

WIN GD |



Decarbonisation of international shipping: Full speed ahead!

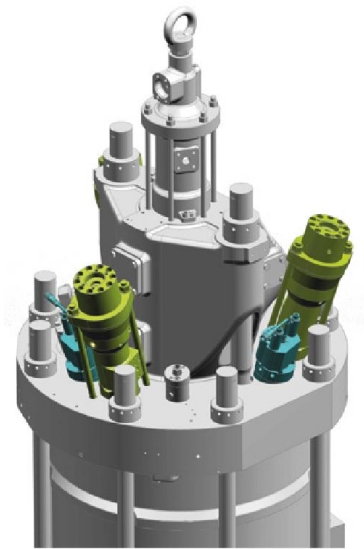
Dr. Andreas Schmid

Senior Advisor R&D

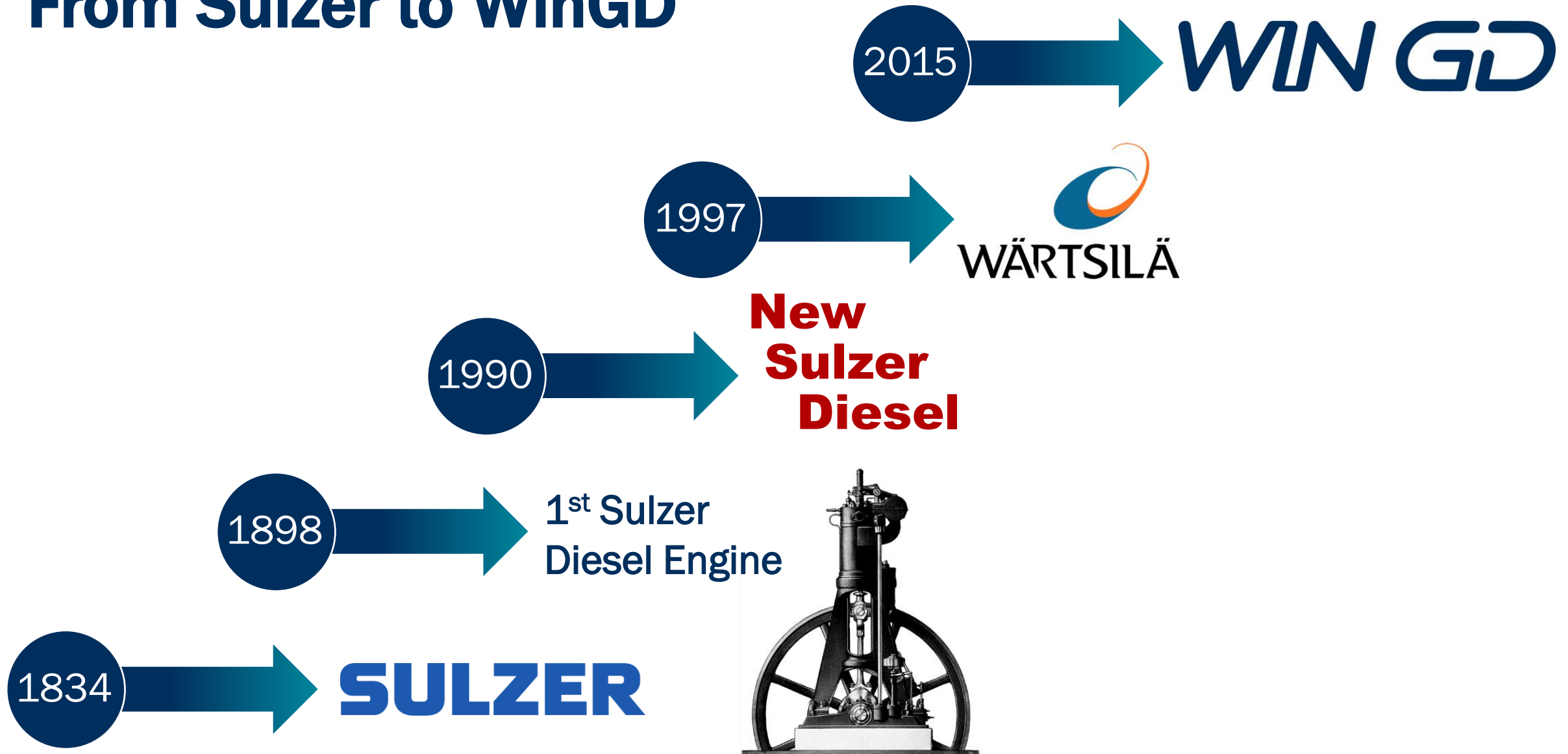
12.11.2024

Main Messages

- Engines are ready!
- Ammonia Combustion works
- Handling System works and is safe



