



七一一研究所  
SMDERI

# **CIMAC Circle 2017 at Marintec China**

## **Engine Application on Tugboat**

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# Engine application on Tugboat

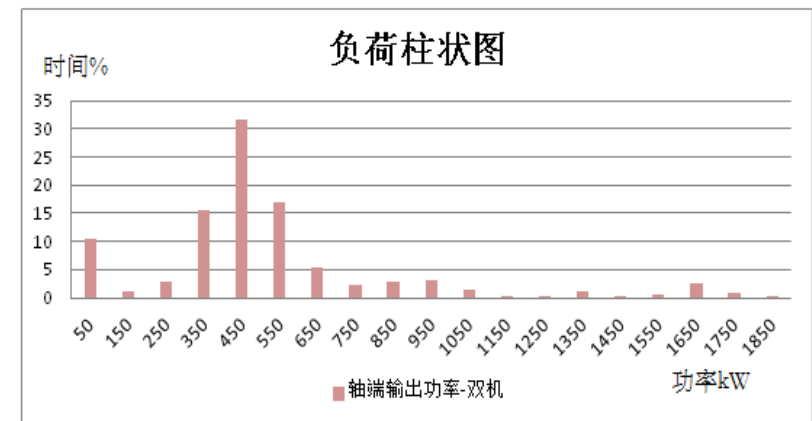
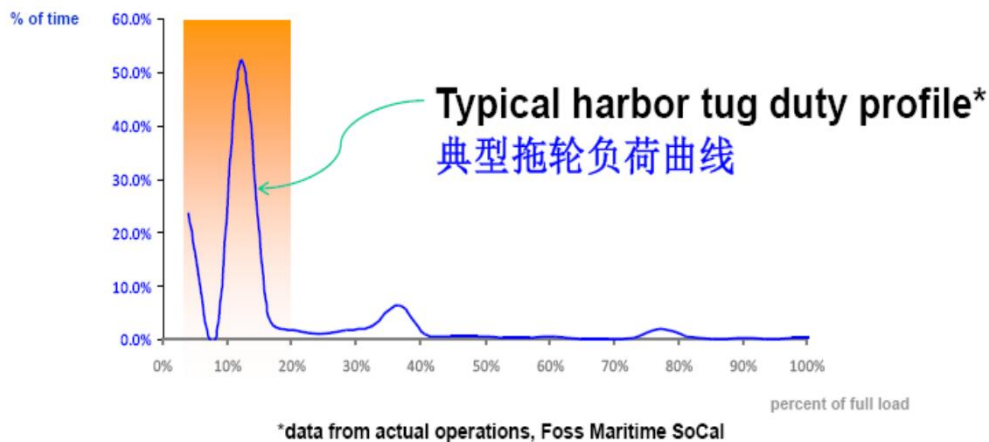


## Driving force

- q Economy
- q Environment
- q Safety
- q Comfort
- q .....

# Engine application on Tugboat

- Typically 80% of running time less than 20% load
- Case study on Shanghai Harbor tugboat duty profile, about 89% operation time less than 30% load.



