JAMA-CLEPA
BUSINESS SUMMIT

JAMA-CLEPA Business Summit

Venice, 27 & 28 October 2016

European automotive suppliers meet Japanese vehicle manufacturers

JAMA-CLEPA
BUSINESS SUMMIT

AVL

Green Driving

Josef Affenzeller
Director Research Coordination
AVL List GmbH

European automotive suppliers meet Japanese vehicle manufacturers

Content

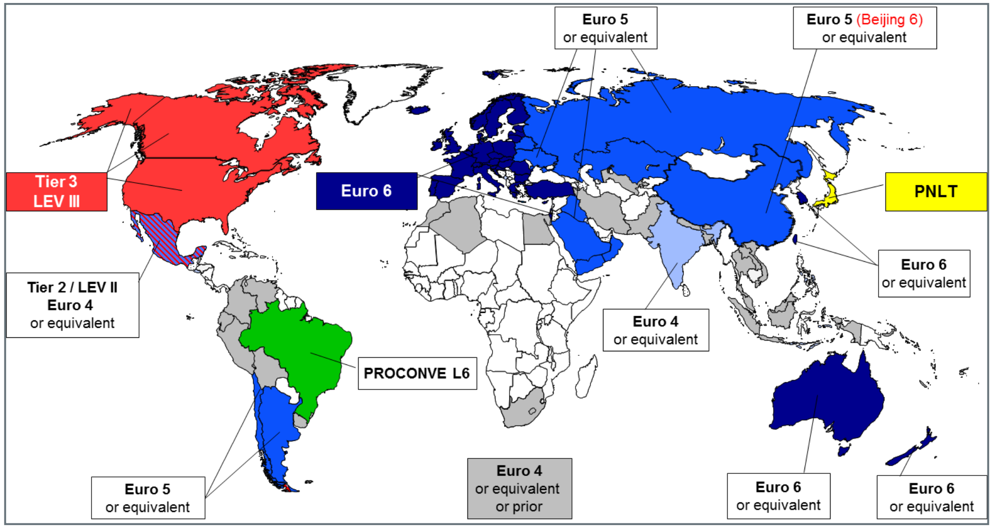
1. Main Trends and Drivers for Green Driving Technologies
2. Main Powertrain Elements
3. ICE Research Needs
4. Electrification
5. Conclusions

Trends

Global mega trends and societal needs are define the key challenges:

- Decarbonisation
- Air quality
- Urbanisation
- Digitalisation
- Safety

Global emission legislation & New global technical regulation GTR15



Example Passenger cars and light-duty vehicles

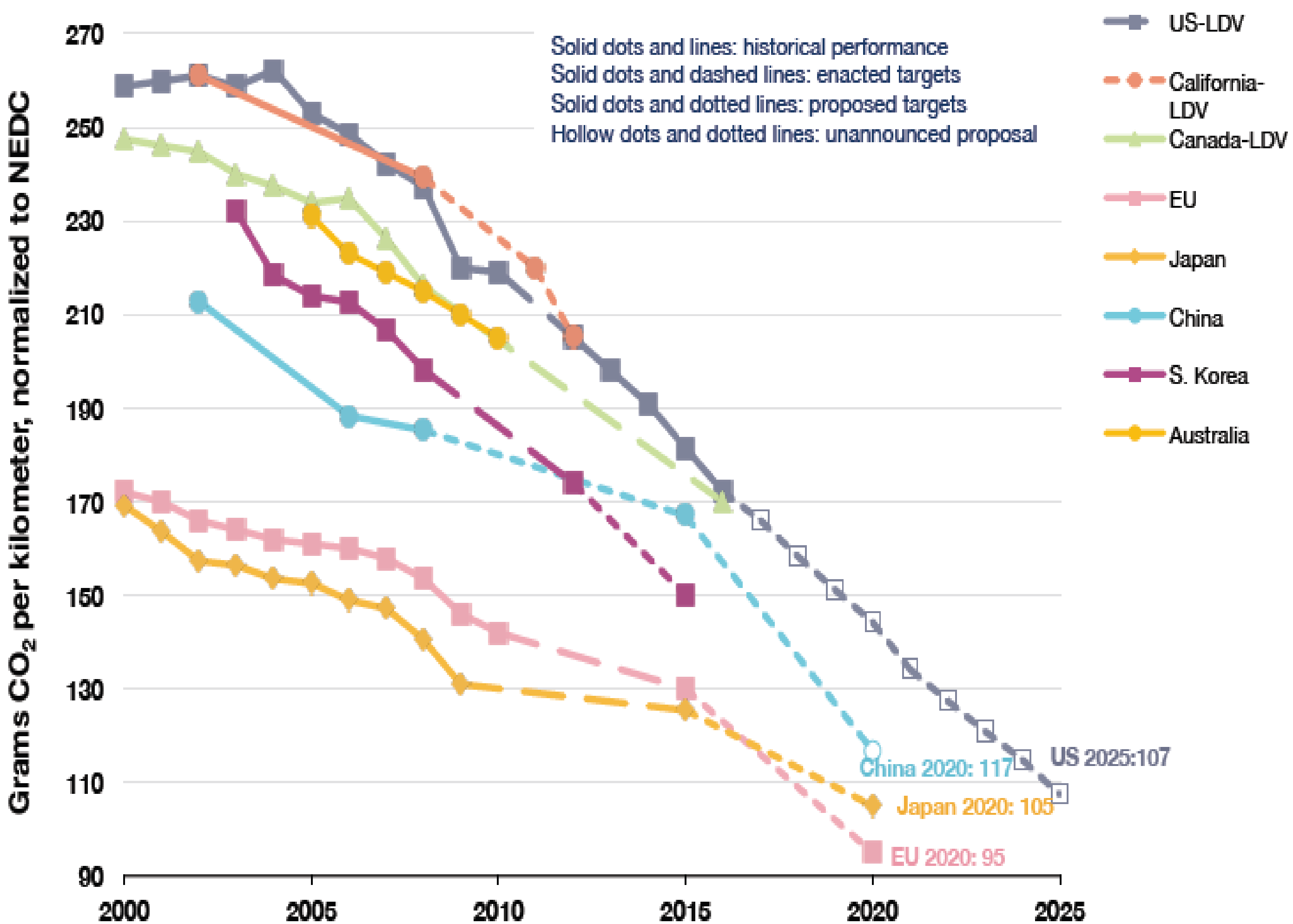
Comparison Europe - China:

	NOx (mg/km)	PM (mg/km)	PN (#/km)
Euro 6d/SI	60	4,5	$6x10^{11}$
China 6b/SI	60	4,5	$6x10^{11}$
Euro 6d/CI	80	4,5	$6x10^{11}$
China 6b/CI	35	3,0	$6x10^{11}$
	-56%	-33%	

New cycle (WLTP), new testing procedures, parameters, specifications for testing instruments, etc

AVL

CO2 / GHG Emission Legislation



[1] China's target reflects gasoline fleet scenario. If including other fuel types, the target will be lower.
[2] US and Canada light-duty vehicles include light-commercial vehicles.

