

# The E-VOLVE Cluster of EU H2020 Projects – Innovative Electric Vehicles and Components

Presenter:

Christof Schernus

*President EARPA*

*Vice President R&I, FEV Europe GmbH*

Co-Authors:

Eric Armengaud, AVL List GmbH

Sabina Asanova, MOBI/VUB

Stella Arapoglou, MOBI/VUB

Eva Flora Varga, MOBI/VUB

Bernhard Brandstätter, Virtual Vehicle

Michele de Gennaro, AIT

Omar Hegazy, MOBI/VUB

Reinhard Tatschl, AVL List GmbH

Valentin Ivanov, TU Ilmenau

Aldo Sorniotti, University of Surrey

A3PS ●●▶▶ RETHINKING PROPULSION

ECO-MOBILITY 2019

14<sup>th</sup> International A3PS Conference

Eco-Mobility 2019

**Diverse Powertrain Concepts  
for a carbon-neutral future**

14 and 15 November 2019

Vienna, Austria



**E-VOLVE**

EV for Life, Value, Efficiency



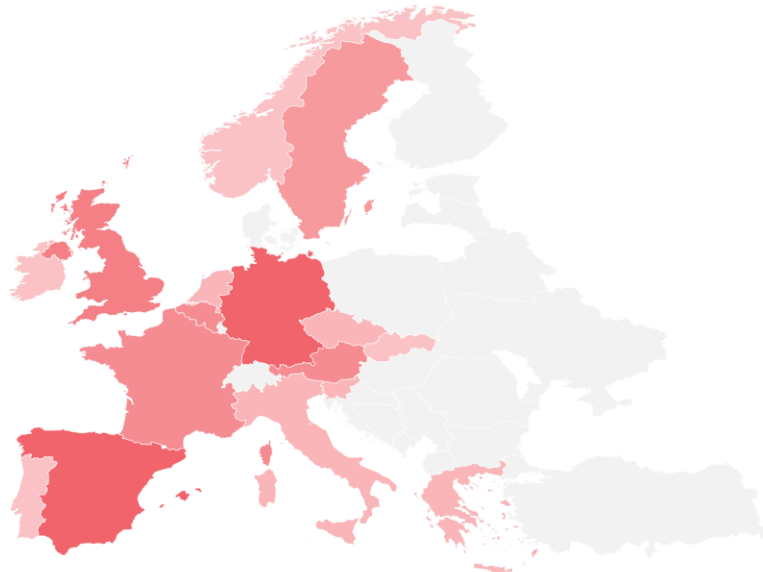
*This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 824311*

# Agenda

- Short Introduction of EARPA
- The E-VOLVE Cluster Concept
- The projects
  - ACHILES
  - CEVOLVER
  - EVC1000
  - FITGEN
  - SELFIE
  - SYS2WHEEL
- Purpose of the Cluster

# European Automotive Research Partners Association – 53 organisations

- Founded in 2002 by AVL, FEV, IDIADA, IFP, Ricardo, and TNO
- Engineering suppliers
- Research organization
- Universities



# EARPA's Foresight Groups (FGs) address future European research strategies



## Connectivity Automation Safety

- Ambition: Zero fatalities
- Identification and promotion of R&I needs for connectivity and safety of all road users



## Future Mobility for People and Goods

- Implementation and business models of the mobility of people and goods in our future society ...
- ... based on technology of other FGs



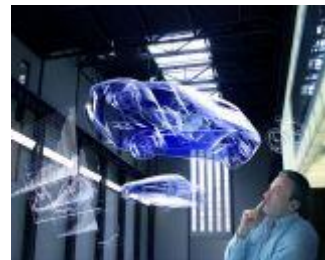
## Energy, Powertrains and Electrification

- Clean, efficient electrified powertrains
- Alternative fuels, holistic view on EU energy systems



## Project Management

- Experts of EU project management
- Rules for participation, legal and financial subjects related to funding and intellectual property



## Integrated and Connected Product Development

- Materials, manufacturing
- Virtual development and design tools
- NVH

# EARPA foresight groups support R&I frame programmes and some policy decisions



## FG Management

- Speaker
- Secretary

## Expert Group

- Max. 1 expert per member
- Up to 6 experts per FG

## Interested Members

- Unlimited participants



# EARPA Experts facilitate successful R&I proposal development

## FG Management

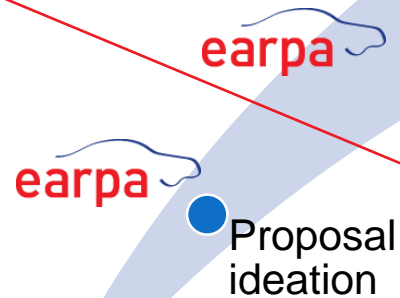
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- Prepared and organised by one Expert volunteer
- “Champion” collects core team and proposal members

## Proposal development

- Lead: Core team
- Collection of non-EARPA-members
- Mergers with other proposals possible

## Proposal submission

## Project execution, dissemination, exploitation





# Discussion of call texts in CRGs for better understanding and targeted proposals

As an example, LC-GV-01-2018 was discussed in depth.

