AUSTRIAN POSITONS FOR ADVANCED PROPULSION TECHNOLOGIES

A3PS Position Paper R&D Demand 2023+

INTRODUCTION

The present A3PS position paper **"R&D Challenges 2023+"** summarizes envisaged developments and trends, as well as priorities of the industrial and scientific A3PS members. Furthermore an overview of R&D challenges in the coming years and the necessary R&D activities to strengthen Austria as a business location is provided.

A3PS expert groups have updated and identified actions and measures towards a climate-neutral, sustainable, efficient and safe transport system via:

1) **Technology-neutral support of mobility and powertrain innovations** in Austria, taking a holistic view of the value creation process, considering **LCA** requirements ("from cradle to grave") in order to meet the 2030 targets and to enable EU mission 2050 targets in full.
2) **Determination of the need of a legal framework**, norms, standards and a strategy, both for R&D activities, the rapid implementation of R&D results and for regular operation (street / off-road / rail).
3) **Fostering of core competencies** in the field of mobility and powertrain innovations in Austria with a strong focus on value creation in Austria.

The A3PS position papers should support the orientation of national R&D activities and technology policy impulses, as a supplement to those priorities set at European level.

Goal:
To empower the Austrian industry & academia in R&D regarding a global perspective → keep Austria competitive

All R&D topics presented in the A3PS area comprise only CO_2-neutral solutions, global oriented

As a "living document", the **position papers** are regularly checked for topicality and revised if necessary. The present position paper provides a **short-term outlook** for 2023-2025 (please see also download at https://www.a3ps.at/a3ps-position-papers

A more extensive list of research requirements including mid-term (2025-2023) and **long-term** (2030+) topics can be found in the **A3PS Roadmap** at https://www.a3ps.at/a3ps-roadmaps.

The position papers cover all advanced propulsion systems: battery electric powertrain technologies, fuel cell technologies and hybrid automotive powertrains with combustion engines using sustainable liquid or gaseous energy carriers. Life cycle assessment serves as method to find the best solution for different mobility applications depending on available energy carriers.

A technology-neutral approach considering all sustainable technologies is essential to reach the ambitious climate goals. This includes sustainable energy carriers also for the existing fleet

of vehicles. In contrast, narrowing down the technology options for a GHG-neutral road sector available delays the ramp-up of a carbon-neutral vehicle stock and leads to higher than necessary cumulated GHG emissions by 2050.[1]

Circular Economy

Circular economy must be considered in all technology sectors. This increases the research demand since beside of functional efficiency, safety, security, durability, etc., recyclability and second life must be considered. This is essential for the overall vehicle, components, batteries, bearing parts, etc.

A circular economy is "a model of production and consumption, which involves sharing, leasing, reusing, repairing, refurbishing and recycling existing materials and products as long as possible".[2] Circular economy aims to tackle global challenges like climate change, biodiversity loss, waste, and pollution by emphasizing the design-based implementation of the three base principles of the model. The three principles required for the transformation to a circular economy are: eliminating waste and pollution, circulating products and materials, and the regeneration of nature. Circular economy is defined in contradistinction to the traditional linear economy.[3]

As climate change increasingly highlights the limits of the environmental devastation of a linear economy, many companies and consumers are moving towards implementing a global circular economy[4], which is a systems solution framework tackling issues such as waste, pollution, and diminishing biodiverse ecosystems. The 9R's are a circular economic framework that examines how materials can be used and reused at their highest value while minimizing waste and environmental destruction. They are *Refuse, Rethink, Reduce, Reuse, Repair, Refurbish, Remanufacture, Repurpose, Recycle* and *Recover.*[5]

A3PS – Austrian Association for Advanced Propulsion Systems

A3PS, founded in 2006 as initiative of Austrian ministry of technology, discussed, phrased and prioritized with members from industry and research institutions the contents of this position paper in early 2023. A3PS is the **strategic platform** of the Austrian technology policy, industry and research institutions and stimulates the development of advanced propulsion systems and energy carriers – to build up common competence and to accelerate market launches.

