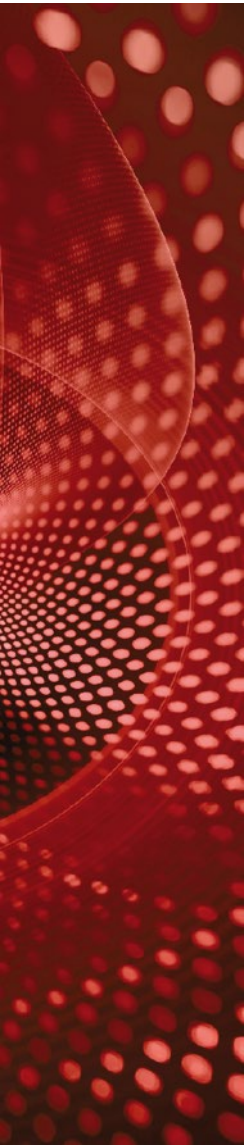
Austrian Association for Advanced Propulsion Systems

A3PS

powered by Bundesministerium Klimaschutz, Umwelt, Energie, Mobilität, Innovation und Technologie



A3PS – Austrian Roadmap for Suistainable Mobility – a Long Term Perspective

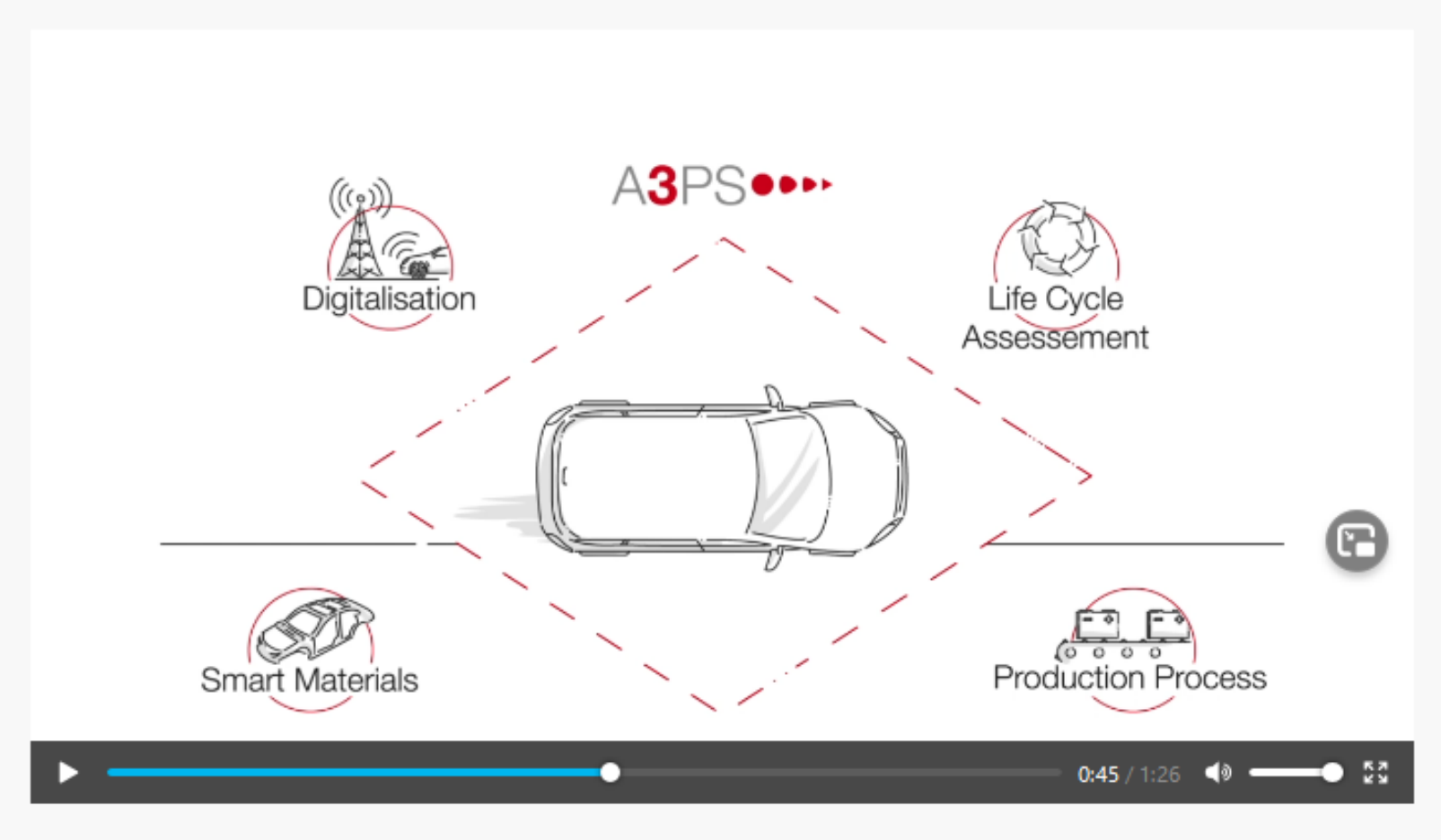
Science Brunch

20. Juni 2022

P. Prenninger, B. Brandstätter, M. Nöst

Rethinking Propulsion.