From Sulzer to WinGD



WinGD: What we do

Marine Engines for large Merchant Vessels



X35 - X40

Small/Handysize Bulker

Small Product Tanker

General Cargo Carrier

X52 / X52-S

Handymax Bulker/Tanker

MR Tanker

X62 / X62-S

Panamax Bulker/Tanker

LR/Aframax Tanker

X72

Cape Bulker

Suezmax

X82

VLOC

VLCC

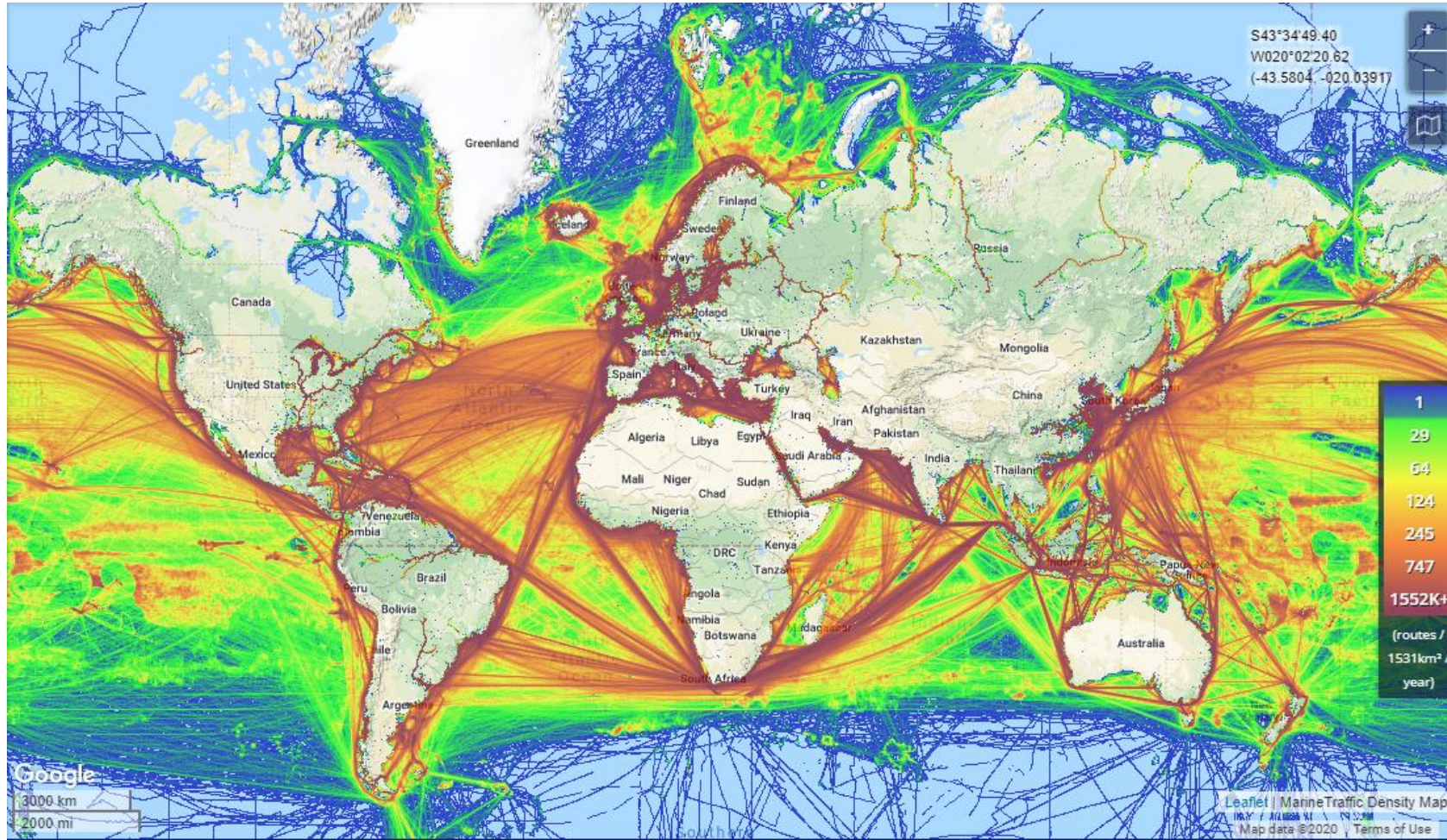
X92

Ultra Large Container



The Task Ahead of the Marine Sector

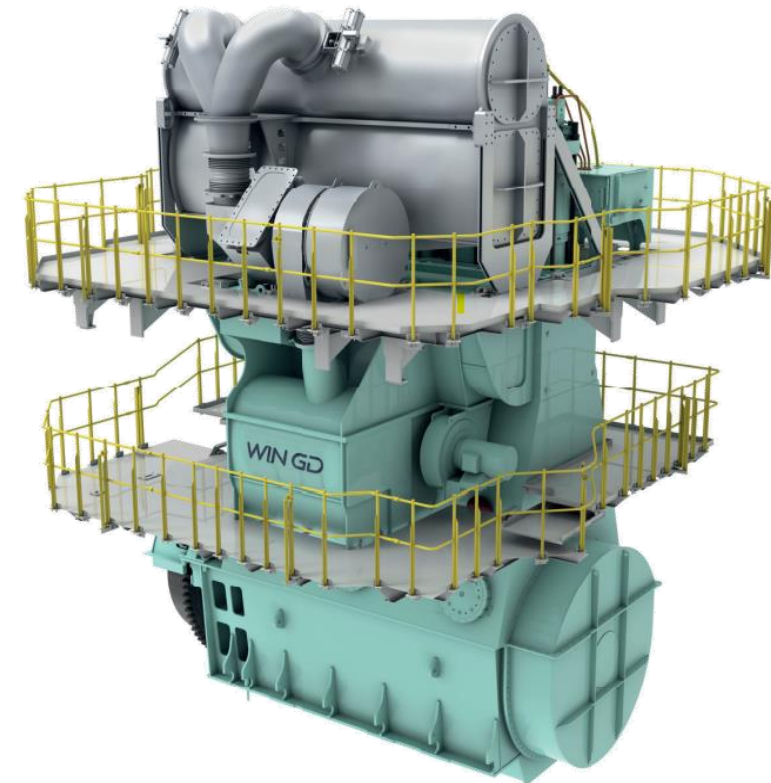
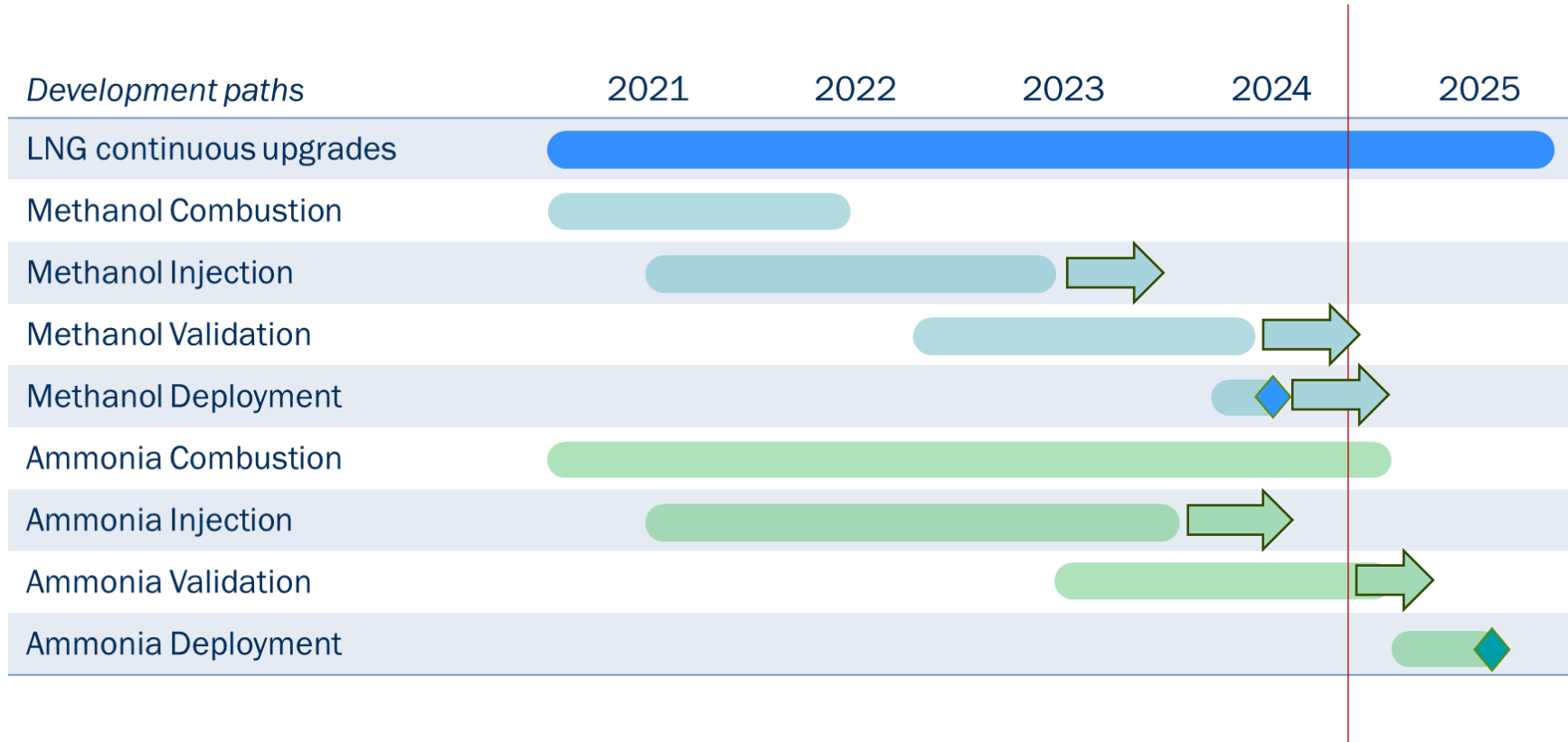
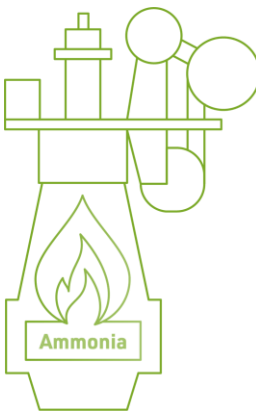
To replace 300 million tons of marine fuels, every year



