

The most attractive technologies for low and medium speed marine diesel engines for future low emission rules

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Dr. Rudolf Holtbecker
Wärtsilä R&D

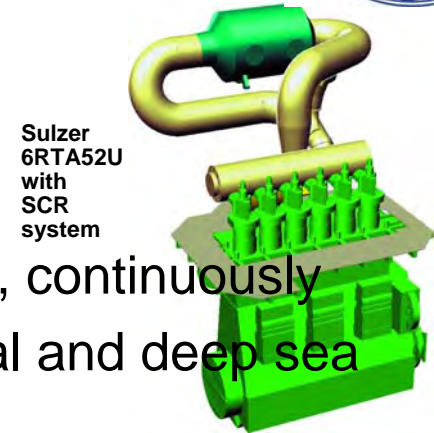


Marine emission rules within next 10 years



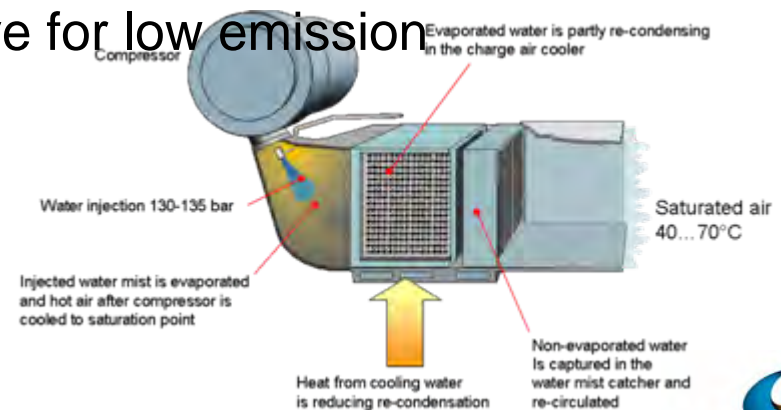
- **International shipping = IMO**

- NOx Tier 2: ~ -15%, ~2011
- NOx Tier 3: -40 to -90 %, > 2016
- Particle: reduction via fuel S-content reduction, continuously
- Validity: Rules overall or differentiation in costal and deep sea area



- **Local shipping regulations**

- Stronger restriction for particulates and NOx in ports
- Emission related port fees (incentive for low emission engines/installations)





Attractivity of solutions

- Low initial costs
 - Low operating costs
 - Low space requirement
- >
- High environmental benefit
 - High reliability
 - Retrofittability
 - Height of realisation costs
(Development&Infrastructure)
 - Fuel flexibility & HFO applicability

An issue for comparability old and new installations? Or also for shipping competitiveness ?

Everybodies interest !?

Must for shipping safety

To equalize competitiveness within shipping industry and have larger impact on environment

Does it make sense to invest in new technologies which might be overruled by next step in rules?

Shipping competitiveness and fuel infrastructure availability

Attractiveness factor: Environment



Increasing environmental attractiveness

Technology		NOx	Particulates	SOx	CO2
Internal	Engine tuning	X			
	Injection shaping	X			
Turbocharging	High press TC	X			
	External gas recirculation	X			
	Internal gas recirculation	X			
	Waste Heat Recovery	X	X	X	X
Water	W/F emulsion	X			
	Humidification	X			
	Water injection	X			
Fuels	Destillate fuel		X	X	
	MDO		X	X	
	Gas	X	X	X	X
Aftertreatment	SCR	X			
	Particle filter		X		
	Scrubber		X	X	