

GASON: A LEAN CNG COMBUSTION FOR HIGHEST ENGINE EFFICIENCIES ABOVE 43% UTILISING AN IGNITION CHAMBER

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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

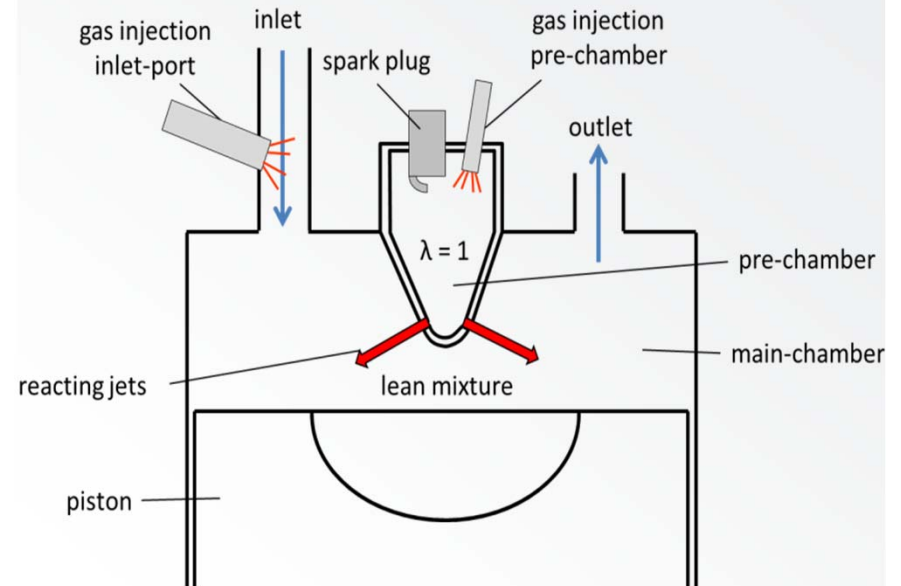
Motivation

MOTIVATION

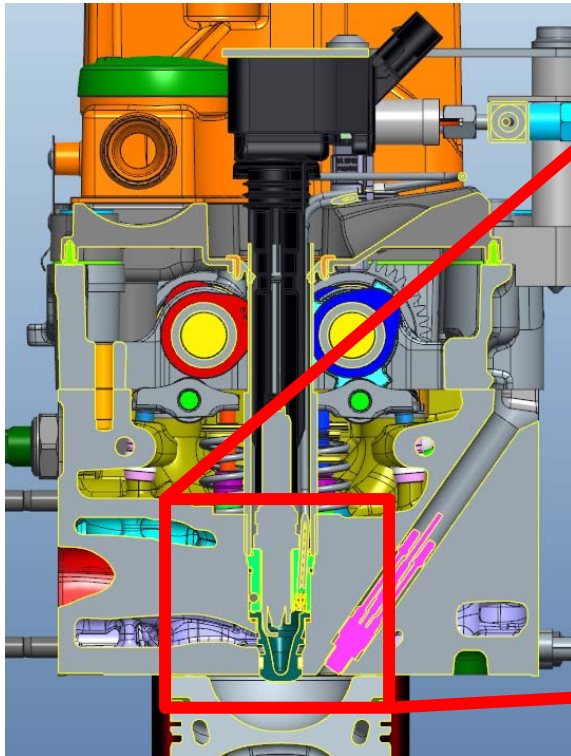
Monovalent CNG-Combustion to exploit fuel advantages and reach maximum efficiency

