E-VOLVE
EV FOR LIFE, VALUE, EFFICIENCY

NEWSLETTER 06/24

Summer is here and we are pleased to present the second newsletter issue of 2024. E-VOLVE Cluster member projects are proceeding greatly in their research and were introduced in many events that have taken place. Also, we still have to introduce two new members that have joined us this year.
Be sure to also check out the events that are coming up in the following months to not miss anything that might be of interest for you.
We hope you enjoy this issue of the cluster newsletter and hope you all have a fantastic summer of 2024.

WELCOME NEW MEMBERS

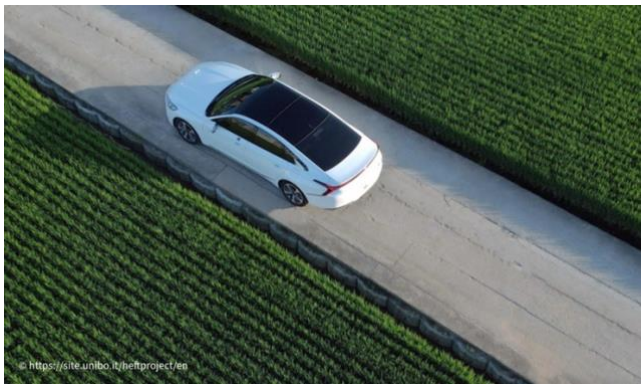
As we already proudly announced in our previous newsletter, many new members have joined our E-VOLVE cluster. The projects EFFEREST, VOLTCAR and Smart Corners have already been introduced last time and now we want to welcome to the cluster with a short summary and introduction, on behalf of all members, the projects: HEFT and MINDED. We are very much looking forward to the future cooperation.

HEFT

NOVEL CONCEPT OF A LOW COST, HIGH POWER DENSITY AND HIGHLY EFFICIENT RECYCLABLE MOTOR FOR NEXT GENERATION MASS PRODUCED ELECTRIC VEHICLES

Duration: 1.12.2022 – 31.5.2026
Coordinator: Mondragon Unibertsitatea
Consortium: 9 partners from 5 countries

Climate change has created an increased need for innovation in various sectors, including the automotive industry. Many corporations are striving to fulfil this need by developing and producing electric cars. However, the production process remains inefficient and environmentally harmful. The EU-funded HEFT project will reverse this trend by introducing a revolutionary synchronous motor for electric cars, which will be recyclable, cost-efficient and require fewer materials while producing fewer emissions and creating novel European circular economies. HEFT is a research project that brings together the expertise of universities, research centers and companies in electric motors, advanced materials and circularity, from basic research to the development and testing of new materials and components.



Follow the project HEFT

E-VOLVE
EV FOR LIFE, VALUE, EFFICIENCY

MINDED

THERMAL AND ENERGY MANAGEMENT FOR INCREASED DRIVING RANGE OF AN ELECTRIC MINIBUS INCLUDING IMPROVED USER-CENTRIC DESIGN AND THERMAL COMFORT

Duration: 1.1.2024 – 31.12.2026
Coordinator: AIT AUSTRIAN INSTITUTE OF TECHNOLOGY GMBH
Consortium: 11 partners from 5 countries

MINDED addresses in full the "expected outcome" and "scope" of the HORIZON-CL5-2023-D5-01-01 topic by delivering a battery electric IVECO eDaily minibus with 20% improved range at 0°C against the 2023 baseline. This is achieved by introducing a highly efficient heating system based on infrared (IR) panels, controlled by a novel user-centric HMI, embedding an optimised thermal and energy management strategy (TEMS) for improved comfort and reduced energy consumption. These activities are complemented with the demonstration of a new HVAC unit based on a heat pump, capable of reducing the vehicle's cooling energy requirements by 15% against the baseline, while leveraging the efforts made on the HMI and TEMS. To do so, MINDED encompasses 10 Technology Bricks, organised in three AREAs:

AREA I: Heating and Cooling System, including (1) IR heating panels, (2) thermal cabin insulation, (3) a thermal mannequin for evaluating passenger comfort, (4) the optimised HVAC unit featuring an e-compressor with gas bearings, (5) the required ECUs, and (6) the user-centric HMI.

AREA II: Digital Twin and Control Strategy, including (7) a new digital twin model, (8) an AI-based algorithm for predicting driving behaviour, (9) the TEMS, and (10) a comfort control strategy for determining optimal settings.

AREA III: Demonstration and Performance Evaluation, demonstrating the IVECO eDaily minibus on the dynamometer at TRL7 and the HVAC unit on the ThermoLab testbed at TRL6.