Main pillars for decarbonisation and emission reduction of road transport

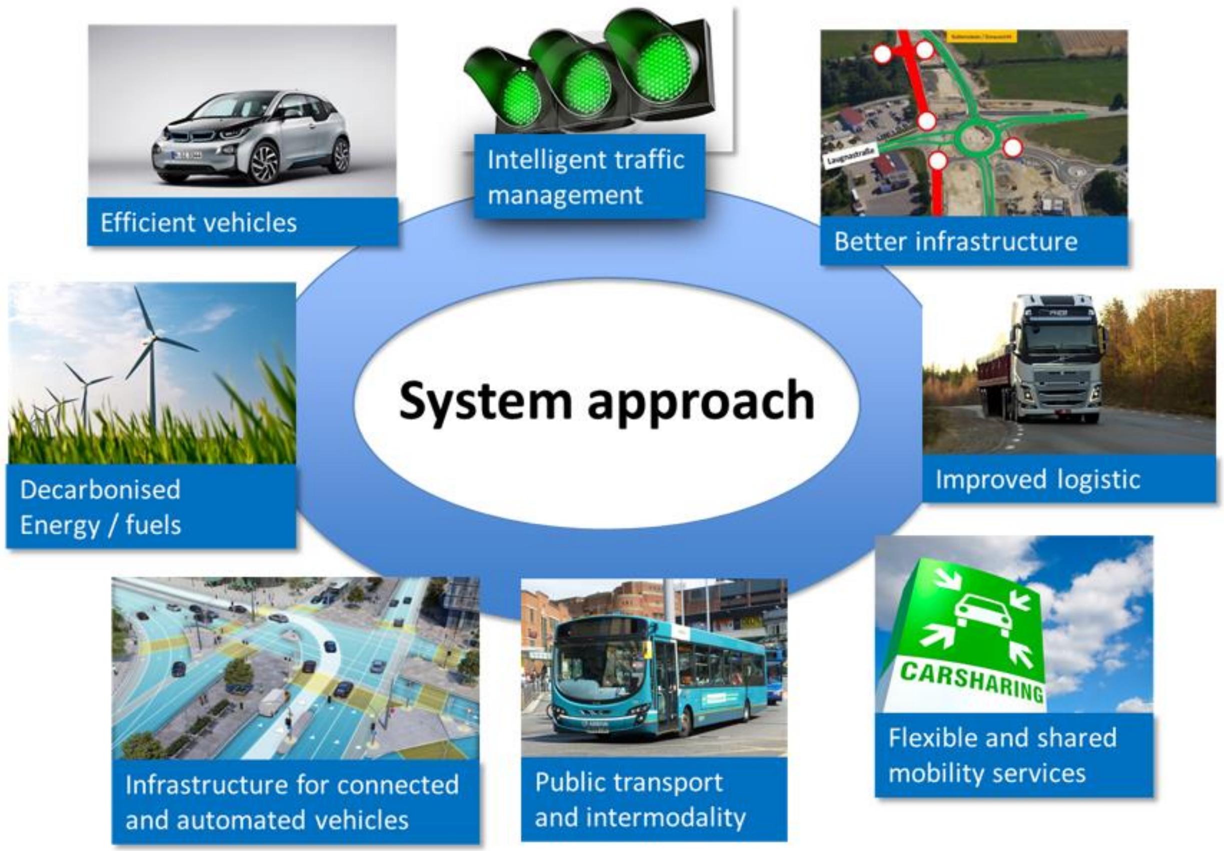
JAMA-CLEPA BUSINESS SUMMIT

Infrastructure

Logistics / mobility services

Energy /resources

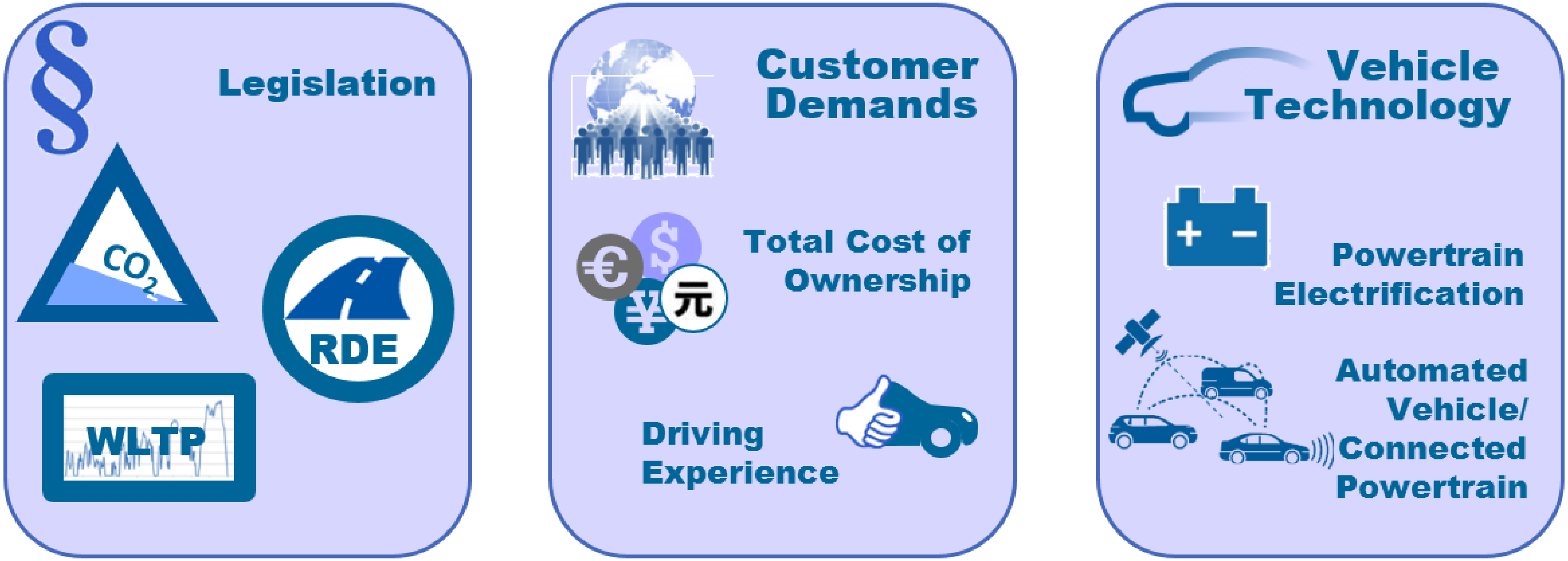
Vehicle and powertrain



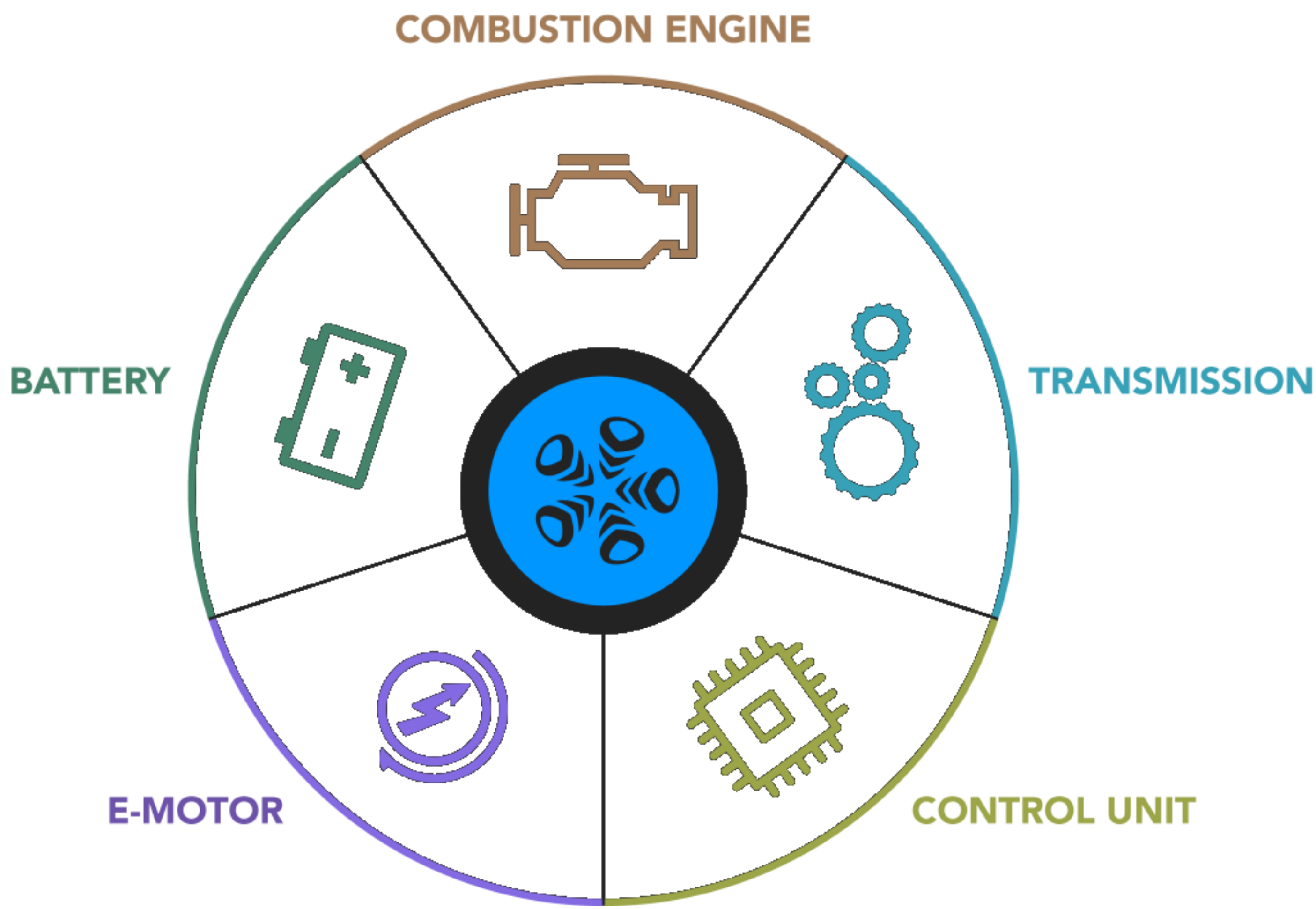
Source: ERTRAC

AVL

Main demands and drivers for automotive powertrain systems

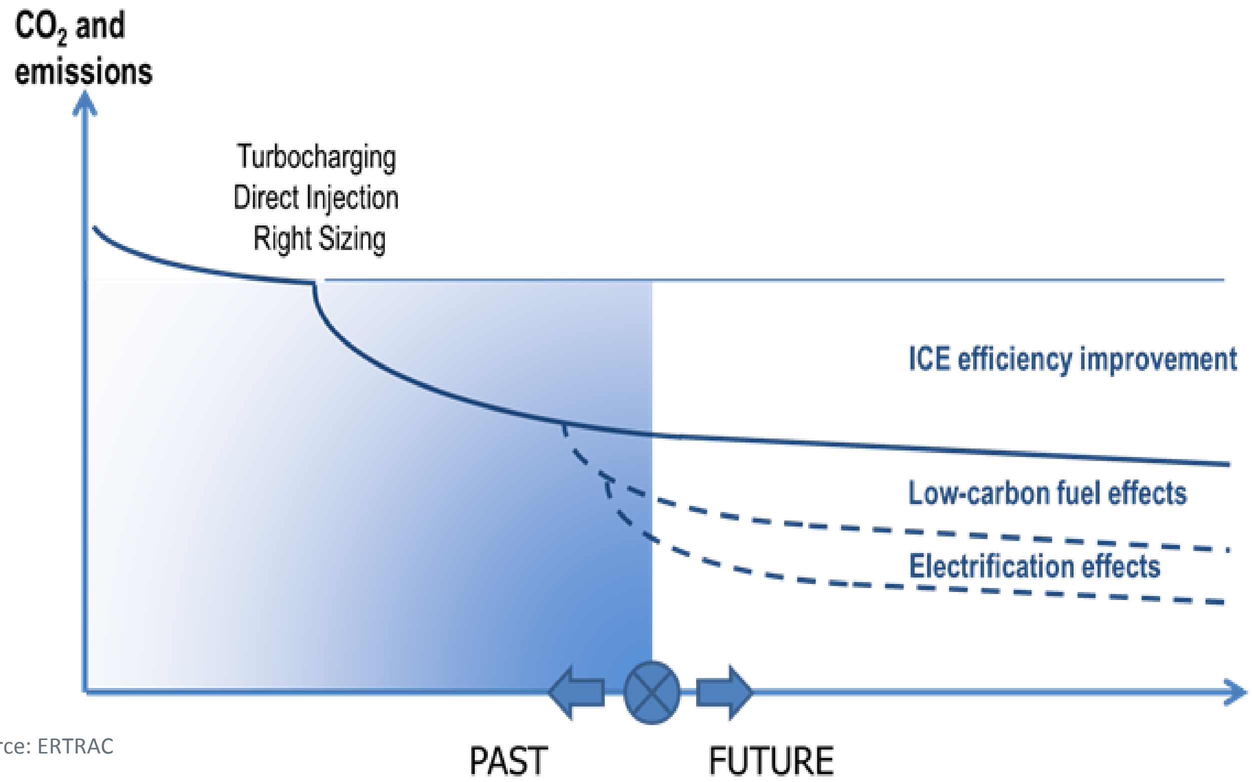