- ➡ 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

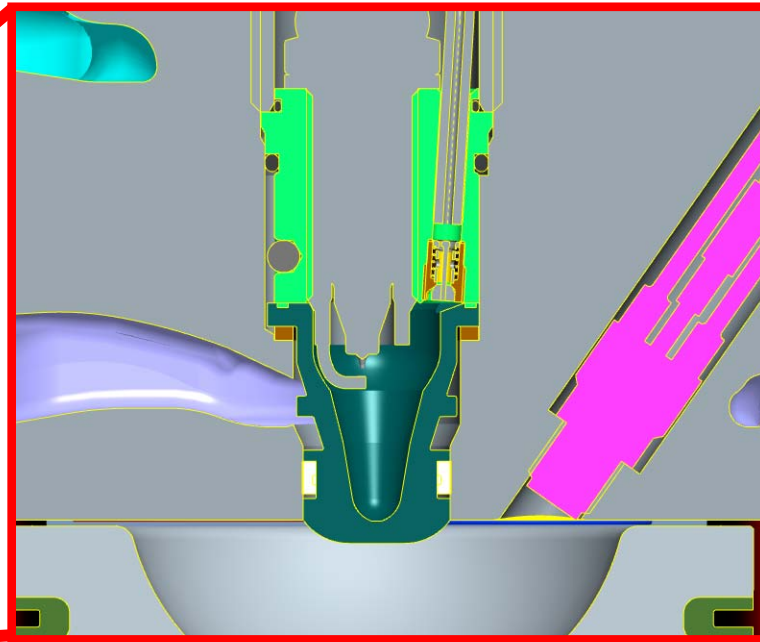
Combustion Process



GasOn: Lean CNG Combustion with ignition chamber Engine Design



Section view through cylinderhead



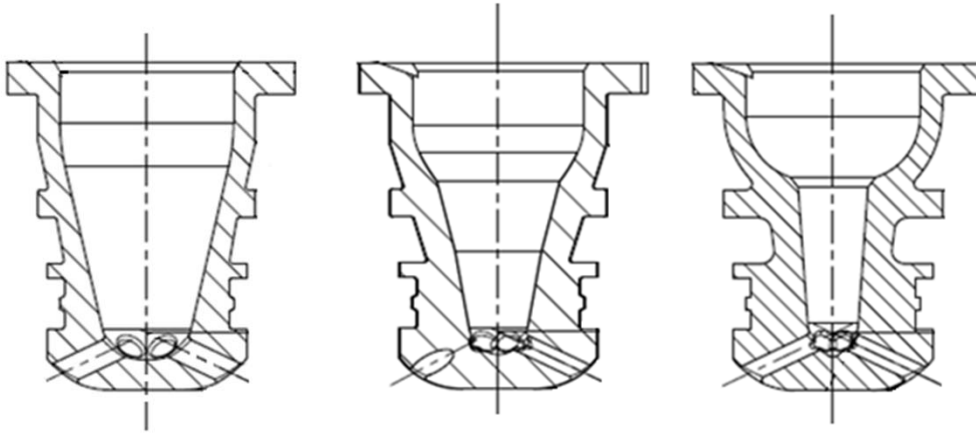
Detail: ignition chamber



Hardware: ignition chamber

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Ignition Chamber Designs



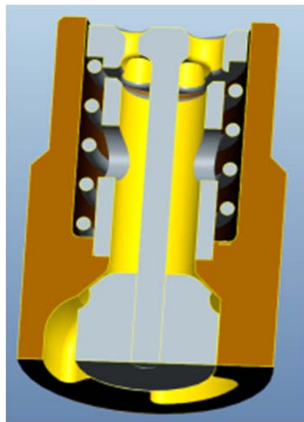
