



GasOn: A lean CNG combustion for highest engine efficiencies above 43% utilising an ignition chamber

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H2020 GV-3-2014 Future natural gas powertrains and components for cars and vans



GasOn: Lean CNG Combustion with ignition chamber Motivation

CNG = eco-friendly / sustainable / cost effective mobility



GasOn: Lean CNG Combustion with ignition chamber Motivation

State of the art:

- **bivalent system**
- **stoichiometric burn ($\lambda=1$)** with TWC

GasOn:

- **monovalent system**
- **lean burn ($\lambda \gg 1$)** to reach CO₂ levels of 20% below best in class (2015)



GasOn: Lean CNG Combustion with ignition chamber

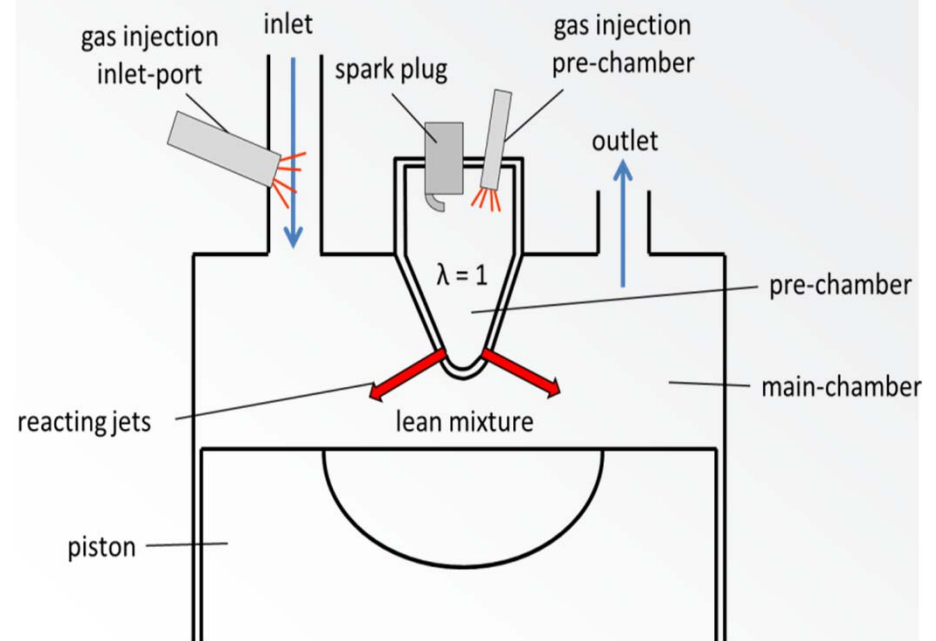
Motivation

MOTIVATION

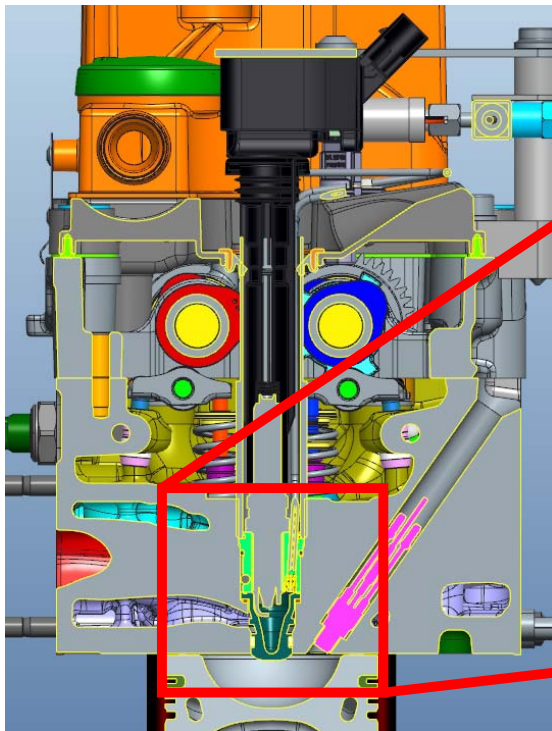
Monovalent CNG-Combustion to exploit fuel advantages and reach maximum efficiency

