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#RTR2026

POWERDRIVE

Power electronics optimisation for next generation electric vehicle components

Prof. Wilmar Martinez
KU Leuven

2ZERO ERTRAC CCAM European Commission With the support of BATT4EU Batteries European Partnership

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Overall project presentation

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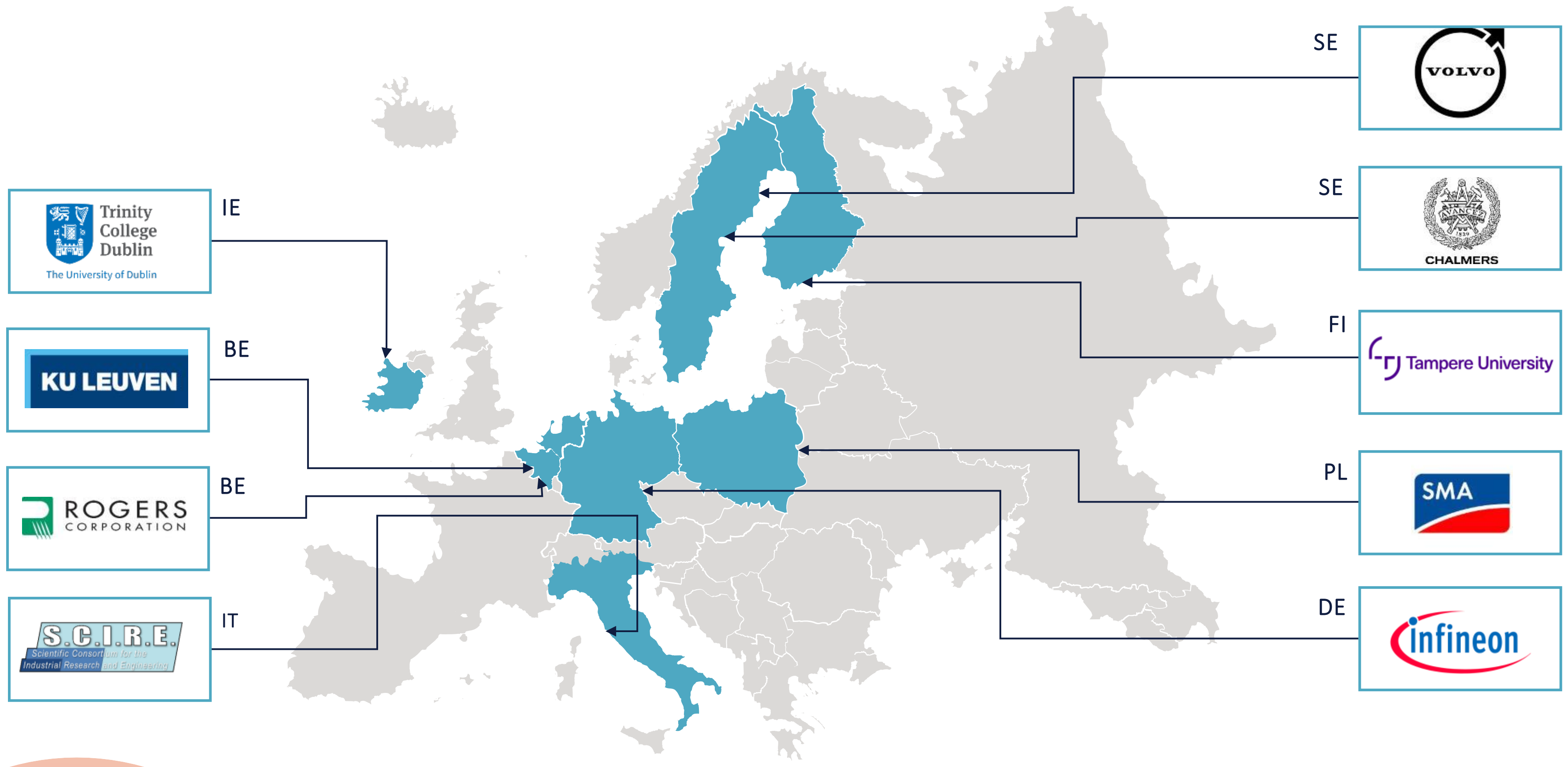
Consortium and Project