Beyond the range improvement, MINDED demonstrates a cost reduction of 5% at vehicle level from simplified systems' installation and reduced battery requirements, and a development time reduction of 30% achieved using the digital twin model and AI. The project generates its primary impact in the bus and minibus vehicle segments, with the MINDED Technology Bricks expected to equip 75% of the IVECO bus fleet by 2035, while delivering technologies exploitable in the medium/heavy commercial electric vehicles market.

Follow the project MINDED

E-VOLVE
EV FOR LIFE, VALUE, EFFICIENCY

CONFERENCES & EVENTS

E-VOLVE Cluster @ TRA 2024

The TRA 2024 took place in April in Dublin. The E-VOLVE Cluster is honored to have the possibility to present our activities, our member projects and exchange with many projects and initiatives.

Here is a small review on what we were able to do at the conference:

EC Lunchtime Session

Figure 1: Eric Armengaud presenting the E-VOLVE Cluster

We were joining the EC Lunchtime Session and had the opportunity to be presented at the stand of the European Commission together with the projects USER-CHI Project, eCharge4Drivers and the cluster Battery Heroes (greenSPEED EU Project, GIGAGREEN project, BatWoMan, NoVOC).

Paper poster presentation

Our joint E-VOLVE cluster paper was accepted for a poster presentation on the topic "E-VOLVE Cluster: Increasing innovation efficiency to support the transition towards sustainable e-mobility" and we were glad to welcome a very interested audience.

Figure 2: Poster presentation

EARPA stand

Figure 3: E-VOLVE Cluster @ the EARPA stand

We appreciated the opportunity to present our E-VOLVE cluster at the EARPA stand and of course, take the opportunity to visit the 2Zero stand, which was also in the same hall for a deep dive into the project portfolio prepared by 2ZERO to learn more about the projects selected under 2ZERO.

E-VOLVE
EV FOR LIFE, VALUE, EFFICIENCY

VOLTCAR @ TRA

Another presentation was held by one of our partner projects VOLTCAR. Jenni Pippuri-Mäkeläinen introduced the paper on the topic of "Development of Next Generation Sustainable Electric Traction Motors".

Figure 4: Jenni Pippuri-Mäkeläinen presenting VOLTCAR

EM-TECH + HighScape publication

EM-Tech and HighScape had a joined accepted publication: "Innovative E-Motor Technologies for E-Axles and E-Corners Vehicle Architectures Enabling Highly Efficient and Sustainable E-Mobility". This paper introduces the main innovations of the two projects, targeting a wide range of vehicle applications, including passenger cars and commercial vehicles.

Figure 5: Eric Armengaud presenting HighScape and EM-TECH

EM-TECH IAAPS @ TRA

On the final day of the TRA2024, EM-TECH's project partner University of Bath / IAAPS held a presentation on their work in the project at the Innovate UK stand. There have been some great discussions about the e-gear approach (3D-printed). You can find more information on the EM-TECH website: here

Figure 6: John Bond at the Innovate UK stand

On behalf of all cluster projects, we wanted to say "THANK YOU" to everyone that visited us and watched our presentations, sharing views and opinions. We are looking forward to meeting you at the next TRA in 2024.

E-VOLVE
EV FOR LIFE, VALUE, EFFICIENCY

EARPA Spring Meeting 2024

During the EARPA- European Automotive Research Partners Association Spring Event in March, Medina Ćustić was presenting the E-VOLVE cluster and participated to a panel answering questions from the audience.

The presentation entailed details of the cluster's initiatives, highlighting the achievements, challenges and exciting opportunities for the future. In addition, Bernhard Brandstätter shared insights on the early days of the cluster and how it got to where we are today.

Thank you Medina Ćustić for presenting the E-VOLVE Cluster and the cluster member projects. We also want to thank EARPA- European Automotive Research Partners Association for the invitation and the opportunity to share our vision, and all attendees for their support and interest.

Figure 7: Medina Ćustić and Bernhard Brandstätter at their presentation

If you want to find out more about the presentation visit the EARPA website or check out the full presentation on Zenodo.

HORIZON RESULTS BOOSTER

Projects joined the Horizon Results Booster

The Horizon Results Booster is an initiative of the European Commission which aims to bring a continual stream of innovation to the market and maximise the impact of public funded research within the EU.
It supports projects eager to go beyond their Dissemination and Exploitation (D&E) obligations - steering research towards strong societal impact and concretising the value of Research and Innovation (R&I) activity for societal challenges.

To achieve this, HRB offers free consulting services to closed or ongoing research projects funded by FP7, Horizon 2020, or Horizon Europe programmes.

