E-VOLVE Cluster Newsletter

E-VOLVE
EV for Life, Value, Efficiency

May 2021

The EVolve future is now!

The virtual E-VOLVE (Electric Vehicle Optimized for Life, Value and Efficiency) Cluster is realizing and monitoring synergies between seven projects from the GV-01 Horizon 2020 call to execute joint dissemination, exploitation and standardization activities.

The Project Members

ACHILES, SELFIE, FITGEN, CEVOLVER, SYS2WHEEL and EVC1000, TELL are the members of the E-VOLVE Cluster.

Interested in learning more about our Cluster members? Visit our website!

PROJECT NEWS

ACHILES: Testing plan to validate demonstrator

Two years and half after the beginning of the ACHILES project (December 2018), the integration into the Audi Q2 BEV demonstrator is well under way. The modelling, design and prototyping of the powertrain and chassis components have been successfully achieved with a new wheel concept, an out-of-phase control for the brake system and a new torque vectoring algorithm for enhanced vehicle motion control. The physical integration of the components into the Achiles vehicle is ongoing at the different facilities of the consortium partners. The interfaces of the developed vehicle subsystems have been defined and the software implementation into the novel Centralized Computer Platform (CCP) is ongoing. Testing is still in progress on the different subsystems and the full vehicle testing plan has been defined to validate the performances of the Achiles demonstrator and compare it to the baseline Audi Q2 BEV with regard to project KPIs.

Figure 1: Achiles Prototype

Learn more about ACHILES.

TELL: Prototype and vehicle controller testing

The TELL project addresses the optimisation and large-scale manufacturing of low and medium voltage electric powertrain solutions, with focus on high efficiency, compact packaging and low cost. Three main applications are targeted: i) Small-to-medium segment electric cars; ii) Hybrid electric cars with a low voltage add-on electric propulsion system; iii) The lightweight urban mobility sector, e.g., electric quadricycles.

In the last 6 months TELL has achieved several important results, e.g.,: i) finalisation of the high power 48V Direct gear Motor Generator associated with a power inverter based on MOSfet from VALEO; ii) the testing of the newly developed inverter from DANA TM4 for the 4WD vehicle; iii) the integration of the new motor/inverter prototypes in the demonstrator vehicles; iv) the finalisation of the algorithms for improving, energy efficiency, traction and stability, fully exploiting the electric drivetrains. Extensive tests of the two vehicle prototypes and the developed vehicle controllers are planned for the summer.

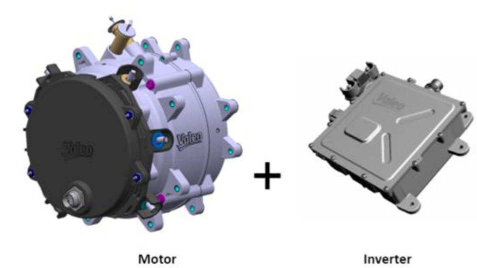

Figure 2: VALEO developed a high power 48V DMG (Direct gear Motor Generator) associated with a power inverter based on MOSfet. A specific power module with GaN transistors in parallel and a dedicated driver have been designed for technology evaluation.

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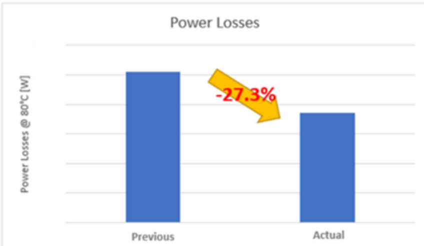

Figure 3: Power loss reduction achievements for the new inverter by DANA TM4 using state of the art Infineon components.

Figure 4: The newly designed motor and inverter from DANA TM4, for the 4WD vehicle demonstrator. The inverter testing recorded a 98.8% of peak and a 97.4% of average efficiencies.

For more information:

- Visit our project web page: **https://horizon2020-tell.eu/**
- Follow us on our LinkedIn page: **www.linkedin.com/company/eu-project-tell**
- Follow us on Twitter: **@eu_tell**

Lean more about TELL

2 years SYS2WHEEL – despite pandemic good progress

The year 2020 was dedicated to developing components and controls that can be integrated into the demonstrator vehicles. The architectures of the 2 demonstrators are well described in 2 deliverables that can be downloaded via the project's homepage. Another publicly available deliverable deals with control mechanisms for electrified propulsion and energy efficiency analysis of torque of sophisticated torque vectoring controls.