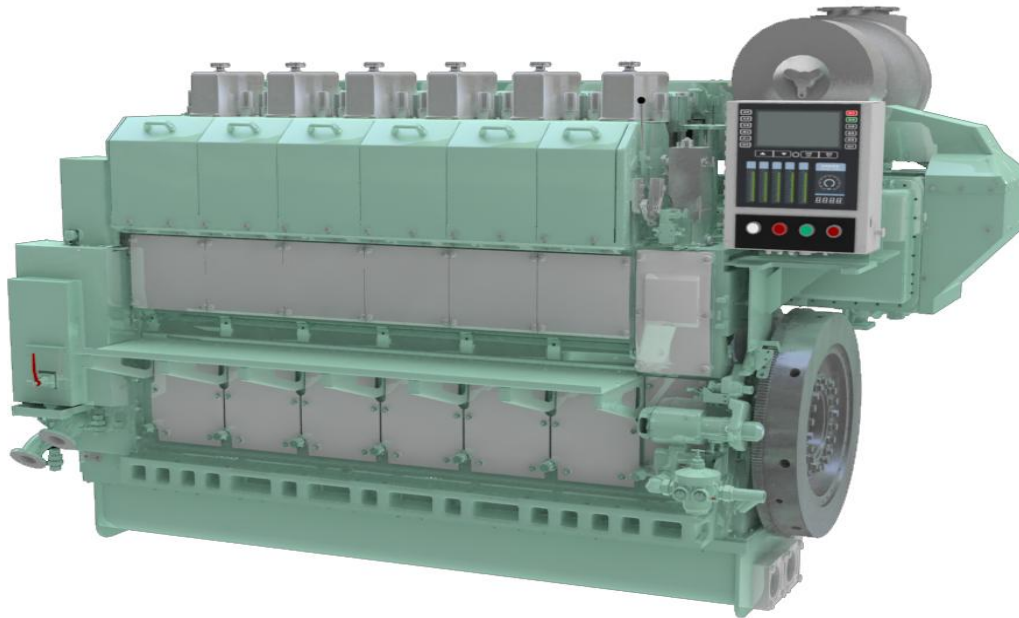
# Engine application on Tugboat

q Invisible smoke and low emissions are required



# Engine application on Tugboat

## q Main diesel engine 6CS21

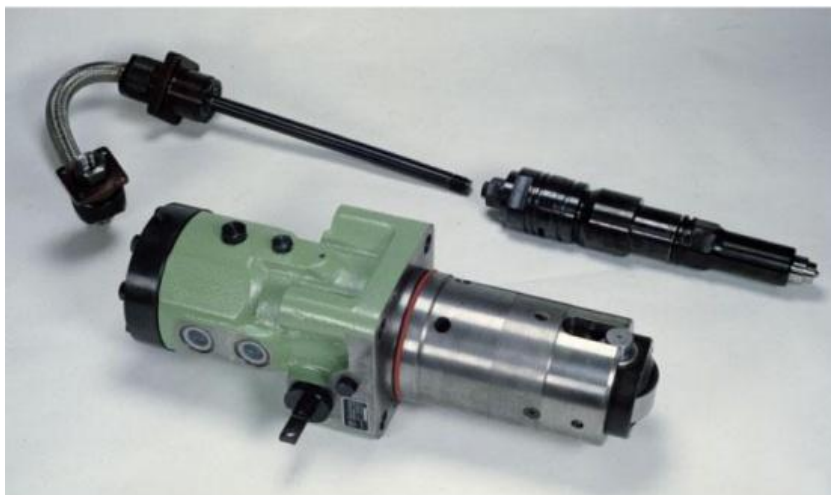


CS21/32	
Bore	210mm
Stroke	320 mm
Fuel	MDO、HFO
Cylinder numbers	6, 8
Speed	900,1000 rpm
Power/cyl	183-220 kW
Power range	1100-1760 kW
Bmep	2.38 MPa
SFOC(MCR)	185 g/kW·h
NOx emission	IMO Tier II

