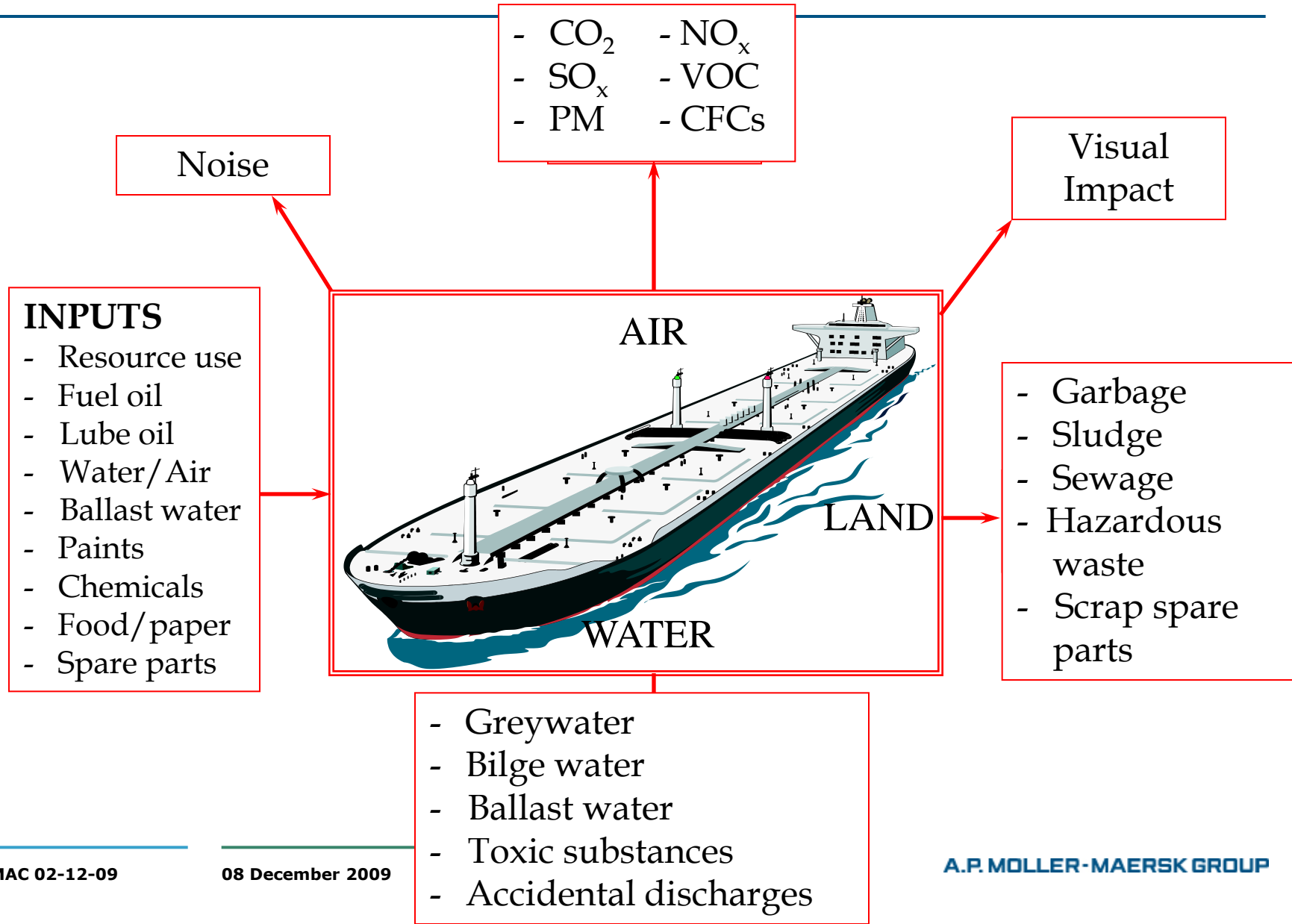
- The A.P. Moller - Maersk Group is a diversified conglomerate, founded in 1904 by Mr A.P. Møller
- 116,000 employees and operations in more than 130 countries
- Business segments:
 - Container shipping, Logistics
 - Tankers, offshore supply
 - Tugs, salvage
 - Container terminals
 - Drilling and FPSOs
 - Oil and gas production
 - Retail activities
 - Shipyards
 - Other companies





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SHIPPING - WHAT ARE THE CONCERNS?