source: <https://www.marinetraffic.com/>

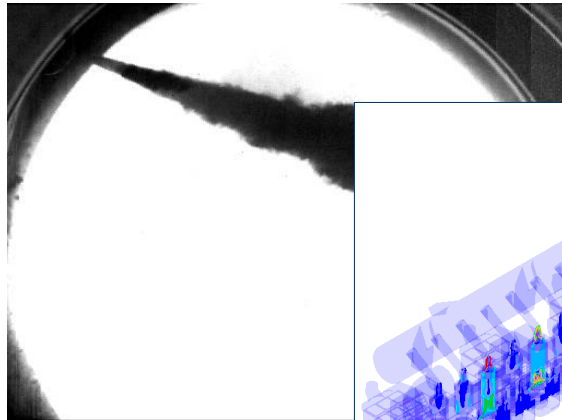
Technology Development Plan in 2020

Advancing on all fronts

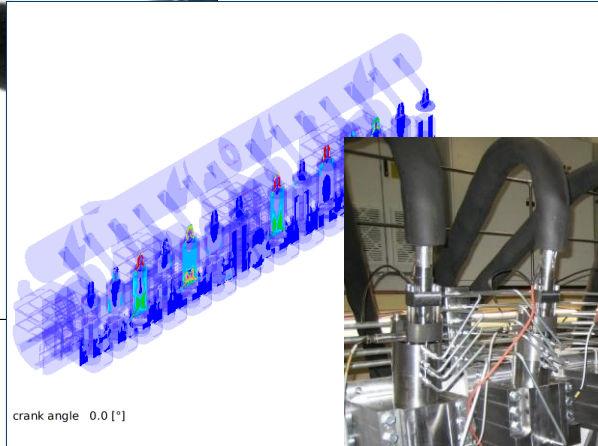


Active Across the Entire Development Chain

Key building blocks of development approach applied to achieve **First Time Right**



Fundamental investigations



Calculation & simulation



Component systems tests



Laboratory tests

Prototype test on first customer engine

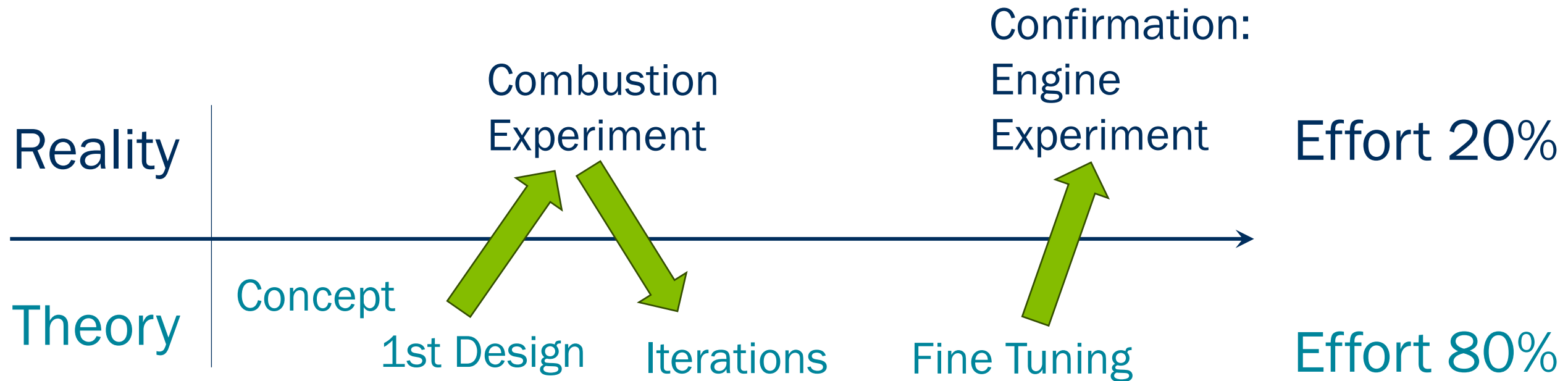


Field tests



Improved Integration of Digital Tools

Faster, more Cost Effective and less Carbon Intense Development Approach



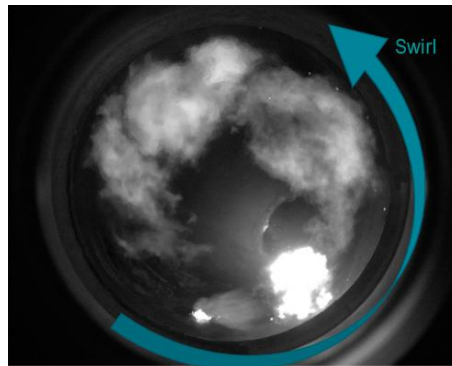
*Focusing on Combustion, only!