Designs with different internal shapes



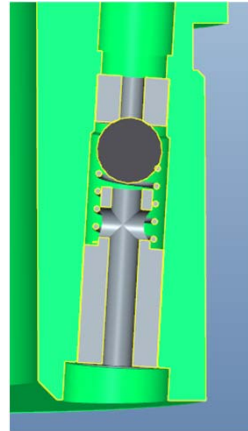
cylinderhead

GasOn: Lean CNG Combustion with ignition chamber Engine Design

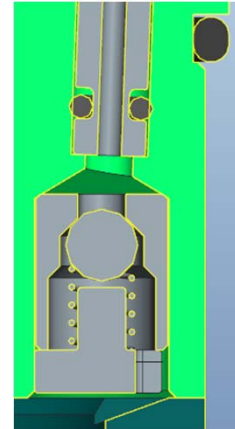
Check Valve



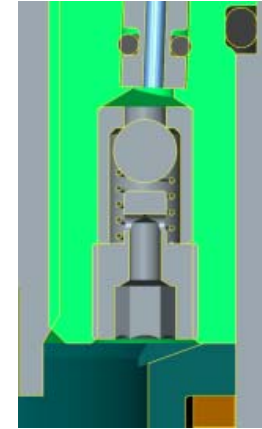
Design 1



Design 2



Design 3

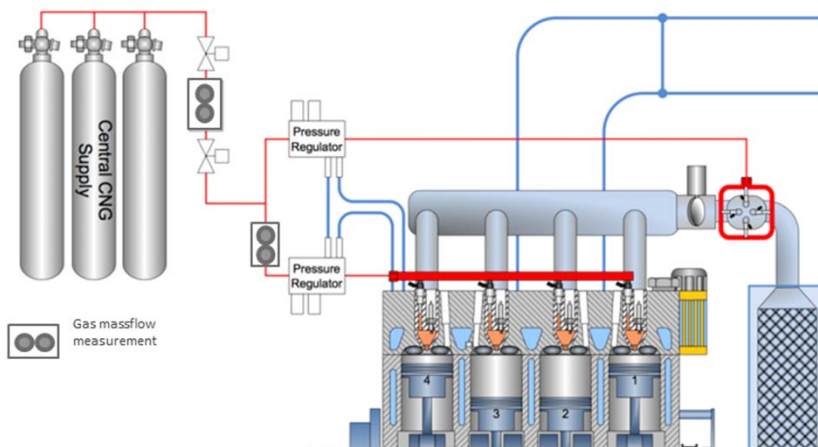


Design 4

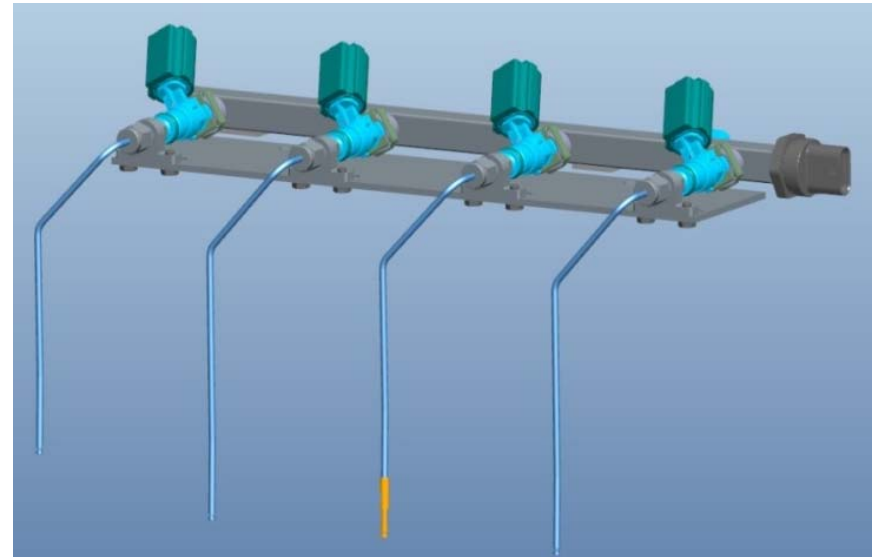
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Dosing System

