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HiPower 5.0

D7.6 Newsletter M12

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EXECUTIVE SUMMARY

This document presents the three HiPower 5.0 newsletters: “At a Glance”, “Covering the Full Powertrain Value Chain”, and “Key Results Shaping the Future of Sustainable Power Electronics”. Together, they outline the project’s vision, highlight its integrated approach across the entire value chain, and showcase collaboration among partners to bring innovations closer to real-world applications. They also demonstrate the project’s latest achievements, underlining its contribution to improved performance, reduced environmental impact, and the transition towards sustainable energy and mobility systems.

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1 Introduction

The Dissemination and Communication Leader, together with the Coordinator, decided to split the Deliverable 'D7.6 Newsletter M12' into several parts to be published regularly on LinkedIn. This approach was considered more modern and effective compared to producing a traditional printed newsletter or magazine.

The project will leverage LinkedIn as a key social media platform to disseminate its newsletter and amplify its impact. By encouraging partners and stakeholders to repost and share content, HiPower 5.0 will take advantage of modern communication dynamics, enabling rapid awareness-raising and broader outreach. This approach will contribute to increasing public interest in the project topic and its relevance to everyday life. These posts will include direct links to the project website, ensuring easy access to detailed information and resources.

The **first project newsletters** were already distributed on LinkedIn:

- First newsletter: HiPower 5.0 At a Glance

  Content: The HiPower 5.0 project continues to advance the future of sustainable and high-performance power electronics by bringing together leading partners across the full value chain. The first newsletter, *"HiPower 5.0 At a Glance",* introduces the project's vision, objectives, and collaborative framework, highlighting its commitment to developing next-generation solutions that enhance efficiency, reliability, and sustainability in power electronic systems.

- Second newsletter: Covering the Full Powertrain Value Chain

  Building on the first newsletter, the second, *"Covering the Full Powertrain Value Chain,"* emphasizes the project's holistic approach. HiPower 5.0 integrates expertise from materials and component development through to system integration and end-use applications. By addressing the complete powertrain value chain, the project fosters strong collaboration among industry and research partners, ensuring that innovations can be efficiently translated into real-world applications and market-ready solutions.

- Third newsletter: Key Results Shaping the Future of Sustainable Power Electronics

  The third newsletter, *"Key Results Shaping the Future of Sustainable Power Electronics,"* showcases the project's latest achievements. These include significant technological advancements, improved system performance, and promising results that contribute to reducing energy consumption and environmental impact. The outcomes underline HiPower 5.0's role in shaping future mobility and energy systems, supporting the transition toward more sustainable, electrified solutions.

Together, these newsletters illustrate the project's steady progress, from vision and collaboration to tangible results. HiPower 5.0 demonstrates how coordinated efforts across the value chain can accelerate innovation and deliver impactful solutions for the evolving demands of power electronics.

In the following you will find the newsletters as shared on LinkedIn.

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HiPower 5.0 at a glance

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27. April 2026

Vision

"Making transport sustainable for all" is one of the key topics addressed in "*The European Green Deal*", achieving a climate-neutral Europe by 2050. Through the Green Deal, the European Commission seeks to transform the European Union into a modern, resource-efficient, and competitive economy - a goal recently underlined by the report "***The future of European competitiveness***".

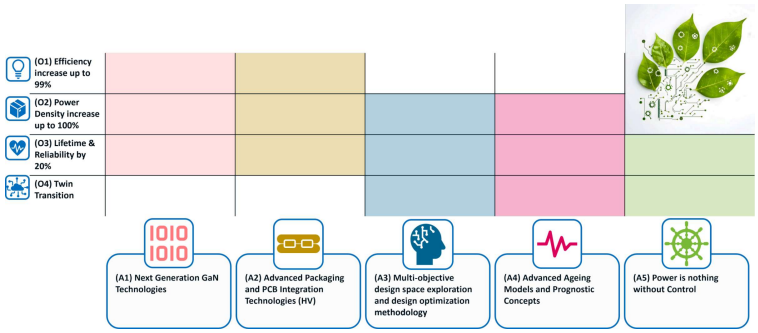
HiPower 5.0 is driven by the challenges and ambitions outlined in the Green Deal and Chips Act, aiming to develop new power electronics (PE) solutions to meet Green Deal targets and to foster a resilient, leading edge, all-European Value Chain for tomorrow's mobility solutions.