Five elements of the powertrain



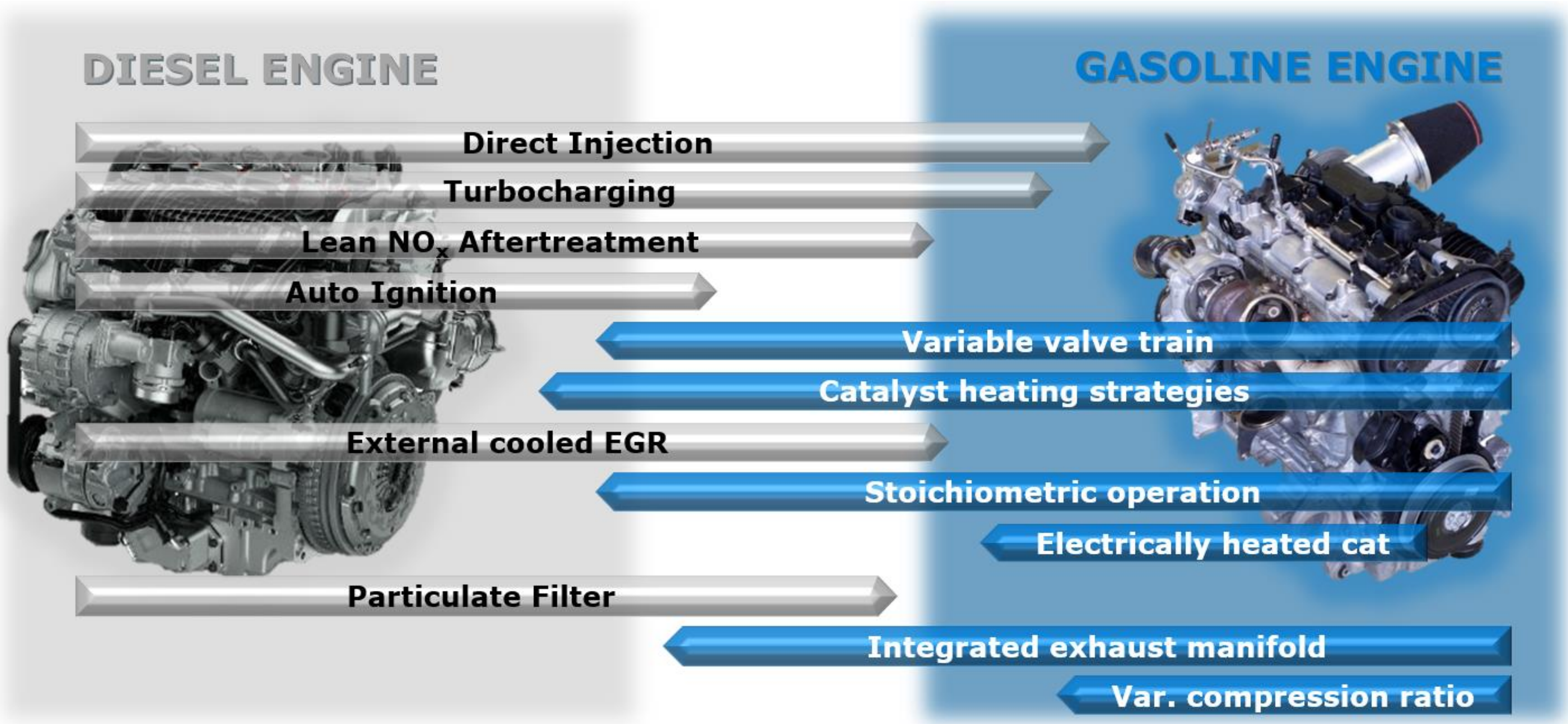
ICE powertrain systems

Trend of CO2 and emissions caused by ICE along with accompanying measures of low-carbon fuels and electrification of powertrains for on road vehicles.



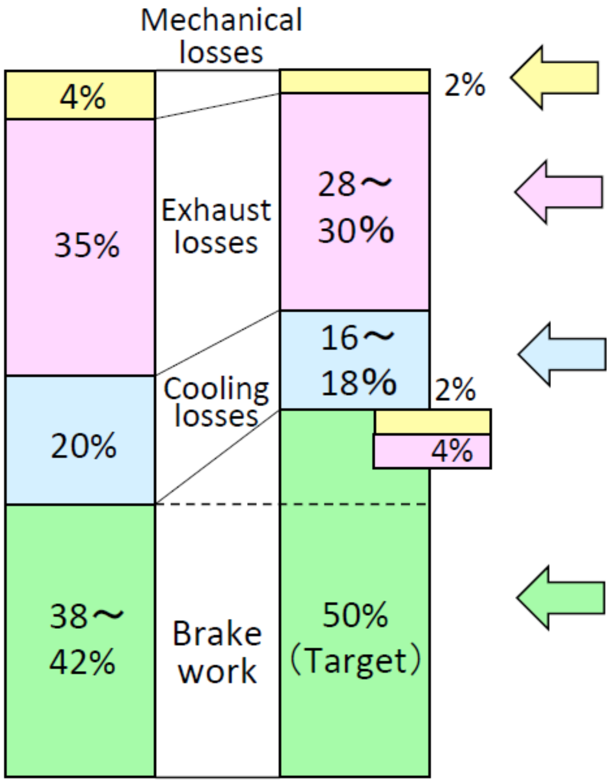
Source: ERTRAC

Modularity of base engines for diesel and gasoline technology synergies



Solutions exemplified to achieve 50% brake thermal efficiency in ICEs

JAMA-CLEPA BUSINESS SUMMIT



≪Energy Balance≫

- ✓ Reducing mechanical losses by 50%

- ✓ Utilizing exhaust gas energy
  - ･Increasing turbocharging efficiency
    - Exhaust gas turbine efficiency: 80%
    - Air compressor efficiency: 80%
  - ･Waste heat recovery by fuel reforming
- ✓ Reducing heat losses by improving combustion

- ✓ Enhancing indicated work by improving combustion

★ Brake Thermal Efficiency Baseline:

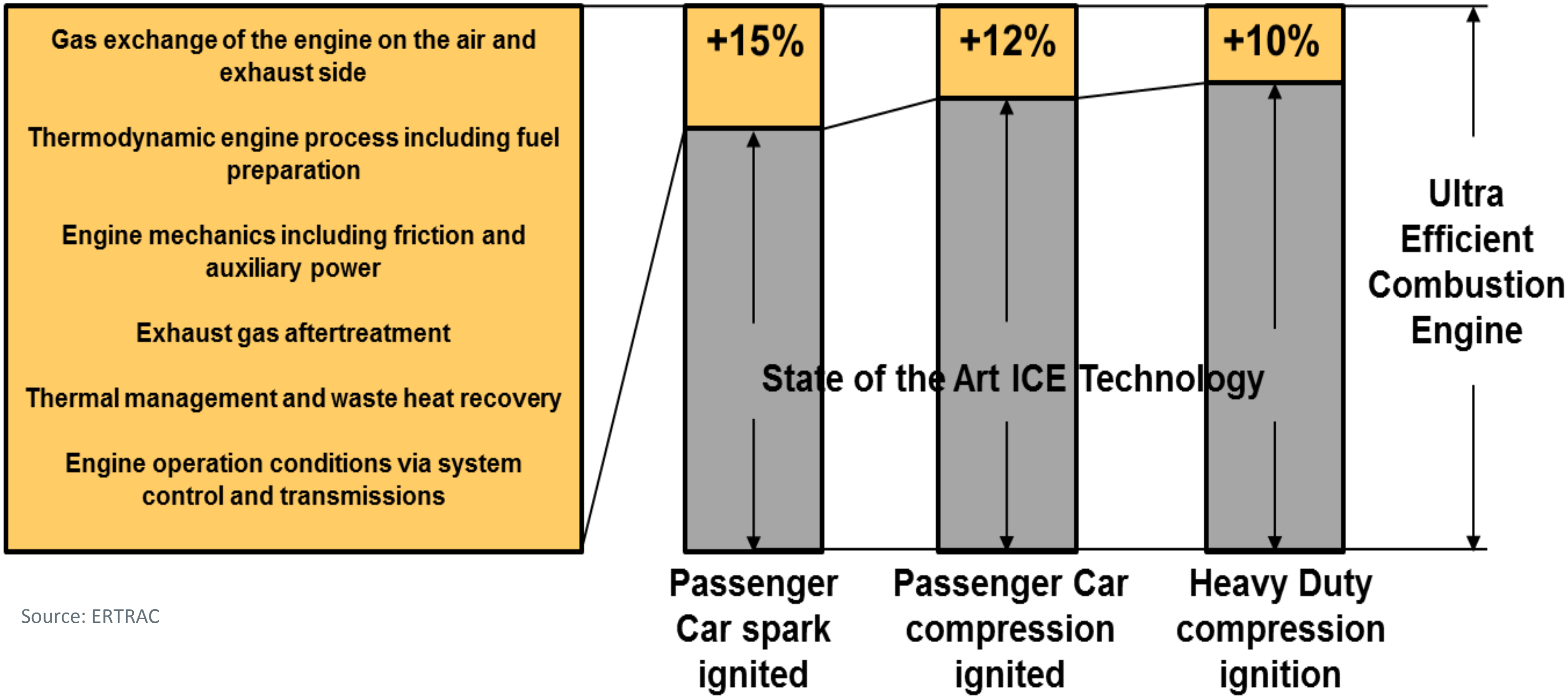
Gasoline engines ⇒ 38%

Diesel engines ⇒ 42%

Source: Prof. Daisho, Waseda University (Japan) at ERTRAC ICE workshop 2015

AVL

ICE efficiency improvement potentials



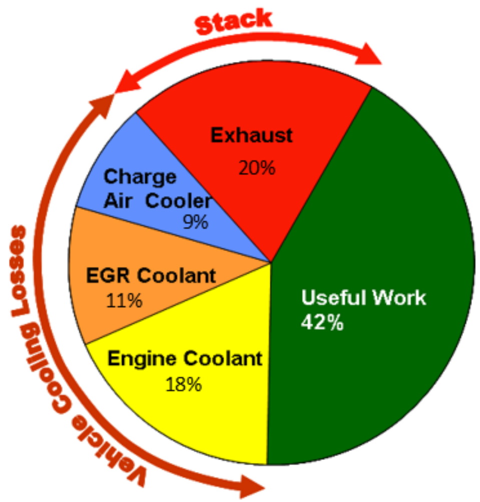
Source: ERTRAC

ICE heavy-duty research needs

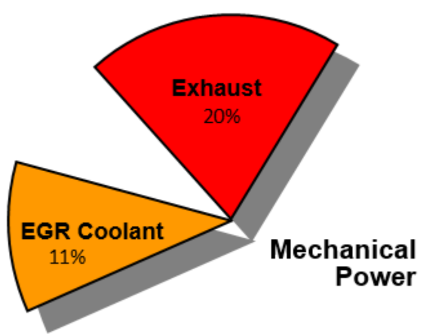
- Engine Rightsizing
- Hybridisation
- Transient Electric RTD
- Ultra-efficient Thermodynamics
- Infrastructure ICT & plug-in
- Optimiced Load/Volume
- Sustainable Fuel Energy Conversion Efficiency

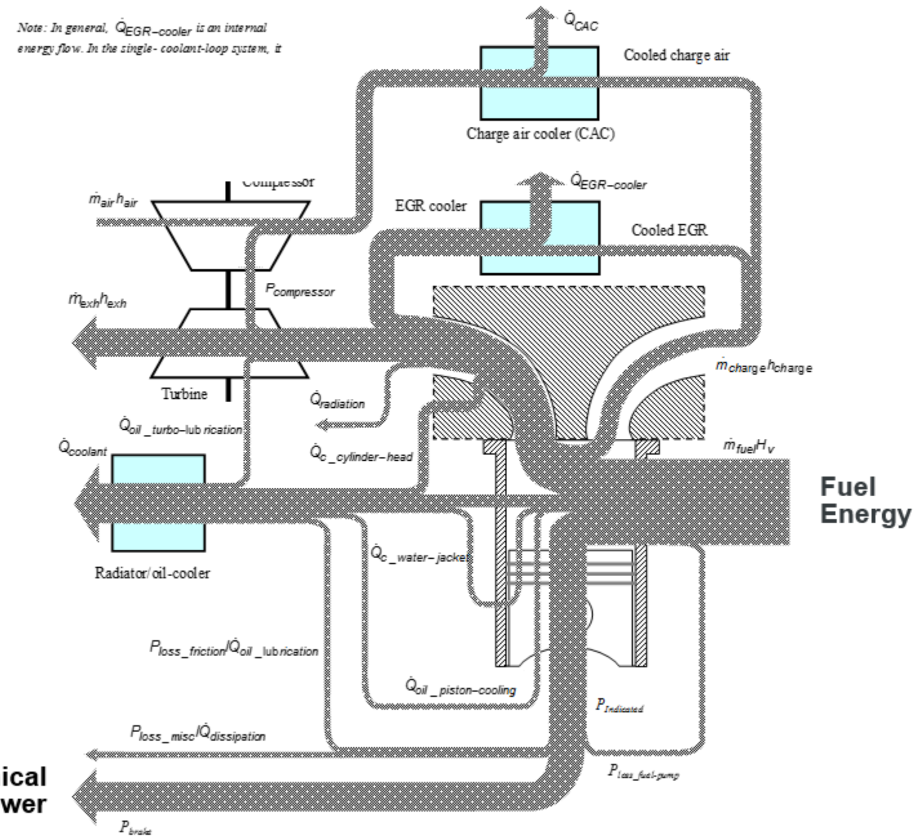
HD ICE research needs in relation to the vehicle and transmission system evolution