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



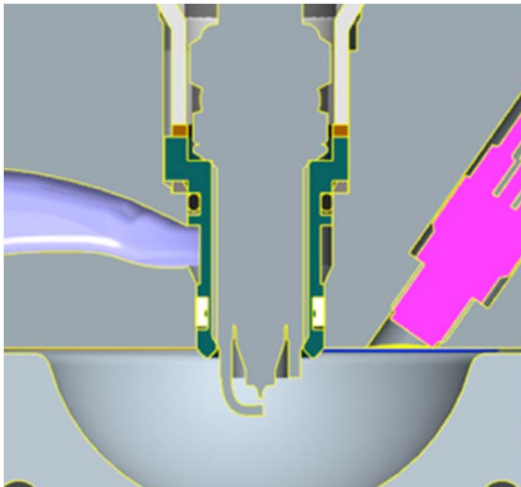
Overview gas supply system



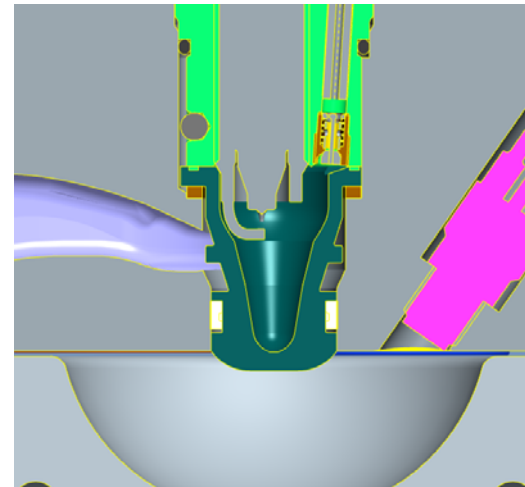
Dosing system to supply CNG into the ignition chamber

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Reference Engine

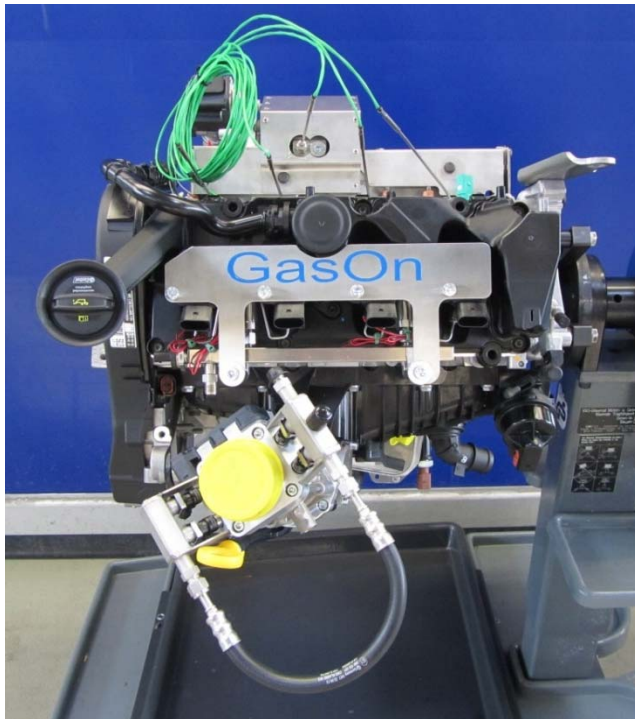


Engine #1: spark plug



Engine #2: ign. chamber

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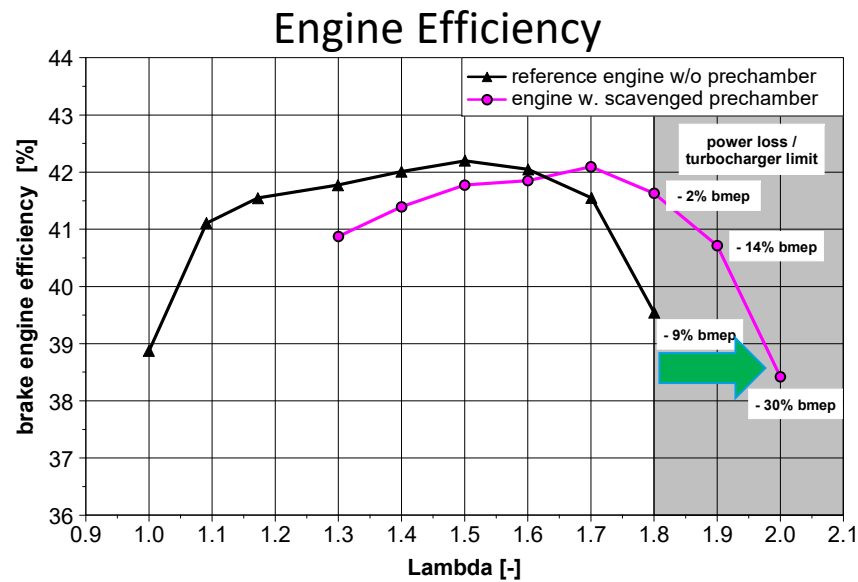
Engine assy



