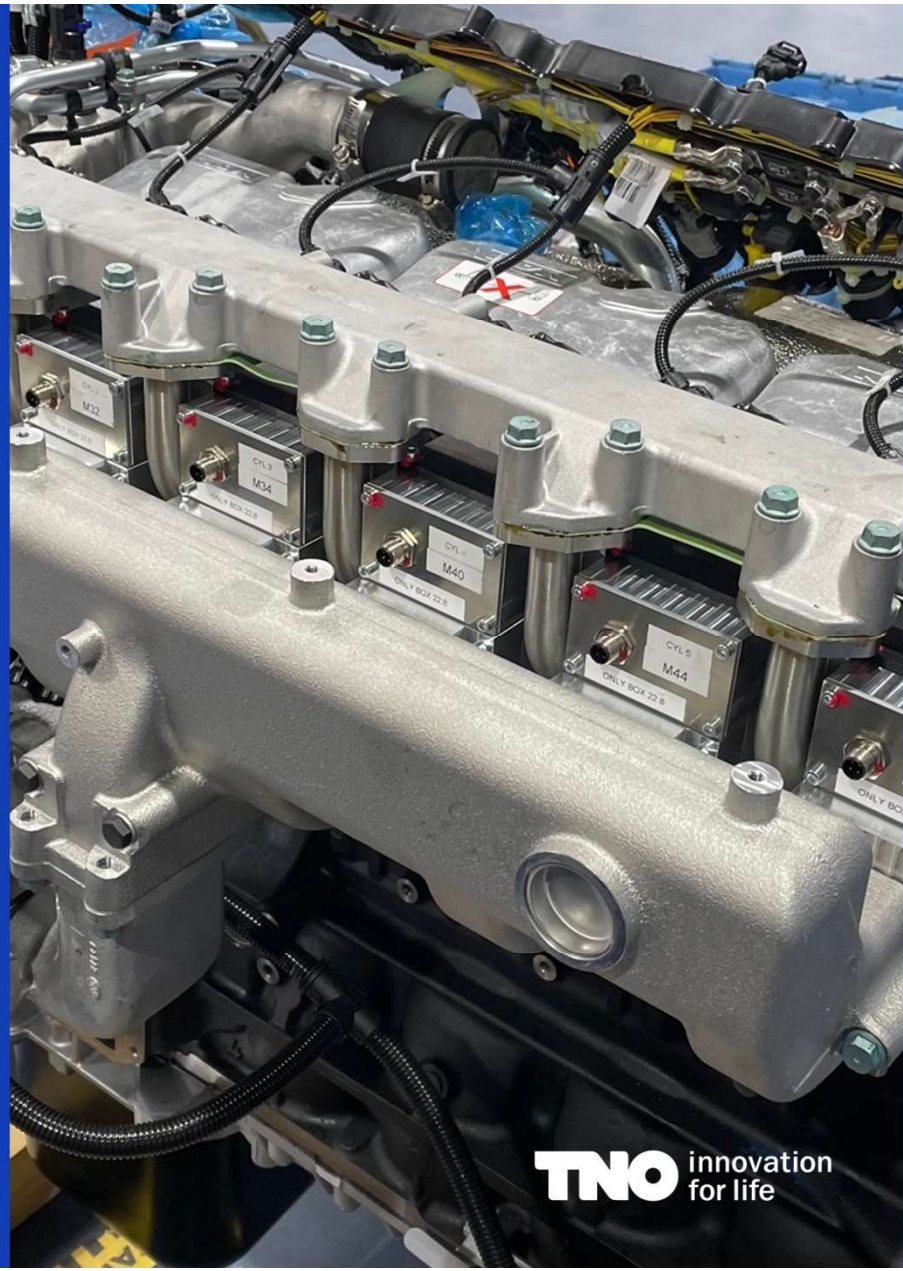
EOCV Technology

An introduction

TNO

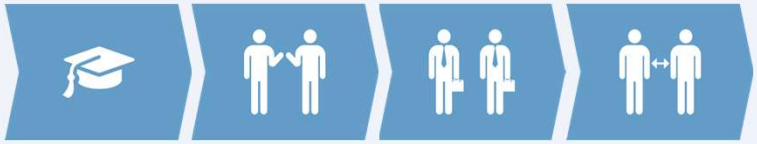


TNO

TNO
The Netherlands Organisation for Applied Scientific Research

- Founded 1932
- Independent
- World wide presence

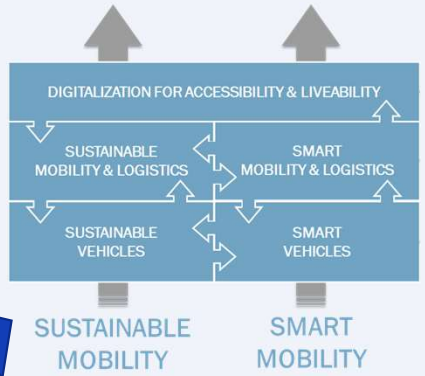
Mission



Develop knowledge and make innovations market ready

Boost the
- competitive strength of industry
- wellbeing of society

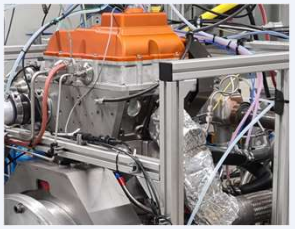
Organised in 6 Units



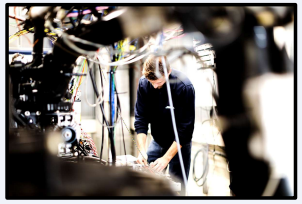
Roadmaps mobility

TNO Powertrains

- Electrified Powertrain Solutions
  - Battery Management (State, Charge, Thermal)
