



Competence Center for Gas Exchange



”Charging for the future”



VOLVO

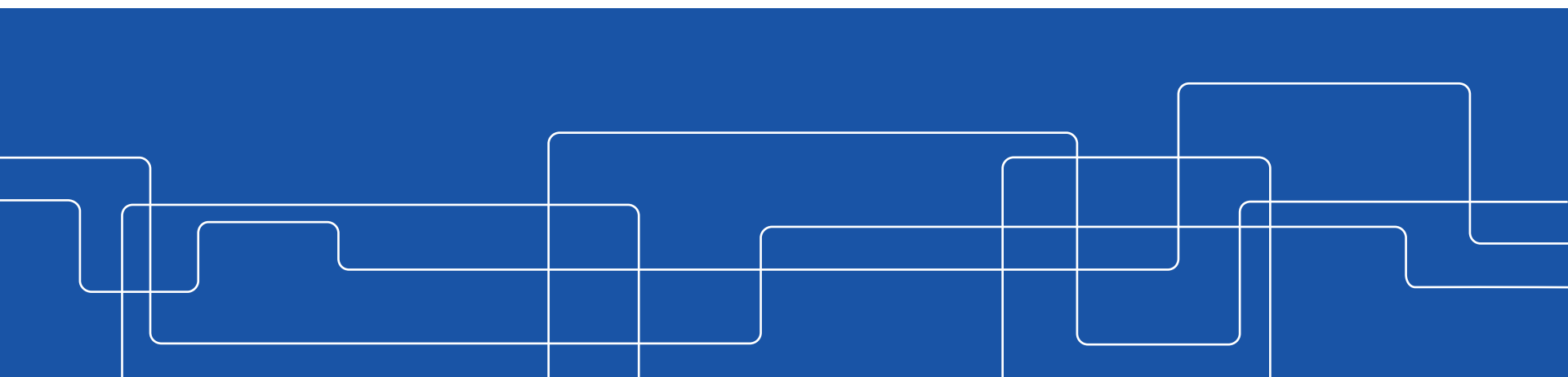


BorgWarner



Heavy Duty DISI Gas Exchange Processes with Alternative Fuels

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VOLVO





Motivation

Alcohol Fuels in HD Engines

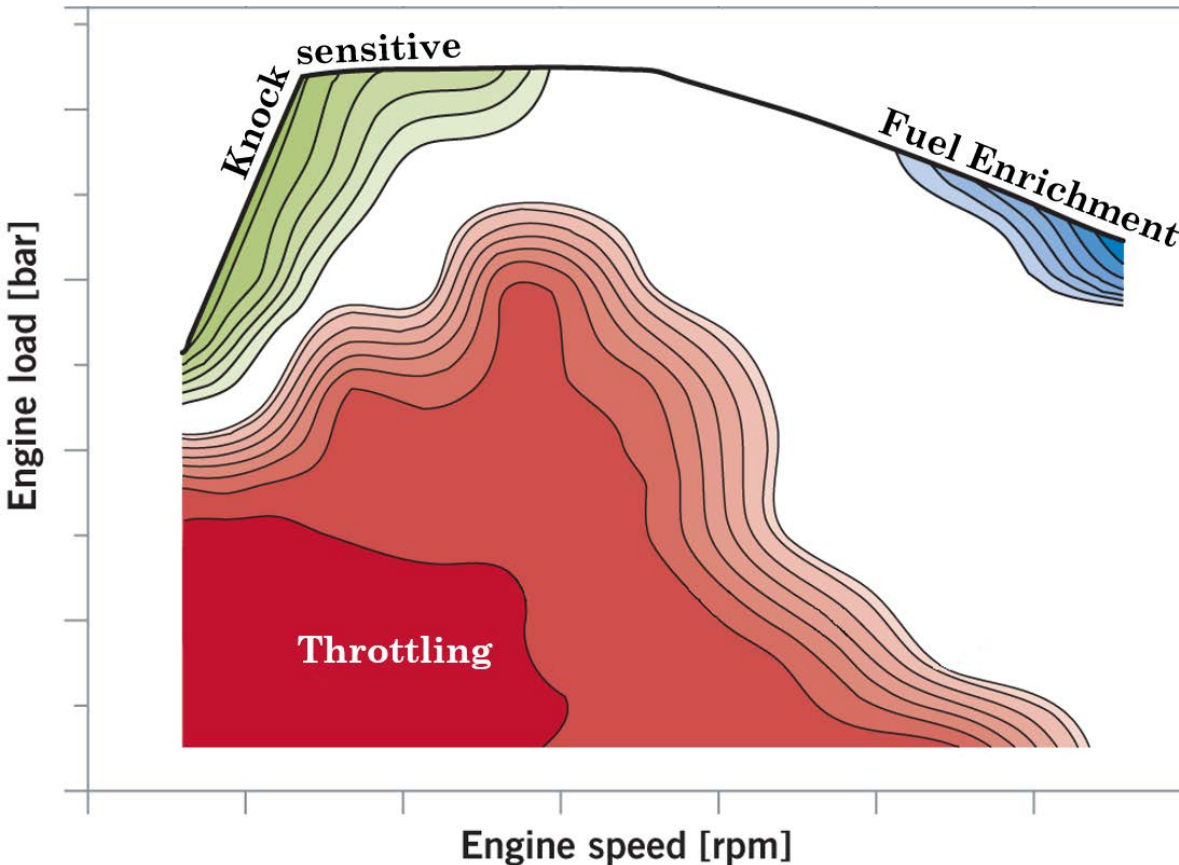
- **Markets**
Renewable source of fuel and reduced imports
- **Direct Injection Spark Ignition**
Improved Efficiency and lower knock tendency