Members developed first project ideas, gathered in core groups and looked for stakeholders outside EARPA like

- Vehicle manufacturers
- System suppliers
- Power electronic producers

This initiative resulted into six successful projects joining the E-VOLVE project cluster

## LC-GV-01-2018 Call description

Scope: Proposals will have to address one or more of the following technical areas:

**Topic I: Integrated electric/electronic architectures** (incl. high voltage) and **control systems for third generation electrified vehicles powertrains.**

**Topic II: Development of smart bus systems, electric motors, power electronics** enabling smaller form factors, when integrated in batteries and motors and modular approaches, **connectivity** and systems for enabling **automated driving functions**, have to be considered.

**Topic III: Modular and flexible on-board charging** optimized for infrastructure capabilities taking into account variable power with **up to 350 kW**

**Topic IV: Breakthrough heating and cooling concepts** to minimize the impact on vehicle range in extreme conditions.



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# E-VOLVE Cluster: The Concept

E-VOLVE brings together the forces of six Green Vehicles H2020 Projects:



GA No. 824244



GA No. 824311



GA No. 824290











GA No. 824335



GA No. 824295



GA No. 824250

-  Driver user friendliness
-  Thermal management of vehicle cabin and interiors
-  Battery thermal management
-  Infrastructure and adaptation
-  Passengers comfort
-  Affordability
-  Range
-  Connectivity



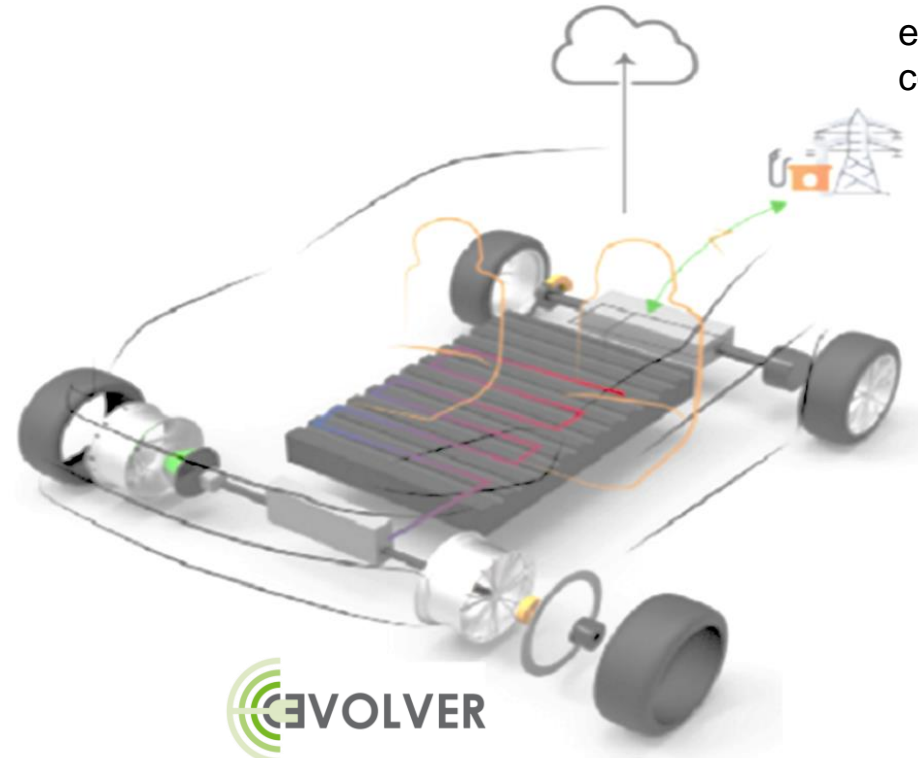
A new architecture with enhanced braking strategy and motion control dynamics



Battery thermal system for improved energy efficiency, enhanced autonomy and reduced costs



Novel in-wheel motor system and suspension concept for reducing weight and increase the driving range, handling and responsiveness



A user-centric development approach combined with connectivity and advanced control strategies



Functionally integrated e-axle ready for mass market of the third generation electric vehicles