  - Modular Energy Management (MEMS)

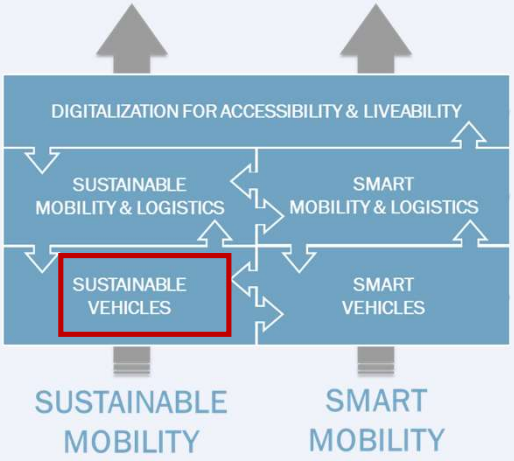


- (Hydrogen) Combustion Technology
  - Hydrogen ICE development for high performance and ultra-low emissions
  - Platform conversion



- Hydrogen Fuel Cells Solutions
  - State-of-health and state-of-function estimation
  - Model-based calibration and validation of the best possible Fuel-Cell – Battery combination

- Innovation Center for Sustainable Powertrains (ICSP)
  - Hydrogen & Natural Gas high pressure infrastructure
  - Battery Competence Center

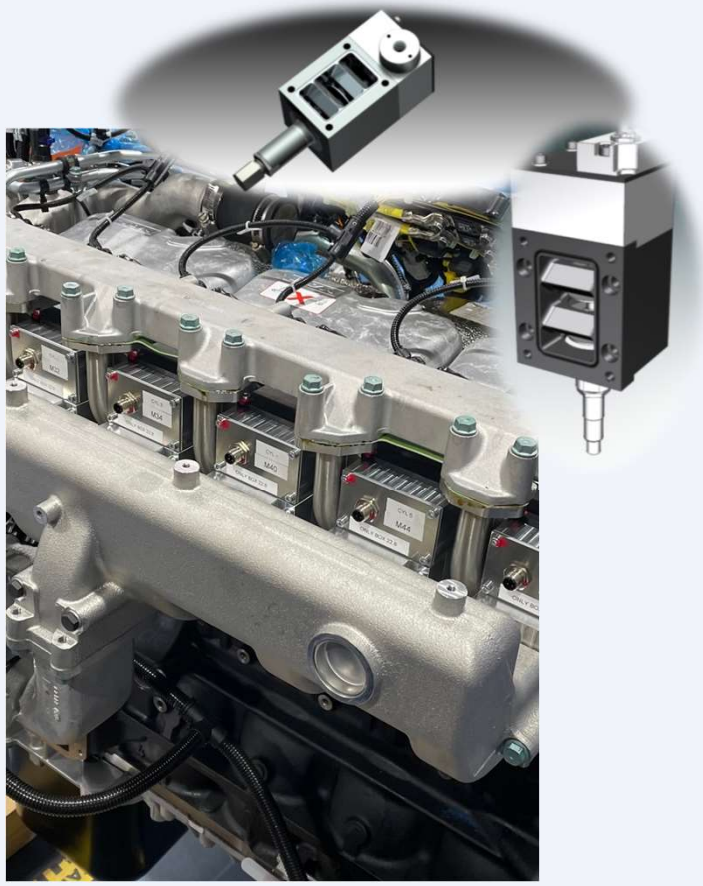


EOCV: Electronically Opening & Closing Valve
Key Functions SI gas engines (NG & H2)