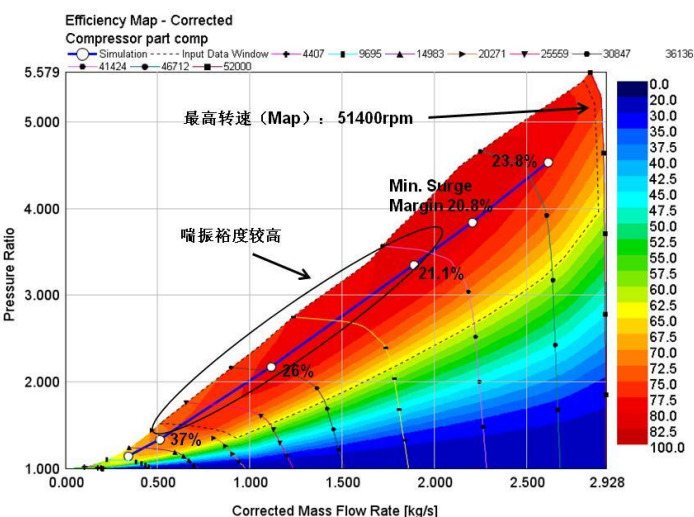
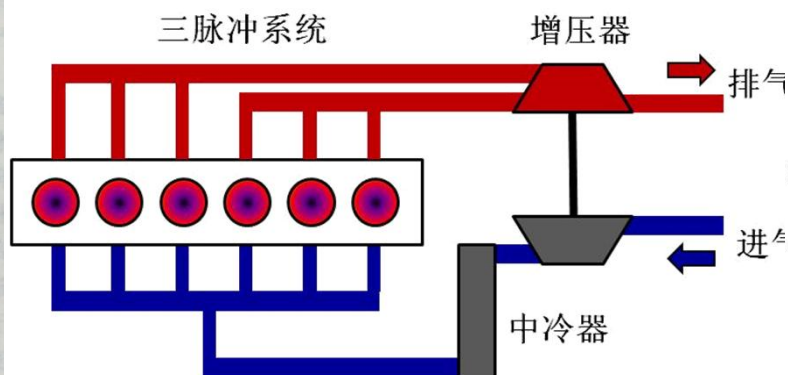