- ➡ Efficiency can be improved by using lean combustion for CNG with $\lambda \gg 1$
Target: $\lambda=2$
- ➡ Increased requirements for ignition system (mixture, pressure)
- ➡ Creating a suitable distribution of NG in the air locally and globally

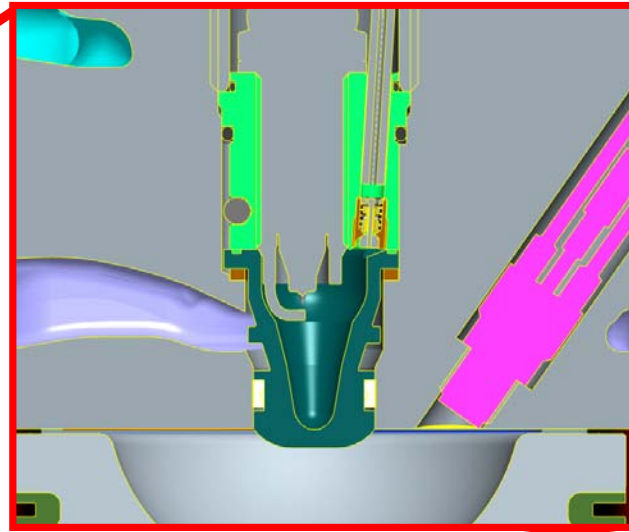
Combustion Process



GasOn: Lean CNG Combustion with ignition chamber Engine Design



Section view through cylinderhead

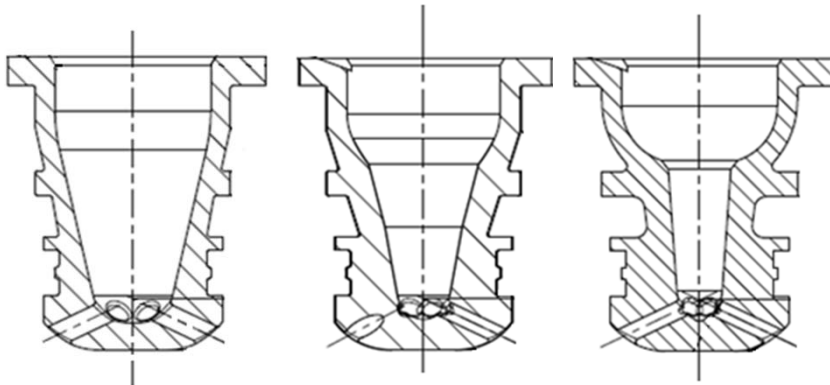


Detail: ignition chamber



Hardware:
ignition chamber