The E-VOLVE cluster partner projects EM-TECH, HighScape, HiPE, PowerDrive and SCAPE decided to jointly apply for this initiative.

The collaboration with the Horizon Results Booster has already started and we are very much looking forward to our future work together. Also, don't forget to read the next newsletter issue for more information on this topic.

DELIVERABLES

RHODaS – Thermal Management System Strategies, Modelling and Simulation

The RHODaS Project aims to make significant advancements in efficiency and thermal performance that will allow further driving range extension, faster charging and easier thermal management of the whole powertrain, as well as possible improvement in cabin-heating and defrosting in winter.

Enhancements to the thermal performance of the powertrains and the extension of the truck driving range by 10% aims to be achieved by exploiting the wide frequency range of the wide band gap materials integrated in the powertrains. Hybrid switches will increase the temperature of operation. A more effective hybrid thermal management system combining micro liquid-cooling and air-cooling systems to mitigate negative effects of high current on health and ageing of the materials and components will also be implemented.

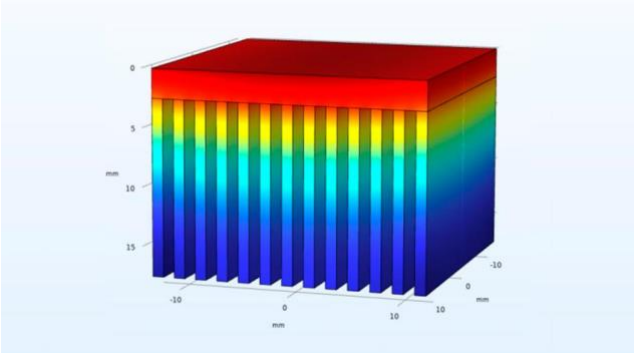


Image 1: The results of temperature distribution in the designed air cooled heatsink

A new report by Aarhus University offers a detailed overview of thermal management system strategies, modeling, and simulation within the RHODaS project. Initially, it focuses on outlining the thermal interface between inverters and cooling systems, examining estimated junction temperatures, and evaluating the potential impacts of design choices on equivalent thermal resistance.

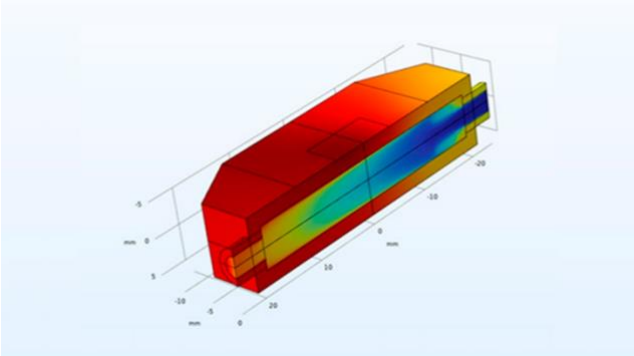


Image 2: The result of temperature distribution in the liquid-cooled heatsink

The document also delves into advanced 3D thermal and power loss modeling, utilising Finite Element Analysis, with a significant emphasis on the role played by COMSOL Multiphysics in heatsink design. Essential simulations cover aspects like liquid-cooled heatsink design and sensitivity studies. Notable contributions such as the introduction of the thermal equivalent circuit model, the RHODaS Thermal Management System Toolbox, and the strategic decision to design six heatsinks for a high-power converter are also covered in the report.

The conclusion addresses the need for advancements in temperature monitoring, proposing sensor networks, and outlining strategies for precise readings to enhance the overall effectiveness of the thermal management approach within the RHODaS project.

Download and read the full report here: RHODaS D3.1 Thermal Management

RHODaS – Fault Tolerant Control of SiC/GaN Power Converters

Fault-tolerant control (FTC) is a strategy that aims to keep closed-loop systems stable when components, sensors or actuators fail, maintaining predefined specific performance requirements, and increasing the resilience of the system against failures.

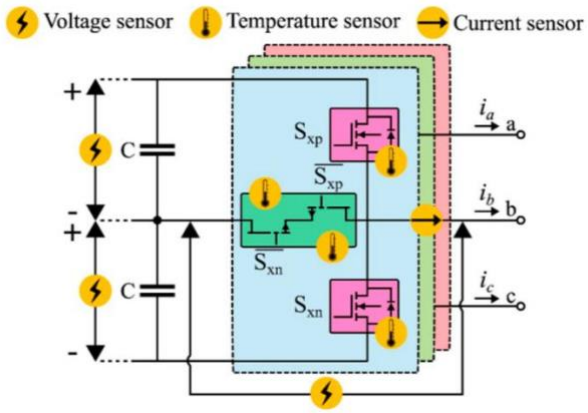


Image 3: Scheme of a low-power converter module with its respective sensors

In the RHODAS project, the objective is to design a new high voltage and high power (150kW rated, 250 kW maximum) power inverter that can be integrated with an electric motor of at least 650Vrms phase to phase, coupling to a gearbox system. In this system, if a critical fault occurs (short circuit, overvoltage, etc.) the protections at the converter level will act, stopping the operation of the drive.

