evs 27

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Model-Based Eco-Driving and Integrated Powertrain Control for (H)EV

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Outline

1. Introduction TNO
2. Motivation
3. Driver efficiency
4. Eco-Driving
5. Integrated Powertrain Control
6. Conclusions

Introduction TNO

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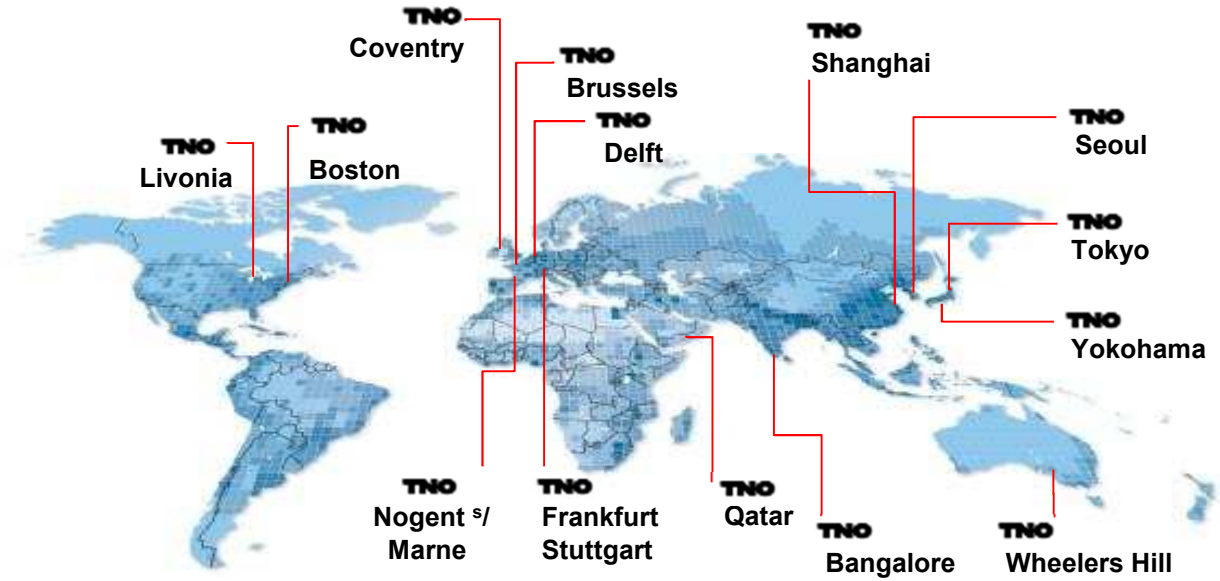
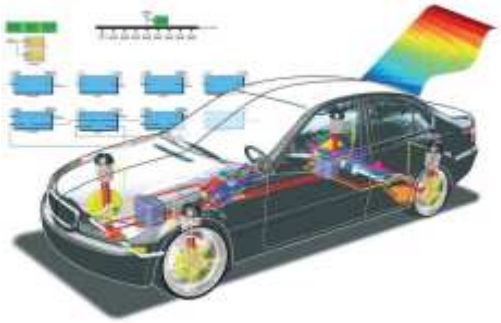


- TNO is the Netherlands' Organization for Applied Research
- Independent R&D organization
- Spin-off companies (e.g. tass)
- Over 75 years of experience
- 4,000 employees world-wide
- HQ in Delft, the Netherlands
- Annual turnover approx. 550 M€

TNO Powertrains – R & D

- Detailed Powertrain Modelling
- Energy and Emission Management
- Battery modelling and state estimation