Reducing environmental impacts is a combination of several initiatives

Implemented technical and operational initiatives:

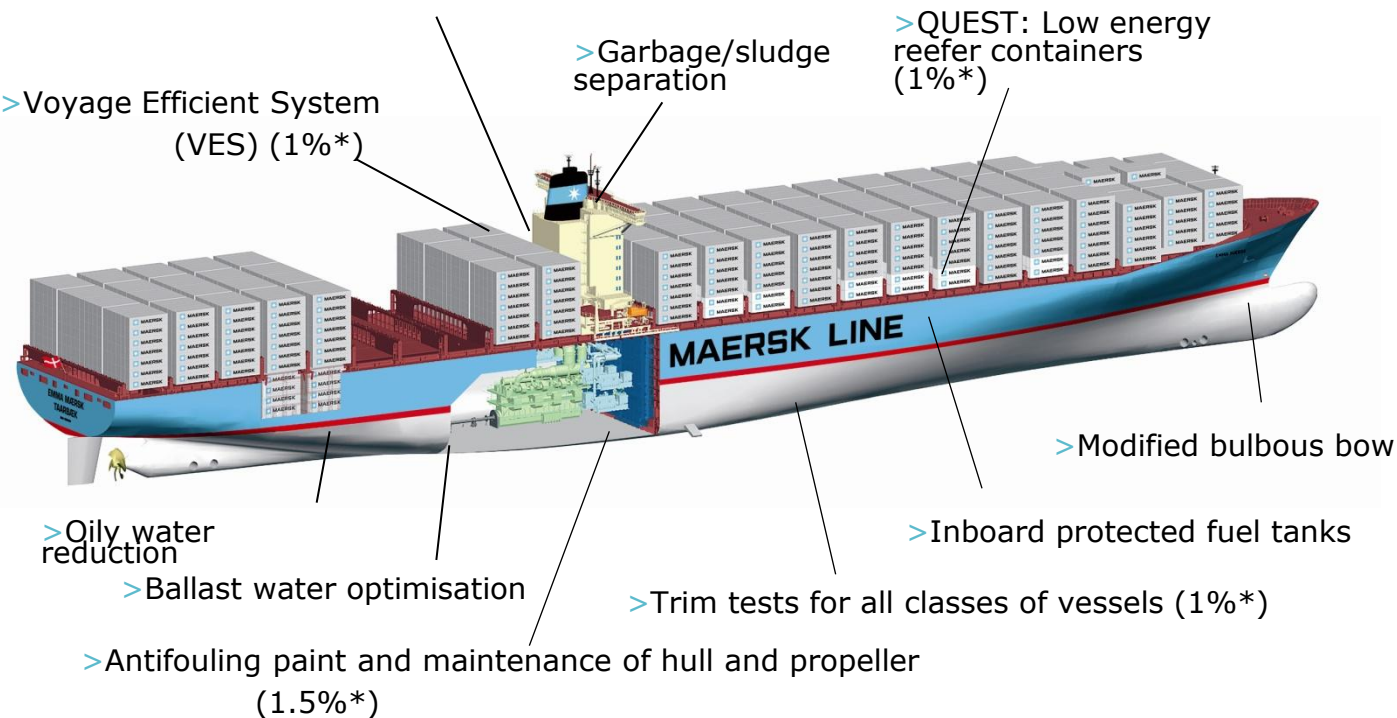
- > Waste Heat Recovery System (9%*)
- > Electronically controlled engine (0,5%*)
- > Adjusting main engines to economical speed (1%*)

Other implemented initiatives:

- ISO 14001 – environmental management system
- Ship recycling policy
- Super slow steaming

Innovation pipeline:

- Propeller design
- Micro bubbles
- Hull optimisation
- Ballast water treatment systems
- Scrubber technologies
- Biofuel
- Etc.