CONSORTIUM

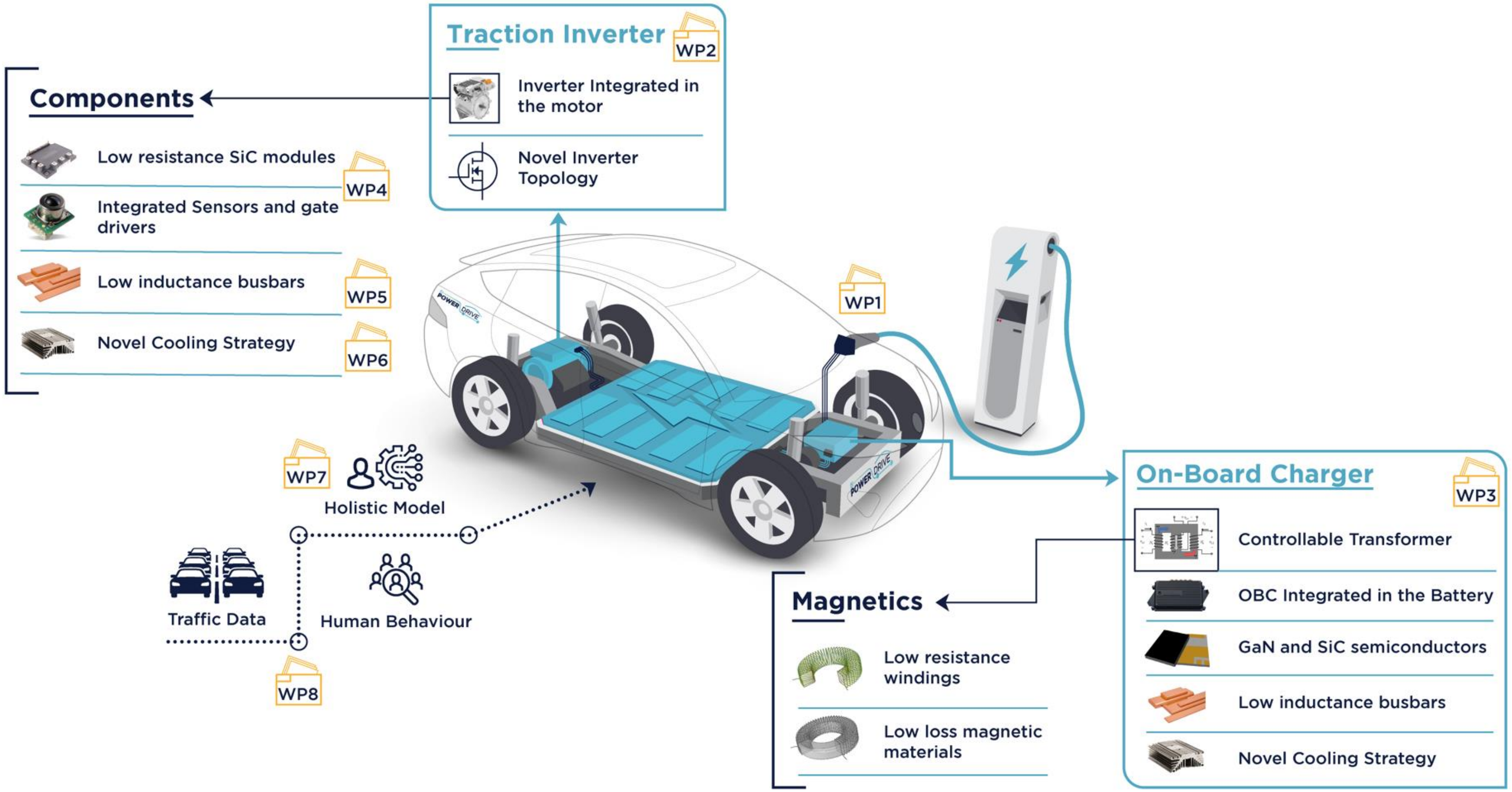


INFO

- CL5-2021-D5-01-02
- RIA
- Project #: 101056857
- 9 Partners
- 7 Countries
- Budget: 5.998.877,50
- Time: 54 months
- May.2022 - Oct.2026