However, harsh drive operating conditions, mechanical wear, aging components, or suboptimal manufacturing processes can lead to failures. Initially inconspicuous, these failures may progress in severity over time, ultimately leading to the breakdown of other crucial components. In extreme cases, a sudden serious failure can render electric vehicle systems inoperative, posing substantial safety risks. Consequently, it becomes imperative to implement a fault diagnosis system tailored to the diverse operating modes of the powertrain. This diagnostic mechanism must adeptly identify various potential faults, ensuring the safety of both the driver and the electric vehicle. Upon successful diagnosis, the implementation of a fault-tolerant control strategy becomes essential. This strategy aims to mitigate the impact on the vehicle's usability and elevate operating safety levels in the face of non-critical failures.

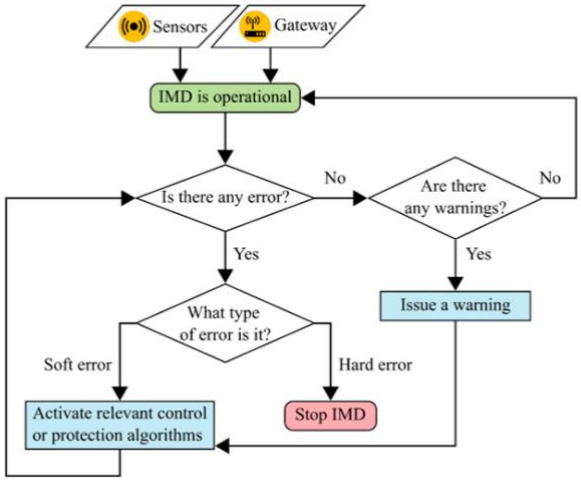


Image 4: Flowchart of the proposed fault tolerance algorithm

A new report by UNIVERSITAT POLITÈCNICA DE CATALUNYA delves into the fault-tolerant control system for the SiC-GaN T-type hybrid converter developed within the RHODaS project. Initially, the concept of fault-tolerant control is introduced along with the different control levels within the proposed integrated motor drive (IMD). Various failure scenarios that may occur in the power converter are addressed, providing detailed insights into their root causes and potential impacts on the system. Additionally, preventive strategies are discussed, emphasising key parameters that demand continuous monitoring to mitigate potential issues. The report also

conducts a detailed analysis of the sensors integrated into the system, elucidating the functions that will be implemented based upon the data acquired by these sensors.

Overall, the report provides a thorough insight into the fault detection, localisation, and mitigation algorithms intended for implementation in the power converters and the IMD system. These algorithms aim to efficiently identify, locate, and mitigate anomalies, enabling a swift and effective response to critical situations. Other key outcomes were the defining of fault-tolerant control concepts, detailing potential faults in the converter and motor, and examining sensor functionalities.

The report will be updated in September 2024, coinciding with the advancement of the high-power converter design and the completion of testing for fault detection, localisation, and mitigation algorithms.

Download and read the full report here: RHODaS D4.1 Fault tolerant control of SiC/GaN power converters

E-VOLVE
EV FOR LIFE, VALUE, EFFICIENCY

COMING UP

1st General Assembly in Potsdam, Germany

July 1st – 2nd 2024

Review Meeting

July 4th 2024

Next Cluster Meeting

July 5th 2024

3rd General Assembly in Erfurt, Germany

July 9th – 10th 2024

3rd General Assembly in Erfurt, Germany

July 10th – 11th 2024

26th Internation Conference on Electrical Machines (ICEM'2024) – Industry Sessions in Torino, Italy

September 1st – 4th 2024

Review Meeting

September 11th 2024

Review Meeting

September 18th 2024

Next edition of the E-VOLVE Newsletter

September 2024

European Researchers Night in Graz, Austria

September 27th 2024

Funded by the European Union

The research leading to these results have received funding from European Union's Horizon Europe research and innovation programme H2020 and Horizon Europe.
Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the funding authority). Neither the European Union nor the funding authority can be held responsible for them.