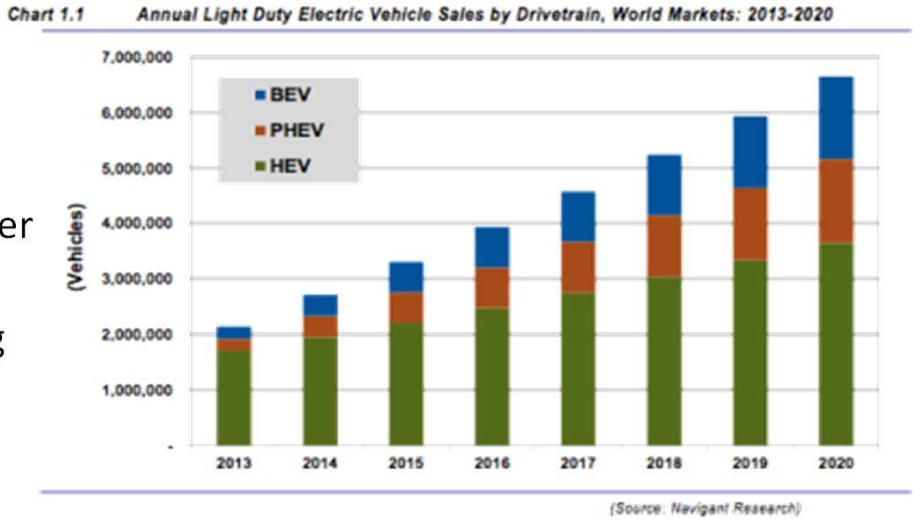


Motivation

Increasing number of (H)EV's

(Navigation Research)

- Light Duty: BEV, PHEV and HEV will roughly triple over the next 7 years
- Electric busses: annual growth rate of 26%, meaning that by 2018, 75000 electric drive busses will be on roads worldwide



Energy efficiency and limited range:

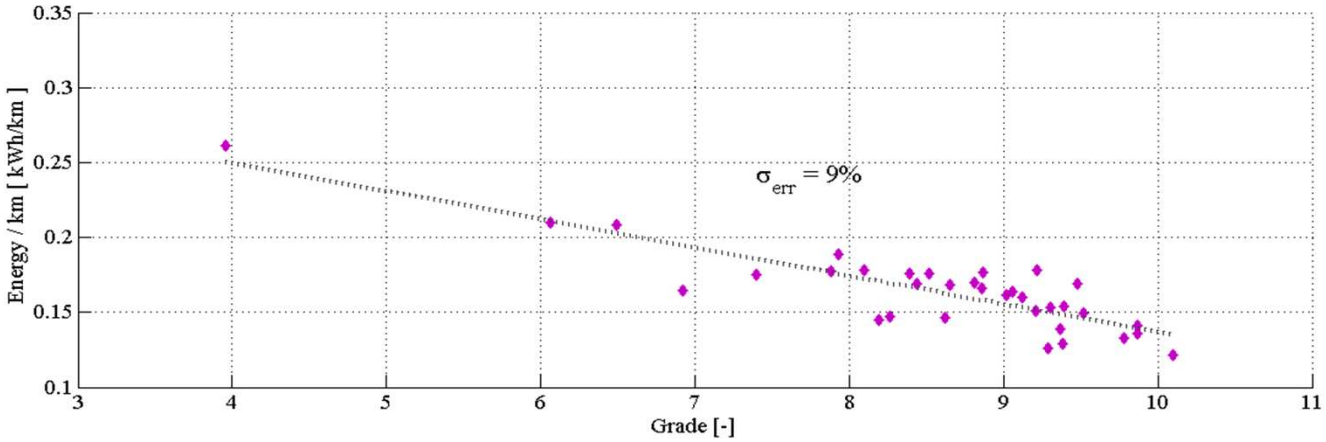
Driver-Route-Vehicle

- Assist driver to perform more energy-efficient
- Offer accurate range prediction
- Energy management