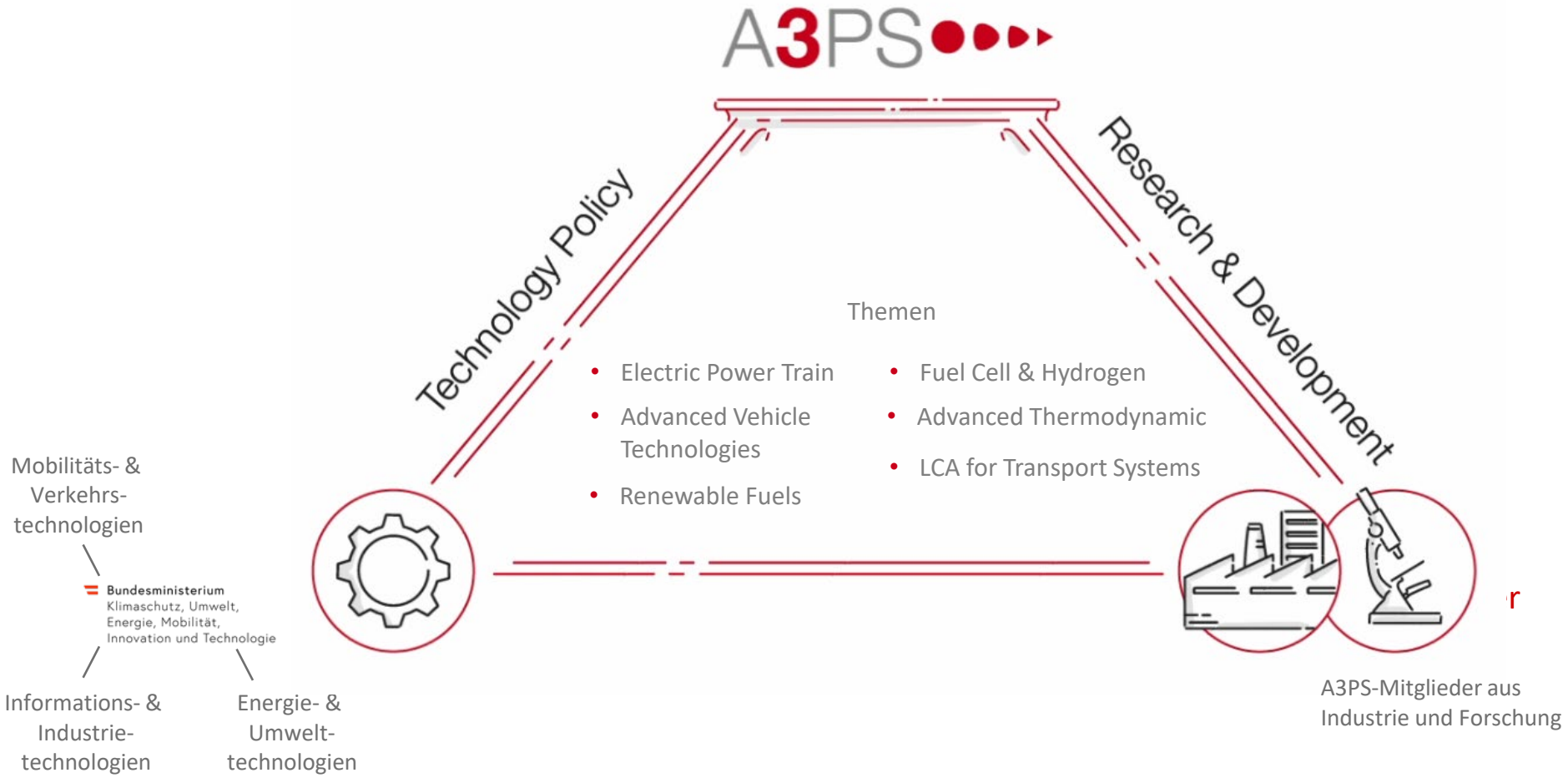
A3PS Vision



https://www.a3ps.at/sites/default/files/200623_A3PS-Video_720.mp4

Rethinking Propulsion.