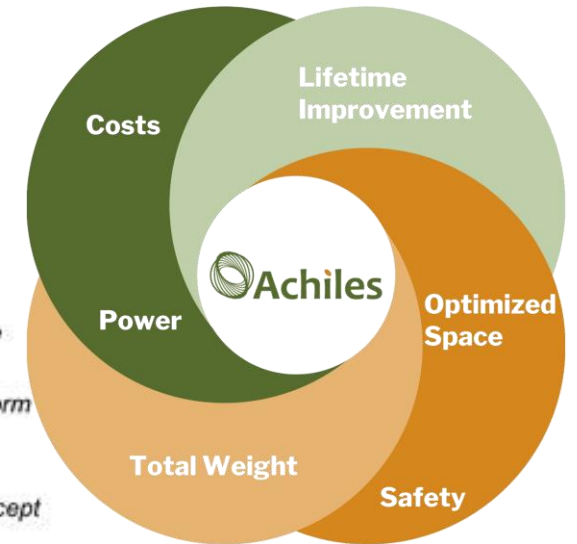
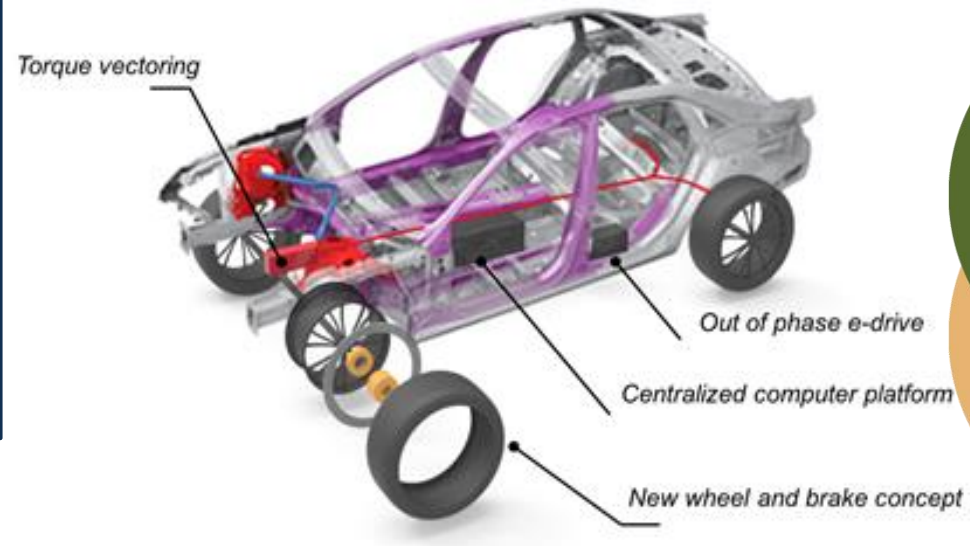
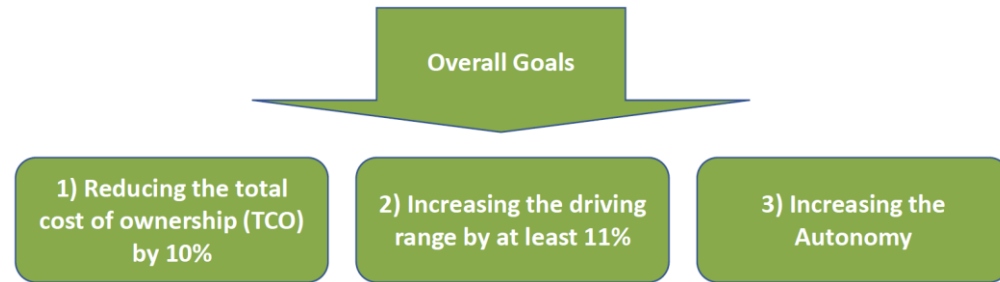
Drivetrain electrification and connected and automated driving



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- **New parts and functionalities in a new E/E system architecture by developing and further integrating four technological concepts.**
- A **new wheel concept** design will be equipped with full by-wire braking, including a new friction brake concept.
- A **centralized computer platform** will host the e-drive functionalities and reduce the number of ECUs and networks while fulfilling safety & security requirements.
- High automation and autonomy concepts
- An **out of phase control** will allow to intentionally operate the electric motor inefficiently to dissipate the excess of braking energy in case of fully charged batteries.
- A **new torque vectoring algorithm** will significantly improve vehicle dynamics.