Driver efficiency

Significant influence of driving style on energy consumption

- Clear correlation driver/energy
- Variations up to 50%



Human factors: driver support and interface quality

- Acceptance (driver types and personalization)
- Distraction

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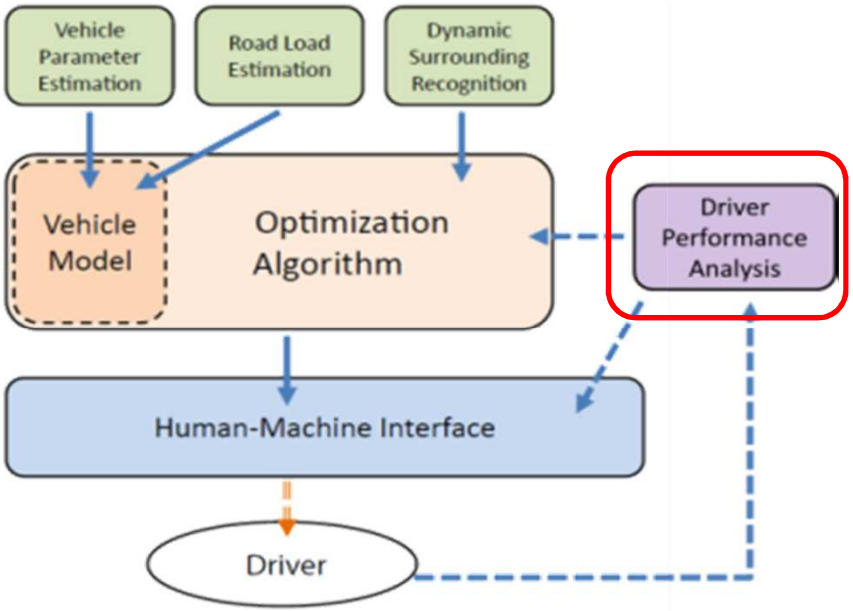
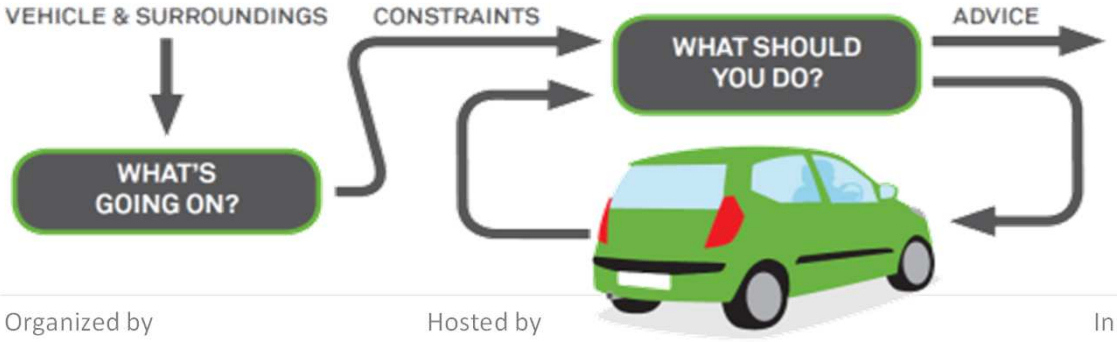
Eco-Driving

Approach





ecoDriver

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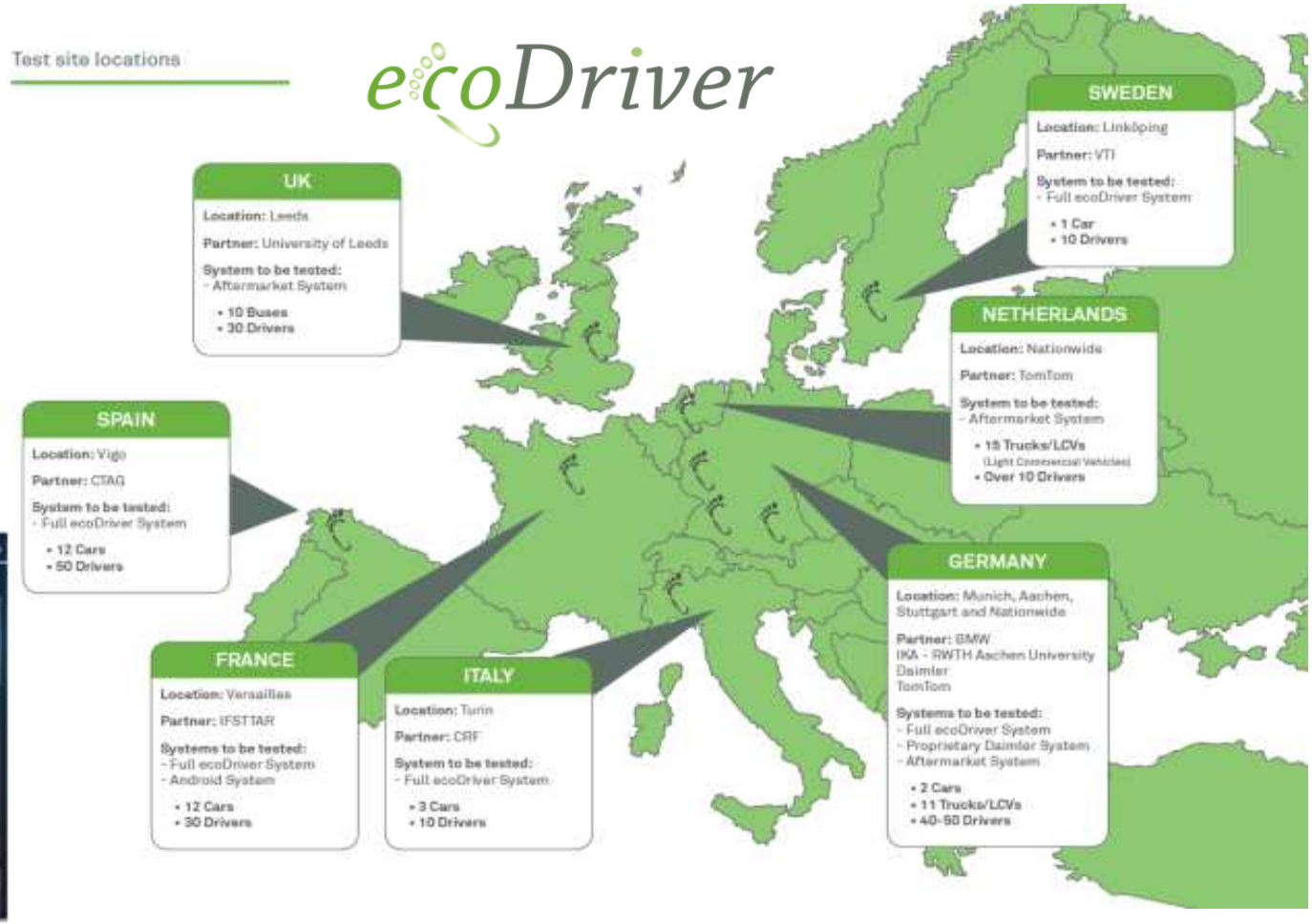

