Task 17
System Optimization and Vehicle Integration

Update on recent activities

Gwangju, May, 2015

public

Austrian Association for
Alternative Propulsion Systems (A3PS)

Table of contents

- **Task 17 (Short Overview)**
- ***Workshop: Power Electronics and Drive Train Technologies for Future xEVs***
  - Overview
  - Topics
  - Participants
  - Outcome
- **Task 17: Next/ Final Steps**

Task 17 - Definition and Scope

IEA INTERNATIONAL ENERGY AGENCY
HYBRID & ELECTRIC VEHICLE IMPLEMENTING AGREEMENT

- **System Optimization and Vehicle Integration**
  - Analyzes technology options for the optimization of EV components and drive train configurations which will **enhance** the **vehicle energy efficiency performance**

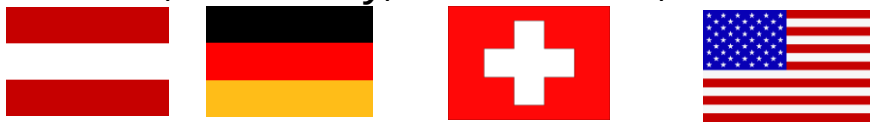
- **Scope** of Task 17
  - Analyzing of existing component technologies and their development potential
  - Theoretical possible operation and configuration concepts
  - Monitoring and analysis of progress in design and configuration
  - Investigation of the potential of new system configurations for the specific opportunities and challenges of different applications and vehicle classes

Task 17 - Short Facts

IEA INTERNATIONAL ENERGY AGENCY
HYBRID & ELECTRIC VEHICLE IMPLEMENTING AGREEMENT

- Running Time: 2010 - 2015
- Technological oriented
- Member Countries:

  Austria, Germany, Switzerland, United States



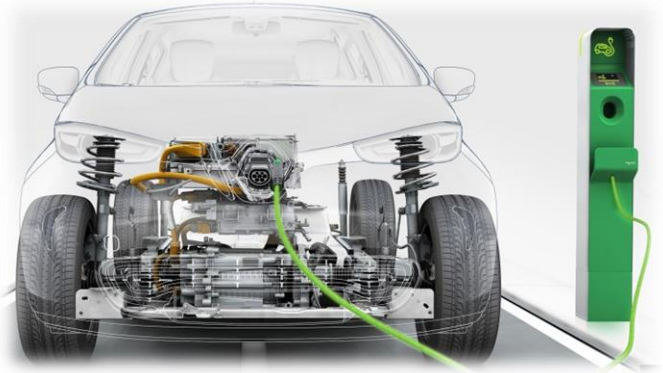


Image courtesy of Renault

- Activities in this Task include:
  - Technology assessment studies
  - Information sharing
  - **Experts meetings (Workshops)**
    2010-2015: **ten workshops took place**