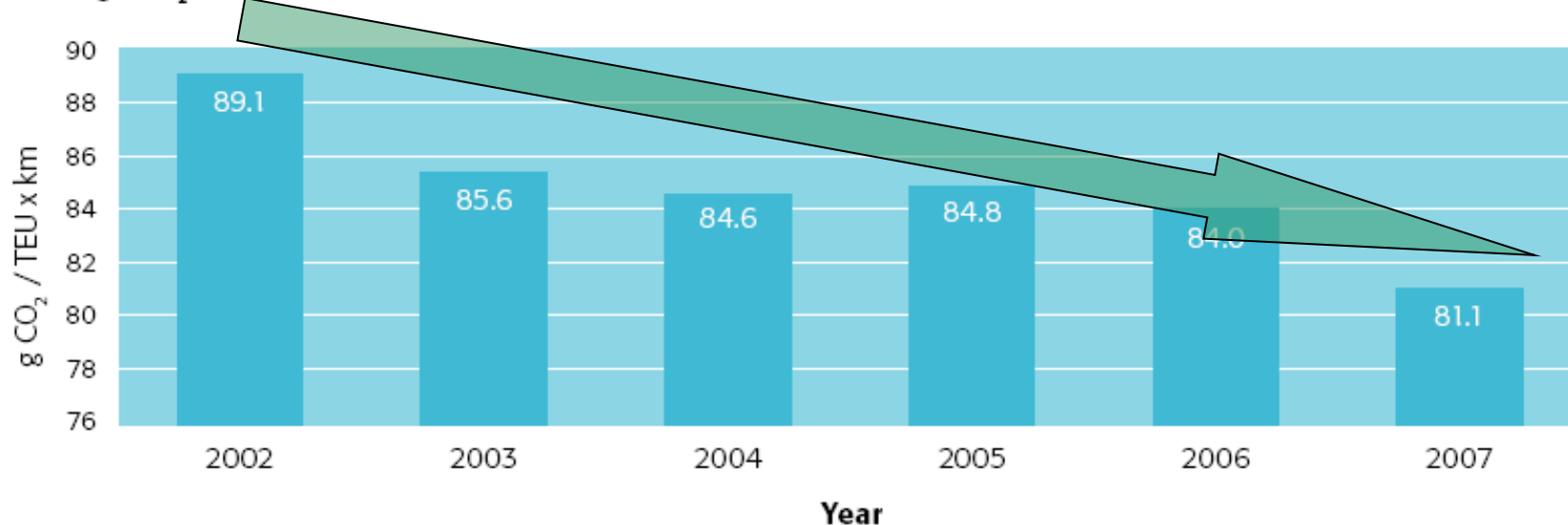
*Fuel and CO₂ emission saving potential

CO₂ emissions: average for APMM owned container vessels

2002 – 2008: 89.1 → 75.7 g/TEU-km

Maersk Line's goal 2017: 20% reduction CO₂ per transported container wrt 2007

Average CO₂ emissions from A.P. Moller - Maersk owned container vessels 2002 - 2007