Ignition Chamber Designs

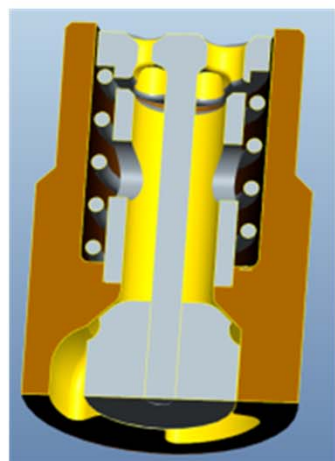


Designs with different internal shapes

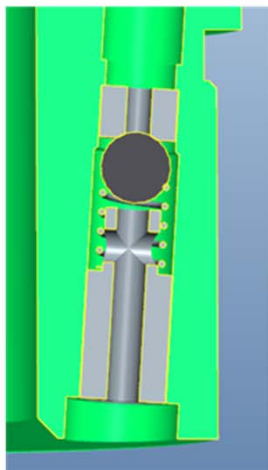


cylinderhead

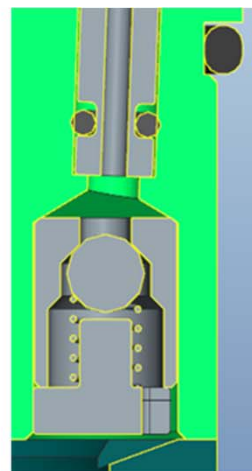
Check Valve



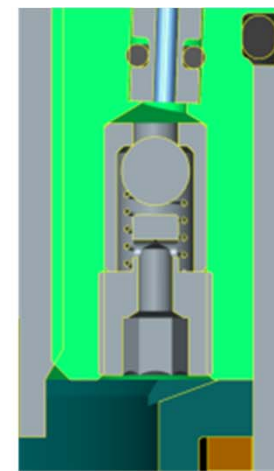
Design 1



Design 2



Design 3

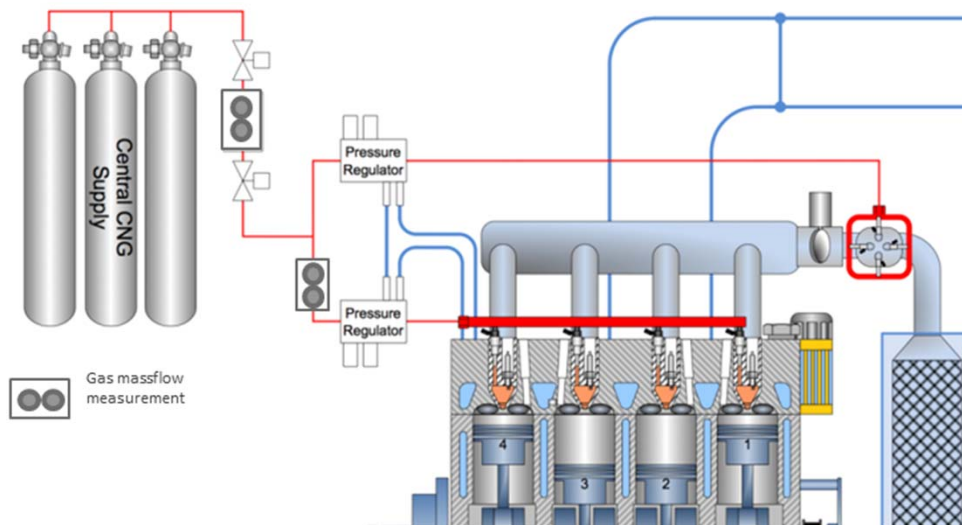


Design 4

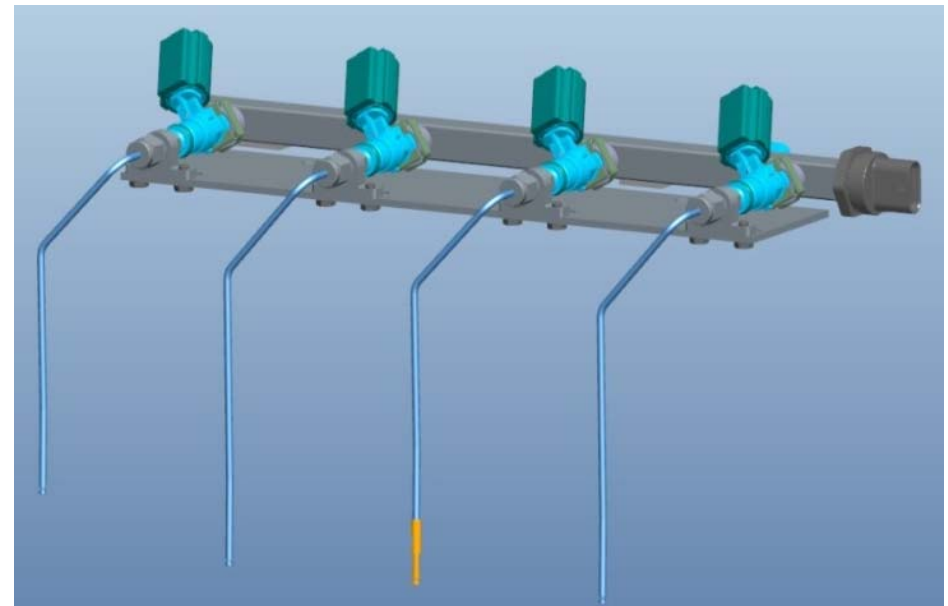
GasOn: Lean CNG Combustion with ignition chamber Engine Design

Dosing System

Target: lowest CNG massflow (<1mg/stroke)