Bridging Industry & Academia with Gov.

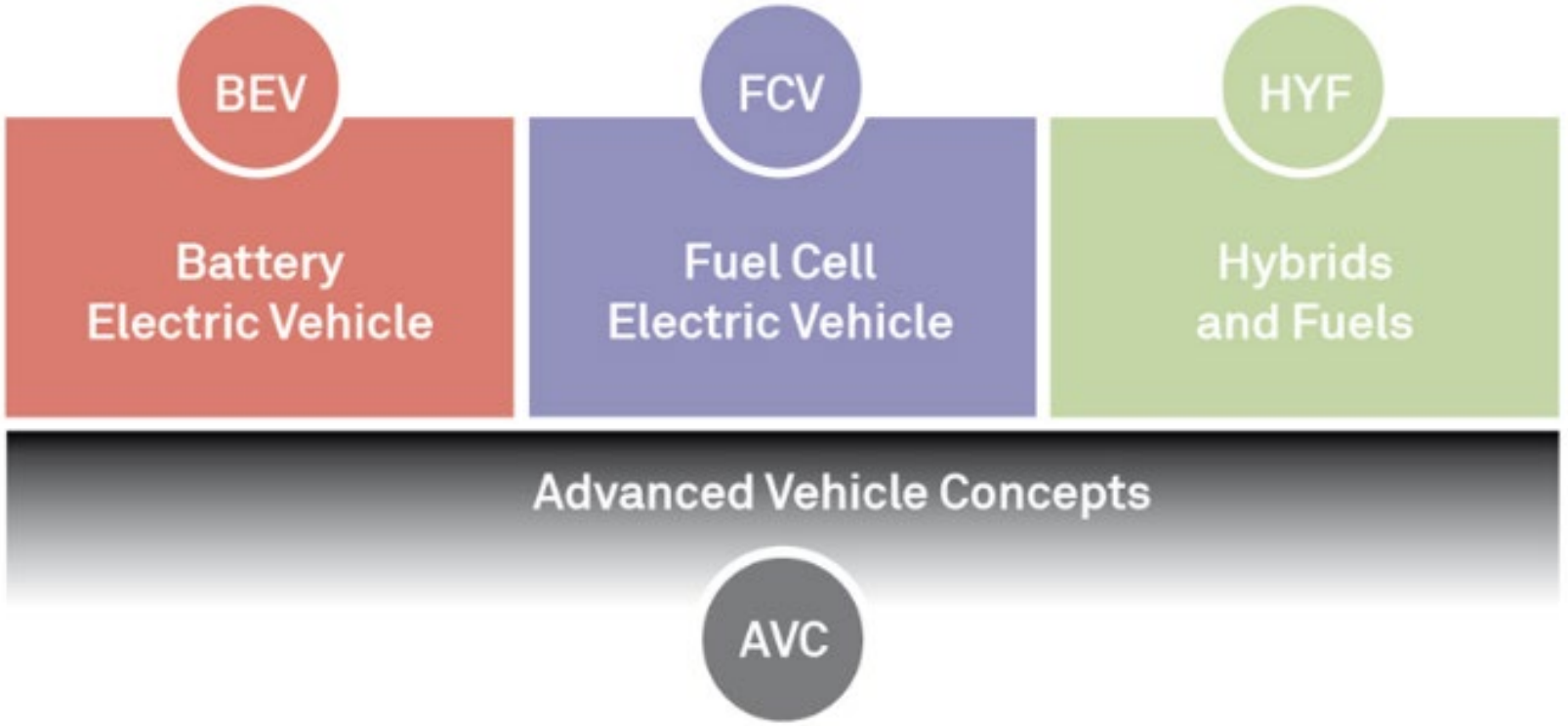


Als strategischer Partner des BMK erfüllt A3PS eine Brückenfunktion.