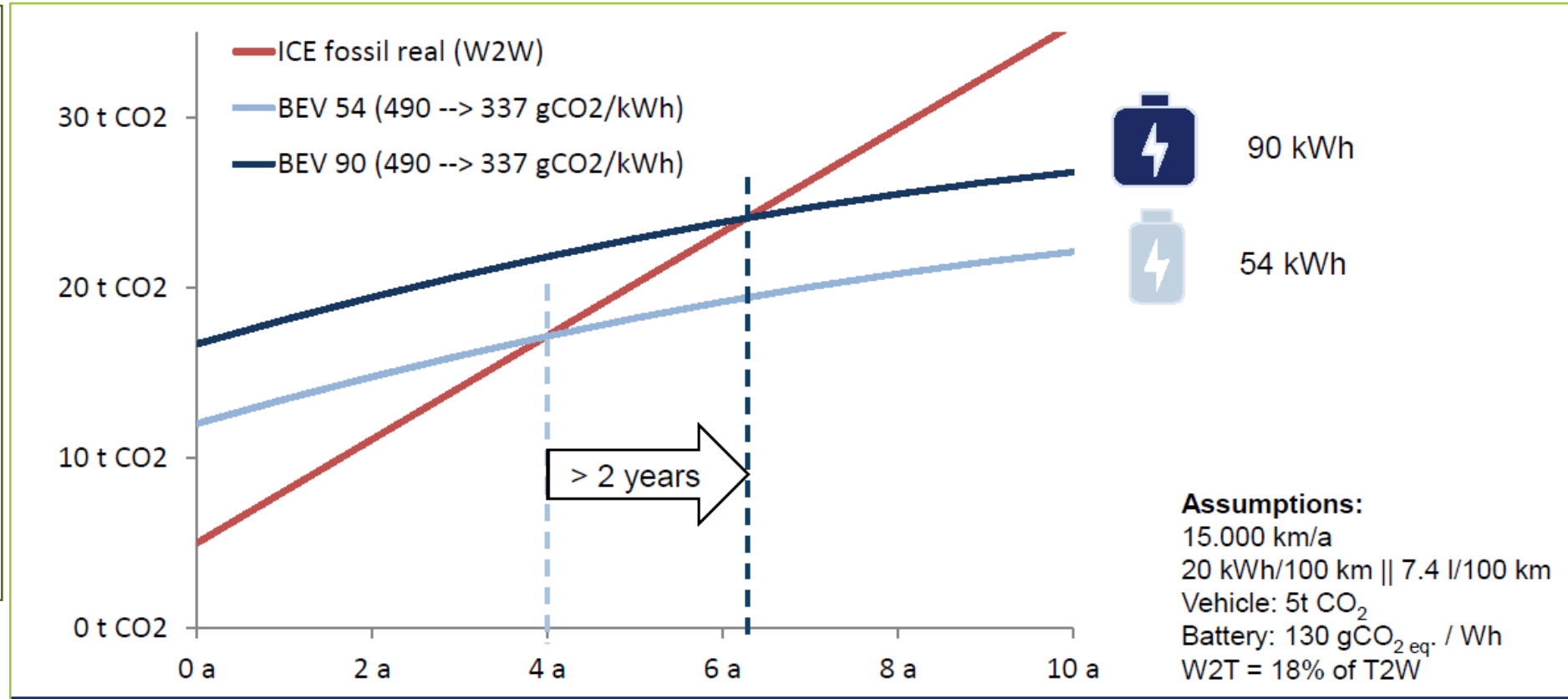


## A leap forward in user's confidence, functionalities and energy efficiency of Future Electric Vehicles

CEVOLVER is a research and innovation project to develop battery-electric vehicles that are primarily used in urban driving, but are comfortably usable for occasional long day trips with an affordable battery,

A holistic energy management aims at achieving the same range with 20% less battery capacity.

CEVOLVER aims at a user-centric development approach that will enable right-sizing the components of future vehicle using data collected in the fleet of connected BEV.

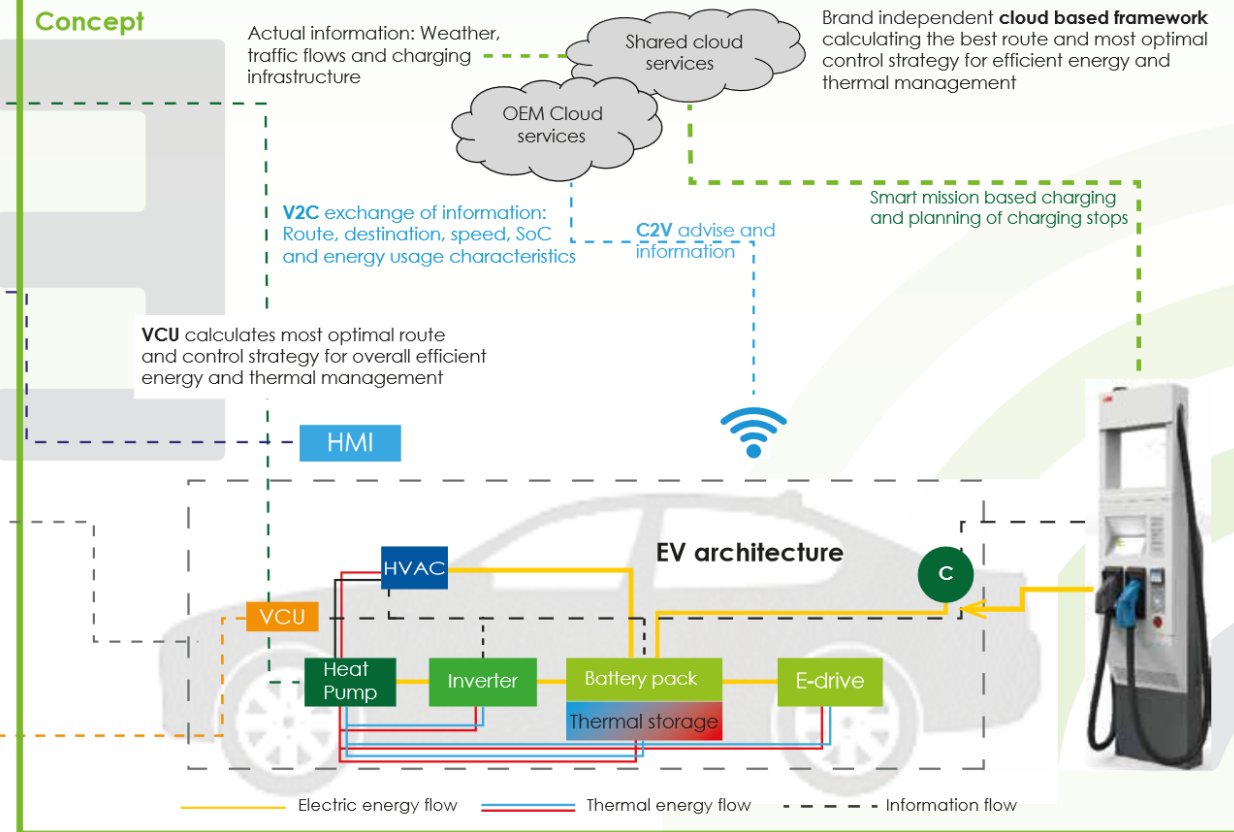
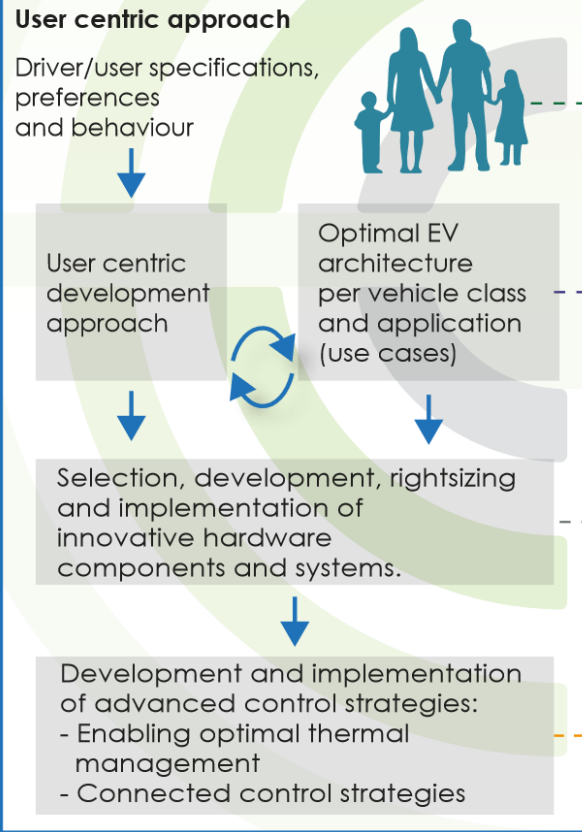