In-wheel energy harvester for supplying sensors in the wheels

HiWiTronics has developed a patented system which is able to harvest energy from rotating parts.

Figure 5: The in-wheel energy harvesting device offers the possibility to transmit signals, sensed in the wheel, with very high data rates to a controller at the chassis.

Implementation of in-wheel e-drive and suspension systems to light commercial vehicle

Implementation of in-wheel e-drive and in-wheel suspension systems to light commercial vehicles brings substantial benefits. Reducing the number of powertrain components and parts of conventional suspension system provide extra space for additional battery pack or for the storage. Thanks to those modular systems, reducing the vehicle complexity and mass production cost becomes easier to reach. Moreover, novel design for torque vectoring and advanced control algorithms, which collects data via sensors equipped to the wheels, are required to control in-wheel e-drive system.

It is crucial to identify which parts carry over from donor vehicle (green) and which ones are new (red) or need to be modified. Visual Bill of Materials (BOM) studies are performed after the alignment of the location of in-wheel e-drive and suspension systems. Finally, the visual BOM as shown in the following figure is used as a reference for further design and implementation activities.

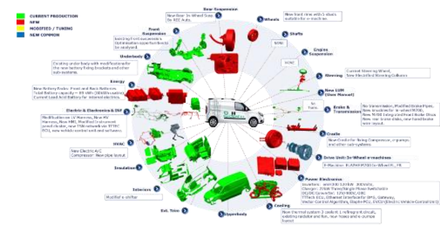

Figure 6: The visual BOM

Learn more about SYS2WHEEL.

SELFIE: Towards the finalization of the battery pack CAD design and safety concept

The project is now in its 3rd year of research and despite challenges in light of Covid-19 pandemic, the Consortium made great efforts over the past months to keep the project on track. While the battery pack CAD design (see Fig. 7) is going to be finalised by end of May and the first components are ready for prototyping, a functional safety concept for the SELFIE battery system has been elaborated.

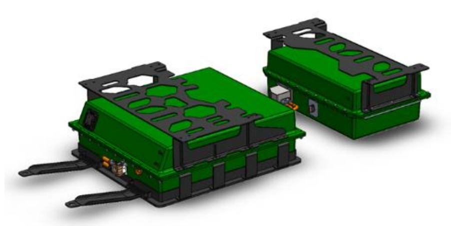

Figure 7: CAD drawing of SELFIE battery pack with cradle

The most important hazard for the battery system is the emersion of gas, emergence of fire or explosion of the battery because of overheating issues. In addition, there is a risk of electrocution and the unexpected loss of traction in

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specific driving situations. Therefore, one major challenge in the SELFIE project is to make sure that critical parameters of the battery system stay within demanded safety limits. The Hazard analysis and risk assessment (HARA) based on ISO 26262 has defined the safety goals and the corresponding Automotive Safety Integrity Level (ASIL). The next step will be the finalisation of the technical safety concept.

Thermal management system development for fast charging is one of the key aspects of this project. Considerable development has been made on the design of the advanced cooling system and includes prototype development and testing in the coming months.

These developments will pave the way for battery pack assembly with thermal management system and finally vehicle integration and testing in a demonstrator vehicle in the later phase of the project.

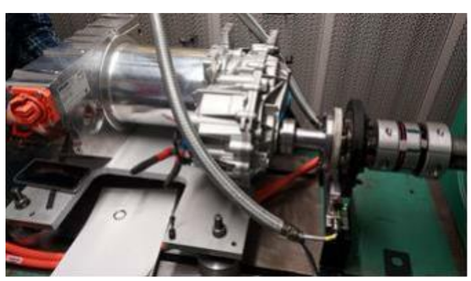
Learn more about SELFIE.

H2020 FITGEN project midterm results

FITGEN has now completed the Project Month 28th in April 2021. The inverter, e-motor, transmission, cooling and control systems' development phases have been successfully completed, and the prototype #1 of the full functioning e-axle has been delivered. The first assessment of the e-axle performance shows that FITGEN is overperforming in many areas, with respect to the KPIs identified at proposal level. In detail:

- the FITGEN motor power density is expected to exceed the initial target of 5.0 kW/kg by 4%, realizing 5.2 kW/kg and 24.5 kW/l;
- the FITGEN motor speed is expected to exceed the initial target of 18,000 rpm by 28%, realizing 23,000 rpm of max. speed and sustaining 27,600 rpm of overspeed;
- the FITGEN inverter power density is expected to exceed the initial target of 25 kW/l by more than 4%, realizing a value above 26 kW/l.

