WÄRTSILÄ CORPORATION

EXHAUST GAS CLEANING

WÄRTSILÄ

Increasing environmental regulation

SO_x

Acid rains

3.5% (2012)
ECA 0.1% (2015)
Global 0.5% (2020)

NO_x

Acid rains
Ozone formation

Tier II (2011)
Tier III in ECA (2016)

PM

Impact on air quality

Along with SO_x reduction

GHG

Global warming

Under evaluation by IMO

BALLAST WATER

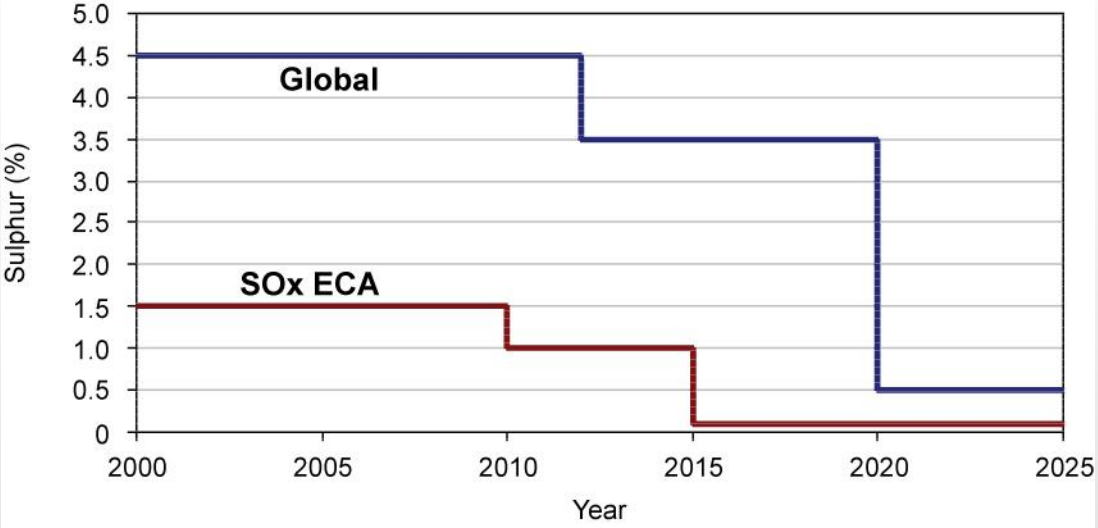
Damage to local eco-systems

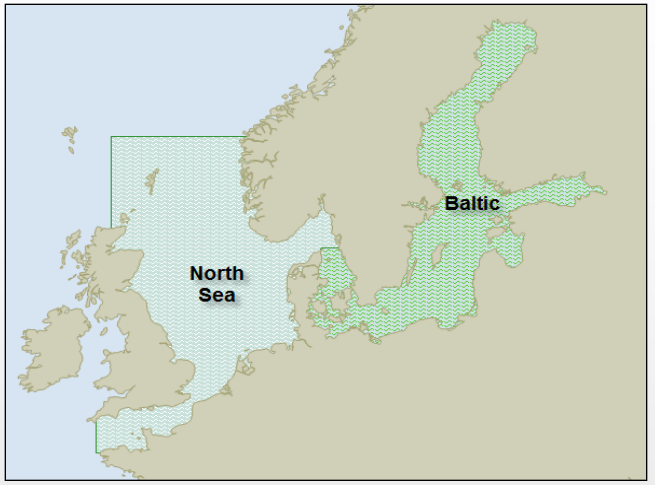
Global ballast convention

Exhaust gas cleaning - a big opportunity

Strict regulations have been set

Emission Control Areas (ECA)





- Sulphur emissions is a recognised problem
- Shipping is a main contributor to SOx emissions, especially in the most sensitive areas
- Business as usual will aggrevate the situation