Improved Integration of Digital Tools

Iteratively moving the combustion concepts towards engine tests

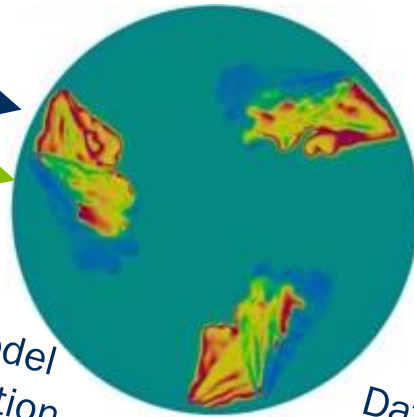
Spray combustion chamber

Large optical access for detailed spray / ignition investigation



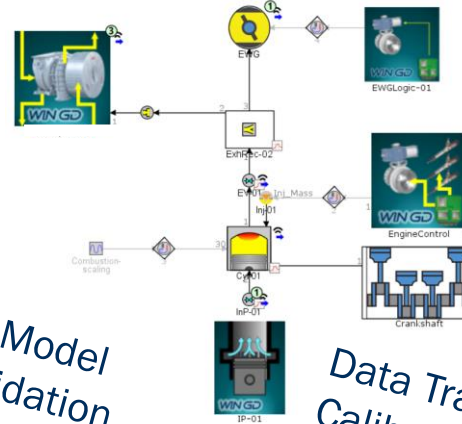
CFD

Detailed spray / combustion / emission formation understanding



1D Engine Modelling

- Engine performance prediction
- Engine operating strategy optimization
- General Technical Data calculation



Engine Tests

- Engine performance validation
- Engine operating validation



Data Transfer / Model Calibration / Validation

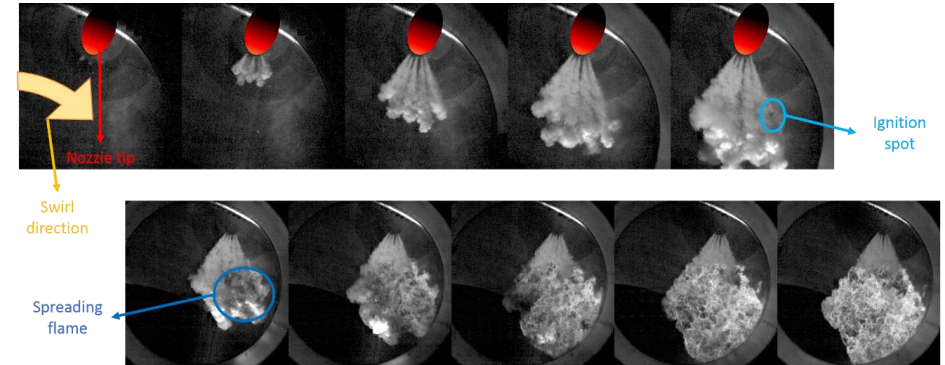
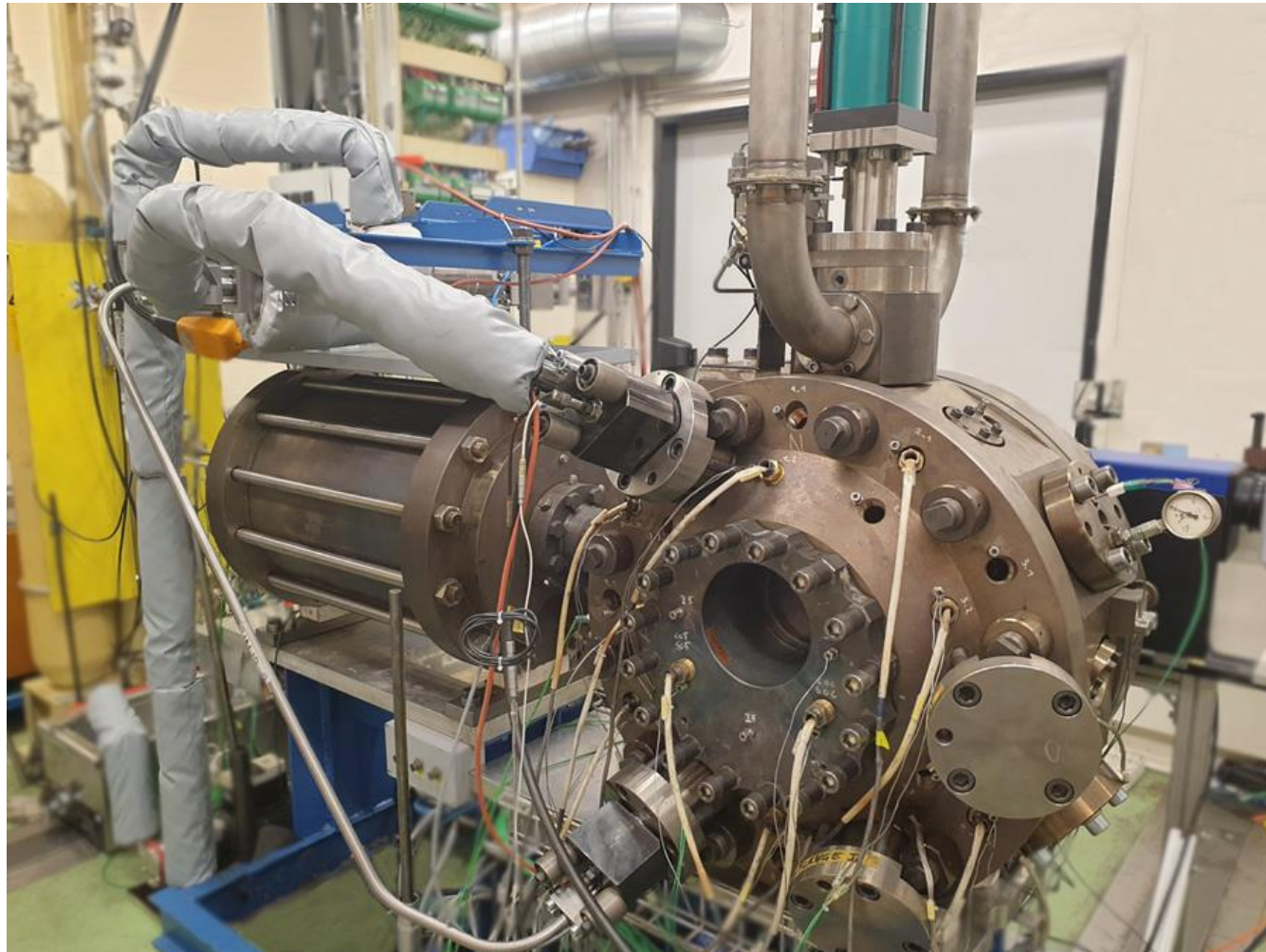
Data Transfer / Model Calibration / Validation