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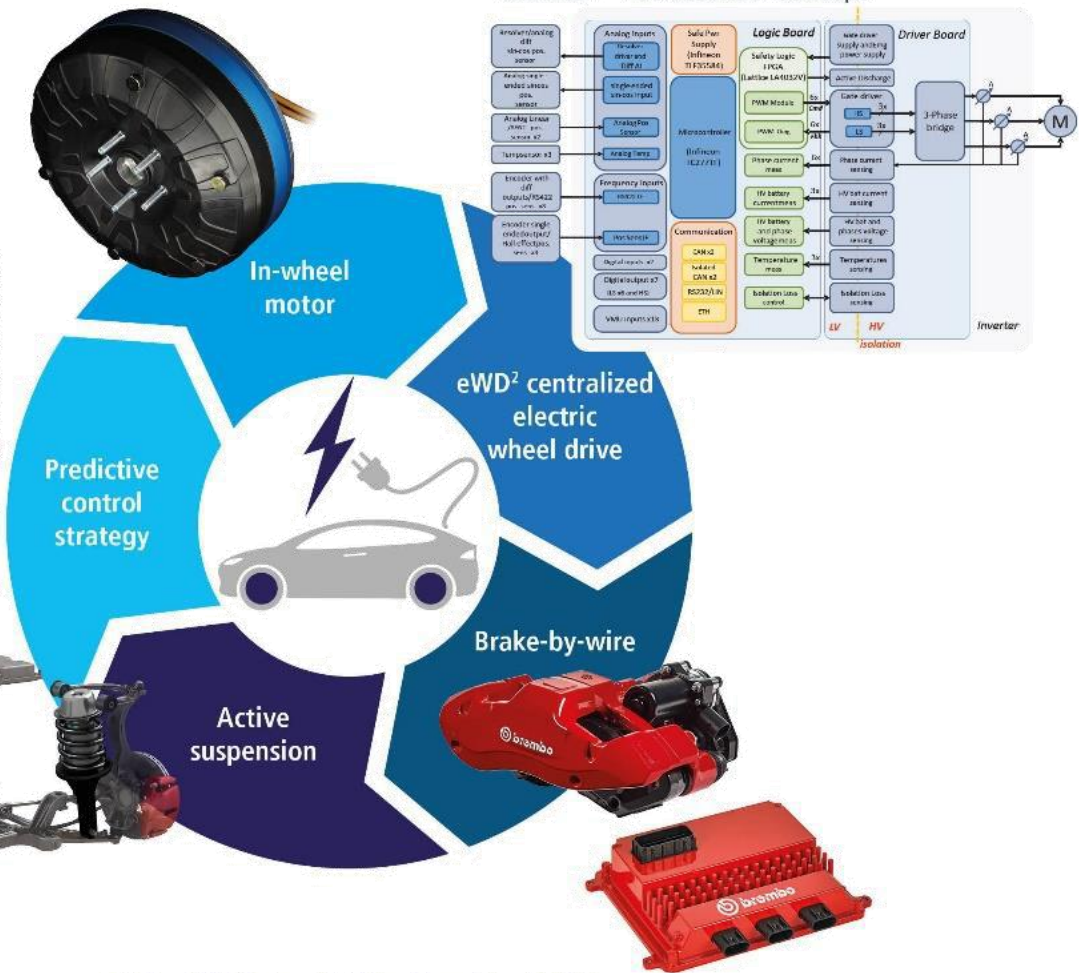
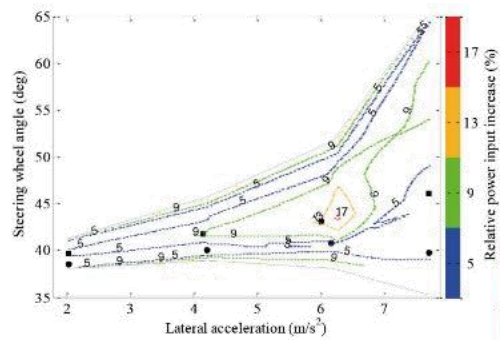