Task 17 - Working Methods

IEA INTERNATIONAL ENERGY AGENCY
HYBRID & ELECTRIC VEHICLE IMPLEMENTING AGREEMENT

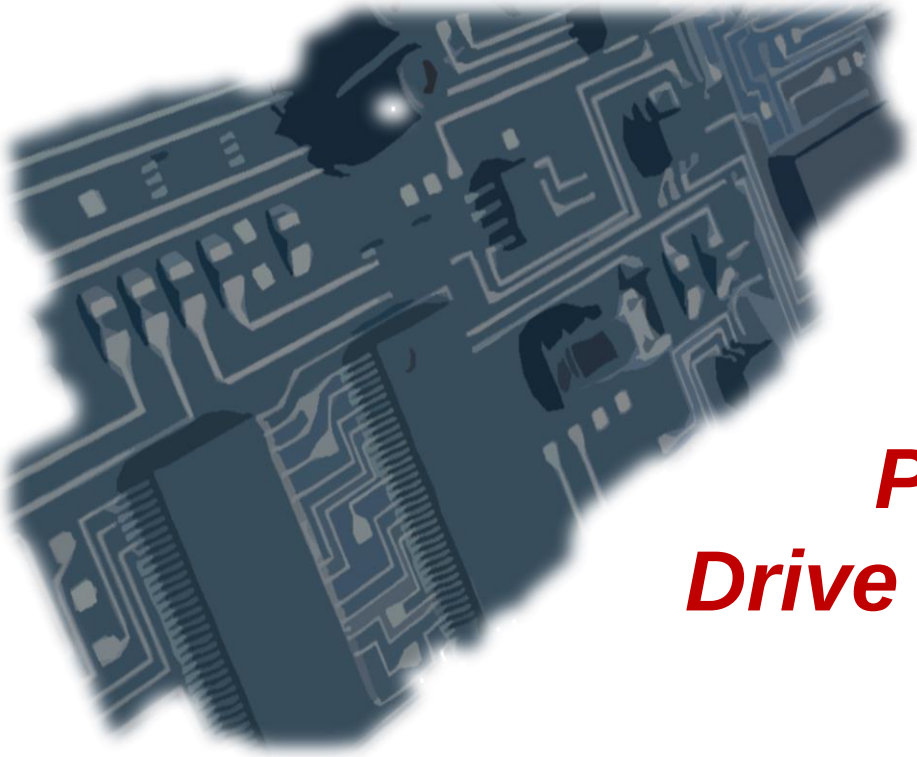
The wide bandwidth of treated topics covered:

- **Components**: batteries, e-motors,…
- **Performance Assessment:** comparison of different configurations
- **Simulation Tools,**
- **Thermal Management,**
- **Battery Management,**
- Functional and Innovative **Lightweight Concepts**
- **Power Electronics** and **Drive Train Technologies**

Image courtesy of Magna Powertrain

Final Task 17 - Expert Workshop

IEA INTERNATIONAL ENERGY AGENCY
HYBRID & ELECTRIC VEHICLE IMPLEMENTING AGREEMENT



Power Electronics & Drive Train Technologies for future xEVs

16th April, Berlin (host: VDI/VDE/IT)

Task 17 - Workshop - Overview

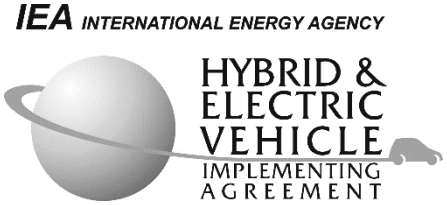
IEA INTERNATIONAL ENERGY AGENCY
HYBRID & ELECTRIC VEHICLE IMPLEMENTING AGREEMENT

- **Titel:** ***Power Electronics & Drive Train Technologies for future xEVs***
- **One-Day Expert-Workshop (16.04.15)**
- **Host: VDI/VDE-IT GmbH (Berlin)**
- **Organisation: A3PS-Office**

Image courtesy of Berlin Brandenburg

- **Speaker and Participants:** 20 persons (Industry, R&D, Policy, IEA)
- **Speakers from:** Austria, Belgium, France, Germany, Switzerland, USA

Task 17 - Workshop
Speaker & Participants - Overview



Task 17 - Workshop - Background

- Automotive industry: traditionally mechanical based but the amount of software/electronics is increasing rapidly → challenge
- Customer demands for ADAS, convenience functions, connectivity, autonomous driving → systems are becoming increasingly complex
- xEVs present unique challenges
  Change to e-technologies → modification of drive train components → fundamental technology turnaround → complex system
- Complex system requires software in the powertrain
- Optimal use of electronics/software in vehicles is THE prerequisite challenge in order to meet all requirements of cooperative vehicle safety, the adaptive vehicle management, electrification and automated driving

Task 17 - Workshop - Aim

IEA INTERNATIONAL ENERGY AGENCY
HYBRID & ELECTRIC VEHICLE IMPLEMENTING AGREEMENT

- Aim of the workshop: summarize & communicate:
  - The status and prospects of **Power Electronics and Drive Train Technologies**
  - Give an introduction about **E/E-Architecture and Intelligent Controls** in order to enhance the overalls vehicle performance.
  - Discuss the **synergies of Automated Driving and Electric Vehicles**
  - Collect ideas for a follow-up task → Gereon Meyer