Data Transfer / Model Calibration / Validation

— Diesel
— NH₃

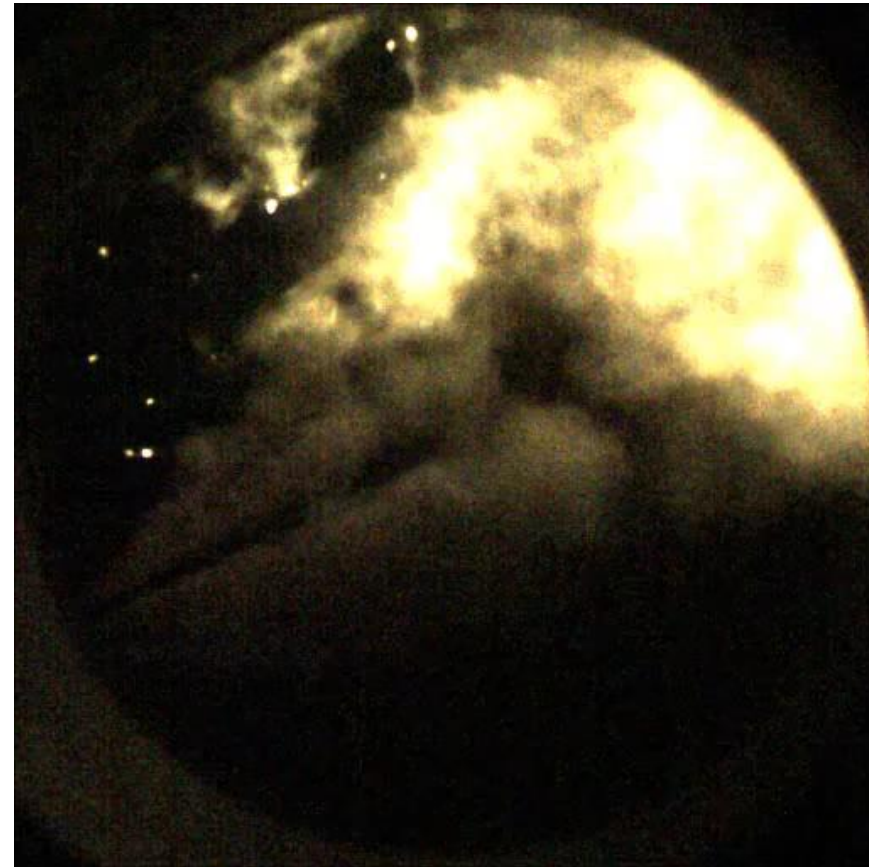
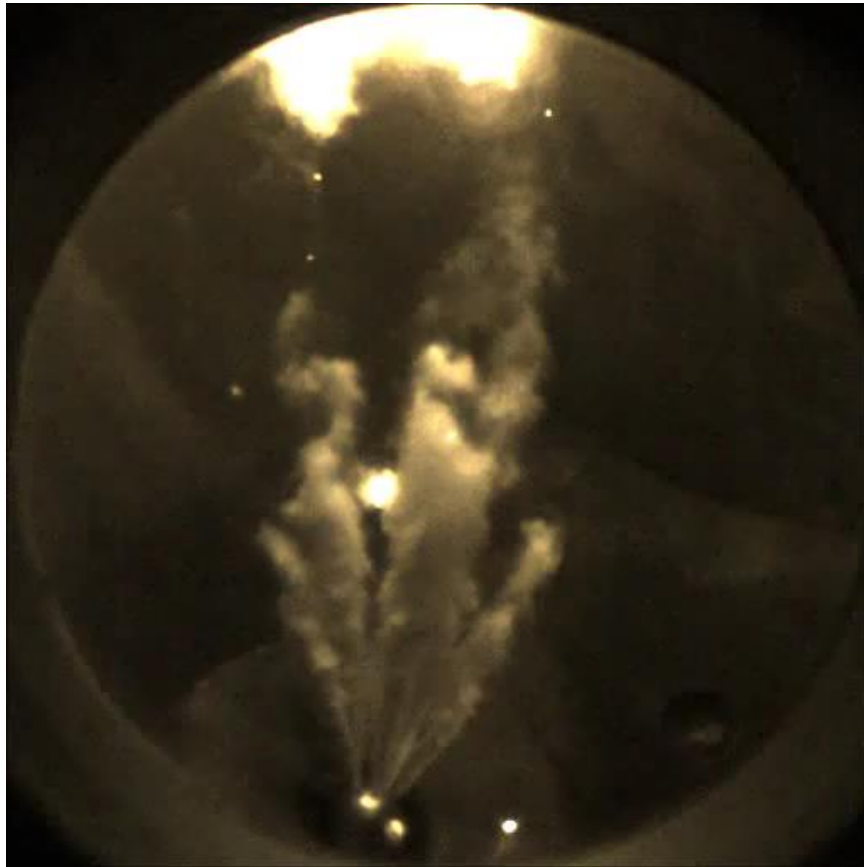
Main Development Tool

Spray Combustion Chamber



Ammonia burns !

December 2022: Worldwide first ammonia combustion under two-stroke engine like conditions

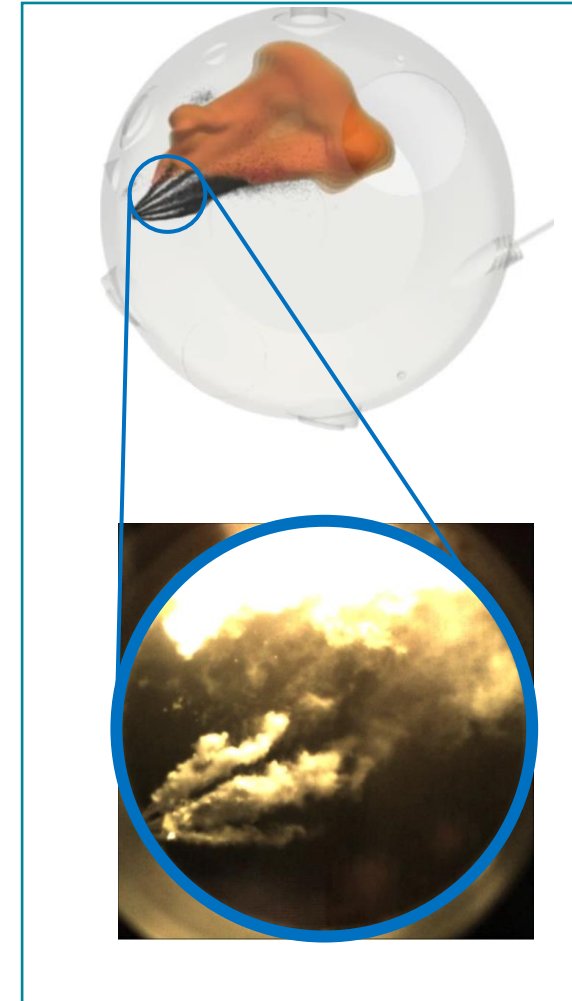
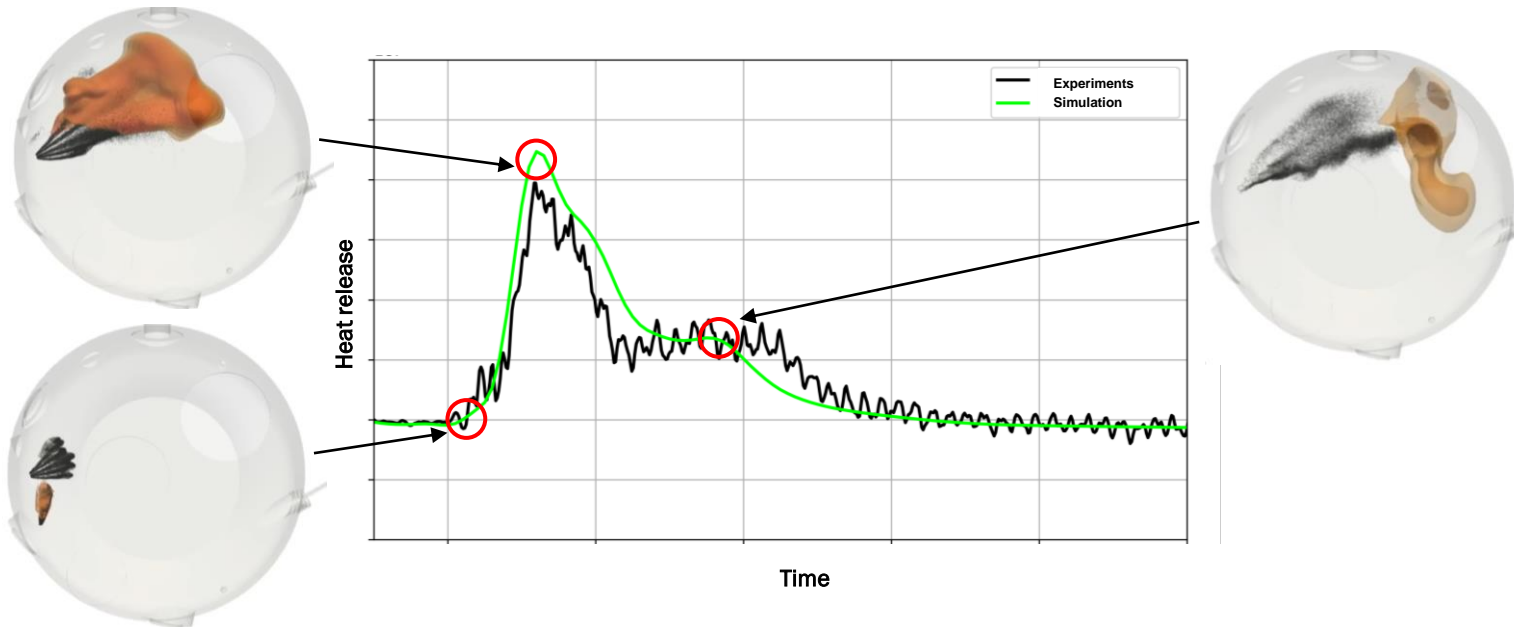