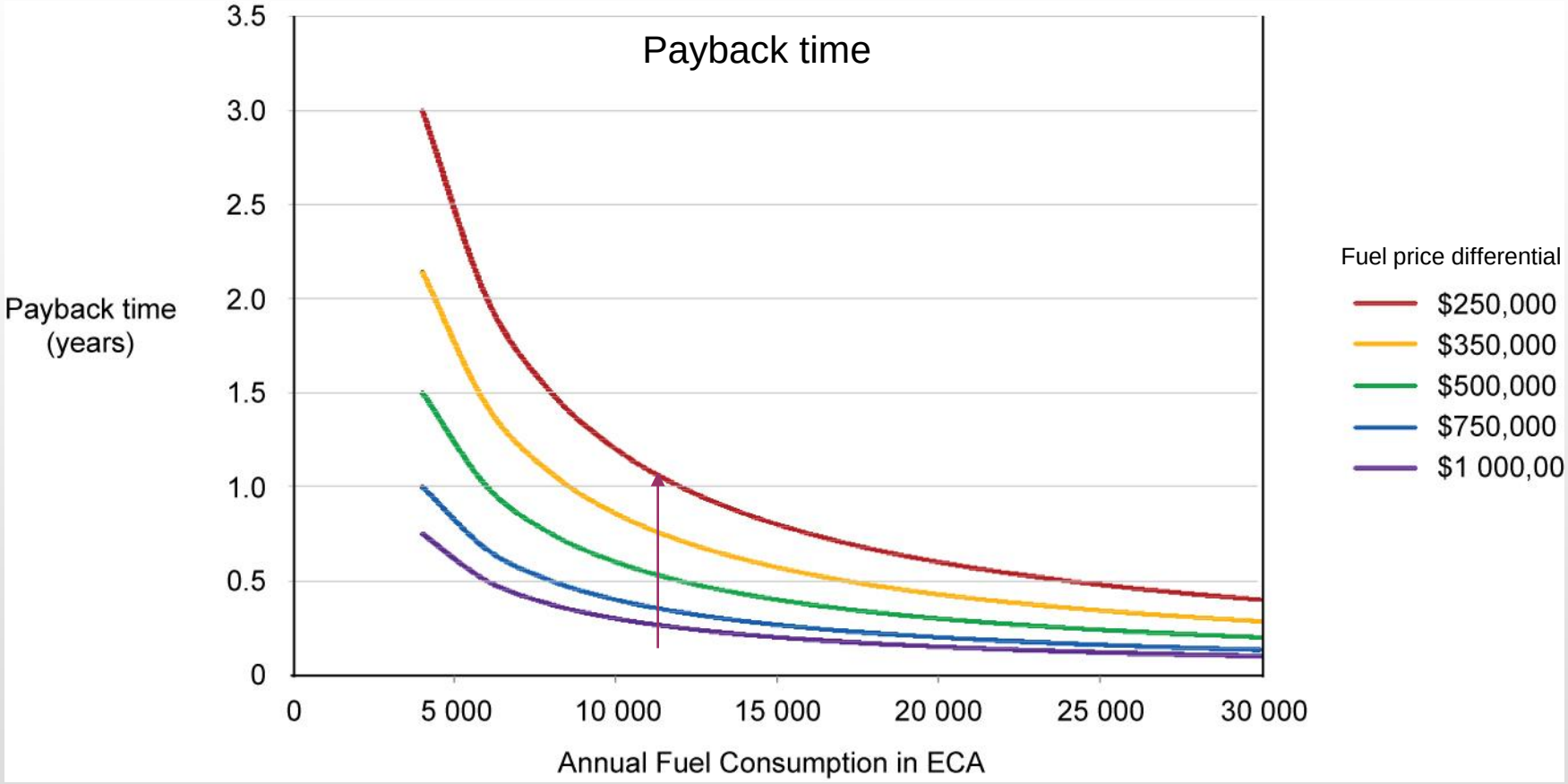
Compliance need not be expensive

Switch fuels or clean the exhaust

- Low Sulphur Residual Fuel (LSFO):
  - Limited availability
- Low-Sulphur Destillates (MGO):
  - Similar to automotive fuel
  - Supply shortage in 2015
  - Current price premium: 50%
- Gas (LNG/CNG):
  - Natural gas prices expected to remain low
  - Infrastructure for bunkering developing
  - Lowest overall emissions
  - Mostly for newbuilds
- High Sulphur Residual Fuel (HFO) with scrubbing:
  - Business as usual
  - Low overall CO2 footprint

Scrubbing is the most cost-effective solution

Return on investment



10 MW Main Engine, 3x0,5MW Aux. Engines,
Total investment cost USD 3.000.000

Significant market potential

- Market is in its infancy but set to develop as 2015 approaches
- Biggest market is retrofit
- Approximately 8,000 vessels affected by current ECA regulations
- Next phase in 2020 will effect an estimated 40,000 vessels
- Retrofit value between €1m to €5m per vessel
- Wärtsilä has strong references with 8 systems installed and several on order

Wärtsilä's scrubber portfolio

Fresh water scrubber (FWS) – closed loop system

- Not dependent on seawater alkalinity
- Zero effluent discharge an option
- Low power demand
- Needs caustic soda as a reagent

Applications: seas with low alkalinity and for operators looking for zero discharge