Now the e-axle is approaching the testing phase. Its performance will undergo full qualification in the drive lab of the Austrian Institute of Technology; subsequently the e-axle will be shipped to Torino, where the Centro Ricerche FIAT will proceed with its integration in the FIAT 500-electric vehicle demonstrator and test its performance in type approval and real-world driving conditions.



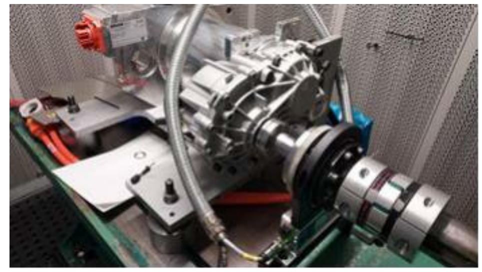


Figure 8: FITGEN Prototype #1 (transmission and motor-inverter group, stand-alone and mounted on the test-bench, courtesy of FITGEN consortium).

Learn more about FITGEN.

EVC1000: European Projects in Green Vehicles at SAE WCX 2021

On 13 April 2021 several European projects have presented their results on the Special Session "Electric Vehicle Drivetrain Dynamics" organized by Riccardo Groppo (ideas & Motion) and Valentin Ivanov (TU Ilmenau) at SAE WCX 2021. The speakers from three Horizon 2020 projects EVC1000, FITGEN, and XILforEV as well as from General Motors and Mississippi State University outlined advanced technologies in the field of drivetrain components.

In particular, Hong et al. (General Motors) discussed the problem of torque ripples in electric vehicle drive and measures for minimization their negative impact. Lehne et al. (H2020 project XILforEV) presented new fail-safe control strategy for brake blending control. Armengaud et al. (H2020 project EVC1000) introduced performance- and safety-related benefits of integrated corner solutions for electric vehicles with in-wheel motors. De Gennaro et al. (H2020 project FITGEN) presented a novel design of the liquid cooling system for e-axle / e-motor. Liu

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(Mississippi State University) outlined results of two studies dedicated to the electrical axle sizing and to the EV design with independent rear motors.

The session attracted many delegates and initiated fruitful on-line discussions.

Figure 9: H2020 EVC1000 video

Learn more about EVC1000.

CEVOLVER: Investigating a new A-class vehicle in relation to fast-charging

CEVOLVER completed its second reporting period with a successful review meeting by the end of April 2021. Like with many other projects, the overall progress of CEVOLVER was delayed some by the pandemic. Nonetheless, the build-up and testing activities of demonstrator vehicles made quite some progress, with CRF continuing the use of a prototype vehicle from a previous EU project and adding a new A-class vehicle for investigation related to fast-charging. Bosch is adding a second demonstrator vehicle to its first prototype to continue its investigations on thermal and energy management, and for later testing of CEVOLVER features like trip itinerary, range prediction, smart fast charging and eco-routing.

In the context of pre-evaluating its use case of the craftsman's one-day job driving 350 km to a work zone in the morning and 350 km back in the evening, Ford contributed a schematic analysis of trip time over average charging power when driving at different constant vehicle speeds.

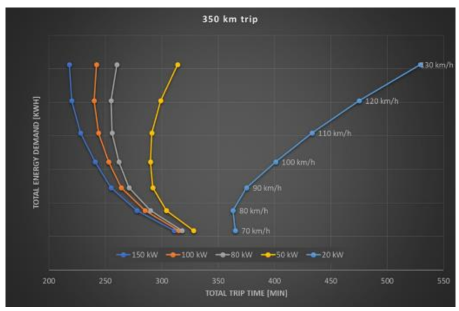

Figure 10: Generic chart of trip time for 350 km as function of vehicle speed and available charging power.

It shows the obvious declining benefit of ever-increasing charging power on trip time when driving at reasonable speeds (e.g. just about 10 minutes saving when travelling at 100 km/h and increasing the average charging power from 100 to 150 kW), as well as the limited benefit or even detrimental effect of driving faster depending on the available charging power. E.g. if the charging infrastructure along that 350-km route would provide just 50 kW average charging power, the craftsman would reach the destination the fastest when riding at 100 km/h. Going faster would delay his arrival by the charging time increasing with the energy consumption at higher speeds. Similar effects can be seen at 100 kW average charging power when going faster than 120 km/h. In both cases, at a certain point "Slow down, if you are in a hurry" is a conclusion, that saves time and energy and helps the environment.

Learn more about CEVOLVER.

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