A3PS addresses all **advanced powertrain technologies** contributing to the improvement of energy efficiency and to the reduction of emissions and supporting the whole innovation cycle (research, development, deployment).

A3PS members congregate in four thematic expert groups. These expert groups elaborate positions, trends, R&D demands and demands concerning the essential legal framework for prospective technologies as for this document.

---

[1] FVV (2022), "Future Fuels: FVV Fuel Study IVb: Transformation of Mobility to the GHG-neutral Post-fossil Age", https://www.fvv-net.de/fileadmin/Storys/Wie_schnell_geht_nachhaltig/FVV_H1313_1452_Future_Fuels_FVV_Fuel_Study_IVb_2022-12.pdf, retrieved 8 May 2023

[2] https://www.europarl.europa.eu/news/en/headlines/economy/20151201STO05603/circular-economy-definition-importance-and-benefits, retrieved 8 May 2023

[3] https://ellenmacarthurfoundation.org/topics/circular-economy-introduction/overview, retrieved 8 May 2023

[4] https://medium.com/topangasupply/defining-circularity-is-sustainable-a-dirty-word-a47bb5ce5ef9, retrieved 19 April 2023

[5] https://www.topanga.io/post/how-the-9r-framework-can-change-our-economy, retrieved 19 April 2023

A3PS's goal is to empower the Austrian industry and academia in R&D regarding a global perspective in order to keep Austria competitive. All R&D topics presented in the A3PS area – such as this positon paper – comprise only CO_2-neutral solutions, global oriented.

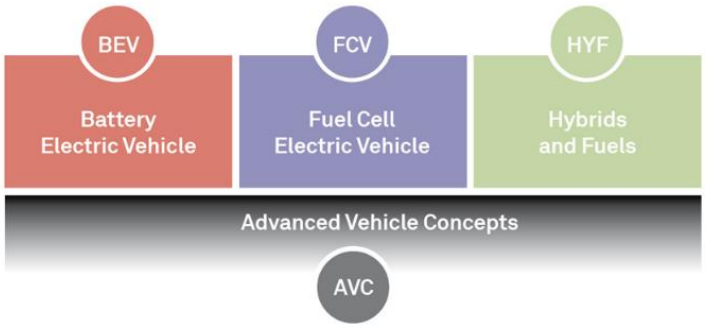

Fig. 1: 4 A3PS thematic expert groups

BEV – Battery Electric Vehicle

Expert group BEV focuses on strong scientific and informative public relations work about **battery electric vehicles**. The group analyses strengths and weaknesses of battery electric vehicles and points out research and development needs.

FCV – Fuel Cell Electric Vehicle

FCV expert group's focus is on hydrogen **fuel cell electric vehicles**. Besides, the group also deals with **hydrogen** production, infrastructure and storage, since sustainable production, price and availability of hydrogen play a key role for the success of fuel cell vehicles.

HYF – Hybrids and Fuels

Expert group HYF concentrates on the identification of needs for research on efficient **hybrid** technology, **sustainable energy carriers** for vehicles as well as **internal combustion engines**. The strengths of Austrian institutions in this field are discussed and highlighted.

AVC – Advanced Vehicle Concepts

Expert group AVC deals with **advanced and future vehicle concepts** comprising **new lightweight materials, innovative production technologies & digitalization of processes** and **digitalization & automation of vehicles and infrastructure**. The group links to the other three expert groups and focuses on a system perspective and integration.