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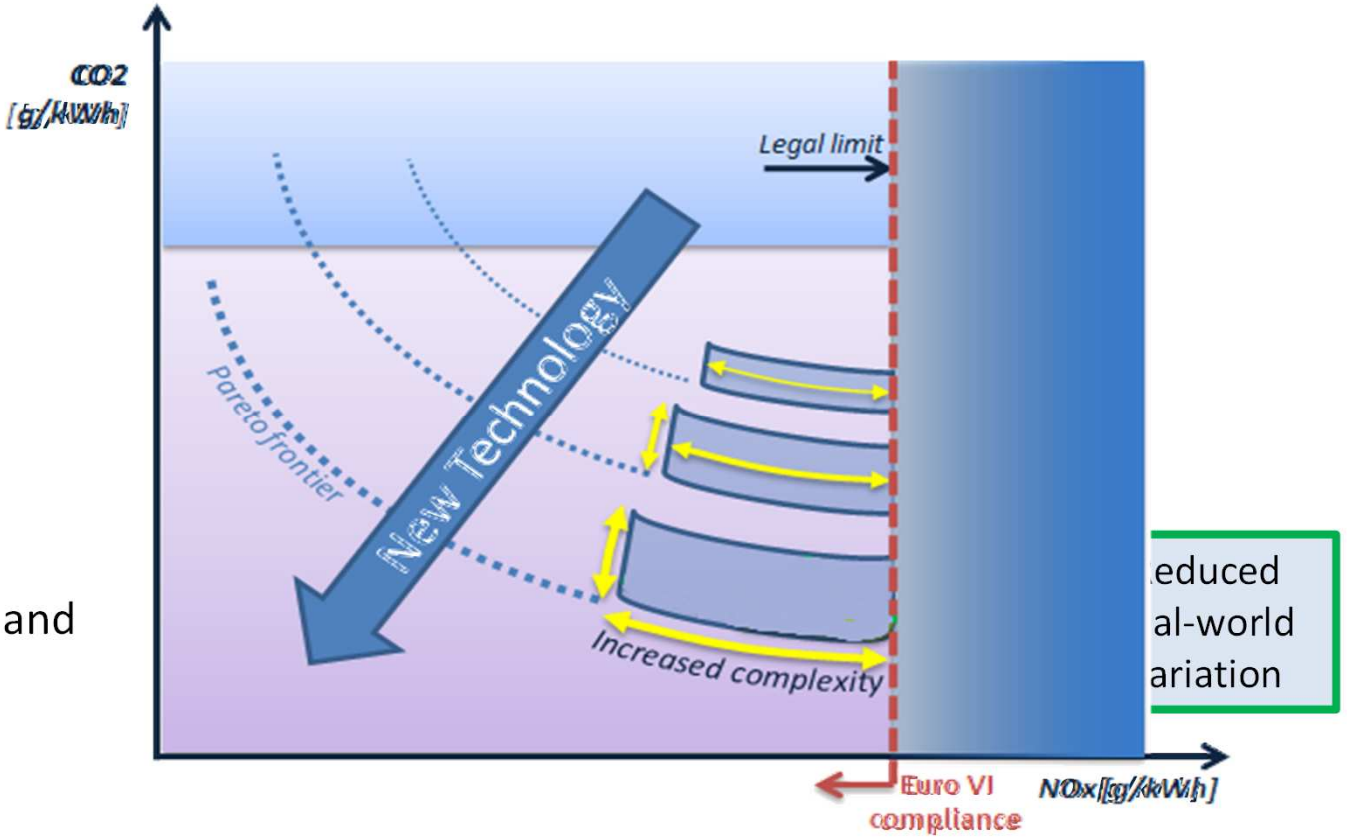
Integrated Powertrain Control