# Engine application on Tugboat

## q Optimization of main engine for low load operation

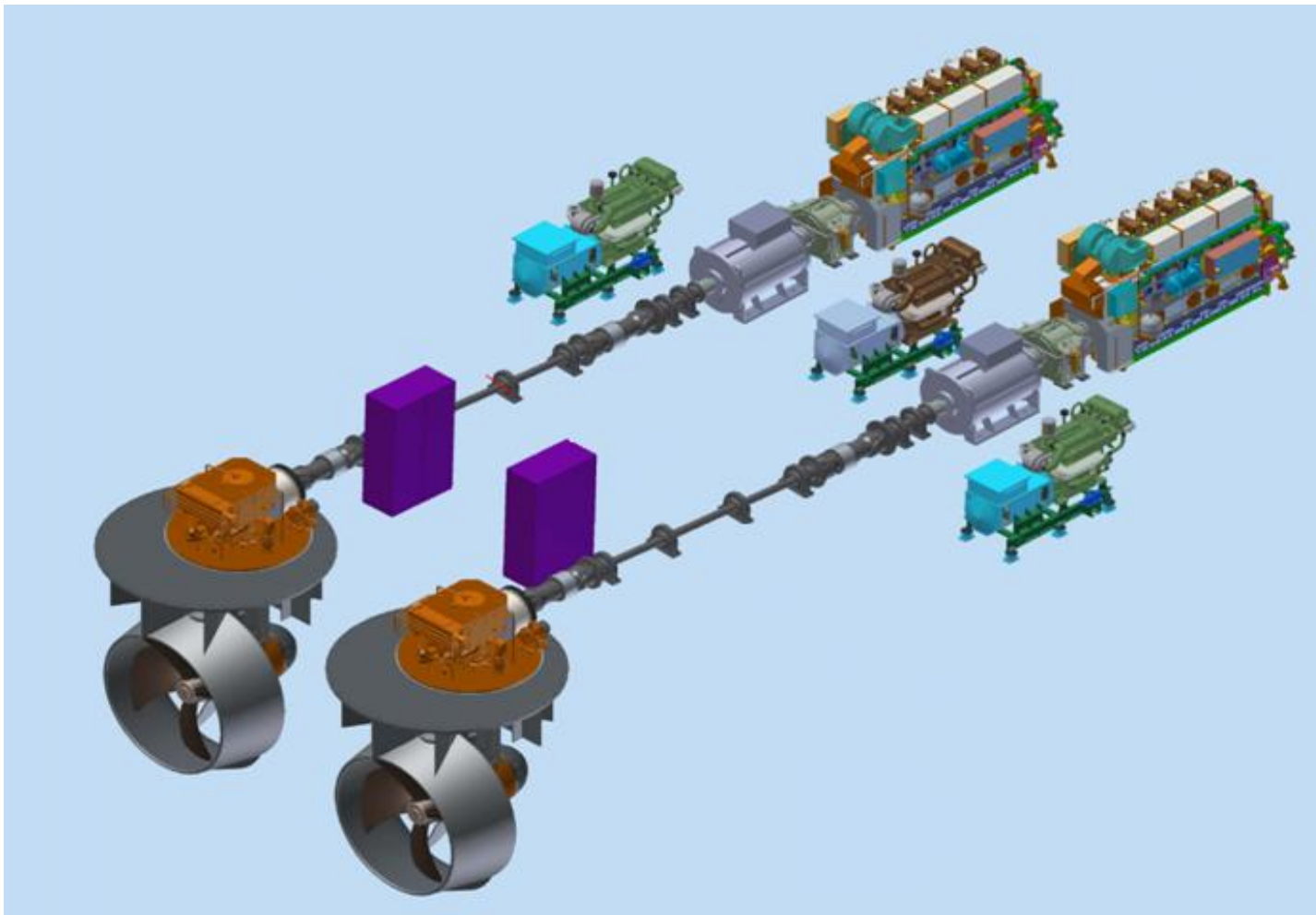


up to 10%  
Saving on fuel  
consumption