## Electric Vehicles Components for 1000 km daily trips

Vision: “To support the transition to electrification by innovative and mass-production optimised components enabling the efficient integration of powertrain and chassis systems to finally increase Electric Vehicles (EV) range and user acceptance”

The EVC1000 project will focus on innovative “corner concept” and will develop new components for in-wheel powertrains:

- i) Efficient, scalable, reliable, low-cost and production-ready in-wheel motors suitable for a wide range of torque and power levels;
- ii) Compact centralized drive for in-wheel motor axles, based on Silicon Carbide technology, targeting superior levels of functional integration and failsafe operation



• Brand-independent components for next generation electrified vehicles

The FITGEN e-axle delivers significant advances over the 2018 State of the Art:

- ✓ 40 % increase of the power density of the e-motor, with operation up to 18,000 rpm
- ✓ 50 % increase of the power density of the inverter, thanks to the adoption of SiC-components
- ✓ affordable super-fast charge capability (120 kW-peak) enabled by the DC/DC-converter, integrated with single- or 3-phase AC/DC-charger
- ✓ increase of the electric driving range from 740 to 1,050 km (including 75 minutes of charging time) in real-world freeway driving with the use of auxiliaries

**AREA I**  
performance density of inverter increased by **+50 %** with peak efficiency of **99 %** (SiC modules)

**AREA I**  
charging with **super-fast charge capability (120 kW-peak)** plus integrated AC/DC charging

**AREA I**  
decreased magnetic losses and **-60 %** reduced weight of all SiC Based PE-components

**FCA reference platform (A-segment)**

**AREA II**  
increased gravimetric power density (**+40 %**) of the high-speed BPM-SM

**AREA III**  
**smart cooling & heat removal:** transmission cooling combined with liquid cooled PE & BPM-SM

**AREA III**  
**functional integration of liquid/oil cooling system** for PE, BPM-SM & transmission

**AREA II**  
high speed BPM-SM (**18,000 rpm**) with high-speed transmission & PE







## SELF-sustained and Smart Battery Thermal Management Solution for Battery Electric Vehicles

SELFIE will develop a novel self-sustained compact battery system for next generation electrified vehicles.