Computational Models in good Agreement

Verification of emission formation and combustion behaviour

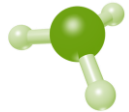
CFD simulation results/outcomes

- CFD simulations yield very promising results when compared with experiments from SCC
- Heat release and combustion pressure can be predicted
- Emission results indicate good prediction capabilities of CFD with respect to measurements
- Spray behavior and flame lift of show good agreement between experiment and simulation

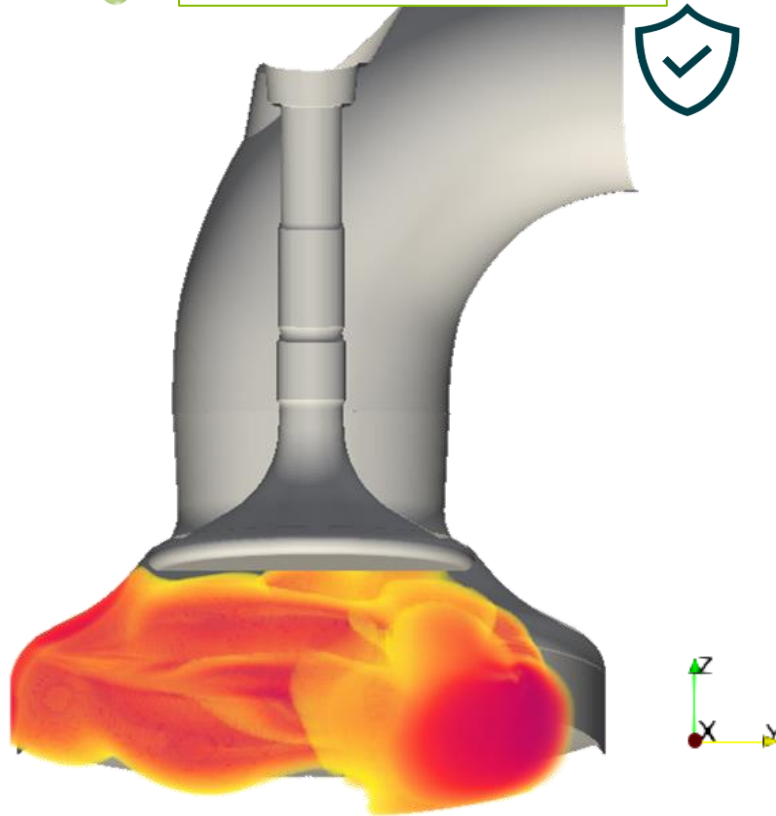


Combustion System Developed

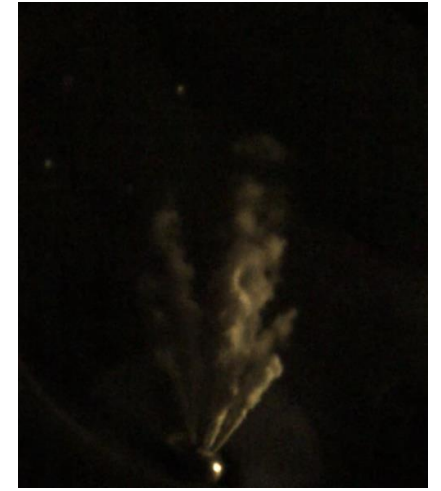
Engine performance based on Computational Simulations



Ammonia Diesel-Cycle Simulation



- Combustion works
- Pilot amount 5%
- Emissions within expected range
- N₂O less than 5% CO₂-equivalent
- NO_x comparable to diesel or lower
- NH₃ slip handled via SCR



RTX-6

Multi Cylinder Engine (MCE)

- Ammonia components are installed on one unit of RTX-6 engine
- **Validation started with methanol** (A&C, component functional tests)
- The prototype injection system is used in synergy to run methanol combustion and performance tests
- SCE520 will allow for ammonia injection (same cyl. unit installation, with the addition of a specific purging system for safety)

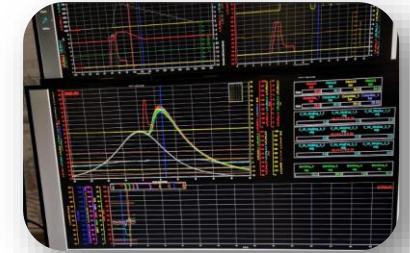
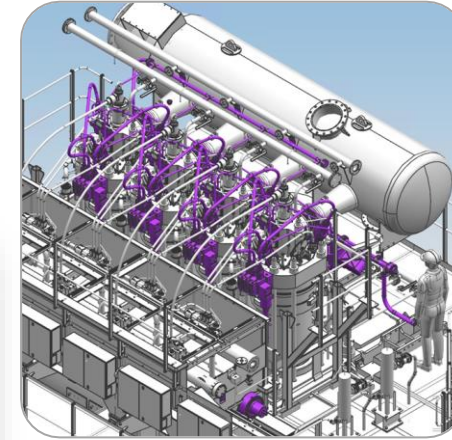