Therefore, the HiPower 5.0 partners aim to **develop highly integrated eDrive components using leading edge wide-bandgap semiconductors and power electronics integration technologies**. In doing so, a **resource-efficient and reliable design** is considered for next generation sustainable mobility solutions in the automotive and maritime domains.

Innovation

The project aims to deliver groundbreaking technological breakthroughs in **new GaN materials and power semiconductors, advanced packaging and integration solutions, multi-objective design tools, including life cycle assessment (LCA), advanced againg models and prognostics**

concepts, and control strategies. Together, these technologies will enable the achievement of the defined **objectives**, including increases in **efficiency** and **power density** of up to 99% and 100%, respectively, a 20% increase in **lifetime**, and support for the twin transition by means of **digital tools.**



Technologies supporting the set Objectives

Project insights by the coordinator

How did the HiPower 5.0 project come about?

The journey began in 2018 with the project **HiPERFORM**, one of the first initiatives to demonstrate the use of **wide-bandgap (WBG) semiconductors** in automotive power electronics. Its main objective was to **showcase the potential of SiC-based architectures** to significantly reduce losses and increase energy efficiency. Building on HiPERFORM's results, **HiEFFICIENT** took the next decisive step in 2020 by moving from device-level performance gains toward **system-level integration, intelligence, and reliability**. The core ambition of HiEFFICIENT was not only to further increase efficiency, but also to make WBG solutions - particularly GaN-based ones - **compact, intelligent, and robust enough for large-scale deployment in automotive applications**. The next major step is **HiPower 5.0**, which focuses on making **GaN semiconductors suitable for 800 V** architectures, integrating **sustainability** as a key design factor, and supporting the scalable **industrial uptake** of these solutions across a broader range of mobility applications, including the maritime domain.

What does the name of the project represent?

First, it reflects the "*Hi*" legacy of previous projects - HiPerform and HiEFFICIENT - you got it! Second, it refers to **Power Electronics 5.0**, as proposed by Prof. Kolar (ETH Zürich).

> "This time, the focus is not driven by new semiconductor devices or new materials, but rather - among other factors - by the need to make power electronics compatible with the circular economy."

Hence, the project focuses on new topologies saving resources, increasing efficiency, and investigating the lifecycle of existing solutions in order to achieve more sustainable mobility solutions.

What makes the project outstanding?

The project fosters an integrated European value chain from semiconductors to mobility application level, in line with and reinforced by the **European Chips Act**.

> "Strengthen the research and technology leadership, as well as build and reinforce its own capacity to innovate in the design, manufacturing, and packaging of advanced, energy-efficient, and secure chips, and turn them into manufactured products."

This will enable the demonstration of new WBG devices in real world applications within just three years.



Project Key Facts
45 partners / **10** countries / **16.5** MEUR funding
3 years runtime / coordinated by **AVL List GmbH**

HiPower 5.0

Acknowledgement

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Covering the Full Power Electronics Value Chain

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The HiPower 5.0 consortium represents a comprehensive, vertically integrated European ecosystem dedicated to advancing next-generation power electronics for electric mobility. Comprising **44 partners from industry, research organizations, and academia as well as one associated partner**, the consortium spans the entire value chain - from fundamental materials research and semiconductor technologies to system integration and final application in electric drivetrains. This broad coverage enables not only **strong technological innovation, but also efficient knowledge transfer** and scalable industrial deployment.



From Materials to Mobility: A Fully Integrated Value Chain

1. Upstream: Materials and Semiconductor Technologies

The project begins with the development of advanced semiconductor materials and devices. These technologies - especially silicon carbide (SiC) and gallium nitride (GaN) - are key to improving efficiency and performance in electric systems.

Soitec contributes expertise in engineered substrates, while Infineon, IMEC, and, CEA focus on device design and manufacturing, transforming materials into functional electronic components. AT&S and Fraunhofer IZM support this with advanced packaging technologies to improve reliability and performance.