Waste-heat recovery by organic rankine circle



Energy Sources for AVL WHR System

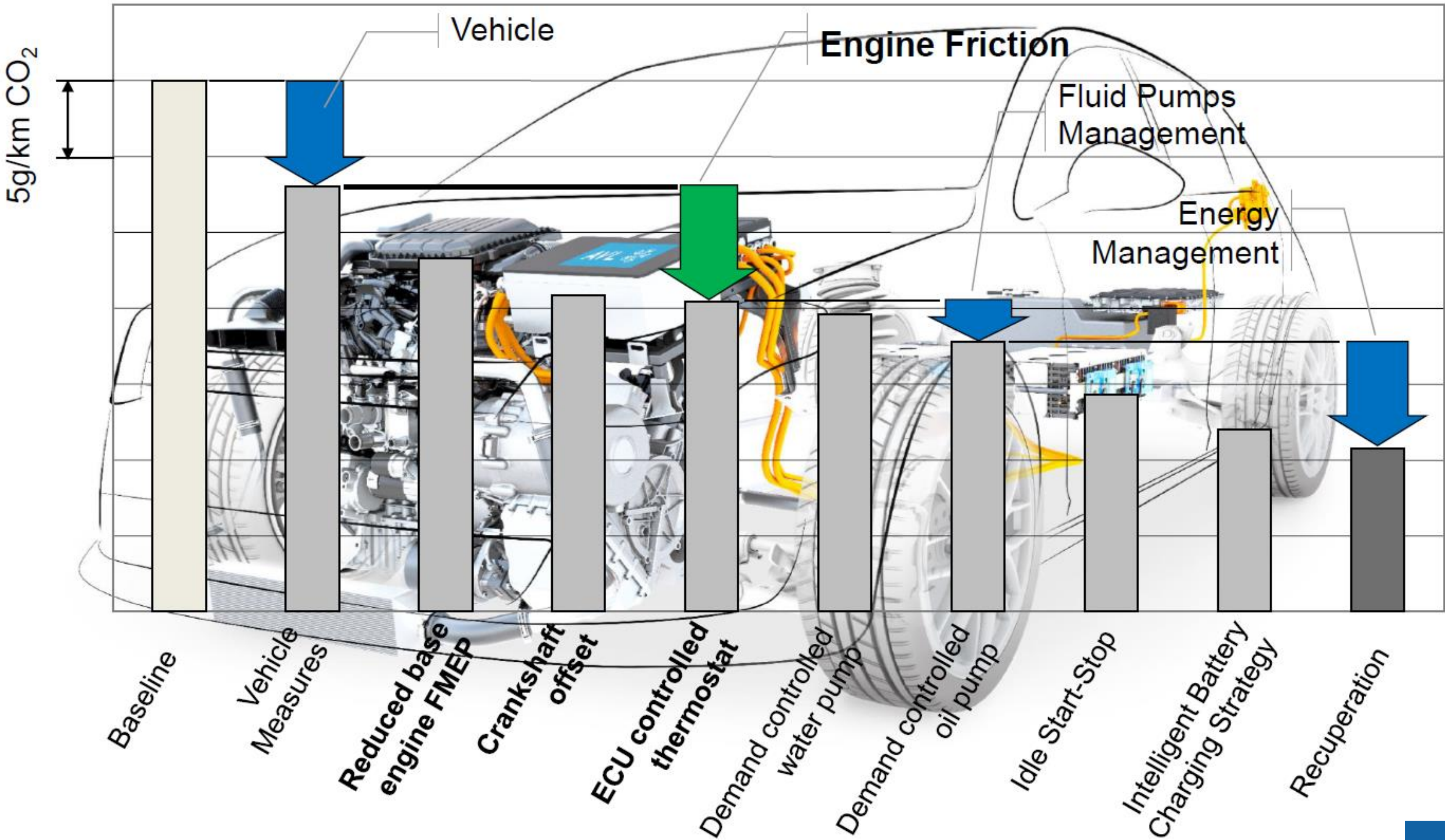




Approx. 4% Fuel Saving for Long Haul Truck Applications

Base engine friction contribution to CO2 reduction

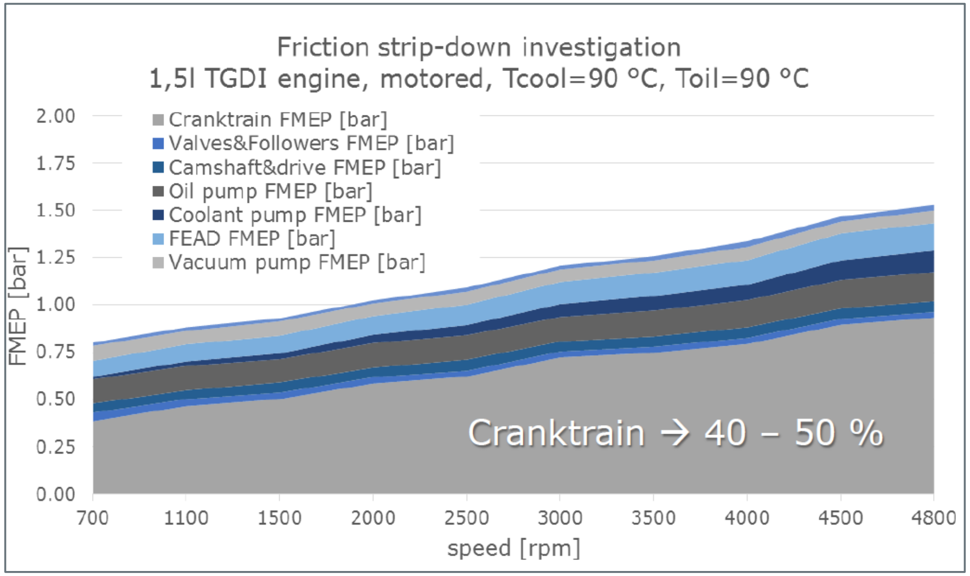
JAMA-CLEPA BUSINESS SUMMIT



AVL

Power-cylinder system design optimization

JAMA-CLEPA BUSINESS SUMMIT

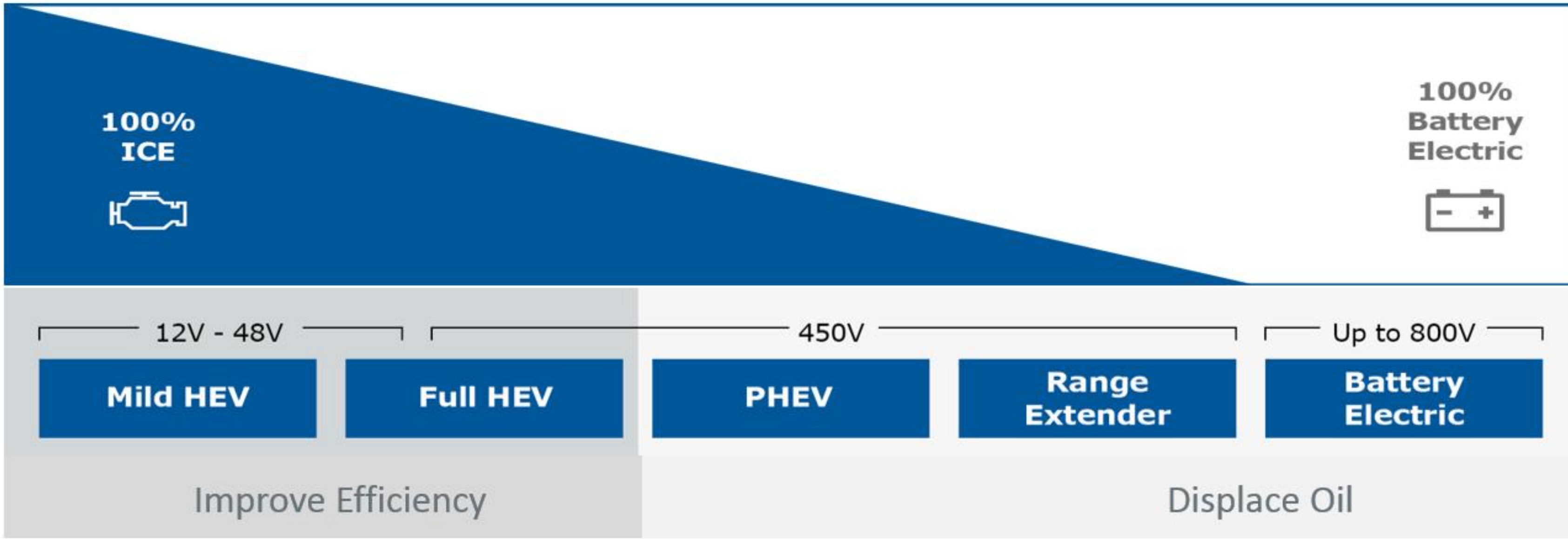


- Among all individual CO2 reduction measures, overall powertrain optimization and lightweight design play a major role to minimize energy losses and improve efficiency.
- Piston & ring package has by far the highest potential for friction reduction.
- It is very important to develop the processes and technologies to properly screen and assess different contributions to overall piston friction performances.
- Reduction of bore distortion/hence ring tension, piston mass, and side forces is the major measure, combined with skirt profile, in order to have an efficient power-cylinder system design.