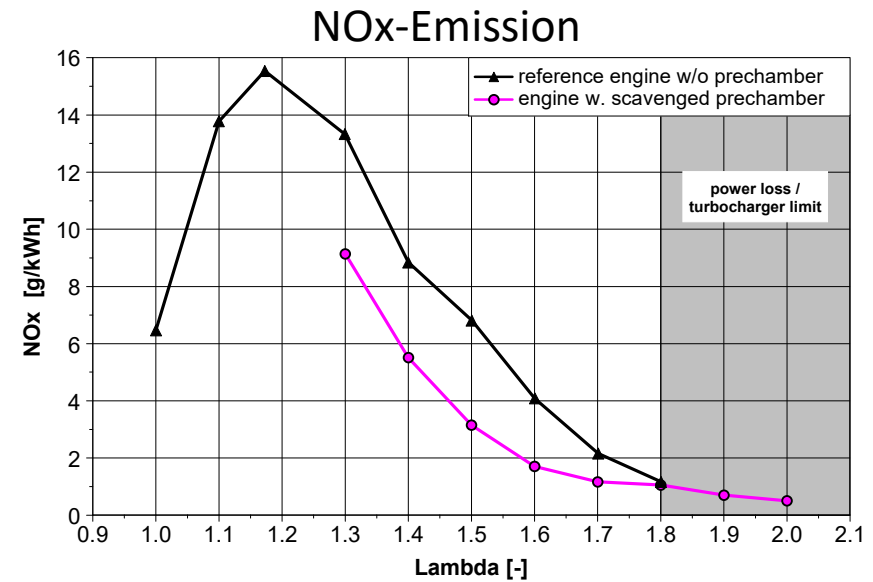
Engine on testrig

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Results



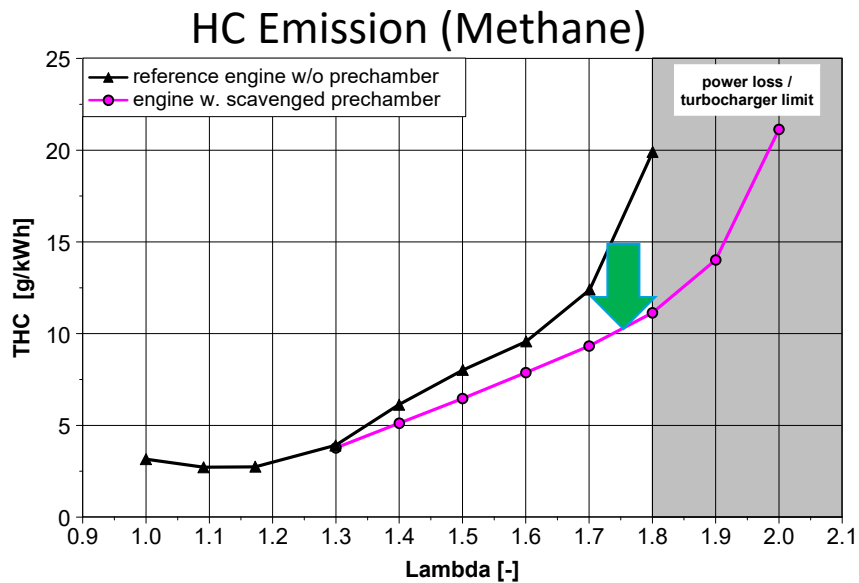
Engine efficiency over lambda



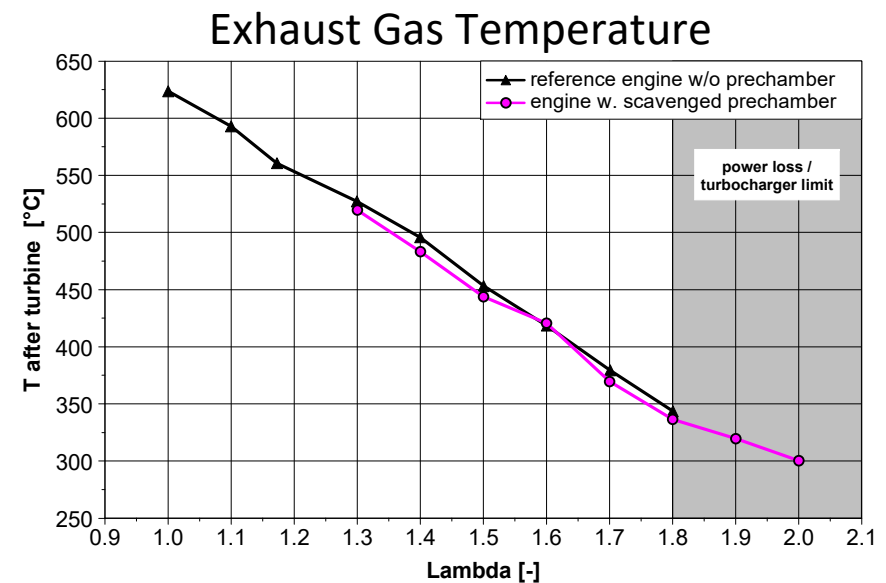
NOx-emission over lambda

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Results



