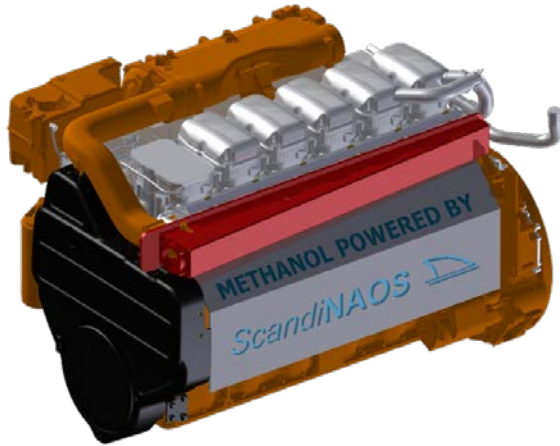


# SUMMETH

Sustainable Marine Methanol



Conversion of the Scania engine

Patrik Molander

ScandiNAOS



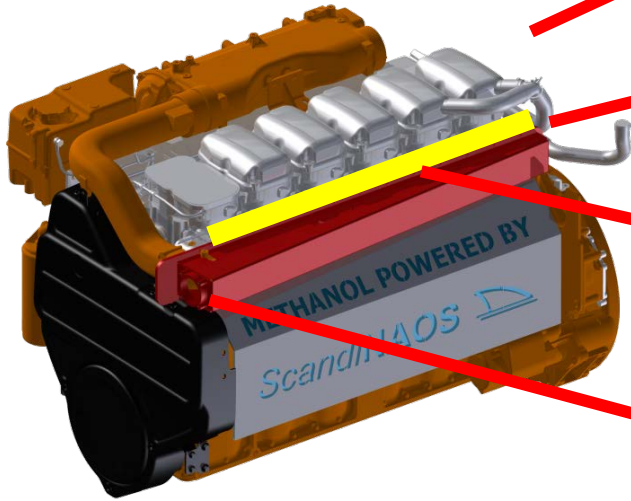
# AGENDA

- Engine concept
- Efficiency and propeller curve
- NOx and PM results
- IMO and EU compliance
- Comparison to diesel engines

# ENGINE CONCEPT – PFI SI

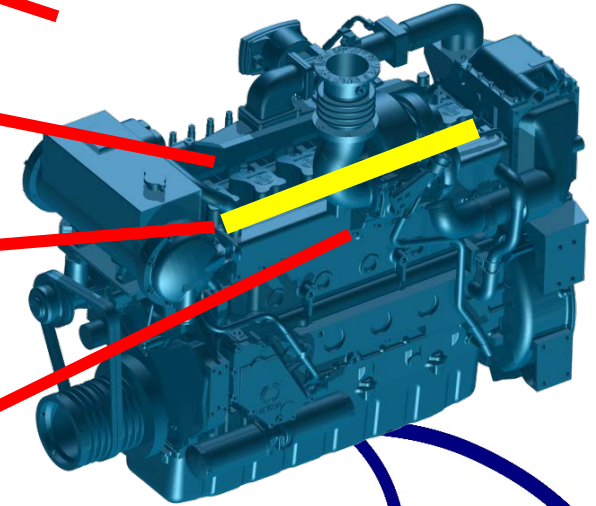
**Scania D13**

- Converted by ScandiNAOS



**Weichai**

-Converted by FiTech



Fuel rail



# ENGINES - GREENPILOT

	Scania	Weichai
<b>Fuel</b>	100% methanol	100% methanol
<b>Ignition</b>	Spark ignition	Spark ignition
<b>Injection</b>	Port fuel injection	Port fuel injection
<b>Volume</b>	12,7 L	11,6 L
<b>Compression</b>	12,3	11,6
<b>Cylinders</b>	6	6
<b>Max Engine speed</b>	2300 RPM	2200 RPM
<b>Max Power</b>	400 kW	313 kW