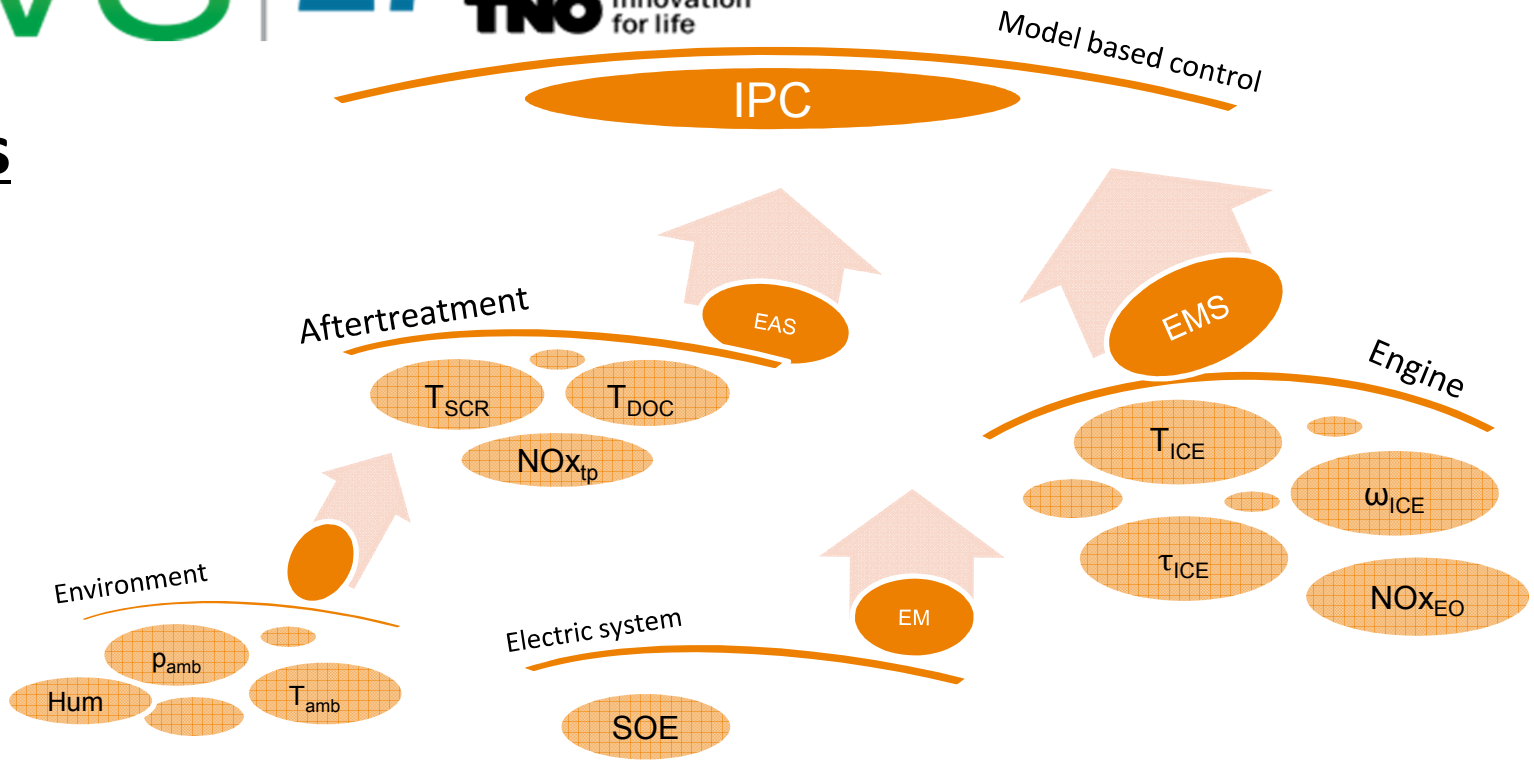
Context

- New technology (e.g. hybridization) helps CO^2-reduction
- But: increased complexity
  - More DoF
  - More real-world variance
- IPC offers solution
- Exploitation of system interactions in a systematic and modular way