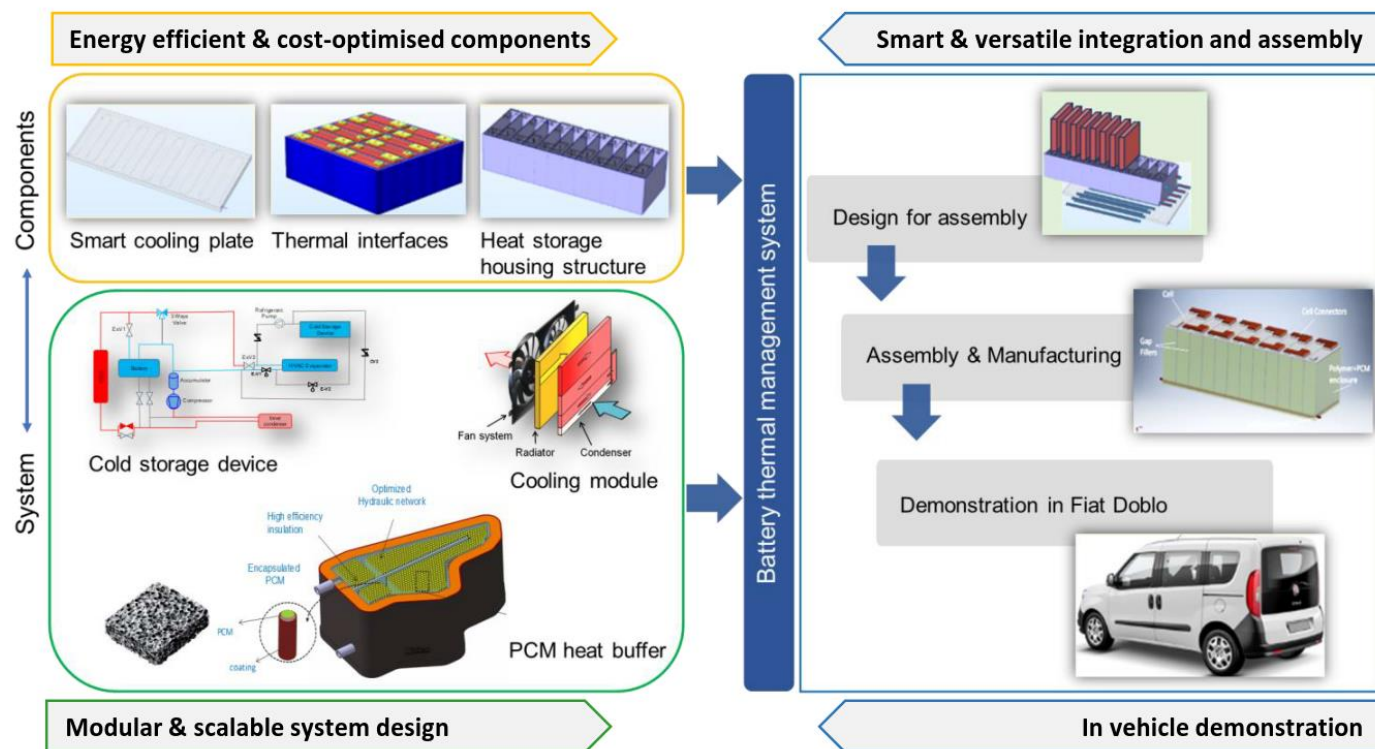
Key innovations powered by cross-industry collaboration:

- Novel battery cooling plate
- Efficient thermal interfaces for excellent thermal exchange
- Thermally active battery housing structures
- Modular design of cooling system
- PCM heat buffer integrated in the body of the vehicle

Targeted benefits:

- Enabling fast-charging up to 6C (using 180 kW charger) resulting in total time for full charge  $\leq 10$  mins (3 times faster than today) for a 30 kWh battery pack
- Enabling long range driving by employing a battery pack capable of handling charging powers up to 180 kW instead of the current 50-100 kW
- Overall cost reduction by 30% at the pack level by simplified design of the battery system
- Increase in energy efficiency by reduction of auxiliary load power consumption: 34-55% during winter and 17-20% during summer

### Battery thermal management concept





The ultimate goal of sys2WHEEL is to develop **sustainable city logistics** and **improve mobility, accessibility, and quality of life** of European citizens by taking a transdisciplinary approach. Both, in-wheel and e-axle solutions have a high potential regarding fully electric commercial vehicles for future city logistics since they provide numerous **advantages and benefits**

### Objective 1

sys2WHEEL will **reduce cost in mass production** by at least 20% through components becoming obsolete and through reduction of wiring costs as time-sensitive networks will be applicable.

### Objective 2

- The **powertrain efficiency** will be increased by improved e-motor windings, advanced rare-earth magnets, reduced powertrain rotating parts, reduced losses, advanced control and weight reduction.
- It will be demonstrated with a full size hardware and software implementation into two existing commercial demonstrator vehicles.

### Objective 3

- **Affordability and user-friendliness** will be achieved by enhanced modularity and packaging. Automotive quality will be addressed by advanced fail-operational safety and ISO 26262 compliance, modular and scalable technologies and lowered total cost of ownership.
- **Space-saving** approaches in sys2WHEEL lead to more freedom for batteries, cargo and drivers.



# Working in synergy...

...will meet future requirements in



energy efficiency

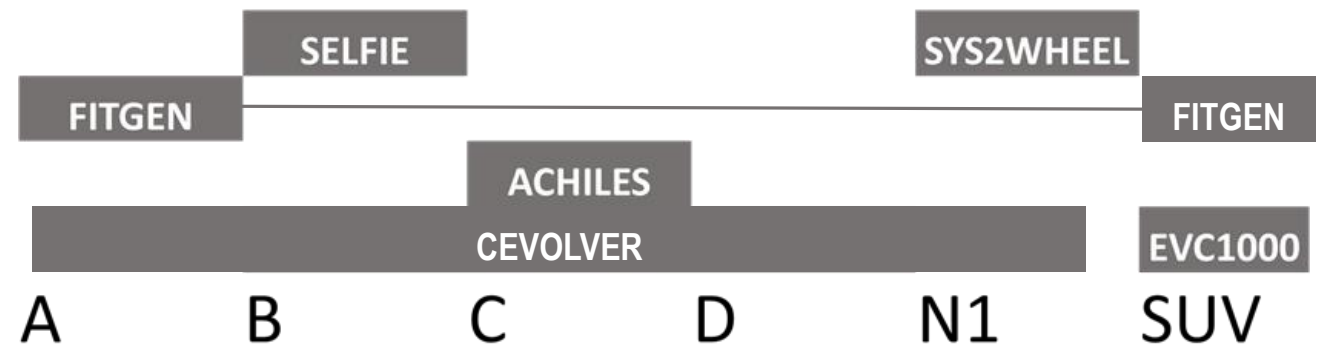


fast charging



increased driving range



## Segment coverage of demo vehicles



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# To maximize....