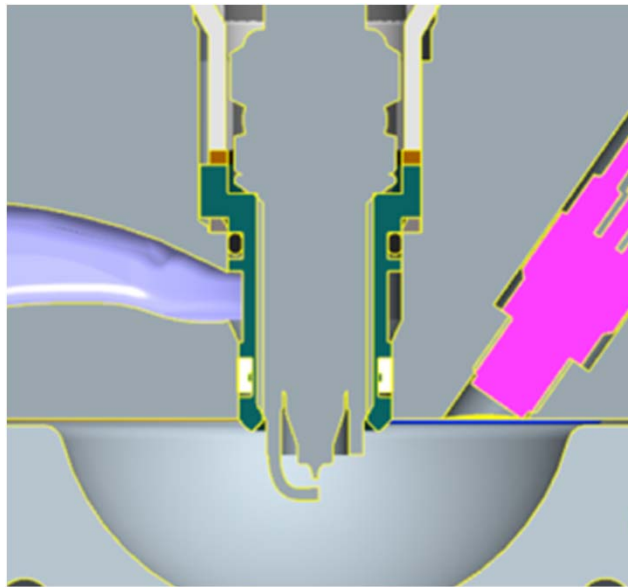


Overview gas supply system

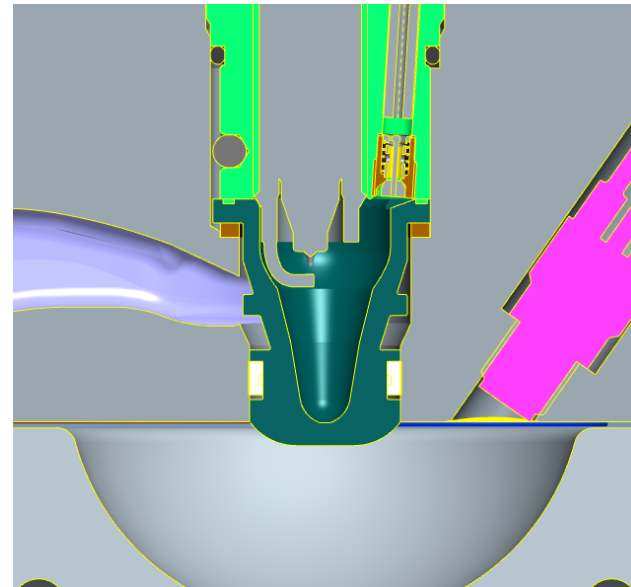


Dosing system to supply CNG into the ignition chamber

Reference Engine

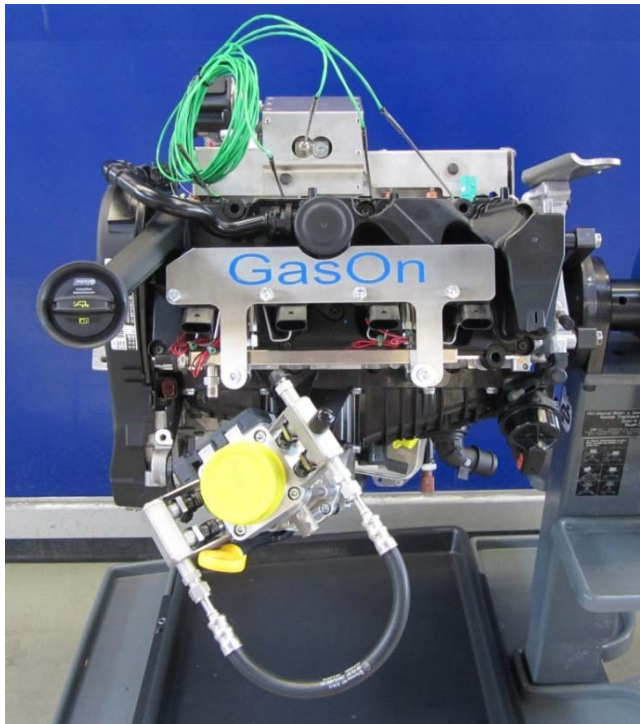


Engine #1: spark plug