# Engine application on Tugboat

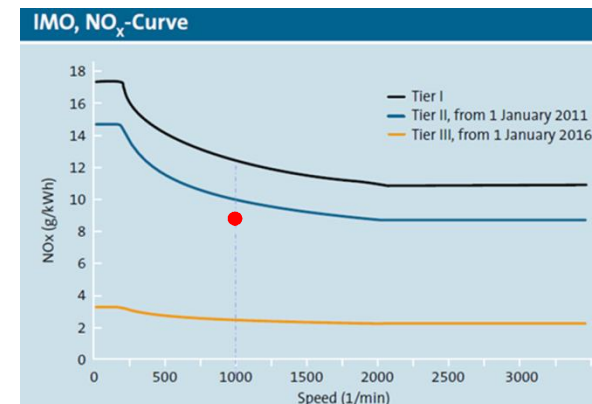
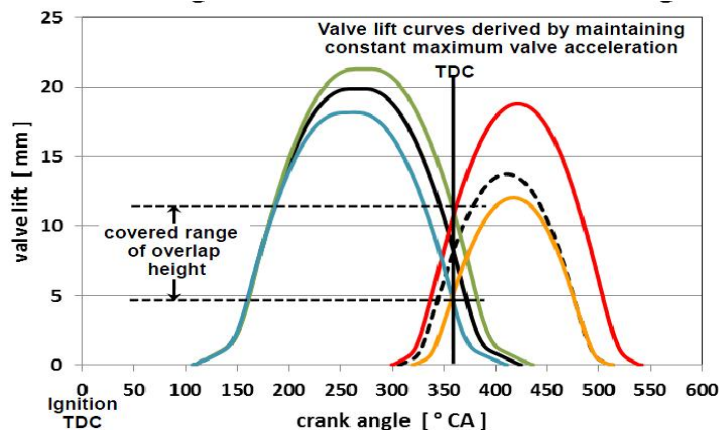
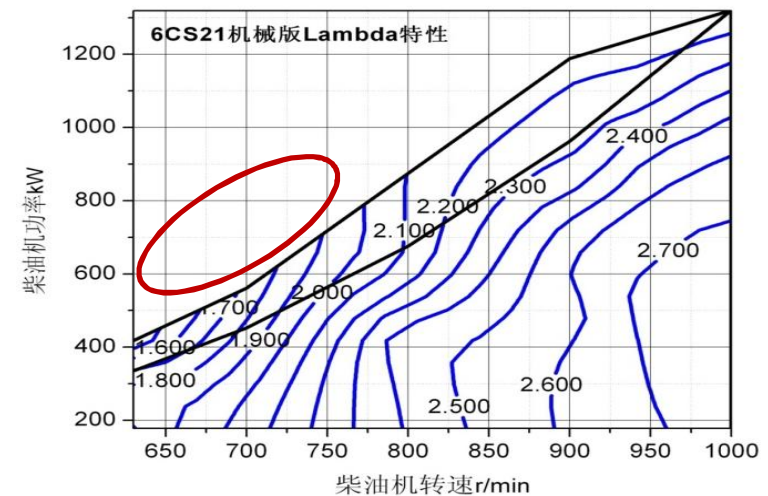
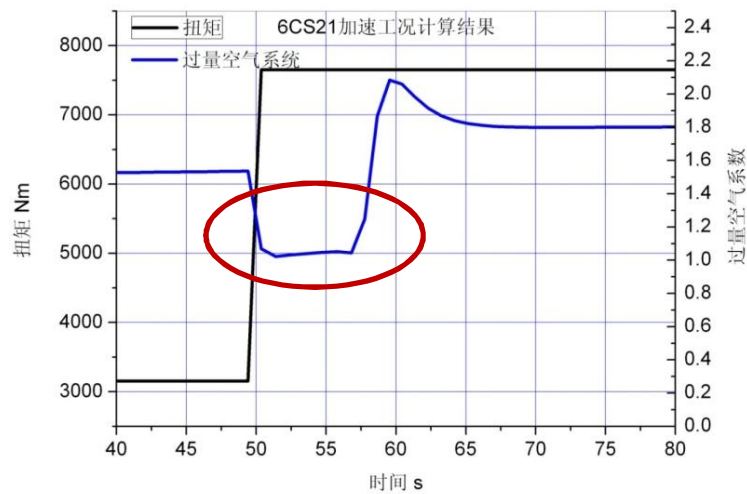
## q Hybrid propulsion system



