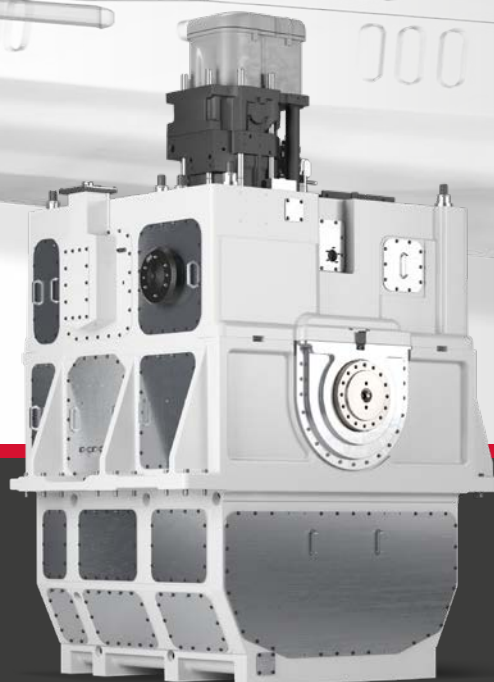




EFFICIENT LARGE ENGINE

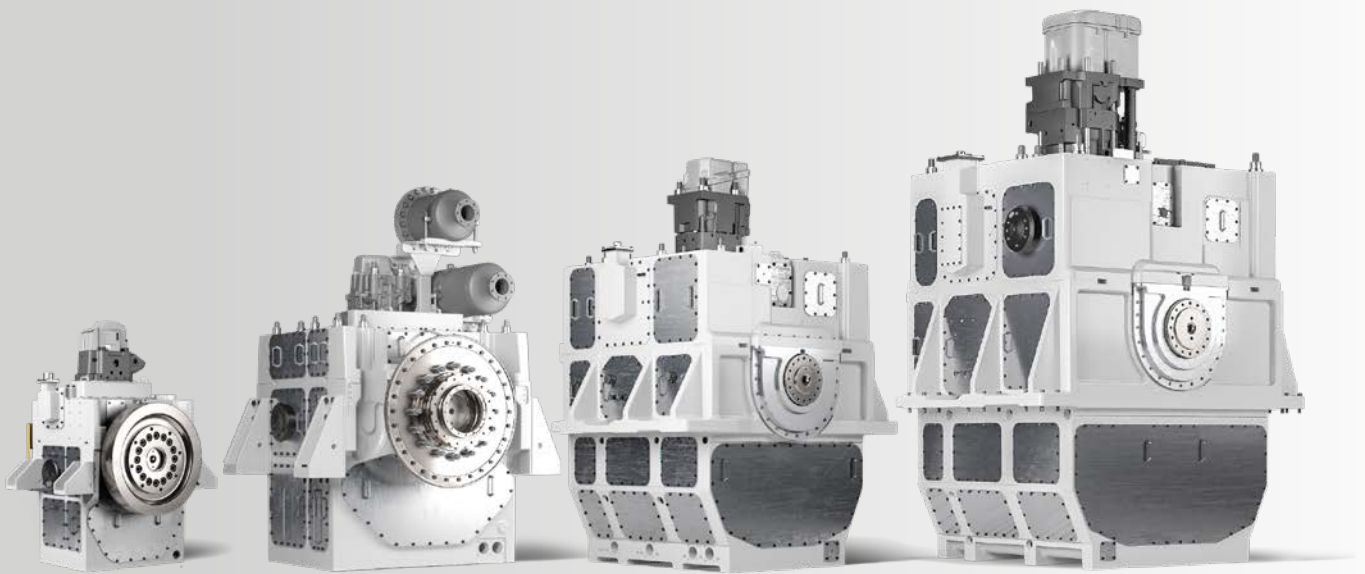
DEVELOPMENT

COMPREHENSIVE SOLUTIONS  
TO FUTURE CHALLENGES



Developing Future Mobility

# COMPREHENSIVE EXPERIENCE RESULTS IN AN EFFECTIVE LARGE ENGINE DEVELOPMENT



FEV offers a full range of large bore engineering services and resources that allow our customers to achieve best-in-class solutions such as:

- > Design and FE analysis
- > Mechanical engineering
- > Industrial design
- > Combustion system development
  - Diesel
  - Dual fuel
  - Gaseous fuel
- > Efficient methods
- > Single cylinder engine (SCE)
  - High speed engines
  - Medium speed engines

- > Engine and exhaust aftertreatment system calibration
- > Engine controls and OBD
- > Certification services like emission certification
- > Propulsion and energy system layout
- > Electrification/hybridization of drive systems
- > Supplier management, localization support, life cycle management
- > Big data analysis and condition base monitoring solutions

FEV supports its customers and meets project requirements by developing new systems and components and by optimizing existing systems. We create roadmaps that offer a view into the future; they

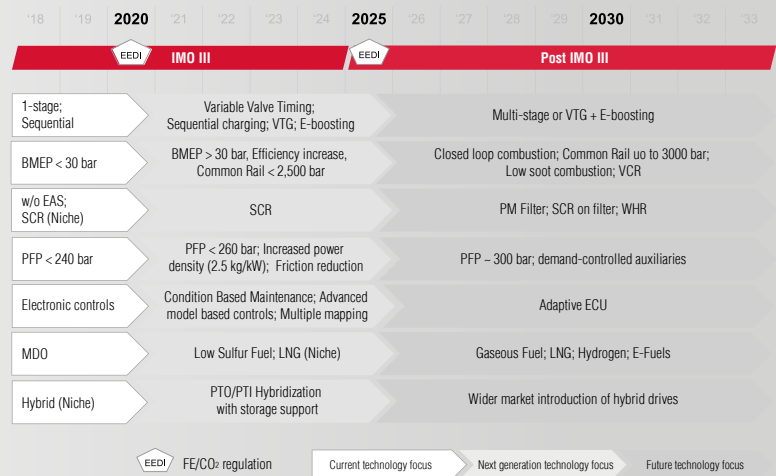
leverage available technologies and consider all of the engineering disciplines. FEV offers rich large bore engine experience and has completed many engine design and development programs for the world's large bore engine industry.