-  Dissemination
-  Exploitation
-  Impact
-  Intersectoral cooperation





# How?



Website



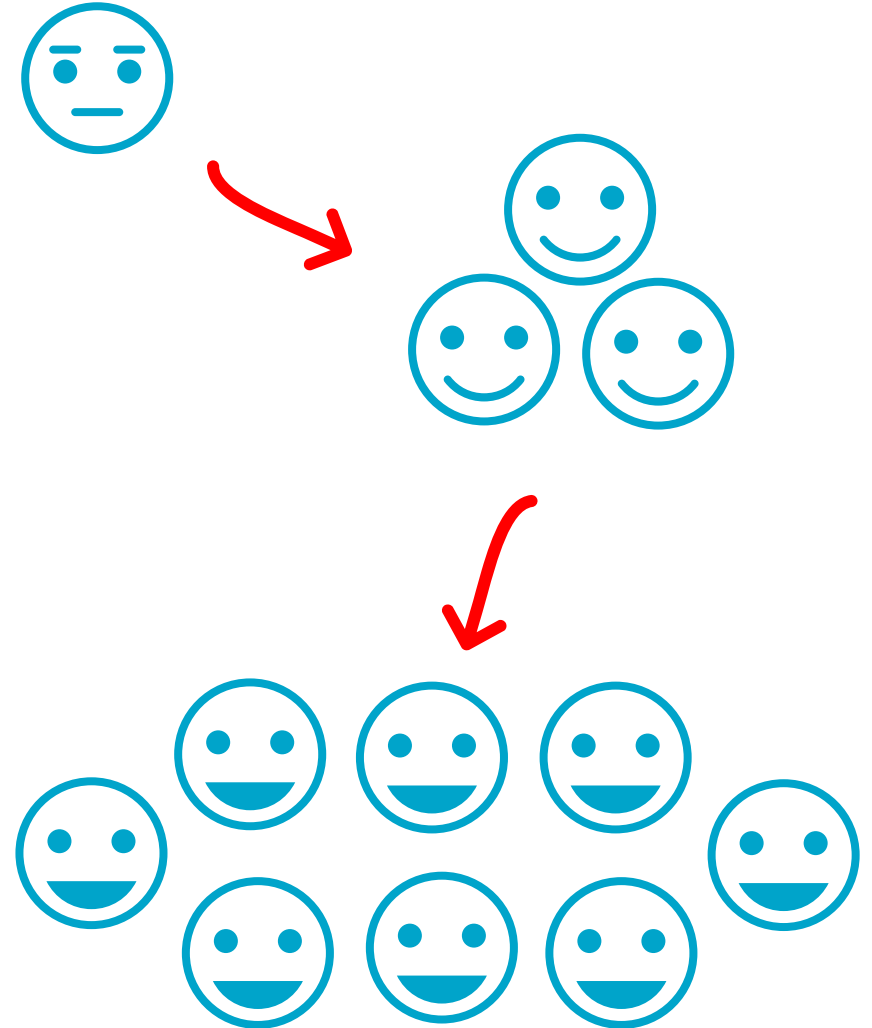
Social Media



Newsletter



Events Participation



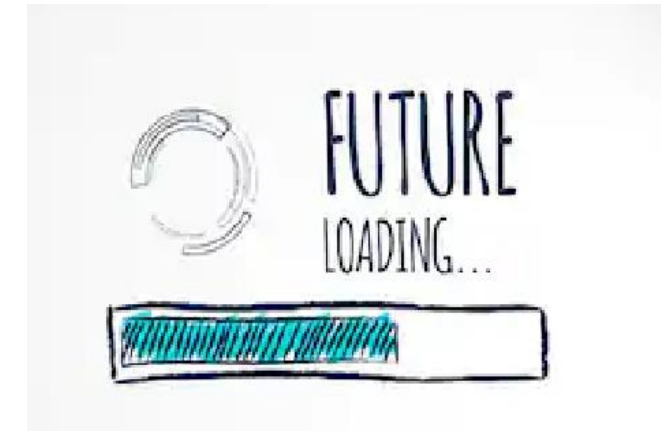
# What else is there?



Book publication: a common book, with input of all Cluster Members



Promotional material: to raise awareness, publicize visual identity



# Interested?



## Contact us

- [evolvecluster.h2020@gmail.com](mailto:evolvecluster.h2020@gmail.com)
  - [E-VOLVE Website](#)
  - [Twitter page](#)
  - [LinkedIn Group](#)
  - [LinkedIn page](#)
- ... or via our Cluster Members



Thank you !