Image courtesy of BMW

Image courtesy of Autoevolution

Task 17 - Workshop - Impressions

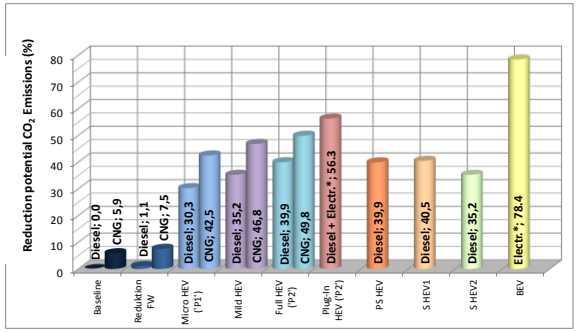
Task 17 - Workshop - Examples

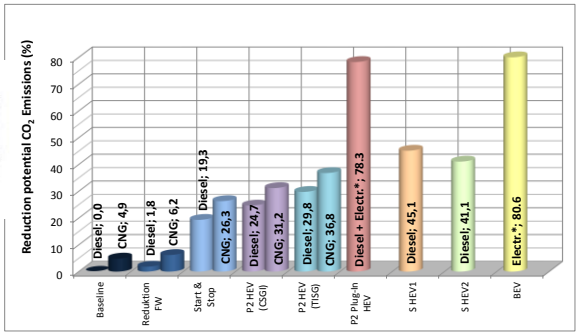
IEA INTERNATIONAL ENERGY AGENCY
HYBRID & ELECTRIC VEHICLE IMPLEMENTING AGREEMENT

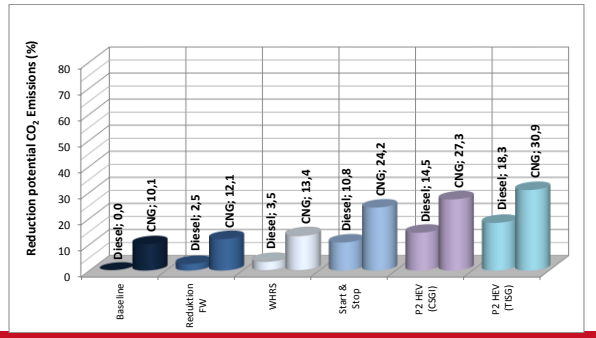
- **Efficiency Improvement Potentials for Light-, Medium- and Heavy Duty Trucks via Hybridization and Electrification in Urban and Sub-Urban Traffic**
  - Start-Stop and Mild HEV offer high CO_2-reduction potential at relative modest add-on costs
  - PHEV almost as good as BEV with advantage of wider range and much lower costs
  - No single best solution but a „best solution“ in each vehicle class, depending on the profile of the transport tour and the related load profile tour of the powertrain

Image courtesy of AVL

Reduction potential CO2 emissions vs. type of vehicle







Task 17 – Workshop - Examples

- ***ARMEVA- Advanced Reluctance Motors for Electric Vehicle Applications***
  - Development of a new rare-earth-free generation of advanced reluctance motors
  - Development of multiphysics simulation models for advanced reluctance motors
  - Comparative assessment to select optimal motor topology for EV's
  - Development of an integrated electric drive system.