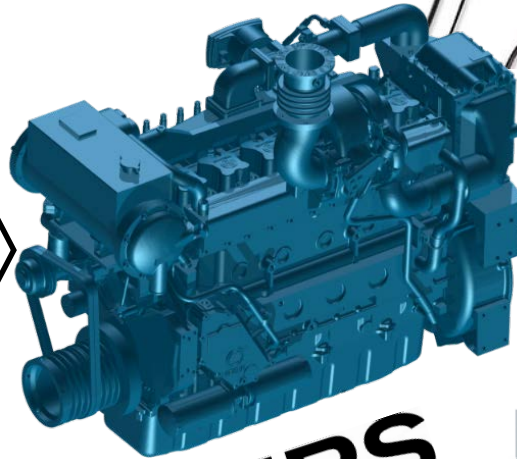


# TEST SETUP

## Mass meters

- Air flow & temp
- Fuel flow

## Humidity



# CHALMERS



## TESTO NDIR (Non-disruptive infrared sensor)

- NOx
- CO
- O2
- CO2

## Cambustion instrument with thermo denuder

- PM & PN (incl. volatile)

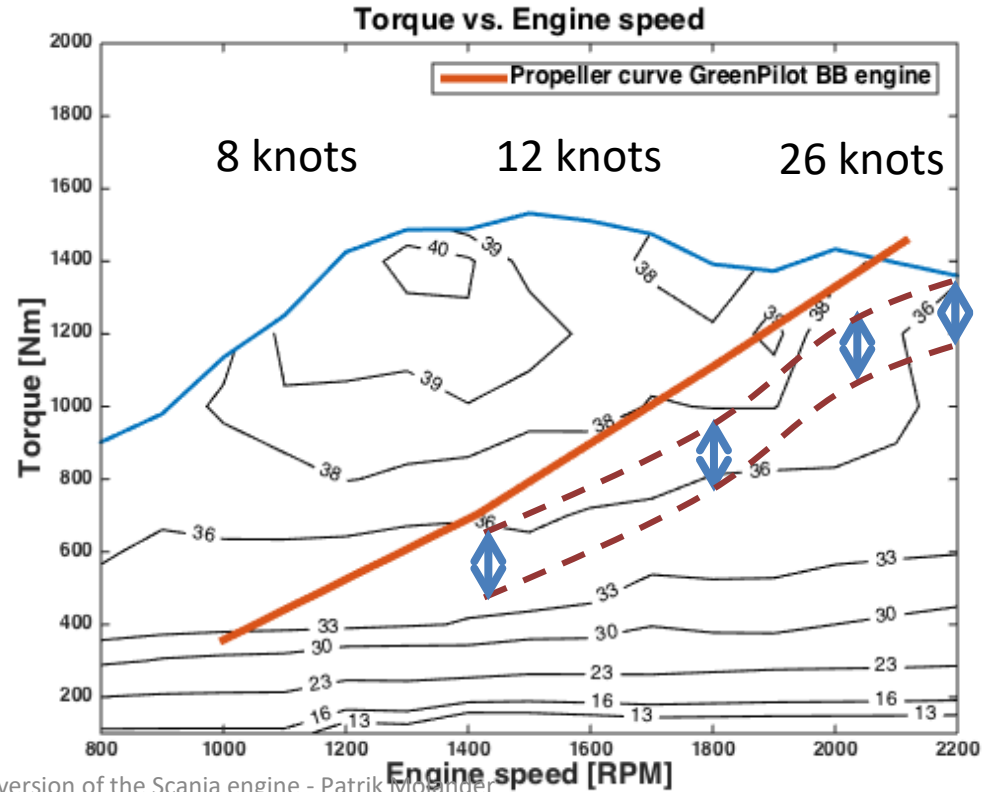
## Strain gauge

- Torque and power



# WEICHAI ENGINE MAP AND PROPELLER CURVE

- Test onboard
- 4 load points, acc. to test cycle
- 1400, 1800, 2000 and 2200 (2150)
- Efficiency 36 to 40%