Diesel Power Density

Near Zero Emissions

- **$\lambda = 1$ operation**
Simple after-treatment
Reduced capital costs for fleet owners
- **Oxy Fuel**
Lower Particulate Emissions

Motivation



Limits of SI Engine Efficiency

(Adapted from BorgWarner Knowledge Library Publication (2015))

Alcohol fuels

- High octane
less knocking tendency (+)
- High latent heat of vaporization
lower fuel enrichment (+)
- Lower stoichiometric A/F ratio
higher throttling (-)

**Improvement of throttling is key
for alcohol fuelled engine's
efficiency**



Research Questions

1

What is the attainable load and efficiency in DISI operation (compared to diesel)? What limits performance/emissions

2

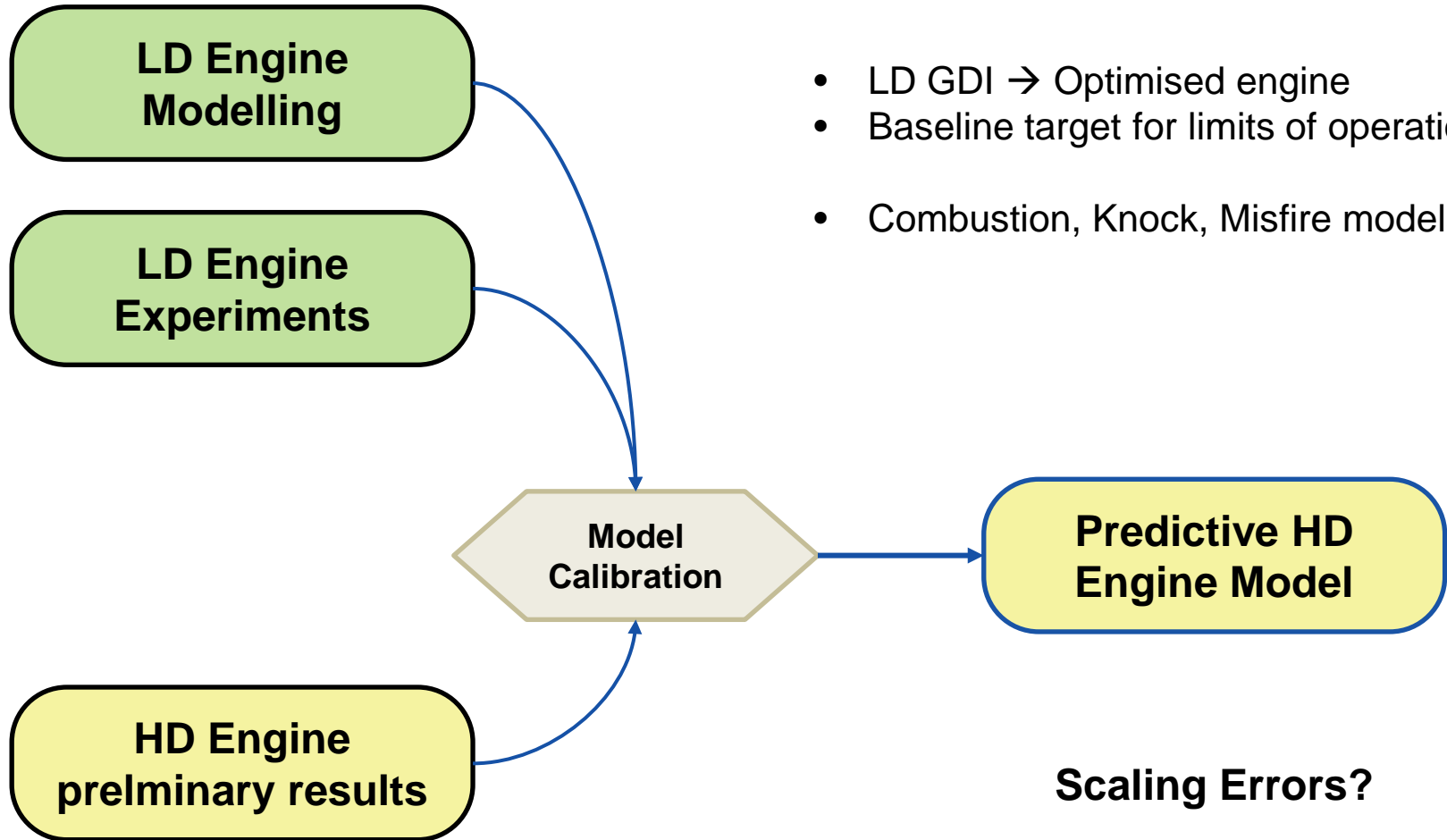
How sensitive is alcohol combustion to residual gases (cooled and uncooled)?

[Comparison of knock and misfire limits with gasoline and projection of gas exchange system architecture for alcohols.]

3

With this combustion process and limits – How can gas exchange system concepts be used to improve performance?

Methodology



- LD GDI → Optimised engine
- Baseline target for limits of operation
- Combustion, Knock, Misfire models

Scaling Errors?



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