



# MODEL BASED CALIBRATION

Engineering enhanced models for engine and EAS systems to enable virtual testing in MiL and HiL environments

## THE CHALLENGE

New legislation requirements, e.g. Real Driving Emissions (RDE), higher system complexity and significant increase in number of xCU-functions require a new approach in powertrain calibration – enabling emission calibration tasks from concept to type approval.

## AVL APPROACH

With MOBEO (Model Based Engine Optimization) AVL offers an engineering enhanced approach for model generation and model integration of real time capable and highly accurate emission models. The tool chain itself is based on the AVL CRUISE™ M system simulation framework and supports a distinctive workflow combining simulation and testing.

MOBEO models provide pre-defined engine and EAS models for Gasoline and Diesel combustion systems and automated parametrization wizards to ensure an effective model setup and scalable model usage.

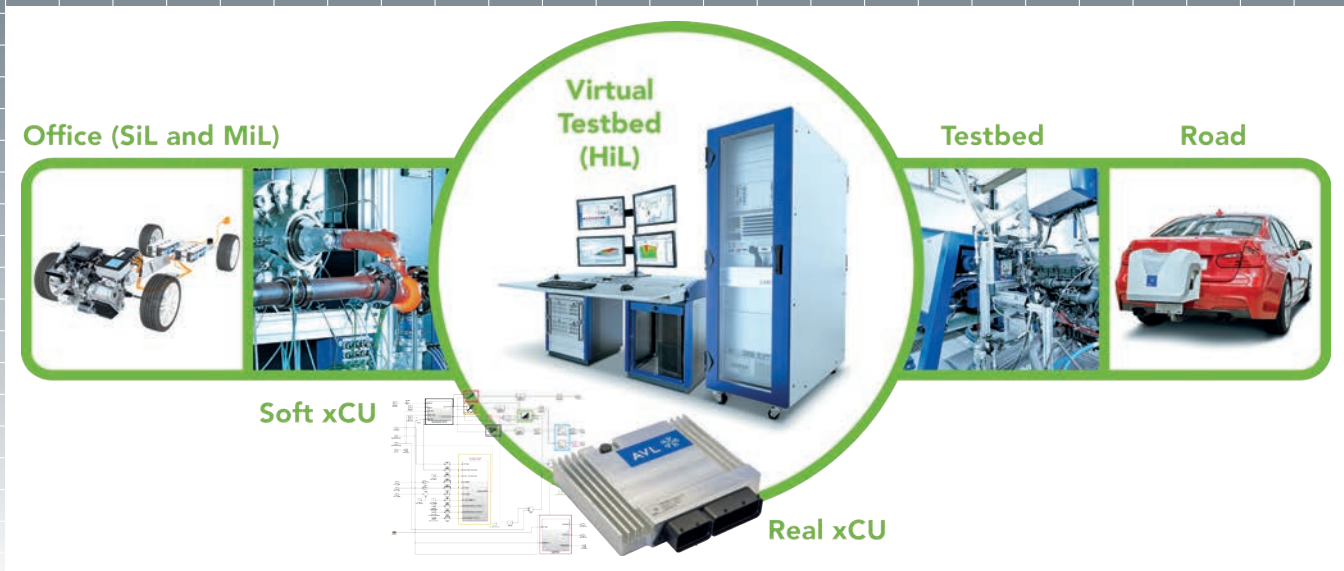
## THE AVL SOLUTION

MOBEO models are characterized by the following features:

- Real time capability in office and HiL environment
- Optimal trade-off between parametrization effort and model accuracy
- Outstanding extrapolation capabilities covering non-standard engine and EAS operations
- Excellent transient behavior within the entire operating map and all engine modes

## THE ADDED VALUE

- Reduced calibration cost due to the usage of cost effective test environments (MiL and HiL) and reduction of prototype hardware
- Increased system robustness due to fact based concept decisions, model based function development and optimized system robustness
- Reduced project timing for calibration due to high degree of automation, avoidance of bottle necks in testing, reduction of the test matrix
- Structured support to prepare for calibration tasks prior to expensive testing campaigns and vehicle trips.



**AVL CRUISE™ M MOBEO SUPPORTS A CONSISTENT WORKFLOW FOR MODEL GENERATION AND MODEL USAGE FOR THE FOLLOWING – EMISSION RELATED – CALIBRATION TASKS:**

#### **ENGINE/EAS – CONCEPT LAYOUT**

MOBEO as part of AVL's multi-disciplinary system simulation tool AVL CRUISE™ M is used in the concept phase for:

- Detailed investigations of different engine and EAS variants (selection of best systems)
- Transient investigations of system behavior
- Consideration of RDE requirements (including full useful lifetime performance)
- Definition of a clear test matrix considering reduced testing effort
- Fact based system layout decisions to achieve a certain emission requirement
- Initial definition of operating strategy

#### **PLANT MODEL FOR CONTROLS AND FUNCTION DEVELOPMENT**

MOBEO is providing a realistic and fast running plant model of the powertrain system in the early stage for control SW development to develop functions such as

- Air/path control
- DPF regeneration strategies
- Purge co-ordinator
- Advanced EGR controls
- Controls for SCR and LNT systems
- On-Board Diagnostics (OBD) functions

#### **VIRTUAL CALIBRATION**

MOBEO models can be easily compiled to all leading real time platforms and be used in controlled loop with the xCU for virtual calibration tasks, such as

- SW Check of initial calibrations
- Pre-calibration up to 70% calibration maturity
- Calibration for non-standard ambient conditions
- Calibration of component protection
- Vehicle/Engine derivate calibration
- RDE evaluation
- Real world fuel consumption optimization
- Sensitivity studies taking into account system interactions
- Software and dataset validation

#### **ROBUSTNESS INVESTIGATIONS**

MOBEO allows to study the impact of stochastically changes of external and internal engine and EAS factors on the overall robustness of the calibration. Model based robustness investigations allow to evaluate the system behavior in the following areas:

- Investigating the behavior of OBD monitors in the field and avoidance of false OBD events
- Optimizing sensor and actuator tolerances to investigate system sensitivities on overall emission performance
- CoP and ISC support over the complete vehicle fleet and over the entire product life cycle

**FOR FURTHER INFORMATION PLEASE CONTACT:**

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