Research organizations such as Silicon Austrian Labs, TU Chemnitz, TU Dortmund, and the Slovak University of Technology Bratislava complement industry efforts by advancing device design, fabrication, and reliability testing. These organizations provide the scientific foundation that underpins innovation across the entire value chain.

👉 This upstream work forms the technological foundation for next-generation power electronics.

2. Midstream: Components, Modules, and Subsystems

Building on semiconductor technologies, the midstream stage focuses on integrating devices into components, power modules, and subsystems for real-world applications.

TDK Electronics provides key passive components such as capacitors and inductors, while Denpaflux supports electromagnetic design and optimization. Engineering partners - including AVL Software and Functions, Ideas & Motion, Prodrive, and Reden - contribute system design, simulation, and validation to ensure performance, cost-efficiency, and reliability.

MAHLE advances electric drive components, while LUMENCY develops embedded sensor technologies.

👉 This stage translates semiconductor innovation into scalable, efficient, and compact power electronic systems.

3. Downstream: System Integration and Application

At the downstream stage, the focus shifts to system integration and real-world applications, particularly in electric mobility. Power electronic subsystems are integrated into complete electric drivetrains and vehicles.

Elaphe contributes innovative solutions such as in-wheel motors, expanding the range of possible drivetrain architectures. Valeo and SCHAEFFLER, as Tier 1 suppliers, are key players in the design and production of power electronics systems, including inverters and converters.

Major industrial players such as Mercedes-Benz and Ampere (Renault Group) represent the automotive application layer. These companies define system requirements, validate technologies in real-world conditions, and ultimately bring innovations to market.

In parallel, AVL, DEIF, and Siemens explore power systems for maritime applications, focusing on optimal performance and maximum efficiency.

👉 This stage ensures that the project's innovations are validated and deployed in real-world mobility solutions.

4. Cross-Cutting Role of Research and Academia

Across all stages of the value chain, universities and research institutions play a vital cross-cutting role. Partners such as **Aalborg University**, **Politecnico di Torino**, **RWTH Aachen**, **TNO**, **TU Eindhoven**, the **University of West Bohemia**, the **University of Stuttgart**, **Virtual Vehicle Research GmbH**, and **Vrije Universiteit Brussel** contribute advanced research, modeling, and experimental validation capabilities.

They also contribute to education and training, ensuring knowledge transfer between research and industry and supporting the long-term sustainability of Europe's innovation ecosystem.

👉 Academia ensures scientific excellence, validation, and knowledge transfer, linking research innovation with real-world industrial applications.

5. System-Level Integration and European Impact

One of the defining features of the HiPower 5.0 consortium is its strong emphasis on system-level integration. Rather than focusing on isolated innovations, the project seeks to optimize the entire value chain, ensuring that improvements at one stage translate into measurable benefits at the system level.

The close collaboration between upstream, midstream, and downstream partners enables:

- Faster innovation cycles
- Reduced time to market
- Improved interoperability between components

From a strategic perspective, **the consortium strengthens European sovereignty in key technologies** such as semiconductors and electric mobility. By integrating capabilities across multiple countries and sectors, HiPower 5.0 contributes to a resilient and competitive industrial ecosystem **aligned with the objectives of the European Green Deal.**

👉 By integrating expertise across Europe, the project strengthens competitiveness and supports the goals of the European Green Deal.



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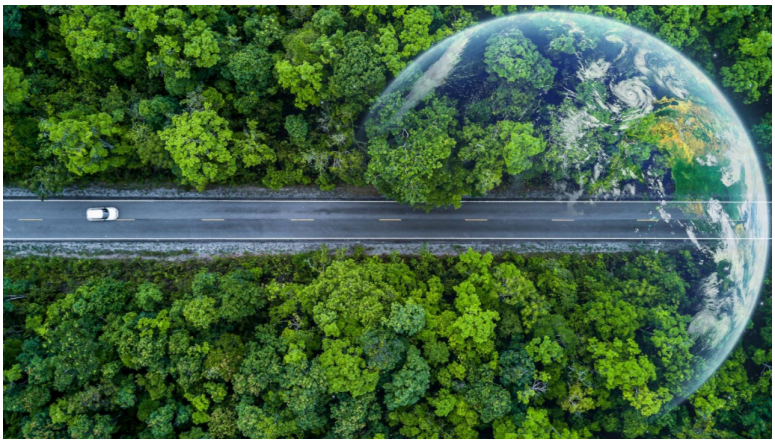
HiPower 5.0