Roadmap Content

- ✓ Renewable Energy Carriers
- ✓ Hybrid Automotive Powertrains
- ✓ Fuel Cell Technologies
- ✓ Battery Electric Powertrain Technologies
- ✓ Advanced Powertrain Integration Technologies on Vehicle Level

A3PS Expert Groups



BEV Dr. R. Ratzi (Miba)

FCV Dr. A. Trattner (TUG)

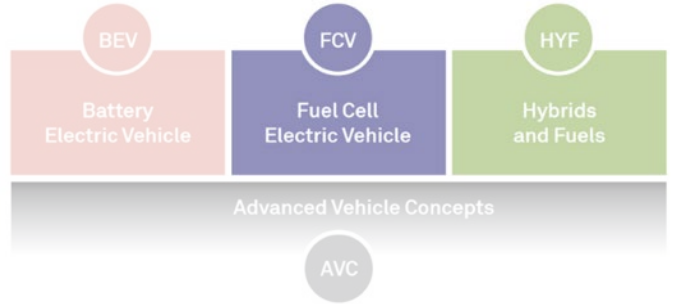
HYF Prof. P. Prenninger (AVL)

AVC Doz. B. Brandstätter (ViF)

Abstimmung und Bündelung des Forschungsbedarfes unter den Mitgliedern

Renewable Energy Carriers

- **Why do we need sustainable fuels including hydrogen?**
  - Sustainable fuels as a climate-neutral energy carrier with
    - high overall efficiency
    - high energy density and
    - simple onboard & strategic storage
- **R&D Focus:**
  - Continuous improvement of efficiency (generation/conversion)
  - Maximization of yield of biomass-based processes
- **Austrian Contribution:**
  - Low-carbon to carbon-neutral fuel production
  - Hydrogen refilling and onboard storage technology
  - Biomass-based fuel production process expertise



Renewable Energy Carriers

Hydrogen Generation

SOEC

efficiency / endurance / lifetime / cost reduction

type of project required

short-term until 2025	**medium-term** 2025-2030	**long-term** 2030+
Increased specific power density and durability by introduction of novel cell components without or with low content of CRM as well as optimized design for hydrogen production, TRL[2022] 2-4		
Protonic Ceramic Electrolysis Cells (PCECs), TRL[2022] 2-3		
Increased specific power density and durability by introduction of novel cell components without or with low content of CRM and optimized design for co-electrolysis of H_2O and CO_2 for PtX, TRL[2022] 2-4		
Improved interconnects and coatings with Cr-retention capability for lower operating temperatures, TRL[2022] 2-3		
Improved monitoring and diagnostic tools for cells and stacks, including degradation and failure modes, TRL[2022] 2-4		
Metal supported solid oxide and protonic ceramic electrolysis cells, TRL[2022] 2-4		
Novel production technologies for improved recyclability of cells and stacks, TRL[2022] 3-5		

Biofuels

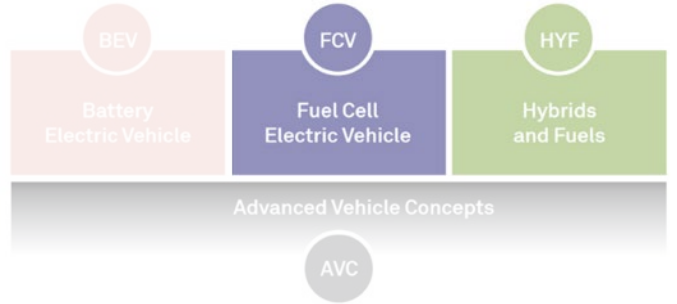
Fischer-Tropsch fuels from biomass

commercial facilities (demo plant available)/ replacement of diesel/ premium fuel