Sea water scrubber (SWS) – open loop system

- Uses seawater i.e. no freshwater needs
- Slightly higher power demand than FWS
- Does not need caustic soda

Applications: main alternative for ocean-going ships

Hybrid scrubbers – both open loop and closed loop operations

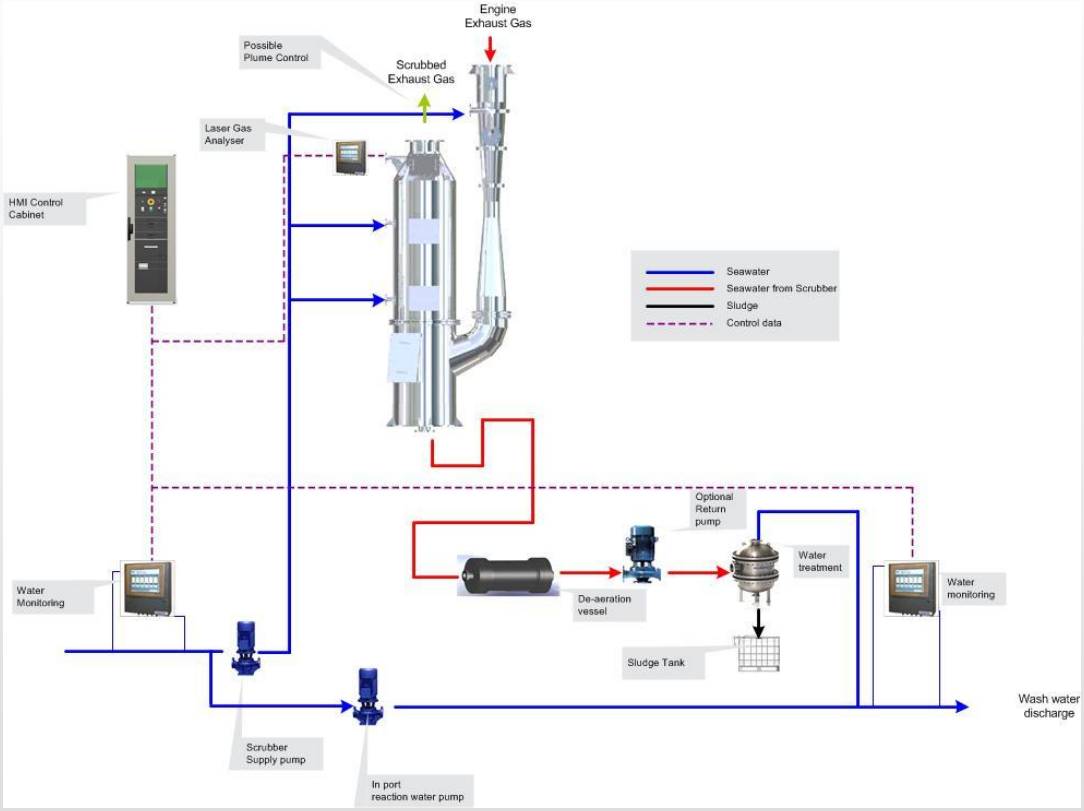
- Flexible system
- More complex system

Applications: ships requiring full flexibility of operations
(e.g. sailing both in low alkalinity areas as well in open oceans)

Cost-efficient system

Key Features

- Open-loop system
- Same process as for IGS
- No additives
- Low running costs
- Simple and reliable
- Module based
- Flexible
- Standardised designs
- Tried and tested



Scrubber reference list

Vessel	Newbuilding or retrofit	SWS	FWS	Details
Suula	retrofit		x	Test installation, test report available
Containerships VII	retrofit		x	Full commercial project with main stream scrubber. Modification to water treatment system ongoing.
Algoma(6+2 vessels)	newbuilding		x	Integrated scrubbers for main engines, auxiliary engines and boilers
Pride of Kent	retrofit	x		More than 30,000 hrs of operation
Zaandam	retrofit	x		More than 4,000 hrs of operation
APL England	retrofit	x		Integrated scrubber for 3 engines, 2.94 MW each
RoRo	retrofit	x		1 x 25 MW and 1 x 6 MW scrubbers
Ignazio Messina (4 vessels)	newbuilding	x		Separate scrubbers for auxiliary engines and boilers, up to 4.5% S-content
Solvang	newbuilding	x		Main engine scrubber and integrated auxiliary engine scrubber

Winner in growing environmental markets

Far ahead of the competition

- Legislation is in place
- Abatement is an economical solution
- Large market growth, both near and long-term
- Wärtsilä Hamworthy is the clear market leader: excellent products and ”turnkey” projects capability
- Wärtsilä is well positioned to win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