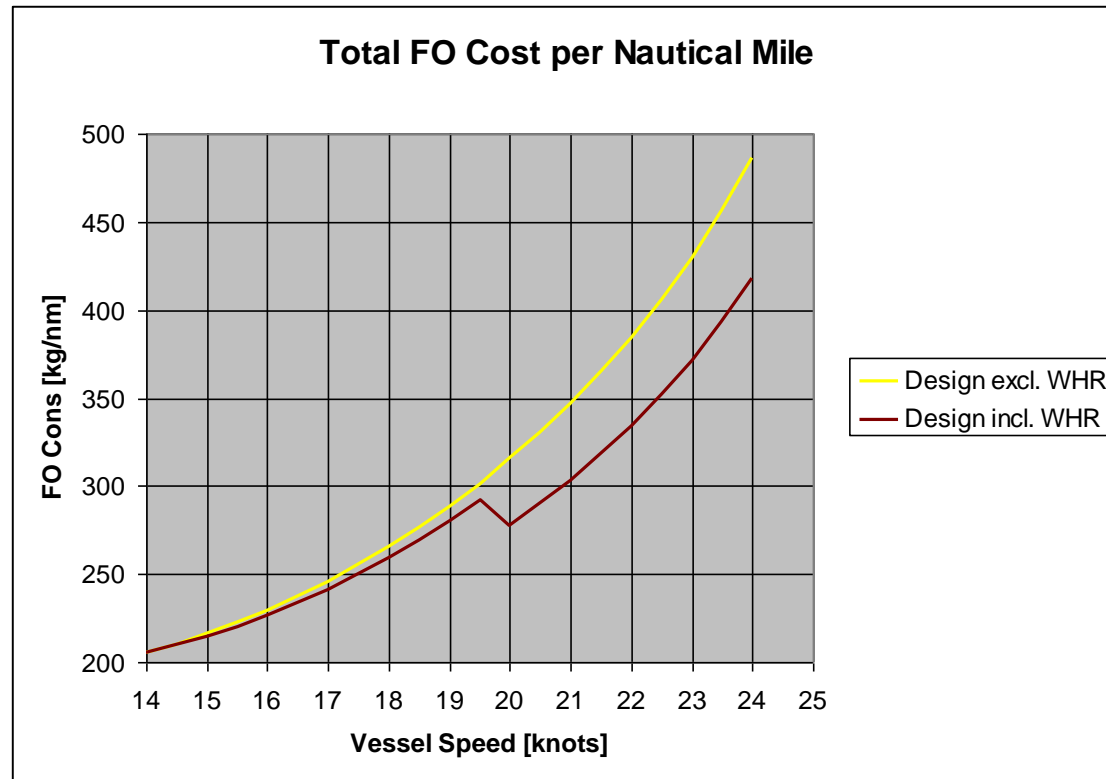




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New Container Vessel design – efficiency improvement

- Hull designed for a realistic operational profile – 7.7%
- Waste Heat Recovery – 9%
- Increased propeller diameter – 3%
- Super long stroke M.E. – 5%
- **Total: 22.7% fuel efficiency improvement**

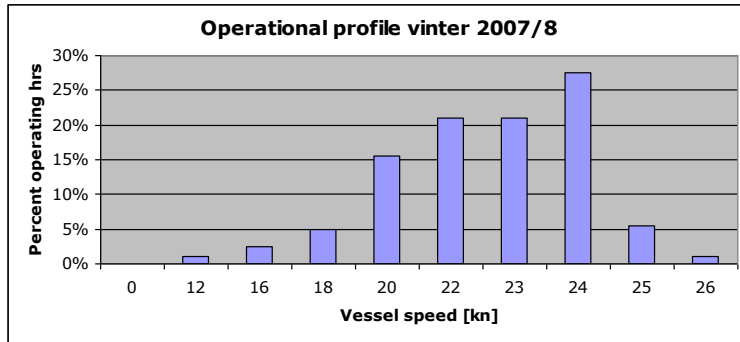




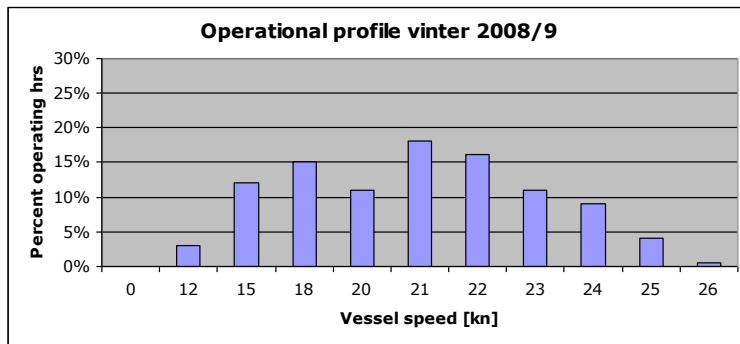
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Operational flexibility: slow speed steaming

Operational speed profiles – 6 mo. averages



2007-2008, Vmean = 22.1 kn



2008-2009

20.2 kn

→ Container vessels operated from Copenhagen have since 2007 been operating without lower limit (110 vsl)

→ The most commonly used 2-stroke engines have been performing slow speed steaming, electronically controlled engines as well as mechanically controlled.