Electric Drive System

SRM Drive integrated in PHEV Powertrain

Image courtesy of Punch Powertrain

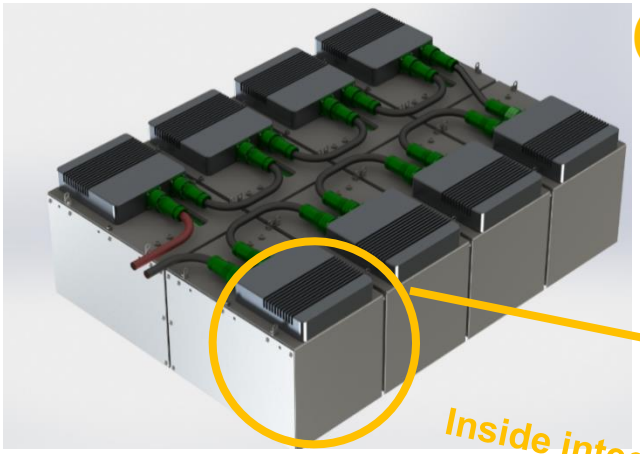
Task 17 - Workshop - Examples

IEA INTERNATIONAL ENERGY AGENCY
HYBRID & ELECTRIC VEHICLE IMPLEMENTING AGREEMENT

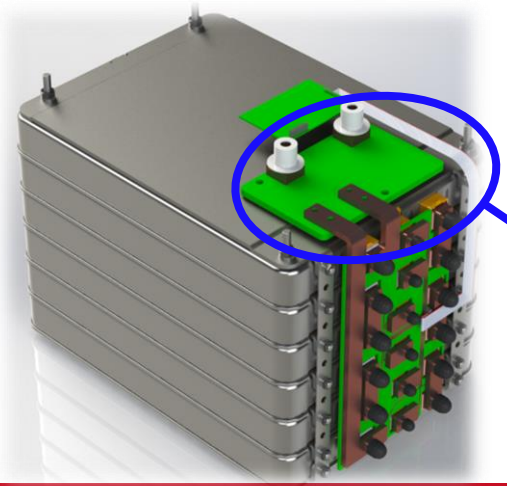
New E/E-Architectures with small modules

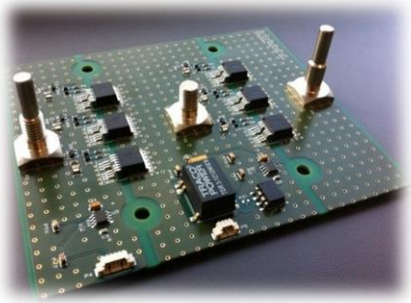
- The classical E/E-Architecture has limitation and has to be challenged
- Introduction of standard modules with integrated functions:
  - INNOVATIVE balancing solution supplying 12V auxiliary network
  - Switch module : Another integrated function which shows other advantages or services to customers

400V battery pack (8x 50V module)



Inside integrated module





Power electronics board with switch module

Image courtesy of CEA

Task 17 - Workshop - Results

IEA INTERNATIONAL ENERGY AGENCY
HYBRID & ELECTRIC VEHICLE IMPLEMENTING AGREEMENT

… *virtual design approaches* in the development of powertrain concepts to improve the efficiency of xEVs

...how *future powertrain architecture* can contribute to efficiency improvements

...new power electronic concepts for *online energy management*

...*cloud data solutions* to improve the intelligence of such vehicles

…possibilities to improve the e-motor by using *advanced E/E-Architecture*…

...*the grid and the vehicle together as a system* in order to meet the requirements of efficiency

...methods to *calculate the maximum junction temperature* in a vehicle drive with a combined cooling system

...benefits of *modular drive train structures*

…*synergies between electric and automated driving → follow-up Task*

The automotive future is hard to predict, but it is indeed promising for the power electronics and motor drives industry

Task 17 - Next steps

IEA INTERNATIONAL ENERGY AGENCY
HYBRID & ELECTRIC VEHICLE IMPLEMENTING AGREEMENT

- Close of Task 17 (2010 - 2015) → Vote

Image courtesy of Formula E

- Final Task End Report till ExCo 43
- Short summary about the outcomes and achievments of Task 17 (2010-1015) at ExCo43
- Follow-up Task!
  Technological orientated - based on Task 17 (proposal of Gereon Meyer – *Electrified, Connected and Automated Vehicles*)

Image courtesy of DAA

Thank you for your attention!

Questions?

Austrian Association for
Alternative Propulsion Systems (A3PS)