Consortium and Project

POWERDRIVE



INVERTER

PARAMETERS	UNIT	3ϕ	6ϕ
DC link voltage	V	800	800
Switching frequency	kHz	20	20
Maximum DC current in bus bars	A	638	638
Maximum AC current RMS in bus bars	A	365	182
Breakdown voltage of laminated bus bar	V	1200	1200
Semiconductors	-	SiC	SiC

ON-BOARD CHARGER

PARAMETERS	UNIT	OBC
DC link voltage	V	800
Switching frequency	kHz	<500
Power	kW	11
Bidirectional	-	Yes
Semiconductor Technology	-	GaN

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Overall Objective

Objective	Goal
Develop a functional ultra-compact, efficient, cost-effective, and integrated **advanced power electronics solution** for passenger BEVs	**28%** cost reduction, **35%** loss reduction, and power densities of around **26.4 kW/kg** and **50.3 kW/litre**
Optimise components (**connectors, semiconductors, magnetics, and cooling circuitry**), and converters (**traction inverter and OBC**)	**98.5%** Efficiency (whole charging profile)
Reduce the overall cost of the advanced power electronics solutions (inverter and OBC) using SiC and GaN and advanced passive devices	**12.5 €/kW** cost density in the set of Inverter and OBC
Integrate traction inverters and OBC into motors	At least **1** integrated inverter-motor and **1** integrated OBC-battery or OBC-inverter
Model, simulate, and predict the operation of the advanced power electronics under different **load, charging, and real driving profiles**	**<5%** deviation between simulation and testing Computational performance which allows time-domain simulation for design purposes
Integrate components and converters in one integrated powertrain platform	At least **1** integrated platform for testing and demonstration
Test, validate, and demonstrate the developed integrated advanced power electronics solutions implemented in a BEV platform	At least **5** full sets of measurements and proof of the actual loss, cost, size, and weight reductions while the performance of the car is kept high

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Results presentation

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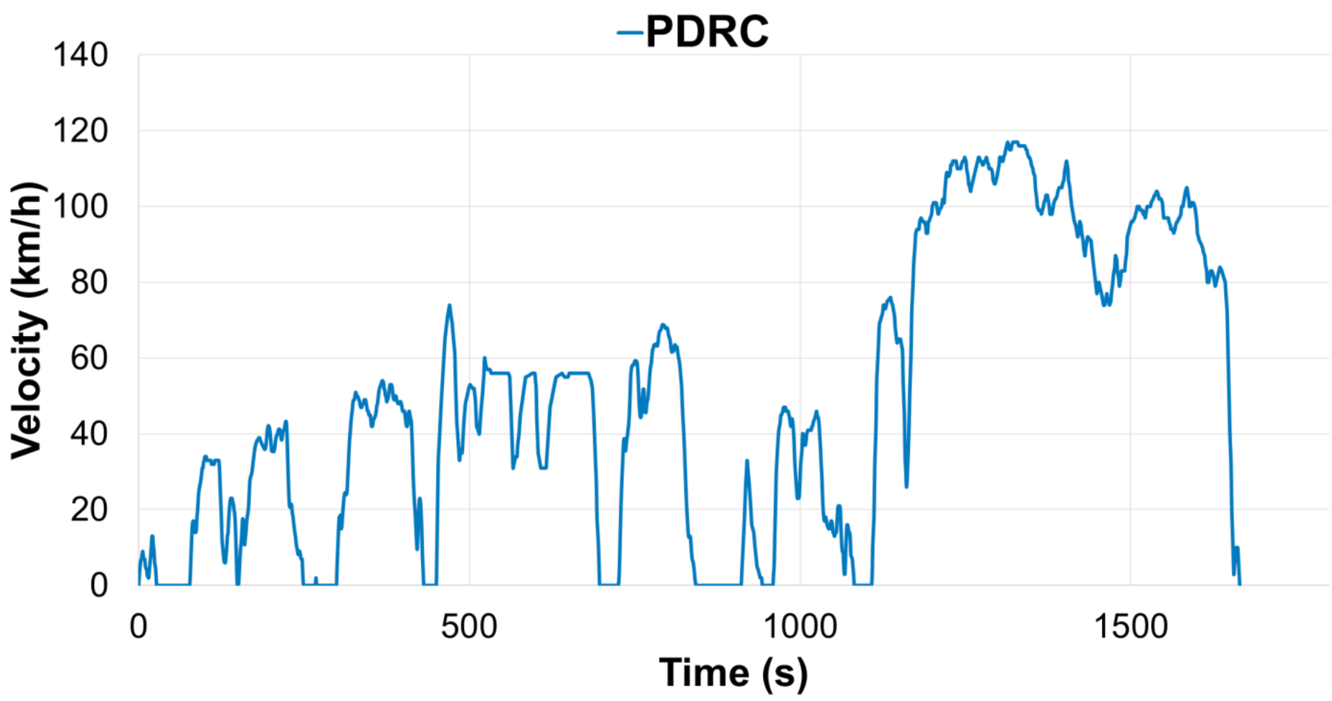
Driving Cycle Optimized for European EV Drivers