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Key Results Shaping the Future of Sustainable Power Electronics

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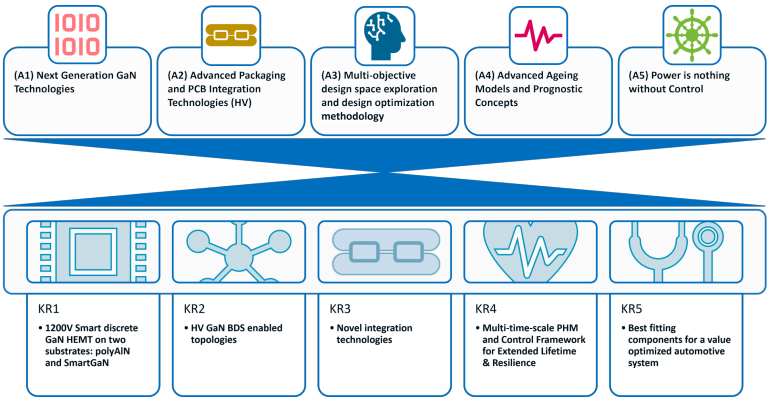
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The HiPower 5.0 project combines cutting-edge innovation with a strong focus on sustainability. Building on **five key innovation topics**, the project delivers key results that enable future applications while integrating **Life Cycle Assessment (LCA)** to ensure reduced environmental impact across the entire product life cycle. In this edition, we highlight **progress on key technological results** and show **how LCA supports more sustainable design decisions**.

Five main innovation topics

HiPower 5.0 project focuses on 5 main innovation topics, enabling the set objectives (see also Newsletter Edition 1). These innovation topics are directly related to the planned key results as a basis for later commercial exp oitation. The identified 5 Key Results are:

- 1200 V GaN devices on two different engineered substrates,
- 850 V monolithically integrated bi-directional GaN switches enabling topologies with reduced conversion stages,
- novel integration technologies to embed high voltage power switches in the printed circuit board (up to 3.3 kV)
- overarching control coordination across all time scales relevant for Predictive Health Management (PHM): from microseconds stresses to long-term aging mechanisms, and
- best fitting components for a value optimized automotive system.



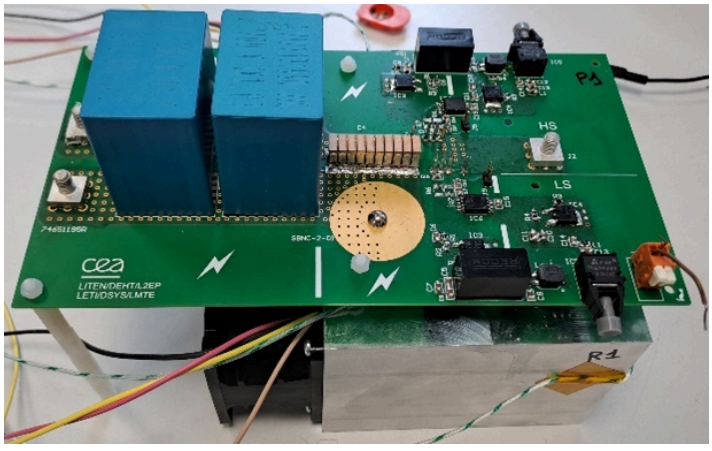
How Innovation Topics are exploited as Key Results

Best fitting Components for a value optimized Automotive System

Within this newsletter, first insights on the innovation topic **multi-objective design space exploration and design optimization methodology** are given. The main objective is to develop and apply a multi-physics simulation framework dedicated to a System and Technology Co-Optimization (STCO) approach, leading to **best fitting components for a value optimized automotive system**. Simulation and modelling make it possible both to assess the benefits of new technologies (newly developed GaN devices within HiPower 5.0) for given applications and to define the key technology micro-parameters to meet application requirements. This supports the establishment of a technology development roadmap.