- Main engine and machinery systems
 - Prime mover: e.g. automated tuning
 - Waste heat recovery, system optimization
 - Ventilation and pump optimization
 - Reefers
- Hull and propeller optimization
 - Non-conventional propellers
 - Drag reduction
 - Anti-fouling





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CLT Propeller Project

- CLT propulsion principle
 - Endplates fitted with minimum resistance
 - Modified pressure distribution on suction & downstream sides
 - Radial load distribution moved closer to propeller tips

- Advantages (expected):
 - Higher efficiency (5-8% fuel savings expected)
 - Lower vibration & noise levels
 - Improved maneuverability

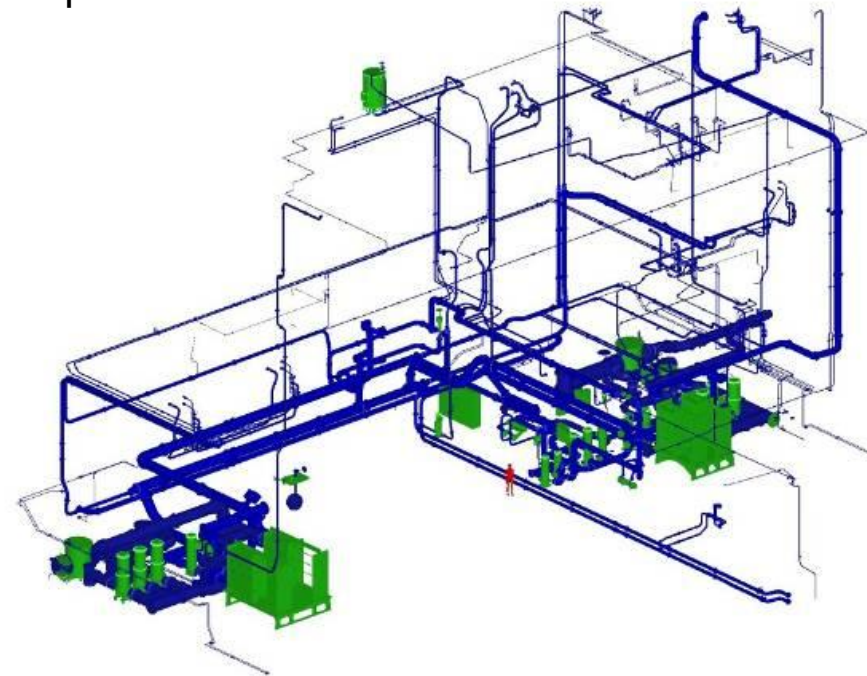
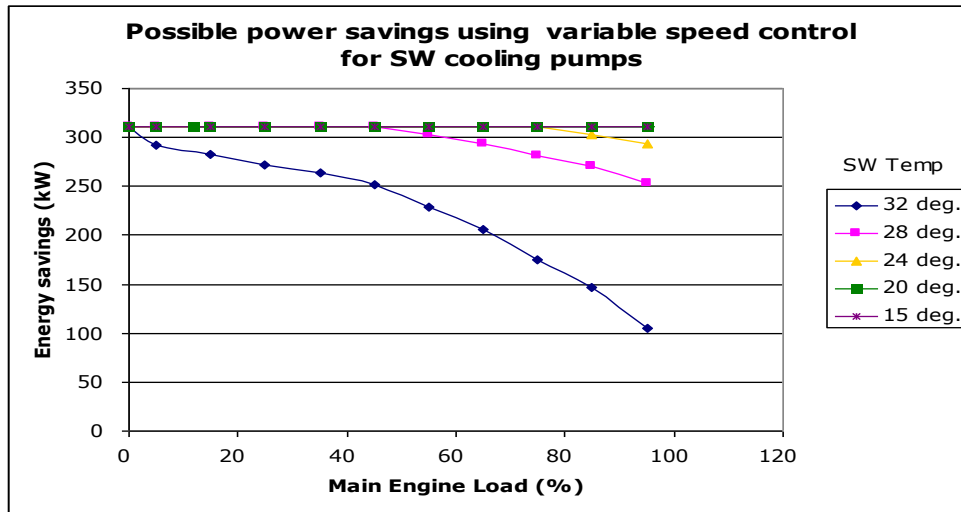
- Main objective:
 - To confirm performance in full scale on Roy Maersk
 - To fit CLT propeller on VLCC newbuilding if performance on Roy is satisfactory