*The team at Trinity College Dublin collected the data of over **3,000 EV trips in Europe to build the PowerDrive** Representative Driving Cycle (PRDC). This driving cycle ensures that the PowerDrive project is developing a powertrain optimised for the needs of European EV drivers.*

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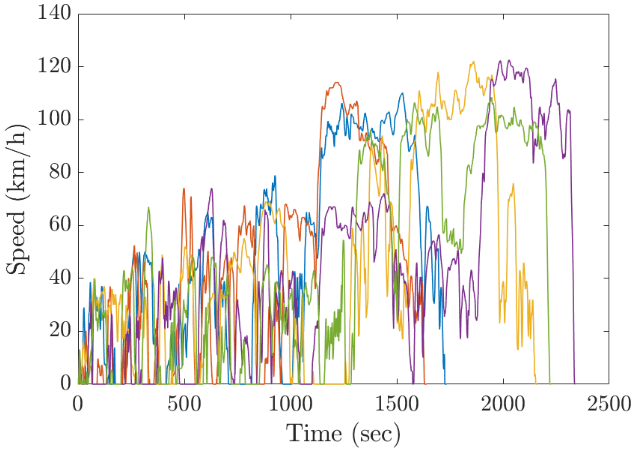
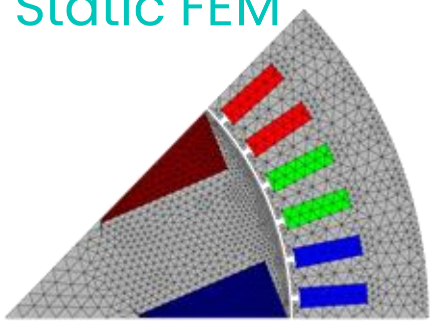
Computationally efficient models with FE-level accuracy