up to 15%  
Saving on fuel  
consumption

# Engine application on Tugboat

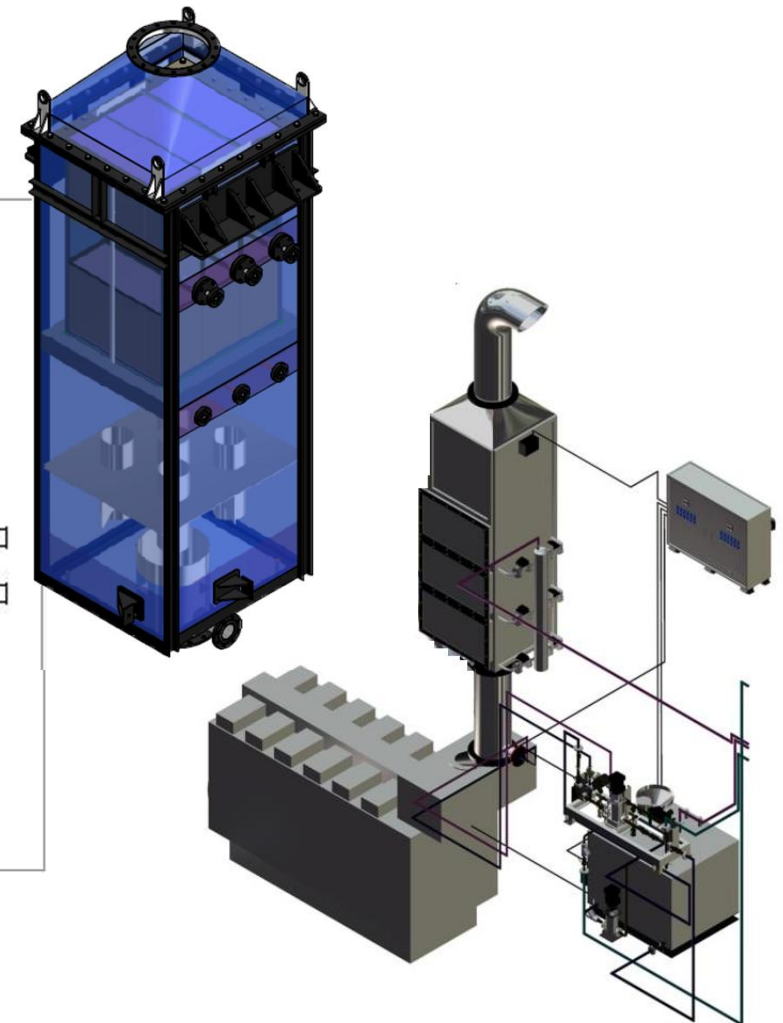
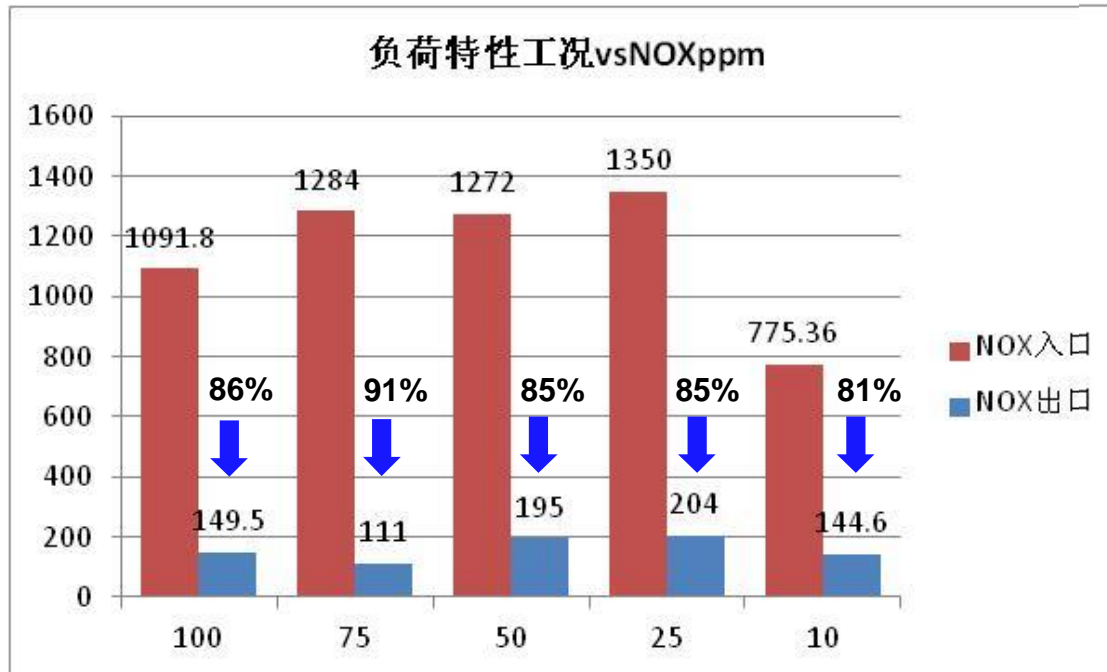
## q Invisible smoke and low NO<sub>x</sub> emission