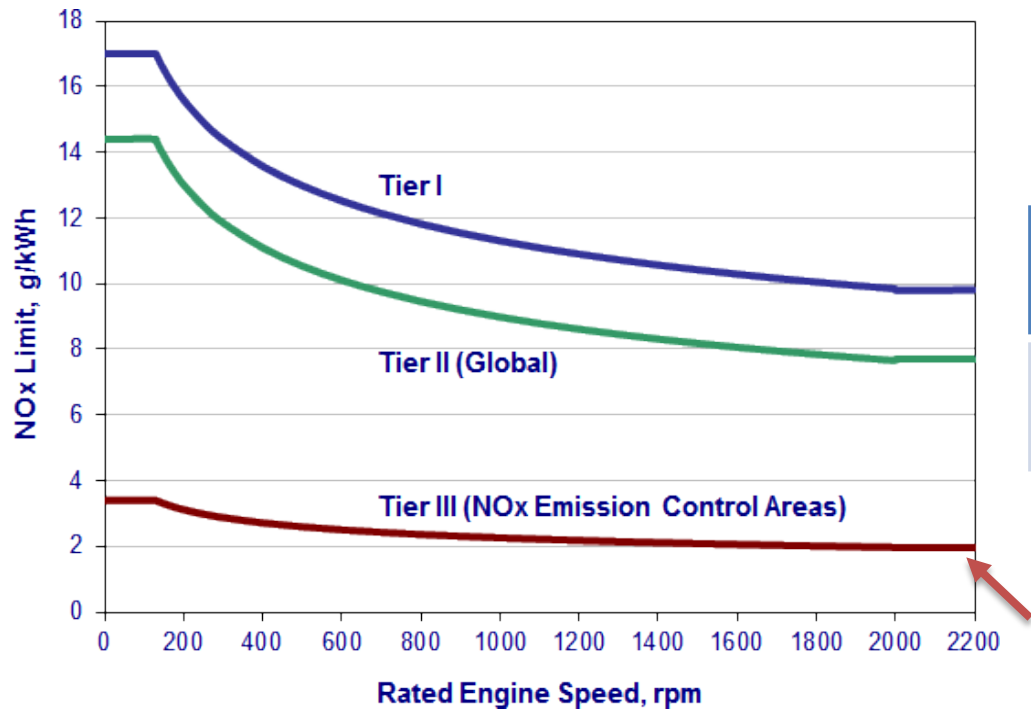


# NOX AND PM EMISSIONS

Engine speed	1400	1800	2000	2150
Engine load (% of MCR)	31	64	77	98
NOx (g/kWh)	3,8	2,7	2,6	1,0
EF PM without thermo-denuder (g/kWh)	0,000208	0,0000182	N/A	0,0000159

➤ Emissions will vary with speed and engine load

# IMO TIER III COMPLIANCE



	IMO Tier III	Dyno test	Real driving
NOx [g/kWh]	1,96	1,38	2,07



# EU 2020 INLAND WATERWAYS COMPLIANCE

- Note: Emission factors calculated acc. to EU
- CO and HC was not included in the test

	Inland waterways 2020	Dyno test	Real driving
NOx [g/kWh]	1,8	1,77	2,27
PM [g/kWh]	0,015	N/A	0,0000282

# ... HOW DOES OTHER ENGINES PERFORM?

Engines	PM [g/kWh]	NOx [g/kWh]	Aftertreatment	Compliance	Reference
Methanol	0,0000282	1,34	No	Tier III, 2020 inland waterways	
Methanol	0	0,4	3-way catalyst	Euro 6, Tier III, 2020 inland waterways	Johnson Matthey
Cummins QSM 11 (2006)	0,16	6,48	No	Tier II	Cummins marine
Diesel		5	No	Tier II	Dieselnet
Diesel	0,01	0,4	High pressure common rail injection, (2) oxidation catalysts, SCR with UREA, particulate filter	Euro 6, Tier III and inland waterways	Dieselnet

# CONCLUSIONS

- Simple and well known technology
- PFI SI methanol engine will comply with present and upcoming EU and IMO regulations without aftertreatment
- Extremely low PM



Thank you!