List of Abbreviations

ABS	Anti-Lock-Brakes
AC	Alternating Current
AD	Autonomous/Automated Driving
AEB	Automatic Emergency Braking
Ah	Ampere hours
AI	Artificial Intelligence / Alcohol Interlock
AM	Additive Manufacturing
API	Application Programming Interfaces
AUTOSAR	Automotive Open System Architecture (global partnership of automotive and software industry)
AVP	Automated Valet Parking
BEV	Battery Electric Vehicle
BMK	Federal Ministry Republic of Austria for Climate Action, Environment, Energy, Mobility, Innovation and Technology
BoP	Balance of Plant
C2C	Cell-to-Chassis
C2P	Cell-to-Pack
C2S	Cell-to-Structure
Ca	Calcium
CCAM	Cooperative, Connected Automated Mobility
CD-Lab	Christian Doppler Laboratory
CF	Carbon Fiber
CO	Carbon monoxide
CO_2	Carbon dioxide
COMET	Competence Centers for Excellent Technologies
COVESA	Connected Vehicle Systems Alliance
CU	Control Unit
DC	Direct Current
DCU	Domain Control Unit
E/E	Electrical and Electronic
ECU	Electronic Control Unit
EDA	Electronic Design Automation
EDU	Electric Drive Unit
EMC	Electro-Magnetic Compatibility
ESC	Electronic Stability Control
EV	Electric Vehicle
FAME	Fatty Acid Methyl Ester (biodiesel derived by esterification of fats such as vegetable oil with methanol)
FC	Fuel Cell
FCV/FCEV	Fuel Cell (Electric) Vehicle
FEM	Finite Element Method
FMI	Functional Mock-up Interface
FMU	Functional Mock-up Unit
GaN	Gallium Nitride
GHG	Greenhouse Gas
H_2	Hydrogen
HAD	Highly Automated Driving
HF-PWM	High-Frequency-pulse-width-modulation
HIL	Hardware in the Loop
HPC	High Power Charging
HPC	High Performance Computing
HREE	Heavy Rare Earth Element
HRS	Hydrogen Refueling Station
HV	High Voltage / Heavy Vehicles
HVAC	Heating, Ventilation and Air Conditioning
HW	Hardware

ICE	Internal Combustion Engine
ICEM	Integrated Circuit Emission Model
IGBT	Insulated-Gate Bipolar Transistor
IIoT	Industrial Internet of Things
IPCEI	Important Projects of Common European Interest
KPI	Key Performance Indicators
kW	kilo Watt
LCA	Life Cycle Assessment
LDW	Lane Departure Warning
LFP	Lithium Ferro phosphate
Li	Lithium
LOHC	Liquid Organic Hydrogen Carrier
LTO	Lithium Titanate Oxide
Mg	Magnesium
MIL	Model in the Loop
MW	Megawatt
Na	Sodium
NMC	Nickel Manganese Cobalt
NVH	Noise, Vibration and Harshness
ODD	Operating Design Domains
OEM	Original Equipment Manufacturer
OPEX	Operational Expenditures
PCB	Printed Circuit Board
PCEC	Protonic Ceramic Electrolysis Cell
PCFC	Protonic Ceramic Fuel Cell
PEM	Polymer Electrolyte Membrane
PI	Power Integrity
PnC	Plug-and-Charge
R&D	Research and Development
RDE	Real Driving Emissions
RFI	Radio Frequency Interference
RFNBOs	Renewable Fuels of Non-Biological Origin
RUL	Remaining Useful Life
SAE	Society of Automotive Engineers; SAE international's J3016 provides a common taxonomy and definitions for automated driving in order to simplify communication and facilitate collaboration within technical and policy domains. The report's six levels of driving automation span from no automation to full automation.
SAF	Sustainable Aviation Fuels
SI	Signal Integrity
SiC	Silicon Carbide
SIL	Software In the Loop
SNG	Synthetic Natural Gas
SOEC	Solid Oxide Electrolyser Cell
SOFC	Solid Oxide Fuel Cell
SW	Software
TCO	Total Cost of Ownership
Ti	Titanium
TRIP	Transformation Induced Plasticity
TRL	Technology Readiness Level
V&V	Verification and Validation
V2G	Vehicle-to-Grid
V2L	Vehicle-to-Load
V2X	Communication from vehicle to X (e.g. Vehicle, Infrastructure, Grid, Load)
VCU	Vehicle Control Unit
W3C	World Wide Web Consortium
xCU	Any Control Unit
XIL	Model, Software or Hardware in the Loop
xR	extended Reality