Multi-physics simulations must couple physical phenomena with different time constants: electrical (~nanoseconds), thermal (~seconds) and mechanical (~hours, weeks, months, ...). To enable simulations with a reasonable timeframe, the use of dedicated Reduced Order Models (ROMs) or data-driven models is required. A key challenge is to accelerate computation while maintaining sufficient accuracy. A simulation error below 10% compared to experimental measurement is an ambitious target.

Up to now, the project has focused on the development and validation of the multi-physics and multi-scale simulation framework as well as the associated initial and ageing models. The figure below shows an instrumented power-electronics switching cell used to collect experimental data (semiconductor losses and temperature), which will be compared with multi-physics simulations to assess the accuracy of the framework. Once validated, these models will be used to simulate mission profiles, enabling the analysis of device aging and lifetime. At the end, this will allow us to optimize the converter design for reliability targets.



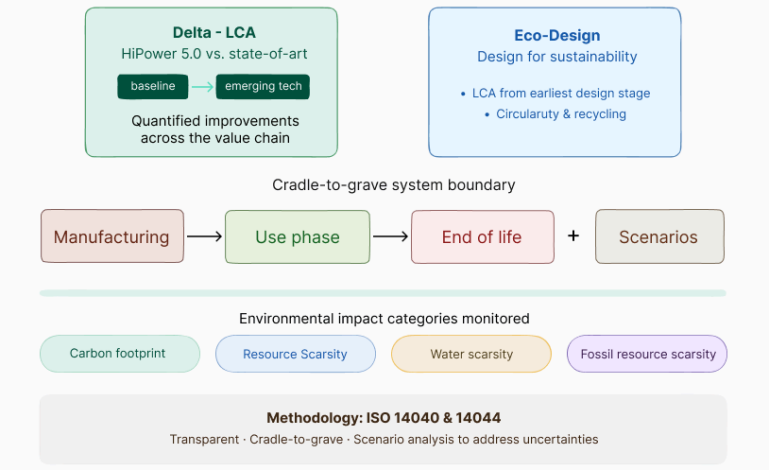
Instrumentation test bench to experimentally quantify the precision of semiconductor electrothermal models

Life Cycle Assessment (LCA)

Life Cycle Assessment is **a key methodology** within HiPower 5.0, enabling a comprehensive evaluation of the environmental impacts of power systems across their entire life cycle. By identifying environmental hot spots, LCA supports informed decision-making aimed at **reducing environmental footprints and improving overall sustainability** - especially important when introducing advanced technologies such as Wide Band Gap (WBG) power devices.

Within the project, LCA will be used to **assess the advantages of HiPower 5.0 solutions** compared to current state-of-the-art systems through a delta-LCA approach. At the same time, it will guide the integration of eco-design principles and recycling strategies from the earliest design stages, ensuring that sustainability is embedded throughout the development process.

HiPower 5.0 adopts a design-for-sustainability approach, performing Life Cycle Assessment(s) early in product development to **steer innovation toward more sustainable solutions**. Starting from a defined baseline, the project will quantify improvements across the entire value chain, from manufacturing and use to end-of-life. Particular attention will be paid not only to the carbon footprint, but also to resource efficiency, including the use of critical raw materials, water, and fossil resources.



LCA approach in HiPower 5.0

The methodology follows ISO 14040 and 14044 standards, ensuring a systematic and transparent evaluation from cradle to grave. Although the project focuses on prototype systems, robust assessments will be achieved by **combining experimental data with established databases and the literature**, supported by scenario analyses to address uncertainties.

Through these activities, the partners will strengthen their expertise in eco-design and circularity, expanding their LCA and Life Cycle Costing (LCC) services for power electronics and converter manufacturers. The **outcomes are expected to contribute not only to technological innovation but also to broader economic and societal impacts**, including future guidelines and policy recommendations for sustainable energy systems.



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2 Terms, Abbreviations and Definitions

HiPower 5.0	Leading edge semiconductor, integration, and control system technologies for highly compact and smart edrive components towards more sustainable power electronics 5.0
DEC	Websites, patents filing, press & media actions, videos, etc.
PU	Public, fully open, e.g. web (Deliverables flagged as public will be automatically published in CORDIS project's page)
R	Document, report (excluding the periodic and final reports)
SEN	Sensitive, limited under the conditions of the Grant Agreement
WP	Work Package

Table 2-1: Terms, Abbreviations and Definitions