Fig. 10 - Methanol injection test on RTX-6

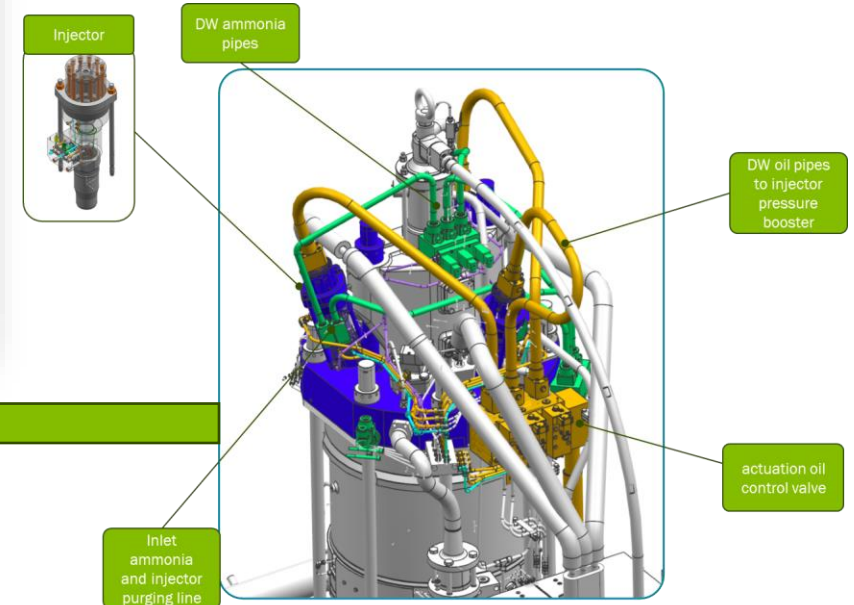
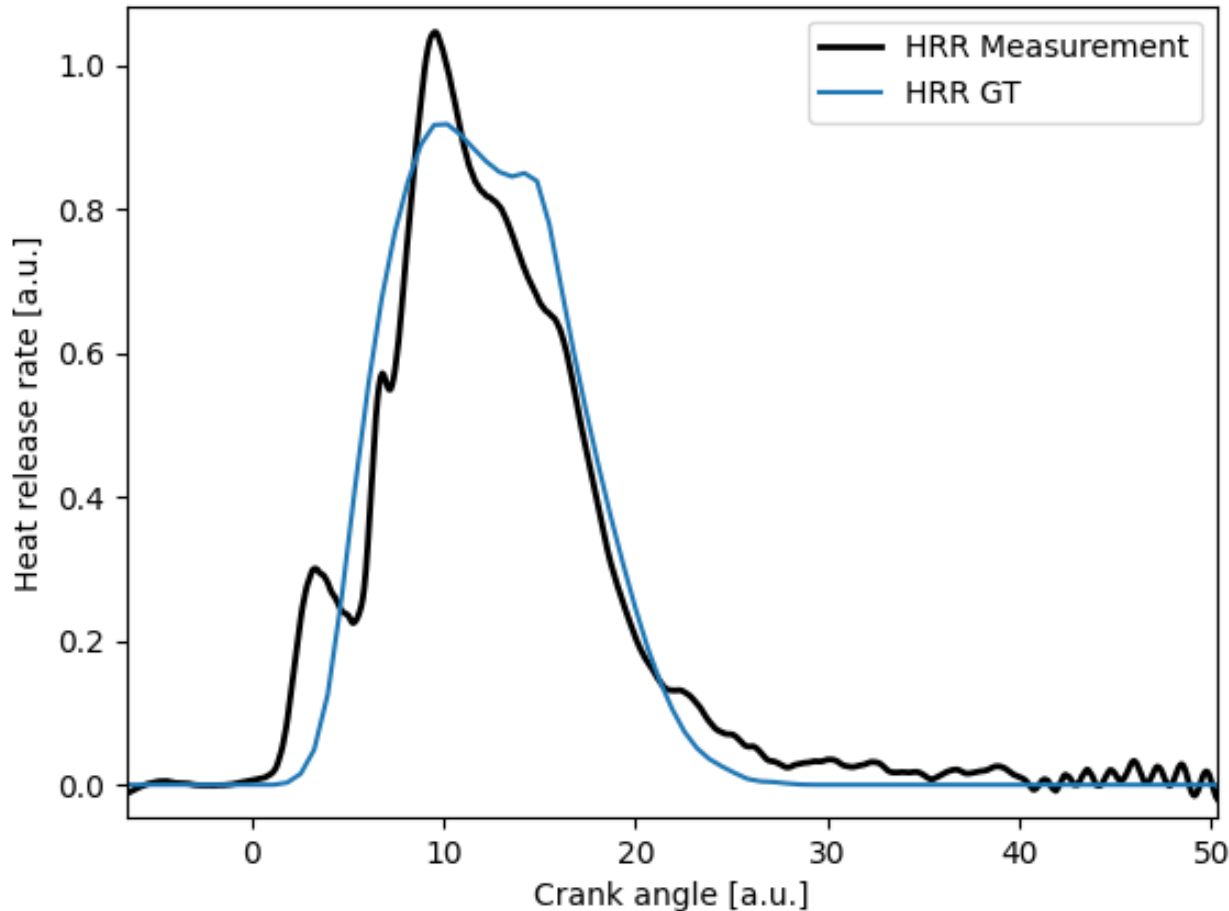


Fig. 9 - X52DF-A cylinder unit, same as SCE520 test engine

Process Works – Hardware works

Confirmation of Safety Concept during Methanol Development



- Train crew
- NH3 Injection System tested on the engine with
 - Water
 - Methanol
- Purging System Works
- Safety concept works
- Computational Methods work