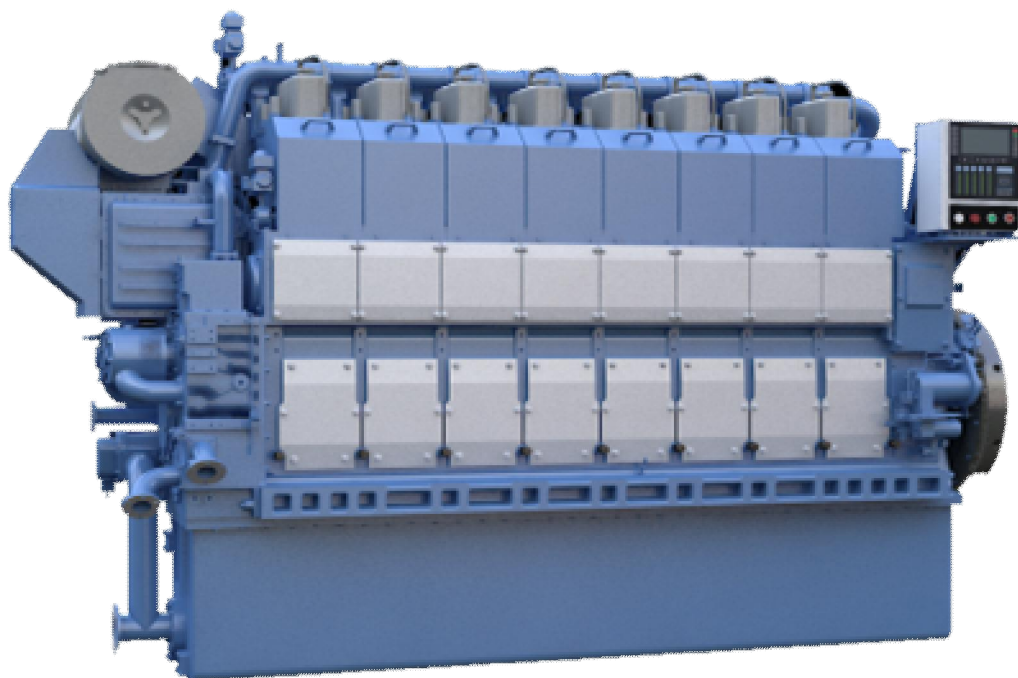
# Engine application on Tugboat

## q SCR for Tier III



# Engine application on Tugboat

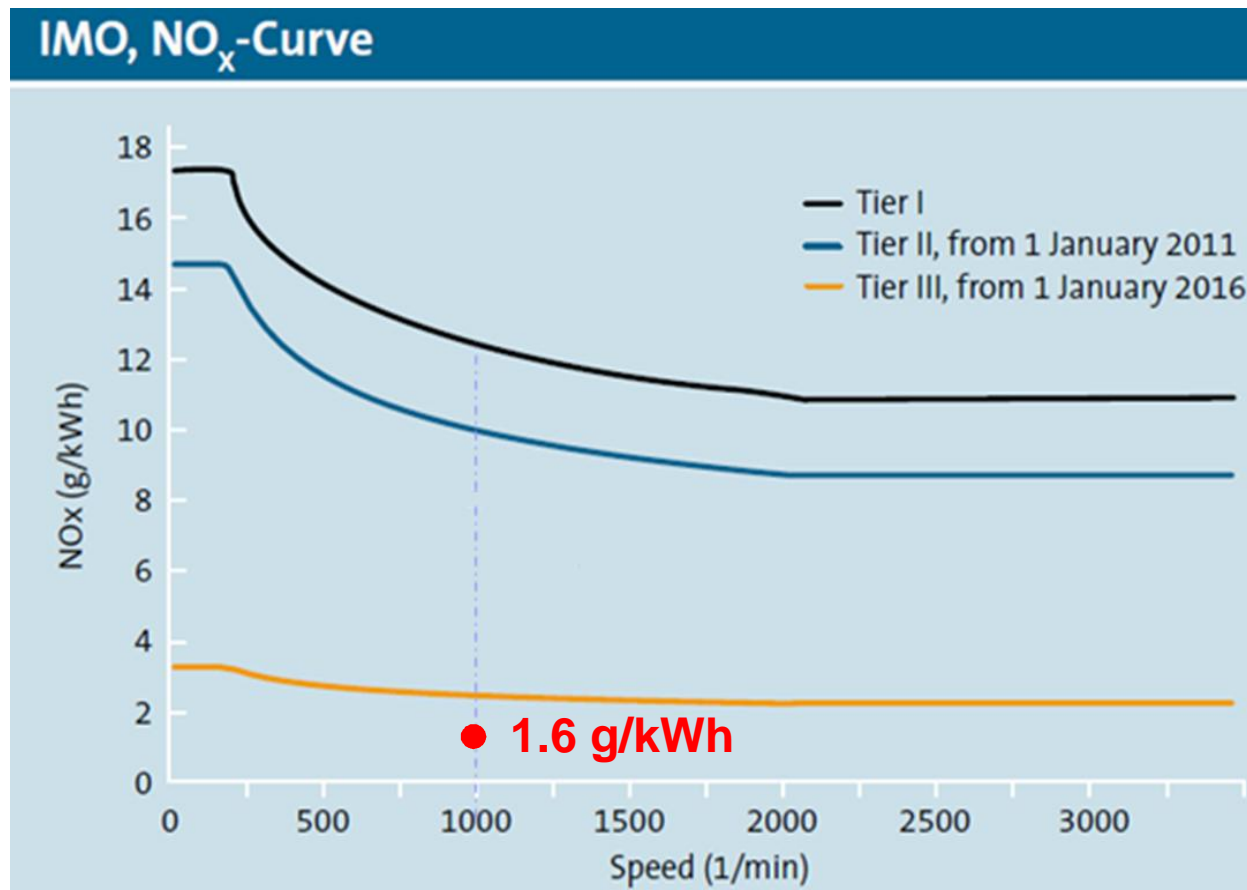
## q Gas engine M23G



M23G Gas Engine	
Bore	230mm
Stroke	320 mm
Fuel	LNG
Cylinder numbers	6, 8
Speed	900,1000 rpm
Power/cyl	165-200 kW
Power range	1000-1600 kW
Bmep	1.8 MPa
SFOC(MCR)	8750 KJ/kW·h
NOx emission	IMO Tier III

# Engine application on Tugboat

## q Gas engine M23G



# Engine application on Tugboat

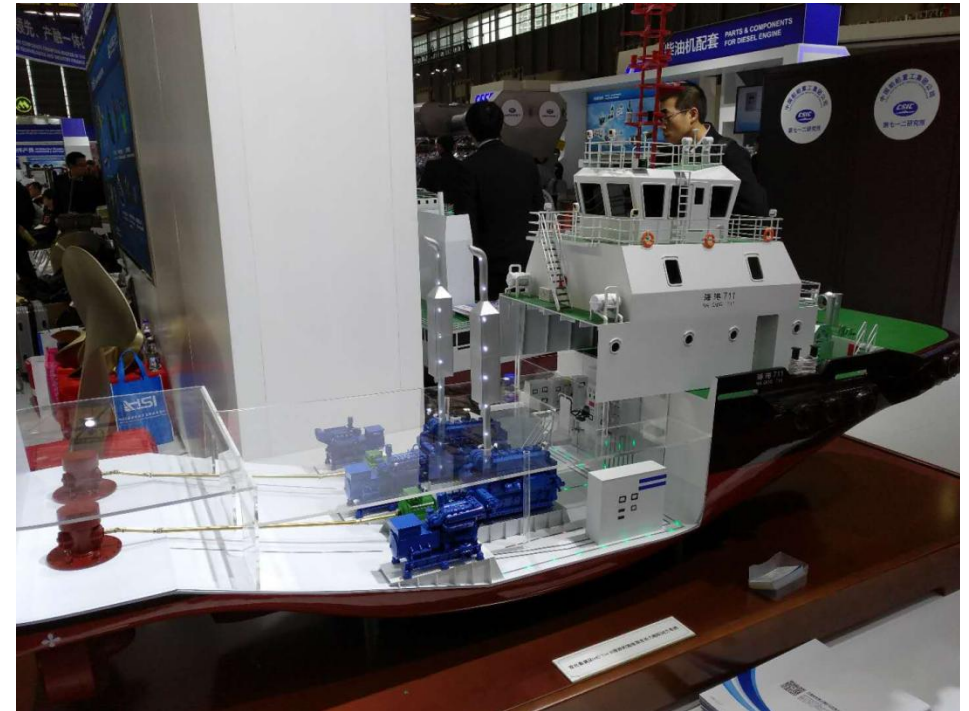
## CASE 1. “Sea Harbor 49” tugboat with 6CS21





# Engine application on Tugboat

## CASE 2. “Sea Harbor 711” tugboat with hybrid propulsion





# Summary

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## For economy:

- q Low load optimization for main engine can achieve good fuel consumption.
- q Hybrid propulsion system assure main engines and auxiliary engines running on high efficiency according to load demand.

## For low emission:

- q Control of air/fuel ratio make sure invisible smoke during quick load response
- q SCR can be applied for IMO Tier III
- q Gas Engine maybe future possibility

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## Thank you very much for your kind attention!