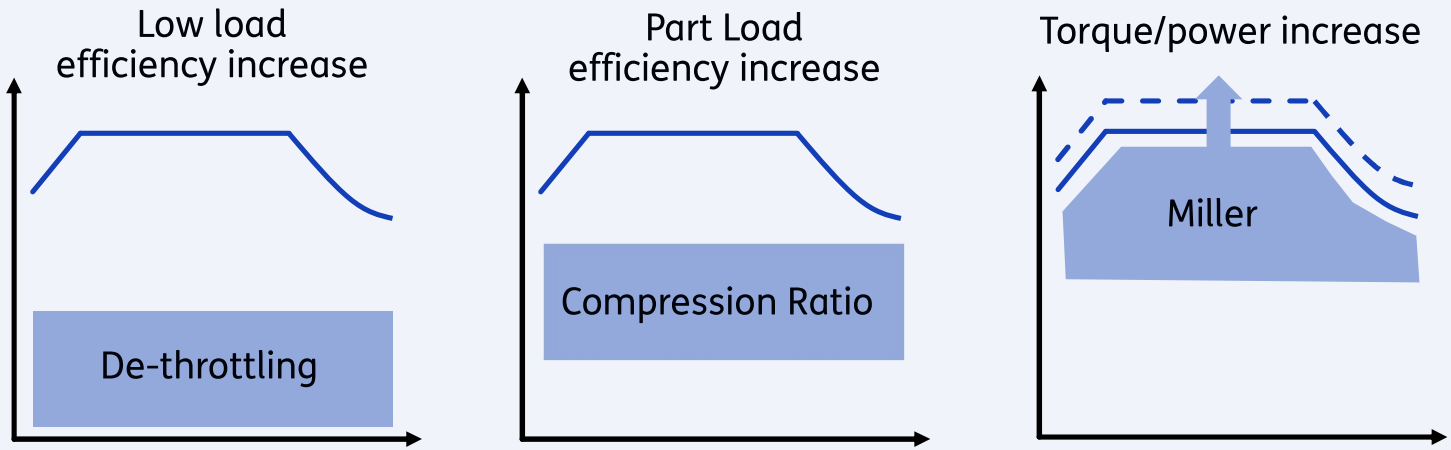
- **Intended/Tested Usage: Cylinder-individual and cycle-resolved Control of Cylinder Charge // Mixture Quantity // Engine Load**

- Reduces intake throttling losses of quantity-controlled engines.
  - Efficiency improvement in part load operation
  - H2-slip reduction for SI- lean H2 engines
  - Ultra-low engine-out emission level without EGR

- Allows Miller timing on demand.
  - Positive Effect on internal mixture cooling (No need for EGR)
    - extending max load curve on NG, optimal ignition timing
    - Allowing using higher geometric compression ratio results in higher efficiency
    - validated for NG fuel, similar results can be expected for Hydrogen internal combustion engines (SI Lean H2)



EOCV: combined functionalities in one device



Cost saving potential and increased performance on power and efficiency

- No need for EGR system (cooler + valve(s))
- No need for new valve train design for adapting a VVA (variable valve actuation) system
- Suitable for Stoichiometric NG and lean H2 SI-engine platforms
- Potential for one engine combustion concept supporting low carbon and carbon free gaseous fuels. (Stoichiometric NG and lean H2)

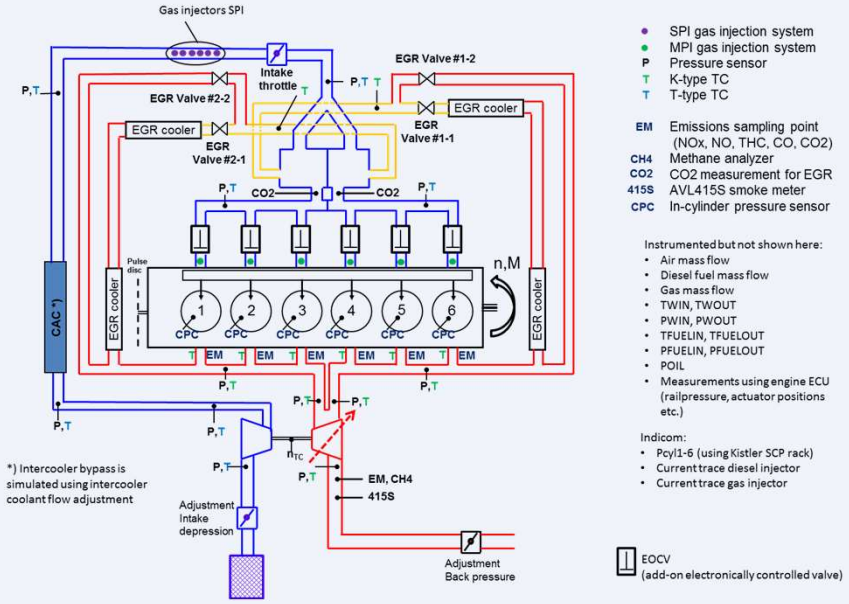
TNO Hands-On Experience with NONOX-EOCV

RCCI research project diesel natural gas

- Research with Japanese OEM: advance combustion RCCI (Reactive Control Compression Ignition) concept with diesel and natural gas.
  Target was to demonstrate EURO VI NOX and CH4 level engine out emission key points.

- The NONOx EOCV was selected due to its high flexibility in creating different engine operation modes without hardware change provides functionality for random operating points and combustion modes

- Additional Outcome of the Study: Extending RCCI Load Range capability (23 bar)




Thank you for your attention