Next Steps

- Injection System works
- Combustion works
- Safety Systems approved

=> Confirmation on lab engine

=> Final confirmation on customer engine

=> Stress test in the real world



Laboratory tests

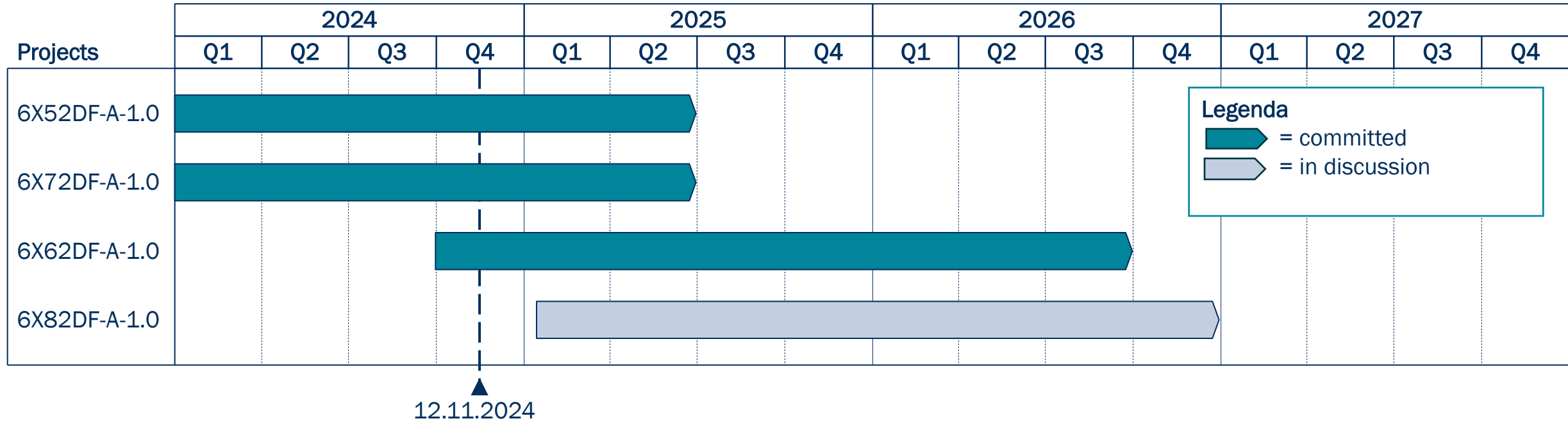
Prototype test on first customer engine



Field tests

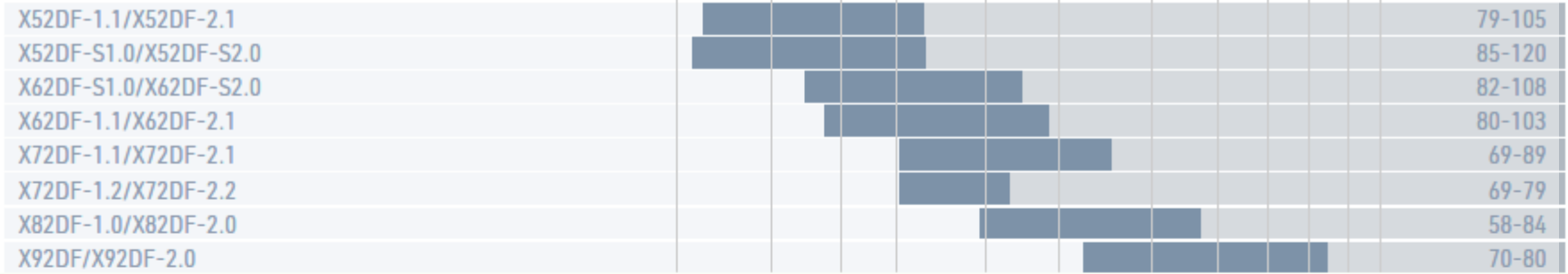


Ammonia Technology Roll-out

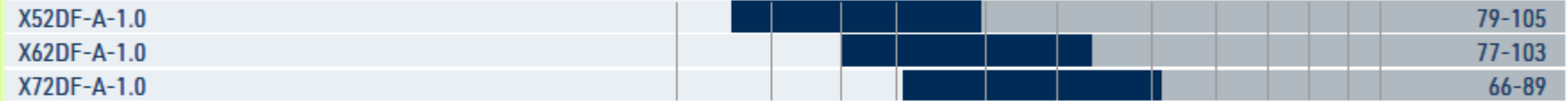


WinGD DUAL-FUEL ENGINES

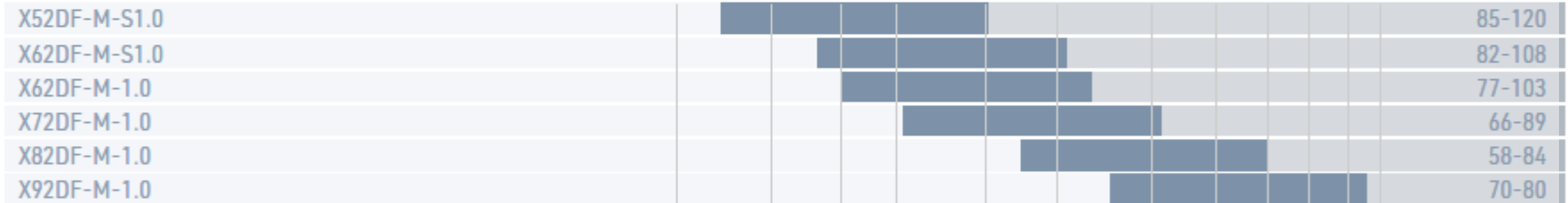
LNG



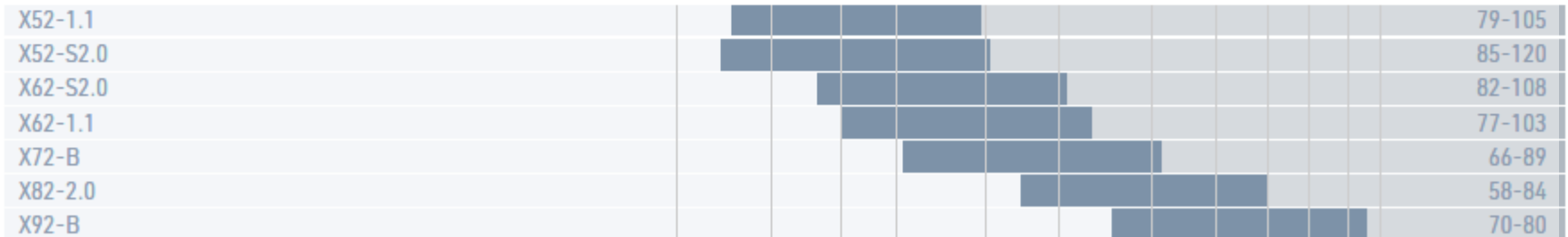
Ammonia



Methanol



WinGD DIESEL ENGINES

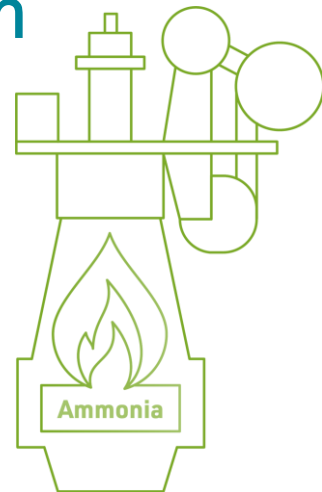


Power (MW)

Speed (RPM)

Thank you

Many thanks to all the
collaboration partners
and colleagues within
WinGD.



WIN GD