Efficiency of pump and ventilation systems

- Re-design of systems aimed at minimizing energy consumption
- Ventilation; SW and LTcooling system
- Potential: max. 1% CO₂ reduction for a container ship



- Air emissions
 - Maximize energy efficiency in design and operation
- NO_x, SO_x and PM
 - Exhaust gas recirculation
 - SCR
 - Water injection
 - Scrubbers
 - PM filters
- Alternative fuels
 - Natural gas
 - Biofuels

Technology

- Mechanic filtering
- UV & Ozone combination

Status

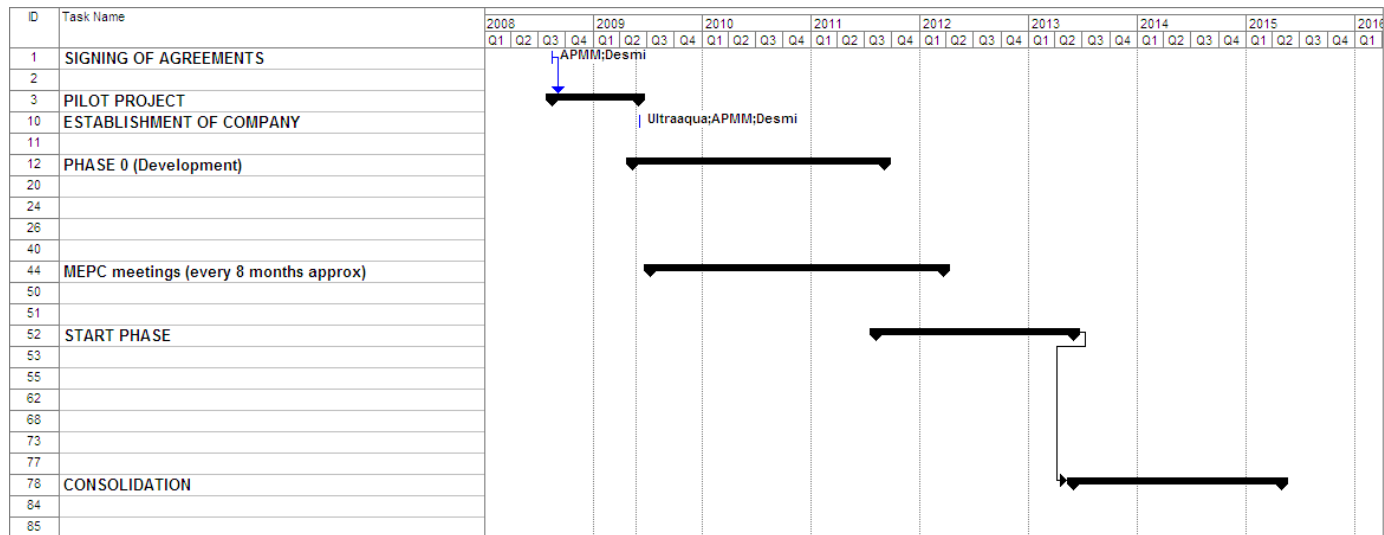
Pilot tests successfully completed

- Company has been established
- Patent application submitted on June 23'th
- IMO basic approval application submitted to IMO August 28'th
 - Positive reaction received from GESAMP, basic approval expected shortly
- Prototype for IMO land based tests is being manufactured



Business Plan

- IMO approval: ~500 m³/h prototype to be used for landbased and shipbased testing, concluded Q3 2011
- Start-up commercialisation with production in DK
- Around Q2 2013 move production to China





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Responsible Ship Recycling

- Inventory list of all fixed and hazardous material for all new builds
- Vessels are rigorously checked before recycling:
 - Radiation survey
 - An audit of hazardous materials
 - Highlighting of ship parts that require particular care upon demolition
- Vessels are only dismantled on APMM approved shipyards
- 3rd party clients.



- Integrated approach towards cost-effective ship operation with reduced emissions
- Performance optimization of vessels in service
- Design for optimum operation
- Innovation aimed at high fuel efficiency and effective emission reductions
 - Retrofit to vessels in service
 - Newbuildings
- Be in forefront of other areas
 - Ballast water, waste handling, paint, ship recycling, ...
- **All of the above will enable realization of ambitious APMM environmental strategy**



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Thank you for your attention