type of project required

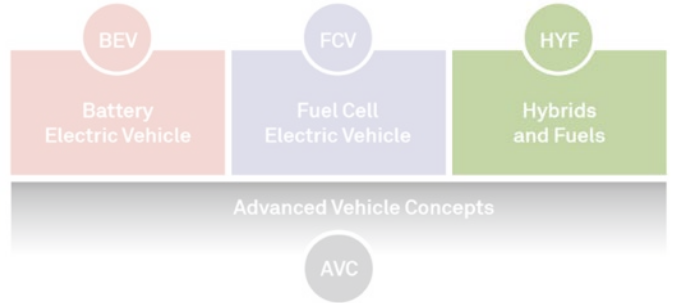
short-term until 2025	**medium-term** 2025-2030	**long-term** 2030+
Utilization of waste materials as feedstock, TRL[2022] 6		
Energy-efficient syngas cleaning for FT synthesis, TRL[2022] 7		
Demonstration of gasification and FT synthesis at large scale, TRL[2022] 7		
First commercial-scale gasification and FT synthesis facility, TRL[2022] 7		

*wide range of TRL because of different generations of PEMFC; PEMFC are already applied in the market but a new generation of PEMFC which require less PGM still requires fundamental research



Hybrid Automotive Powertrains

- **Why do we need hybridization?**
  - Hybridization for efficiency and fast market introduction of xEV
  - Plug-in hybrids for zero emission city driving and easy commuting
- **R&D Focus:**
  - Efficiency improvement of powertrains
  - Adaption to sustainable climate-neutral energy carriers
  - Transformation of products/production towards circular economy
- **Austrian Contribution:**
  - Hybrid system optimization
  - Virtual and experimental development including tools & testing
  - Hybrid components and subsystems
  - Vehicle assembly & production



Hybrid Automotive Powertrains

short-term until 2025 | **medium-term** 2025-2030 | **long-term** 2030+

ICE for Hybrid Powertrains

ICE Technologies

Zero-impact emissions and significant efficiency improvement (eta>50%)

type of project required

- Low-pressure port/direct injection H_2 engine (H_2-injector, tank/gas pressure for PFI/DI, ignition system, combustion stability, avoidance of backfiring/anomalies, safety of H_2 engines), TRL[2022] 6-8
- High-pressure direct injection hydrogen-engine (tank/gas pressure, H_2-DI-injector, combustion stability/anomalies, safety of hydrogen DI engines), TRL[2022] 4-6
- Highly efficient compressors, turbines and turbochargers incl. e-blowers mech./electr. compound turbines, TRL[2022] 5-9
- Combustion and aftertreatment systems for hydrogen and climate-neutral/fossil-free energy carriers (e-gas, e-fuel, advanced biofuels, NH3, alcohols), TRL[2022] 6-9
- ICE with special operation strategies (incl. single point operation), TRL[2022] 5-6
- Reduction of heat losses to the exhaust and to the coolant inside the engine, TRL[2022] 3-5
- Sensors and controllers for high efficient operation (incl. comb. real and virtual sensors, AI based control systems etc.), TRL[2022] 3-8
- High strength functional materials for engines, material resistance against hydrogen and bio-/ syn-fuels, TRL[2022] 3-6

short-term until 2025 | **medium-term** 2025-2030 | **long-term** 2030+

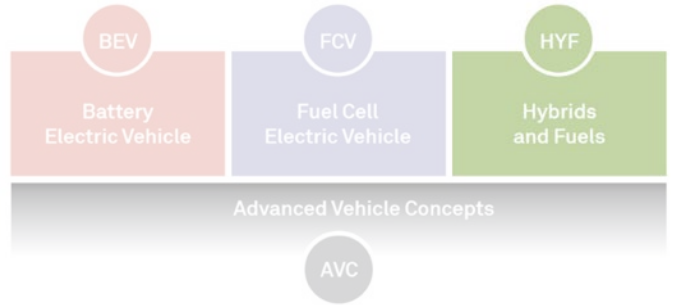
Cross-cutting technologies

Development Tools & Methodology

time to market / cost / safety / security

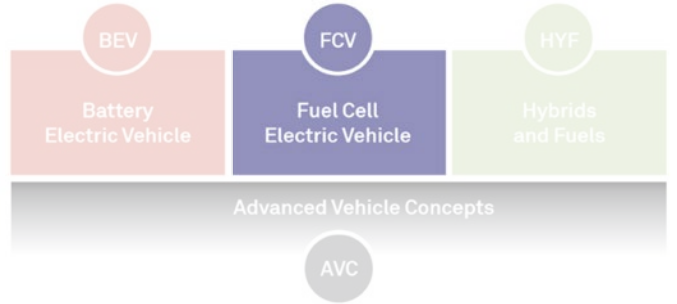
type of project required

- Simulation & control platform / simulation & development environment, TRL[2022] 4-8**
- Testing systems and measurement technique / manufacturing, EoL testing, TRL[2022] 4-8
- Model /AI based development tools (joint virtual & real-world tools, digital twins) incl. real time models for XiL-development, TRL[2022] 3-7
- Real time fully connected design and manufacturing simulation process, TRL[2022] 3-6