Engine #2: ign. chamber

GasOn: Lean CNG Combustion with ignition chamber Engine Design



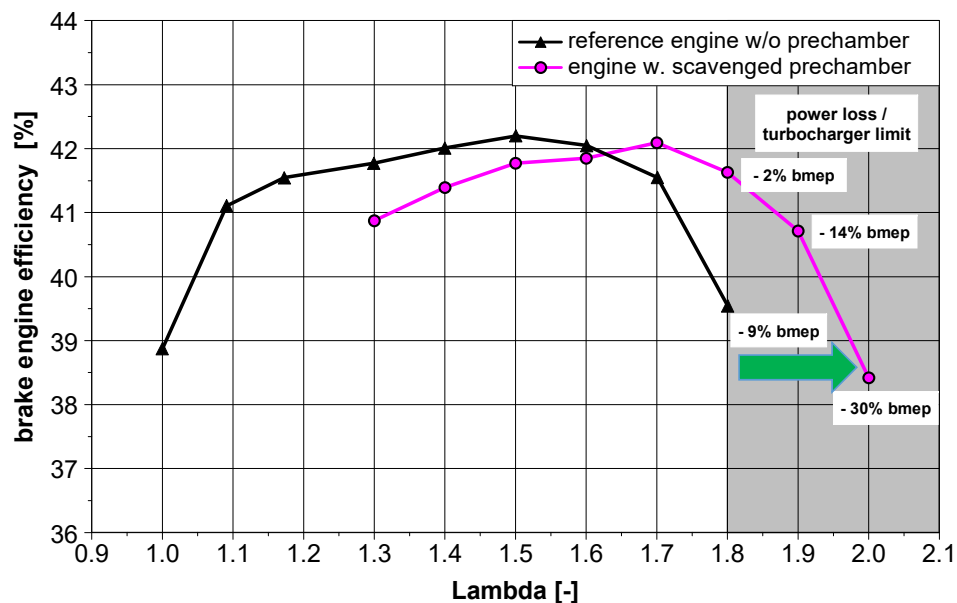
Engine assy



Engine on testrig

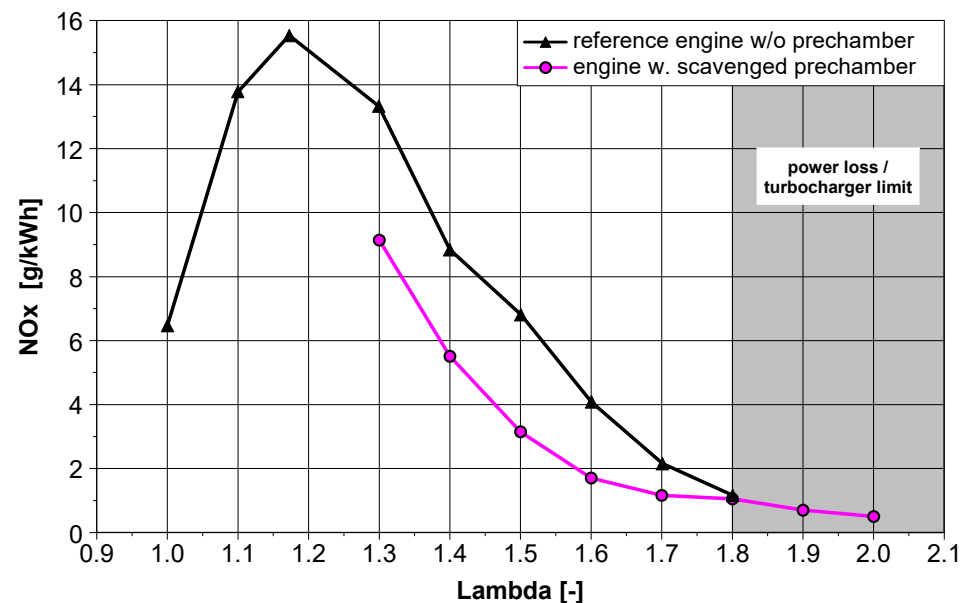
GasOn: Lean CNG Combustion with ignition chamber Results

