



CIMAC

Emission Challenge for Chinese Inland Water Ways

CIMAC Circle @ Marintec Shanghai, Dec. 3th., 2015
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Agenda

- Legislation, the Driving Force
- How to set it in Force
- Technology
- You should Survey the Compliance





Emission Legislation in Detail for Deep Sea and Inland Water Ways

Area	Name	Type	Introduction	NOx	HC	CO	PM
Deep Sea	IMO II	world wide	2011	9,0 - 10,5	-	-	-
	IMO III	nonECA	2016	9,0 - 10,6			
	IMO III	NECA	2016	2,3 - 2,6	-	-	-
Inland Water Ways	EU Stage 2.1	5 - 15 ltr	2009	7,8		5,0	0,50
	EU Stage 2.2	15 - 20 ltr	2009	8,7		5,0	0,50
	EU Stage 5		2019	0,4 - 1,2	0,19	3,5	0,01 - 0,015
	ZKR Stufe II	130 - 560 kW	2007	6,0	1,0	3,5	0,20
	ZKR Stufe II	> 560 kW	2007	8,3 - 10,0	1,0	3,5	0,20
	US Tier III	7 - 15 ltr	2013	6,2		-	0,14
	US Tier III	15 - 20 ltr	2014	7,0		-	0,27
	US Tier IV	600 - 1400 kW	2017	1,8	0,19	-	0,04
	US Tier IV	1400 - 2000 kW	2016	1,8	0,19	-	0,04

Proposal for new China legislation

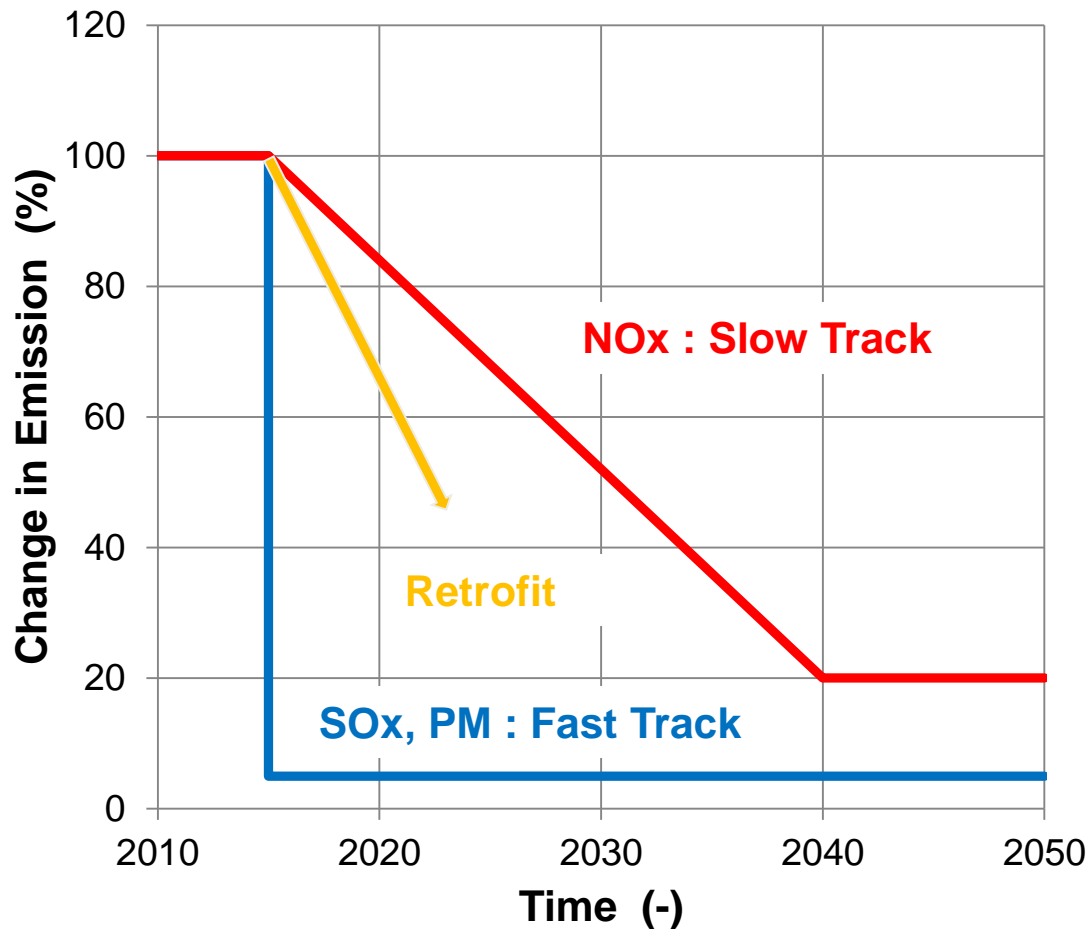
Stage 1,
Introduced 1.1.17

Stage 2
Reduced PM values
Introduced 1.1.20

Actual Limitation can be achieved without after treatment. **Bolt numbers** require after treatment or EGR.
All values in g/kWh.