Fuel Cell Technologies

- **Why do we need Fuel Cell powertrain technologies?**
  - Highest efficiency and highest potential for energy savings
  - Zero emissions of pollutants, noise and GHG
  - Electro mobility with long range & short refuelling times
- **R&D focus?**
  - Efficiency, durability/reliability and cost of components and systems
  - Development tools, measuring and testing technology
  - Ab initio circular economy fit products & production
- **Austrian contribution?**
  - Fuel cell expertise of research institutes and universities
  - Development and production of fuel cell components and systems
  - Tools, instrumentation and test systems for development



Fuel Cell Technologies

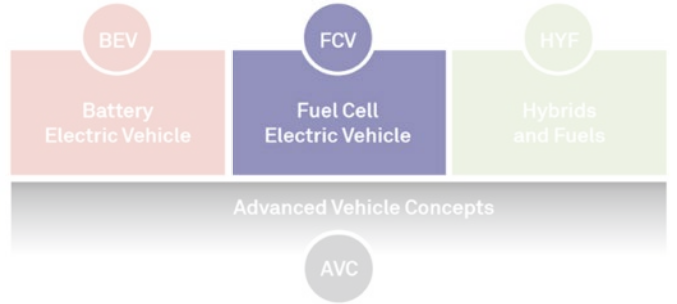
Production and Industrialization of Fuel Cell Components and Vehicles

Fuel Cell & Component Production

cost reduction / high volume production technologies

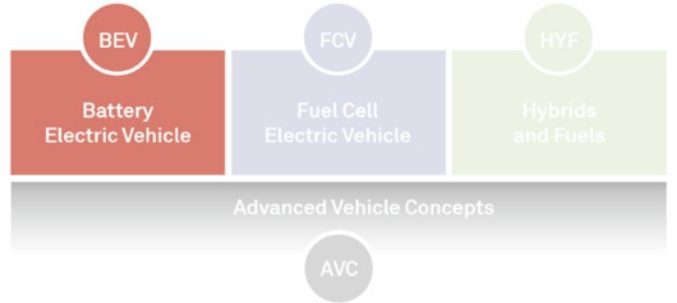
type of project required

short-term until 2025	**medium-term** 2025-2030	**long-term** 2030+
Developing new manufacturing technologies (cell, stack and BoP components), TRL[2022] 4-6		
Innovative sensors and actuators, TRL[2022] 3		
Production processes including automation and semi-automation to improve production speed, TRL[2022] 4		
Real-time quality control in the manufacturing process, TRL[2022] 3-4		
2nd Life of fuel cell vehicles, TRL[2022] 3-4		
Recycling of fuel cell vehicles, TRL[2022] 4		
Controll units (possibility of using AI and other emerging digital technologies to improve the manufacturing and /or maintenance), TRL[2022] 3-8		
Creation of Austrian seamless supply chain for fuel cell and BoP Components, TRL[2022] 3-8 Production and recycling of fuel cells, TRL[2022] 4-6		
Manufacturing machines and R&D equipment like test benches and measurement technologies, TRL[2022] 3-4		



Battery Electric Powertrain Technologies

- **Why do we need BEV powertrain technologies?**
  - Significant reduction of local pollutants
  - Contribution to petroleum-free economy
  - Significant increase in efficiency
- **R&D Focus**
  - High Voltage Systems (< 1000V)
  - Electric Motor & Power Electronics
  - Battery, Battery Management & Charging Systems
  - Vehicle System Integration & Thermomanagement
  - Recycling and Life Cycle Assessments
- **Austrian Contribution**
  - Strong Research and Production Community
  - Ideal Conditions as a Pilot and Pioneer Region
  - Network with Neighboring Countries
  - A3PS Exchange Platform