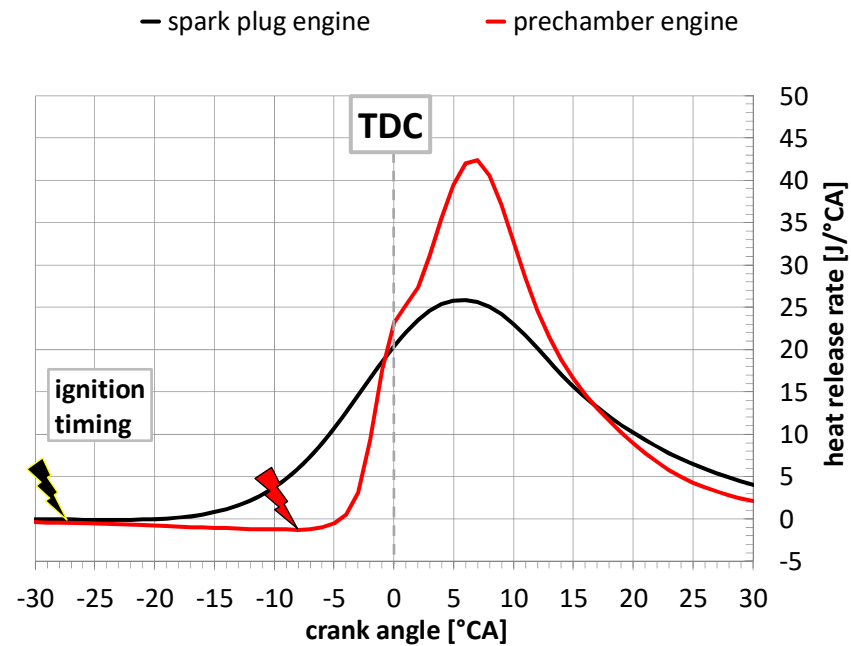
THC Emission over lambda



Exhaust gas temperature over lambda

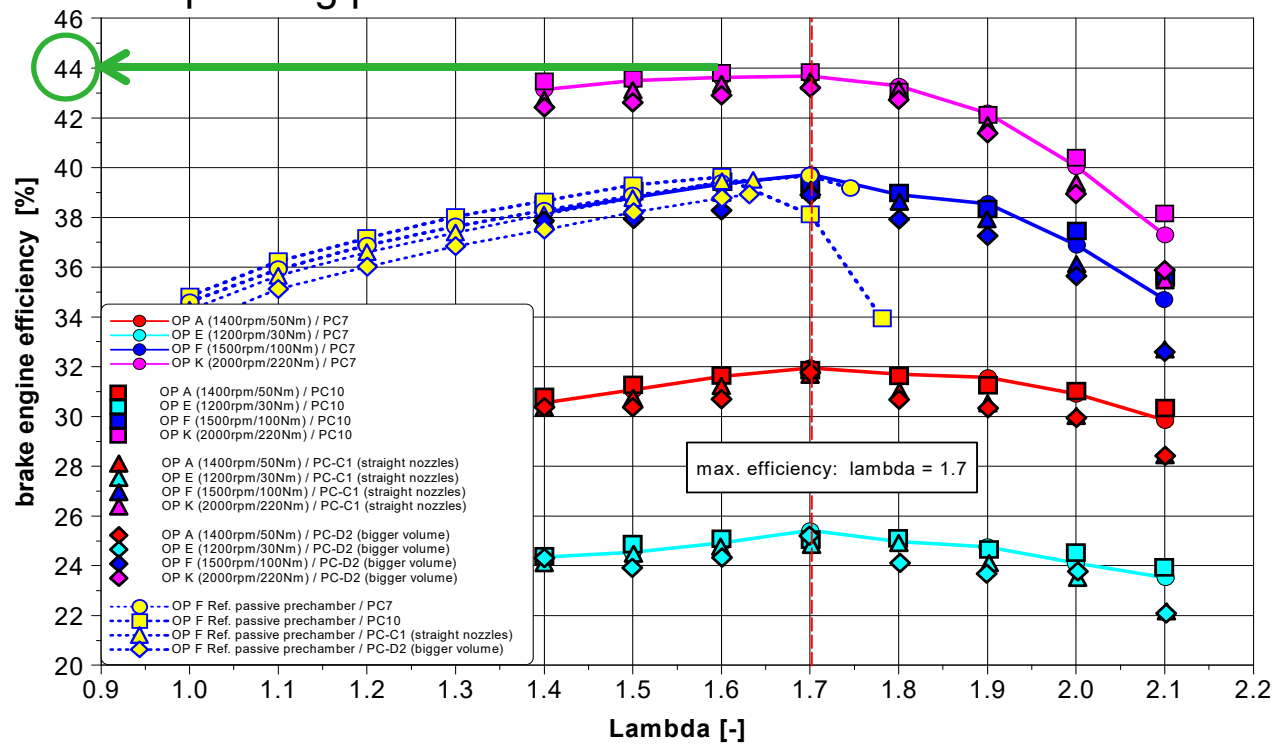
GasOn: Lean CNG Combustion with ignition chamber Results

Later ignition/ faster combustion



GasOn: Lean CNG Combustion with ignition chamber Results