How to Introduce new Limitations



Slow Track

Introduce new legislation only for new buildings like IMO for NOx emissions

Fast Track

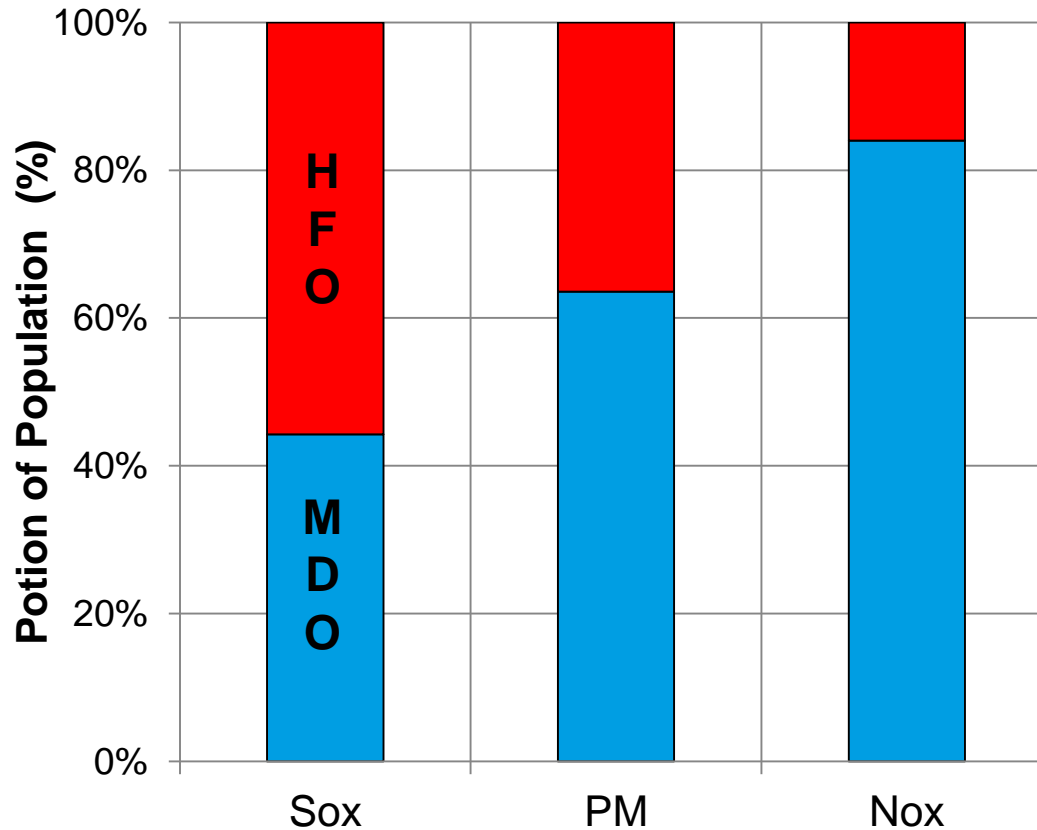
Introduce new legislation immediately for all operators like IMO for SOx emissions

Third Way

Implement incentives to convince operators to invest in environ friendly solutions



Emission Contribution of HFO fired Vessels



Assumptions:

HFO

Sulfur = 2,5 %

Ash = 0,15 %

MDO

Sulfur = 0,35 %

Ash = 0,10 %

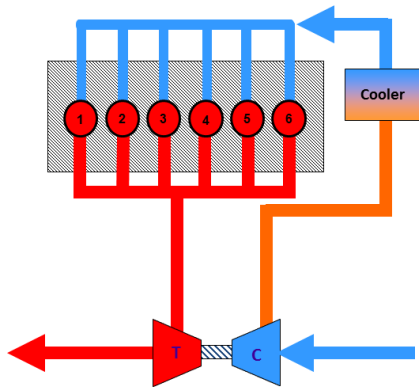
Population

HFO = 15 % of Fleet

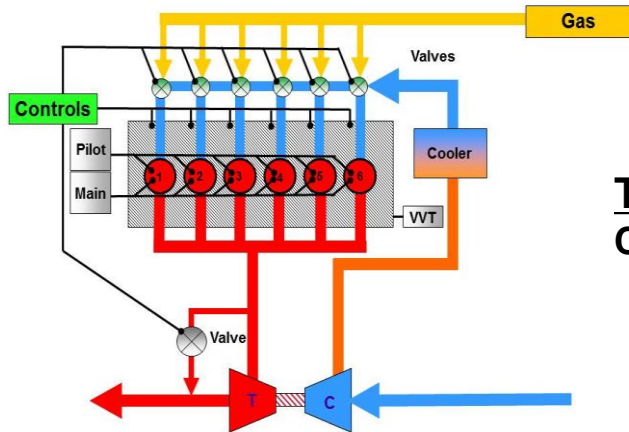
MDO = 85 % of Fleet



What is the right Technology ?



Today : Diesel
Simple, Cheap,
but Dirty

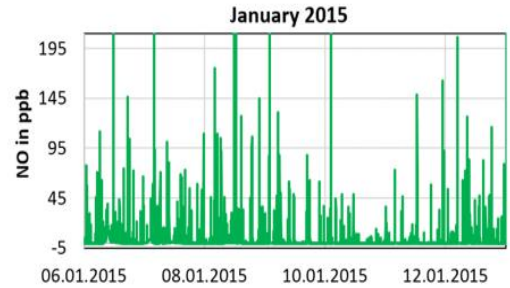
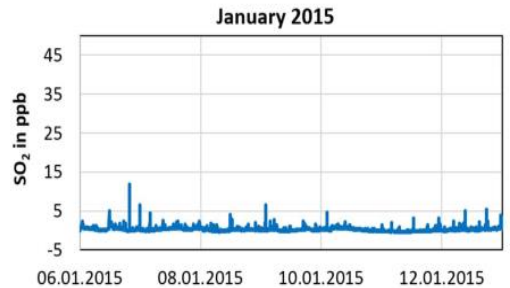
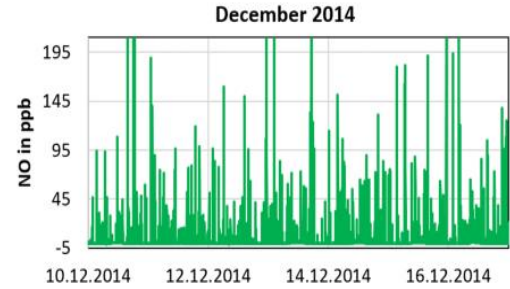
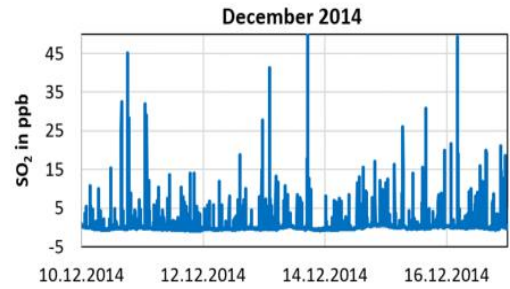
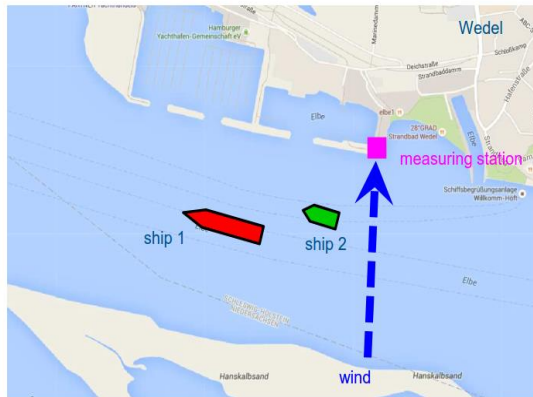