Integrated Powertrain Control

States

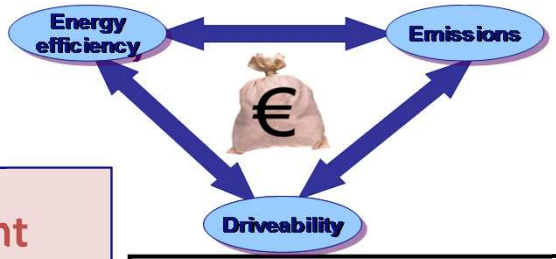


Online optimization based on all relevant component states:

Integrated powertrain control (IPC)

Integrated Powertrain Control

Control



Integrated Energy & Emission Management

Benefits model-based approach:
- Exploit synergy subsystems
- Reduced development time
- Reduced calibration time
- Reduced system costs

Drivetrain control
WHR control
Fuelling
Air manag.
DPF control
SCR control

Fuel

Engine
Aftertreatment
Emissions

WHR

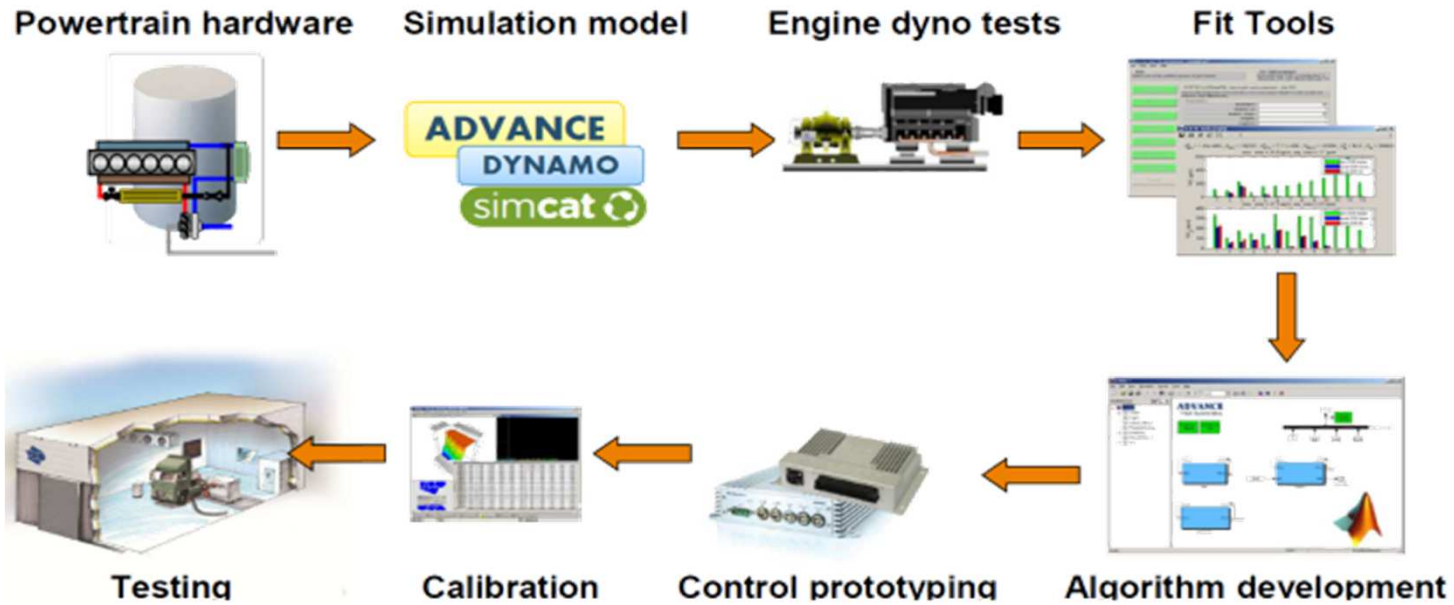
E-Machine

Driveline

Fuel consumption, power output

Integrated Powertrain Control

Tool chain



Conclusions

- Model-based approach improves energy efficiency for both driver and vehicle
- Combination of driver assistance and advanced powertrain is preferred
- Less emissions (HEV) and less range anxiety (EV)!

Thank you for your attention!

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You are also welcome at the tass international booth G710

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