Engine Efficiency



Engine efficiency over lambda

NOx-Emission

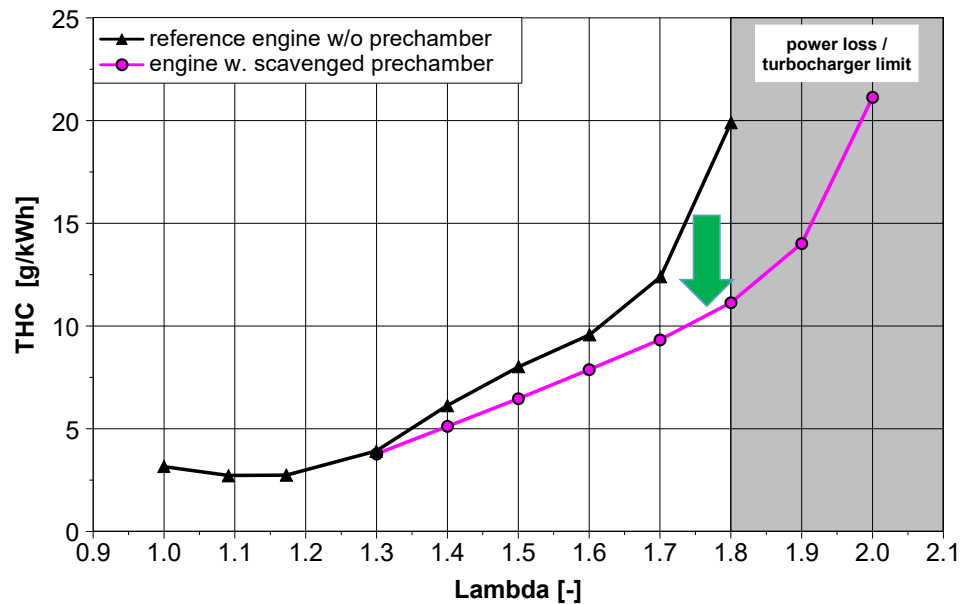


NOx-emission over lambda

2000 rpm; 220Nm

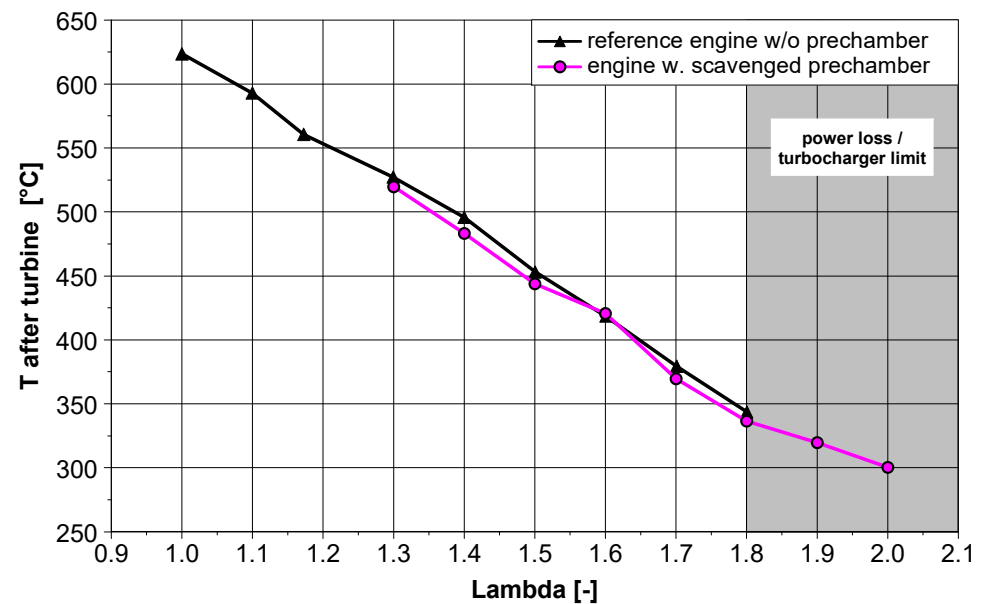
GasOn: Lean CNG Combustion with ignition chamber Results

HC Emission (Methane)