Tomorrow : Gas ?
Complex, Expensive
but Clean





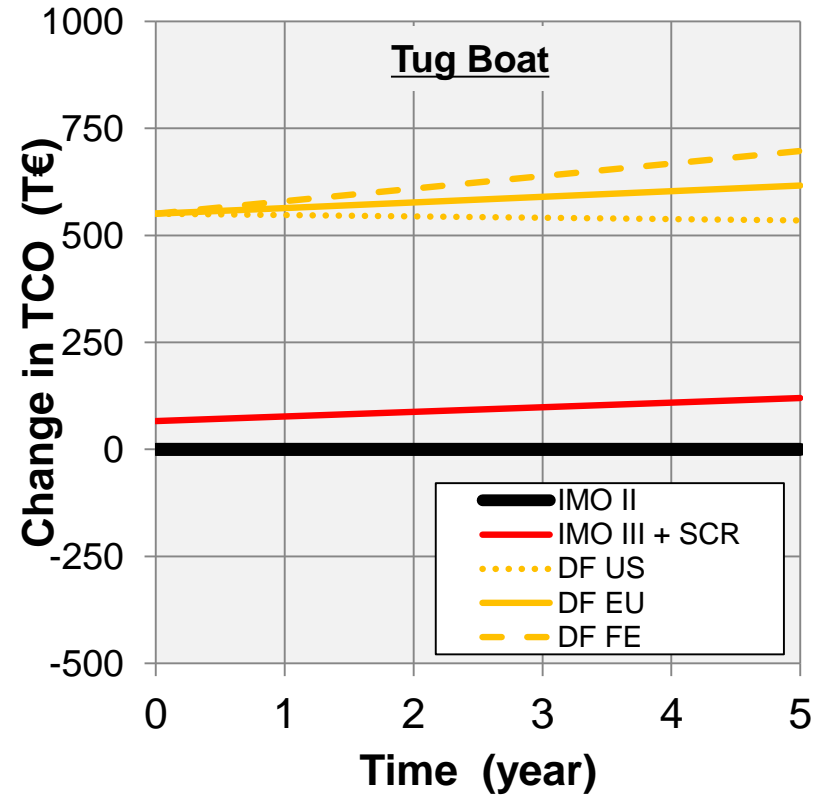
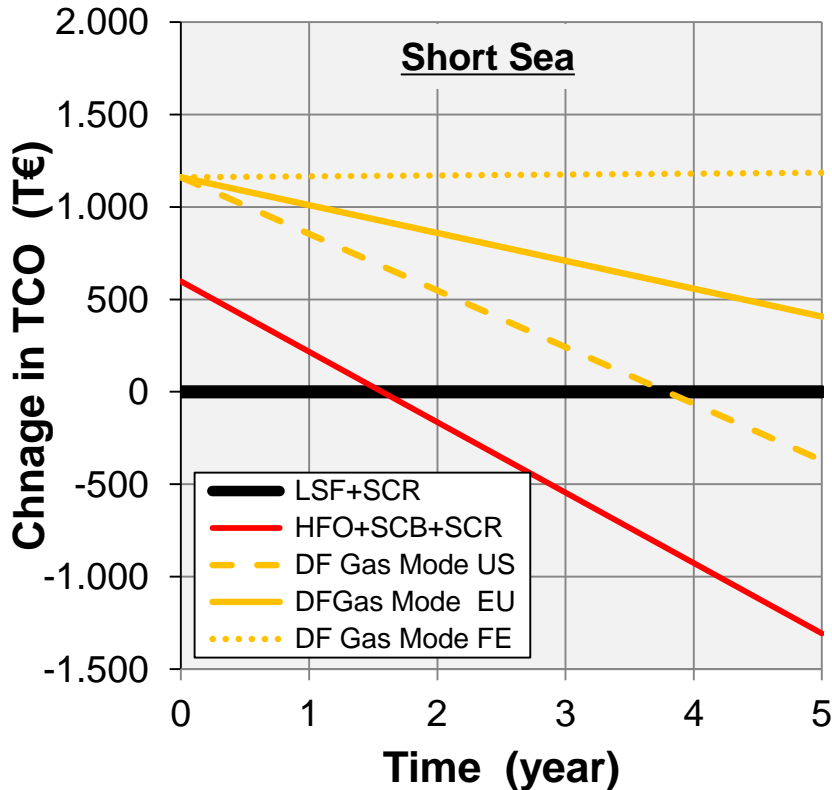
Emission Survey by BSH in Hamburg



The BSH Surveys all Ships, Entering the Port of Hamburg. Results show, that with the Introduction of SOx Limitation since 1.1.2015 most of the Ship are Compliant.



TCO Comparison HFO (Diesel) versus Gas



TCO Calculation was Carried out for Gas Prices in USA (US), Europe (EU) and Far East (FE).

For 2 MW HFO Short Sea Ship with 6000 h/Year @ high Load Gas can be a Cost Effective Solution

For 2 MW MDO Harbor Tug Boat with 3000 h /Year @ low load the Gas Solution is not Very Attractive.

Summary

- The planned emission limits for Chinese inland water ways are based on European **EU Stage 2** Values, which can be achieved with standard Diesel engines.
 - Therefore **Gas Fuel** or **After treatment** are not needed. **Low Sulfur Fuel** is huge stage ahead. No HFO in future.
 - For a fast track solution a **Retrofit Kit** have to be available and yards have to prepare capacity.
 - The **Financial Side** has to be convincing for the operator. A government funding / coordination like in Norway is helpfull.
 - Beside technology the **Complexity** and the **Cost** of emission reduction solution are of major importance.
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