AVL

Electrification system solutions from HEV to BEV

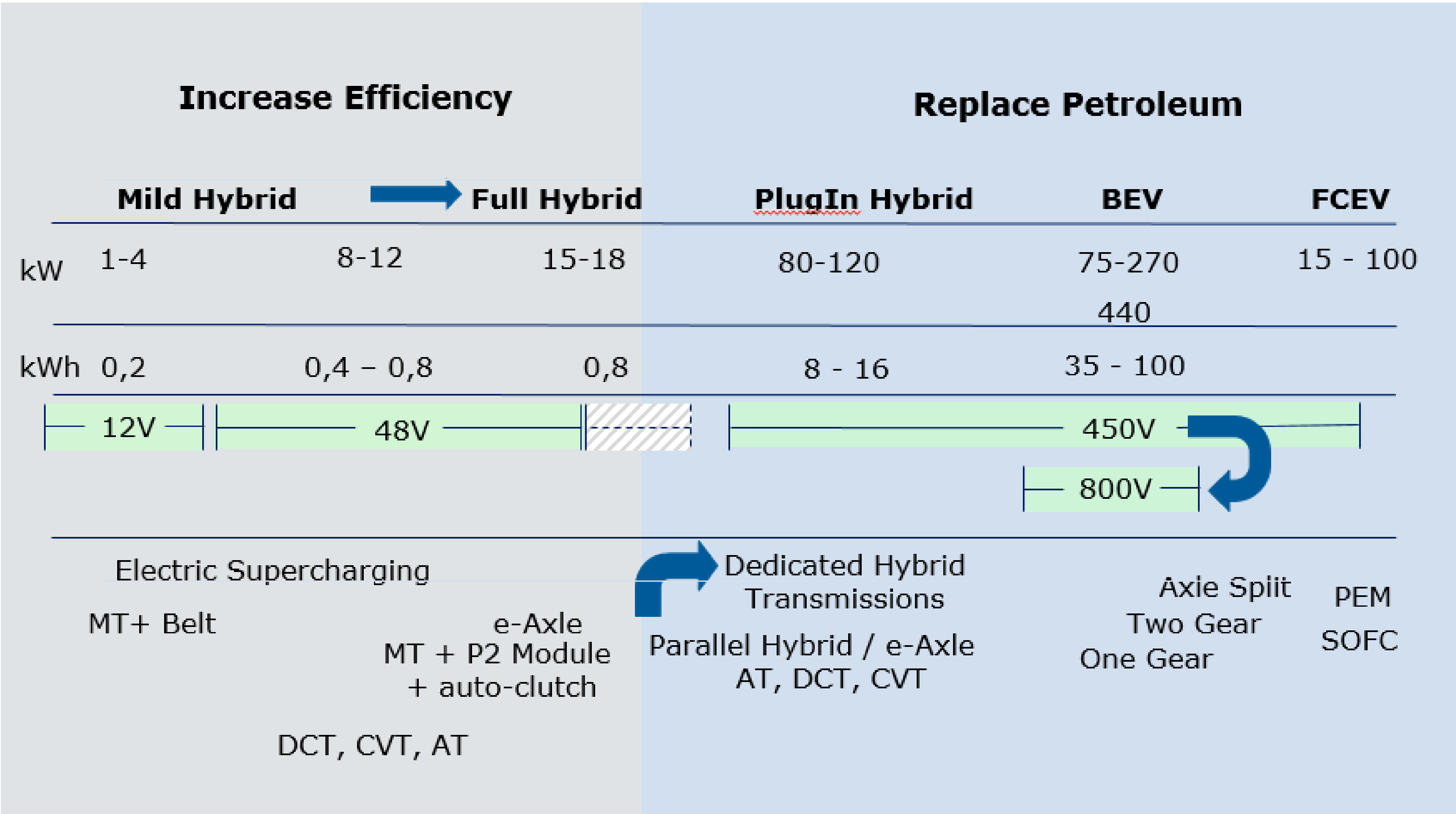
JAMA-CLEPA
BUSINESS SUMMIT



AVL

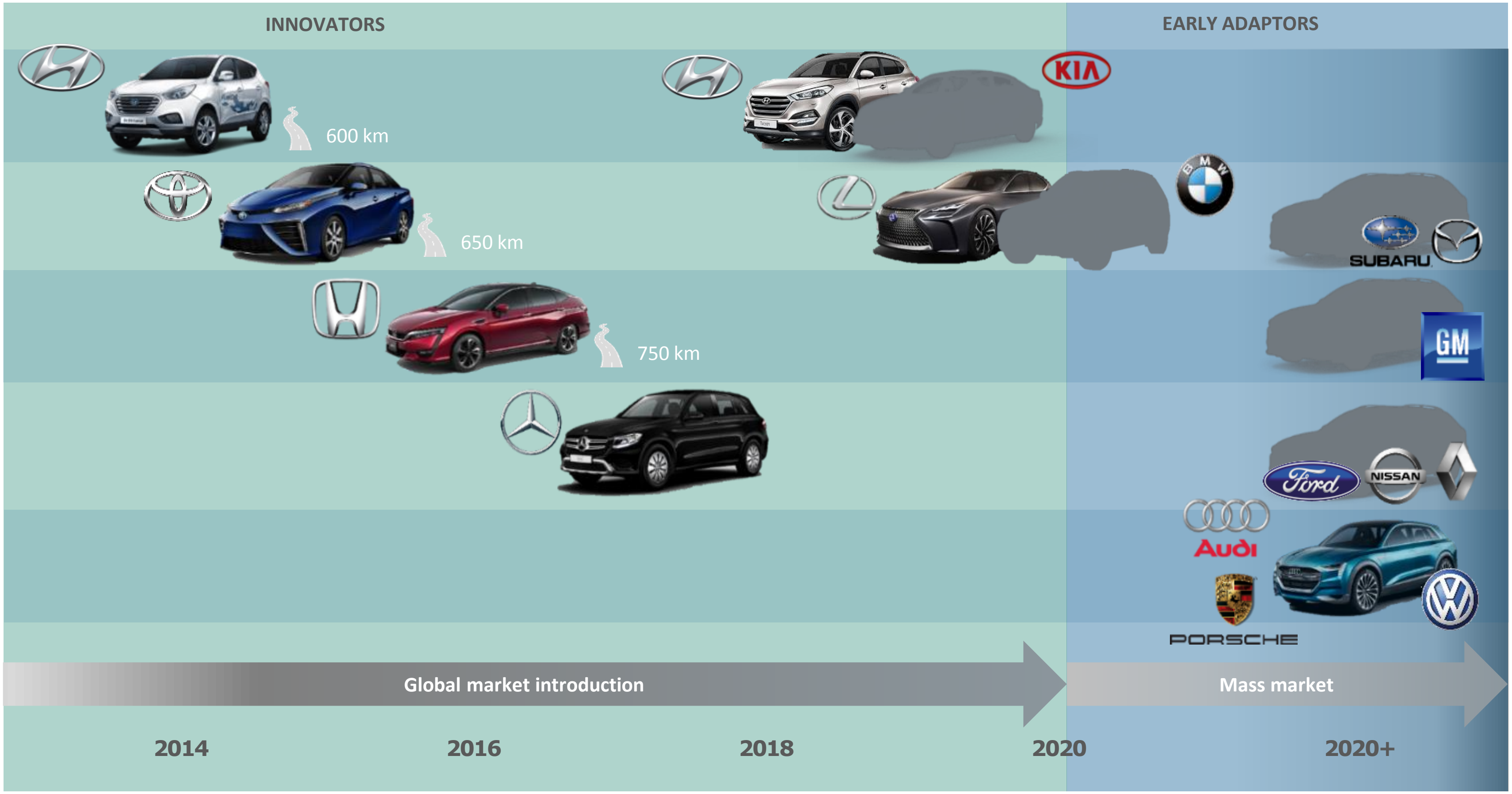
Technology 2020-2025

JAMA-CLEPA BUSINESS SUMMIT

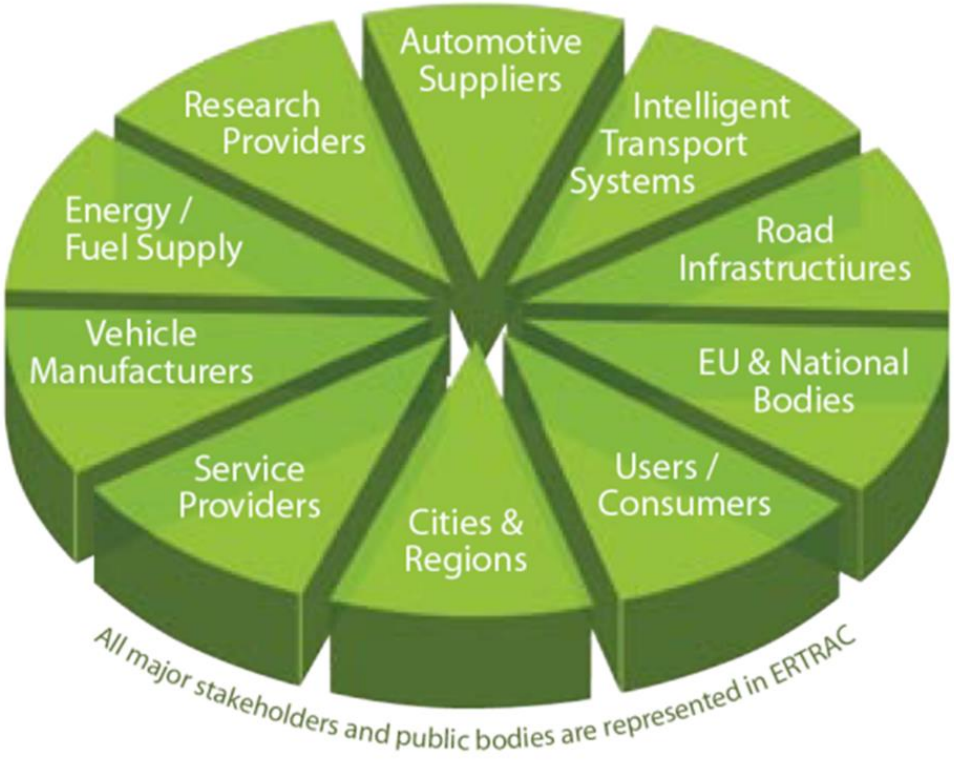


AVL

Fuel cell technology introduction



European Road Transport Advisory Council



Since 2003 ERTRAC gathers the different stakeholders in order to

- develop a common vision of future road transport,
- promote collaborative, pre-competitive research

www.ertrac.eu

Conclusions

- CO_2 and regulated emissions are the main drivers for powertrain technologies
- A system approach is needed to achieve the goals
- Still significant potential for more efficiency of the ICE
- Various electrification options available
- Cooperation between researchers, technology suppliers and OEMs needed to reach the targets on regulatory issues, costs and user acceptance
- ERTRAC today the leading European think-tank to develop visions and roadmaps

JAMA-CLEPA
BUSINESS SUMMIT

Thank you for your attention!
ご清聴ありがとうございました。
Grazie per l’attenzione!

European automotive suppliers meet Japanese vehicle manufacturers