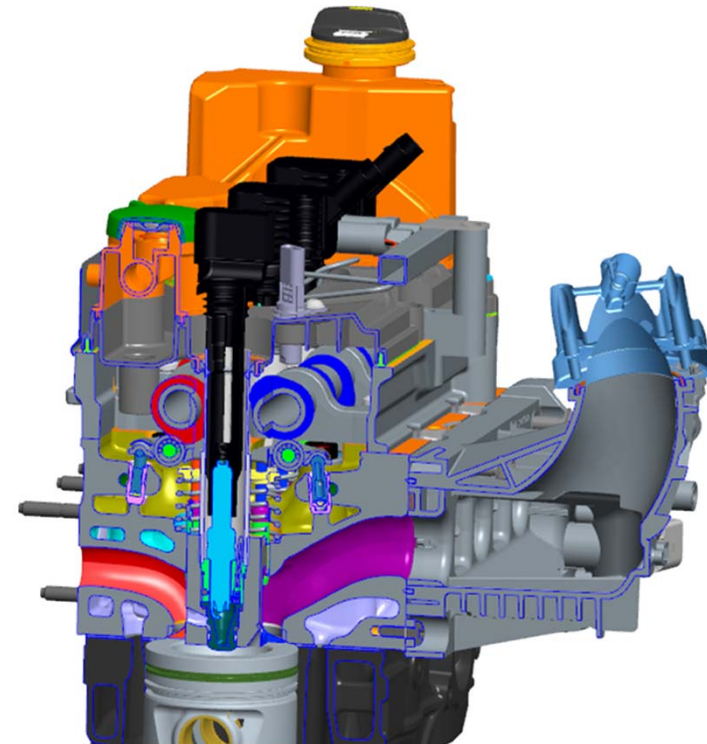
Engine efficiency with lambda sweep in relevant operating points



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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



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Thank you

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