For more than 30 years, we have provided comprehensive experience in large engine design and development to our customers and we continue to support them, today and in the future.

# LATEST TECHNOLOGIES ARE CONSIDERED TO ACHIEVE FUTURE TARGETS

At FEV, large engine development projects are performed with advanced tools and methods:

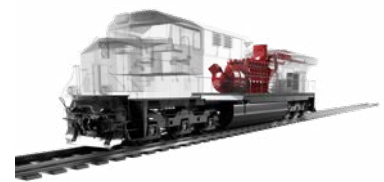
- » The unique FEV Firing Order Investigation tool
- » Vibrations are assessed by MBS simulations before the first prototype exists
- » Accurate prediction of emissions-BSFC across hardware changes via 1D and 3D simulations
- » High efficient gas engine solutions with optimized charge motion, combustion chamber layout and knock control
- » Combustion system optimization considering thermodynamic performance as well as thermal load
- » Complete set of ECU functions for diesel and alternative fuels engines
- » Advanced algorithms for condition based monitoring systems



Concept/Detailed design and simulation



Prototype Development



Field Testing

SOP

Requirements definition

- |               |                 |
|---------------|-----------------|
| Fuel          | Performance     |
| Manufacturing | Retrofitability |
| Appearance    | Safety          |
| Power         | Reliability     |
| Innovation    | Serviceability  |
| Cost          | Noise           |
| Quality       | Efficiency      |

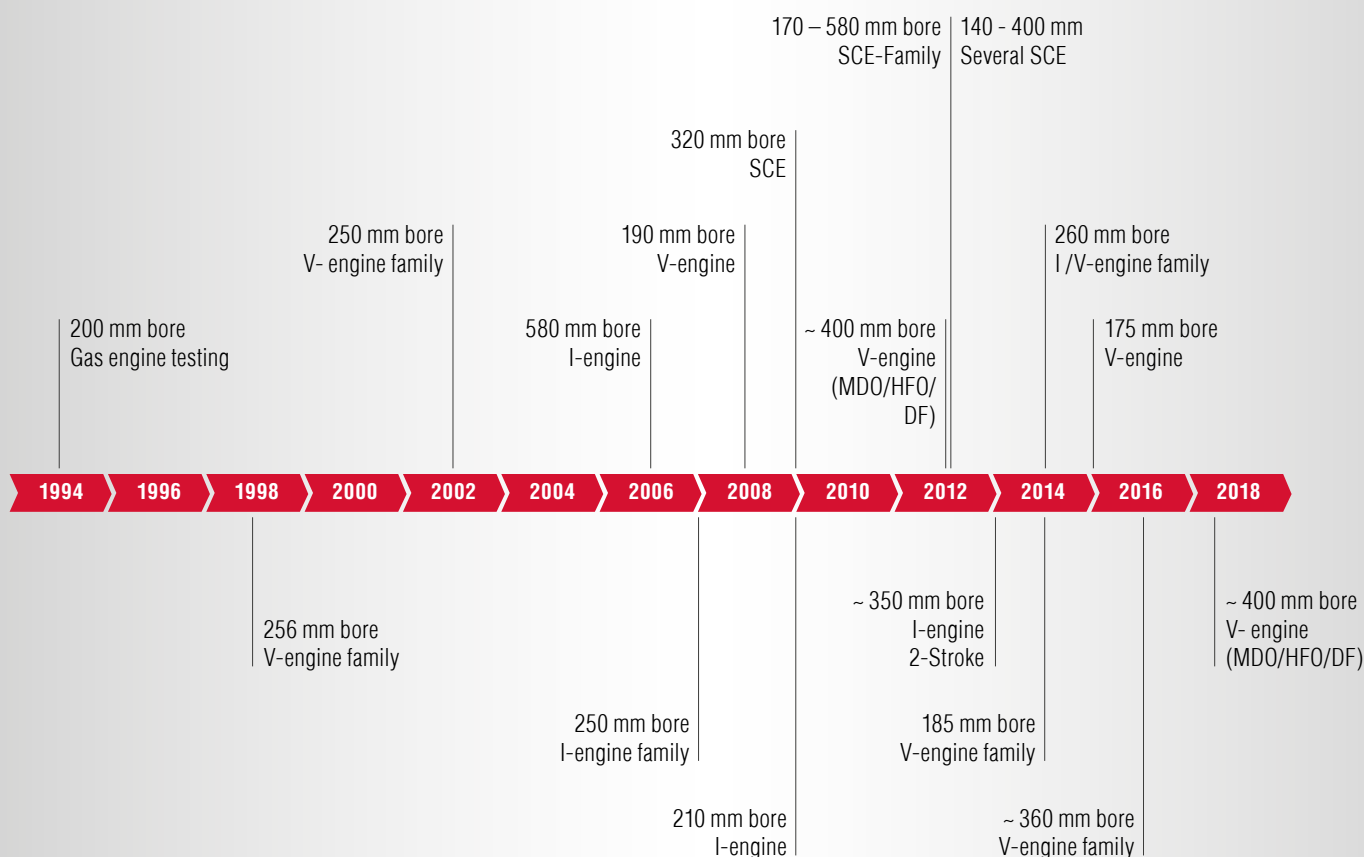
Combustion Development SCE



Function and Durability Testing (MCE)



**FEV large engine development experience**  
**Project examples**



/fevgmbh  
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