Battery Electric Powertrain Technologies

short-term until 2025 | **medium-term** 2025-2030 | **long-term** 2030+

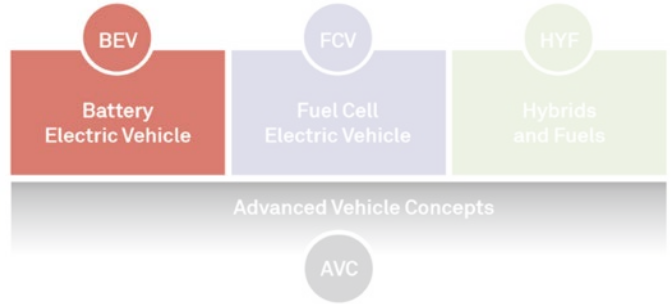
Energy Storages

Solid State Batteries
(4th generation) Cells & Moduls

high energy content / power density / efficiency / durability / safety / cost / integration

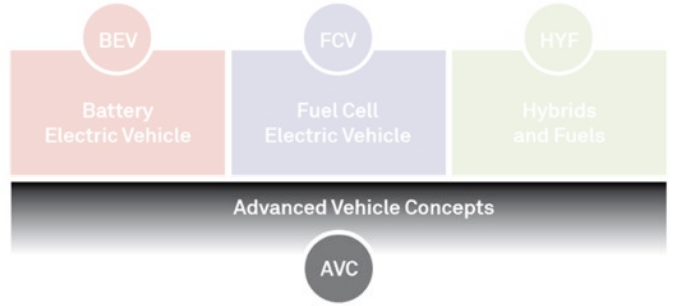
type of project required

- Cell design (material optimization, producibility, low carbon footprint ...), TRL2022 2-3
- Multiscale modelling (material, cell & system level, processing ...), TRL2022 2
- Manufacturing processes, research and production pilot lines, TRL2022 2-4
- Battery design, processes & strategies for recycling and 2nd life, TRL2022 2-4
- Material research (conductivity, electro-chemical stability, usable at temperatures up to and above 100°C, sulphide solid state electrolytes, lower toxicity, ...), TRL2022 2
- Highly safe battery, TRL2022 5-9
- Thermal management (reduced temperature sensitivity), TRL2022 4-8
- Battery management system and battery diagnostics, TRL2022 8-9



Advanced Powertrain Integration Technologies on Vehicle Level

- **Why do we need Advanced Vehicle Concepts?**
  - Advanced Propulsion Systems need optimized vehicle integration
- **R&D Focus**
  - Smart materials with the focus on new lightweight materials
  - Innov. production technologies & digitalization of processes
  - Digitalization & automation of vehicles and infrastructure
- **Austrian Contribution**
  - OEMs, suppliers and academic research institutions with expertise in holistic vehicle development
  - Test regions and real-world labs for driving tests environments
  - Smart and lightweight materials: research-centers



Advanced Powertrain Integration Technologies on Vehicle Level

short-term until 2025 | **medium-term** 2025-2030 | **long-term** 2030+

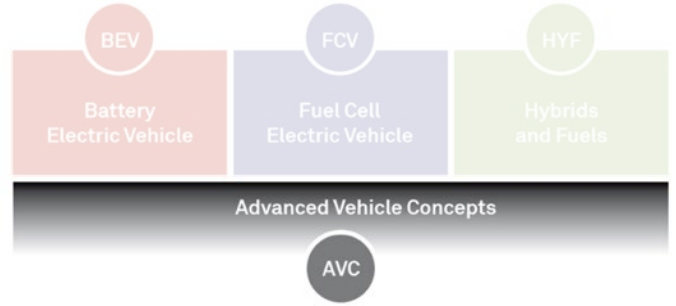
Advanced Power Train Integration Technologies on Vehicle Level

Development Tools, Methodologies, Measurement and Test

Enabling significant energy efficiency increase, considering circular economy and life-cycle

type of project required

- Digital twin of energy systems (enabling operation close to limits and prediction), TRL[2022] 7
- Standardized LCA methods and data, TRL[2022] 9
- Methods for LCA and circular economy in the design phase, TRL[2022] 8
- Local/multi-physical data driven modelling, virtual sensors, TRL[2022] 7
- Computing: neuromorphic, edge, cloud, TRL[2022] 6
- System of Systems Engineering, TRL[2022] 8



„Austrian Roadmap available for download“

https://www.a3ps.at/a3ps-roadmaps

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