THC Emission over lambda

Exhaust Gas Temperature

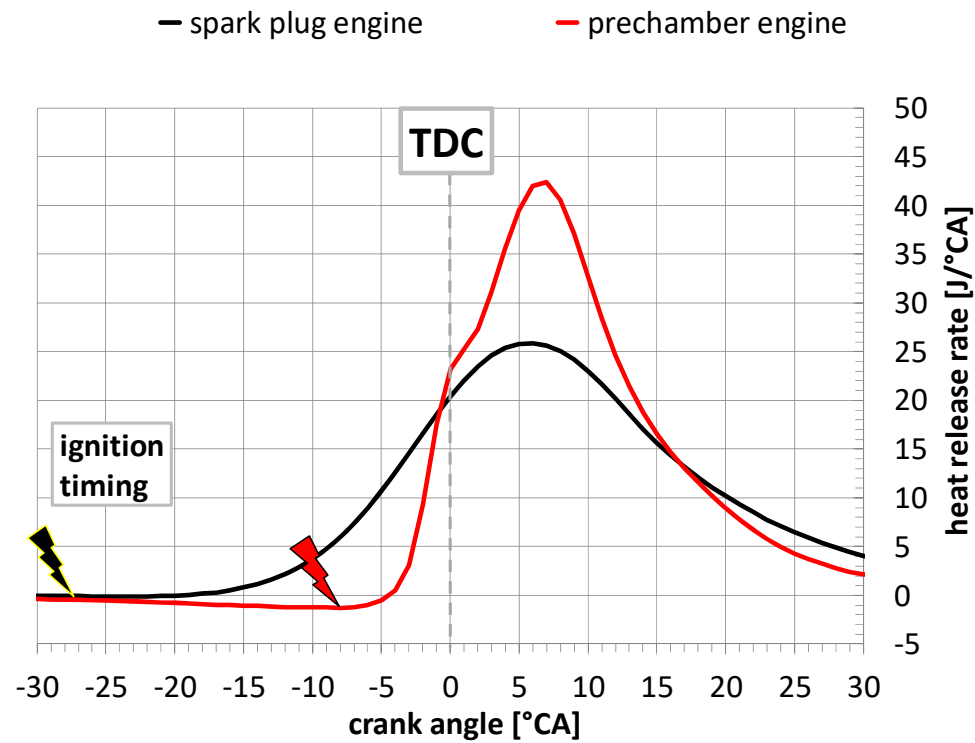


Exhaust gas temperature over lambda

2000 rpm; 220Nm

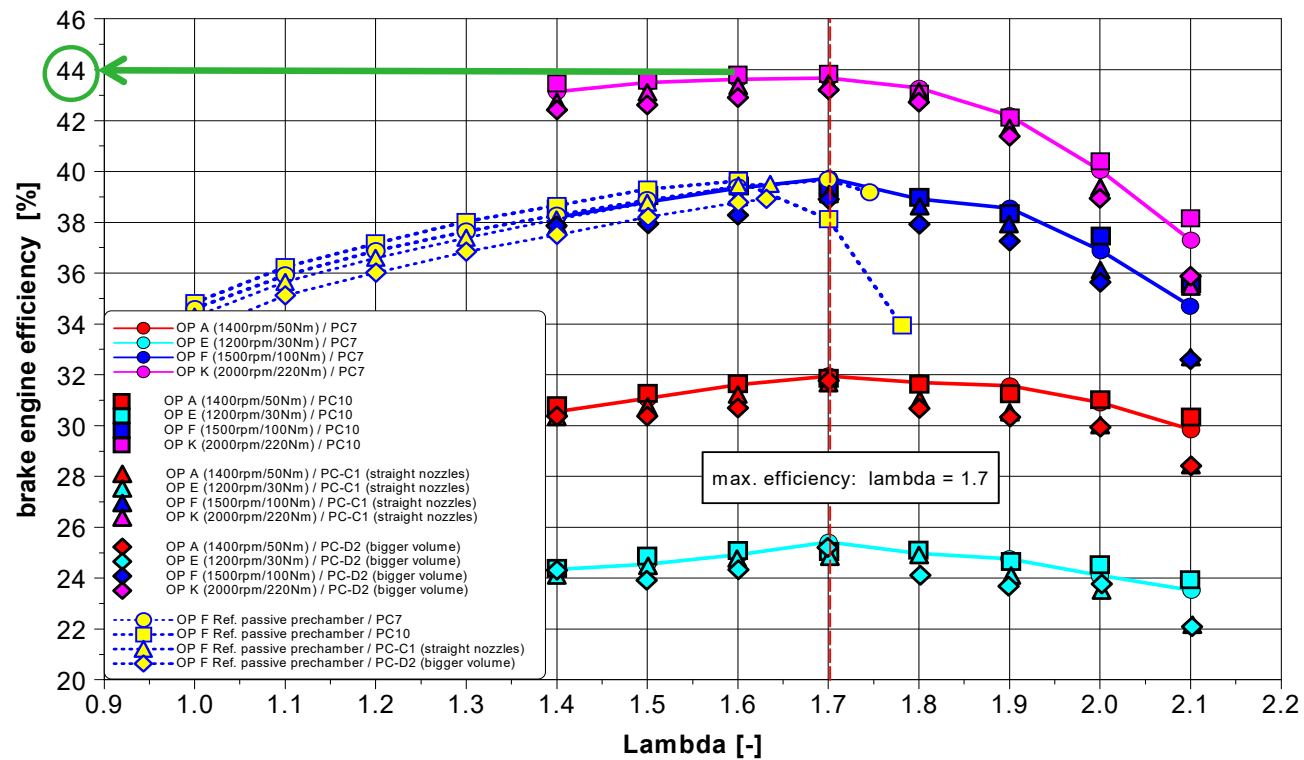
GasOn: Lean CNG Combustion with ignition chamber Results

Later ignition/ faster combustion



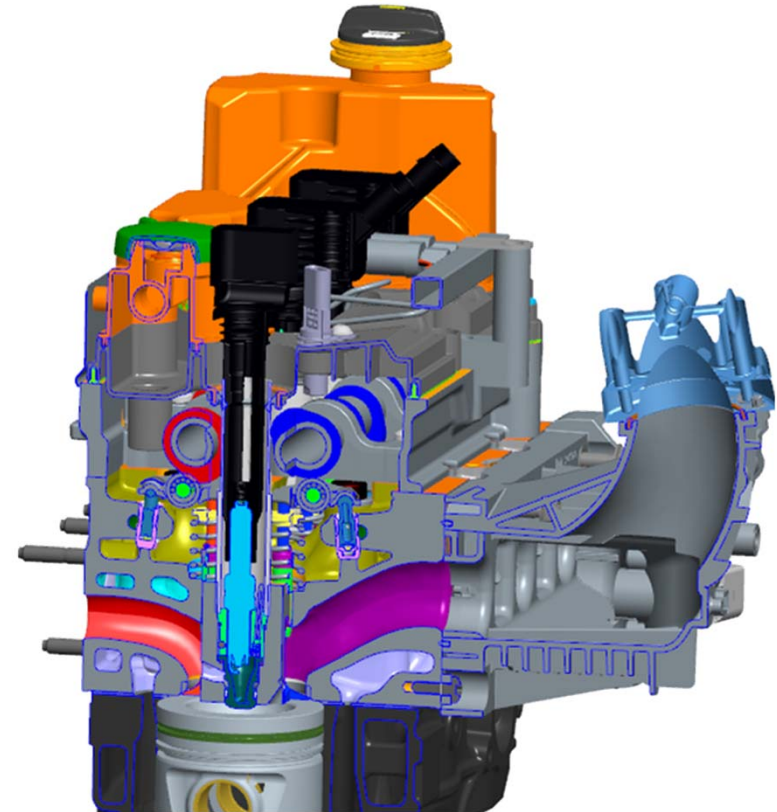
GasOn: Lean CNG Combustion with ignition chamber Results

Engine efficiency with lambda sweep in relevant operating points



Conclusions

- Ignition chamber combustion increases lean limit
- Downscaling from large bore engines to 2.0l engine successful
- Engine efficiency of 44% already shown
- Challenging aftertreatment system



Thank you!

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