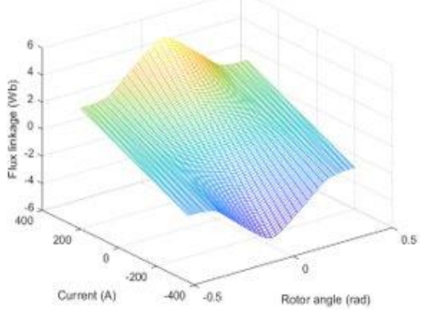
Drving Cycle

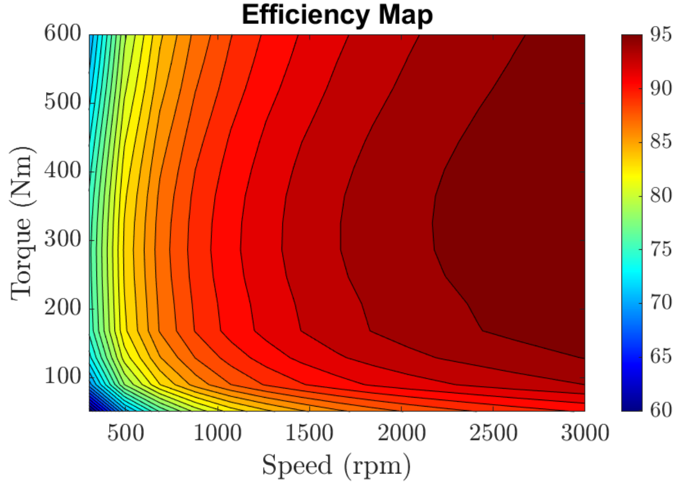


Static FEM

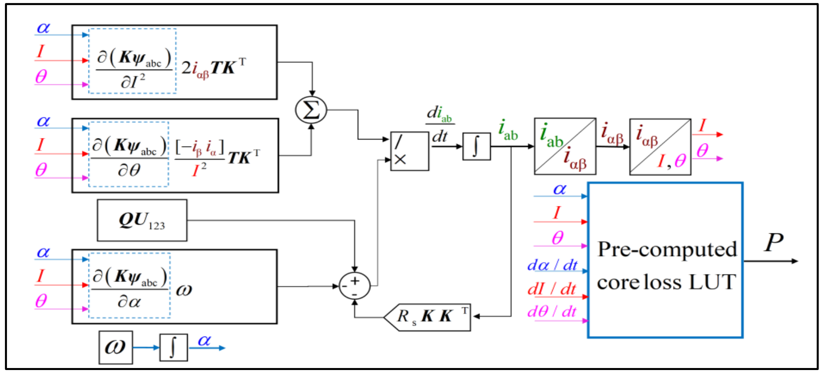


Lookup tables





Dynamic model in Simulink



- Performance: 0.42 ms/step vs. 45 ms in FE (≈**105× faster**); core-loss model **120× faster**
- Efficiency Map generation: 15×15 torque–speed grid in 1.5 min vs. 82 min (FEM)

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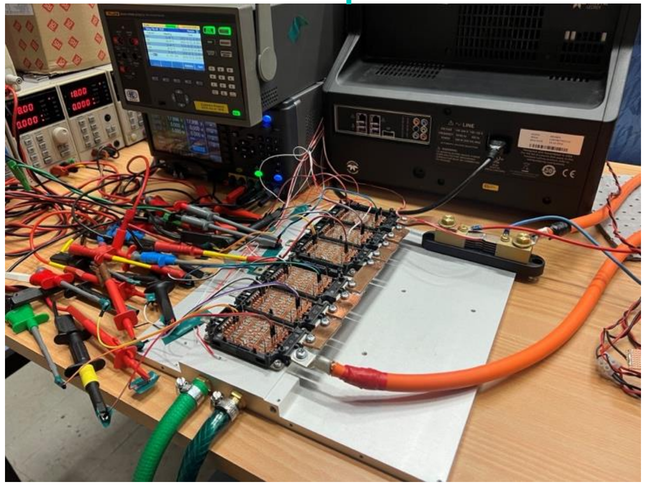
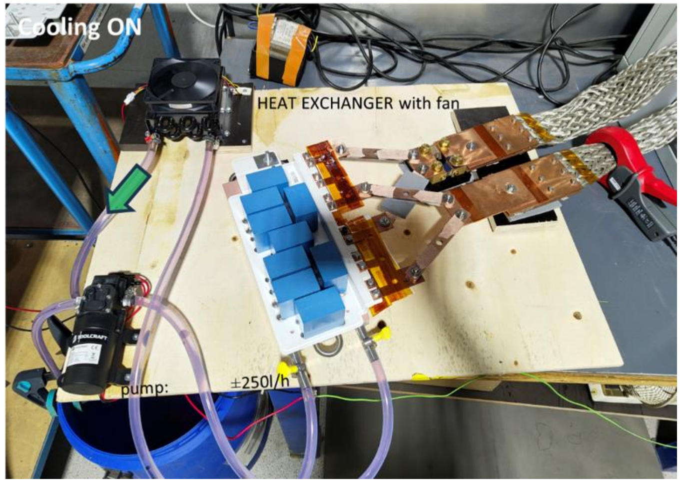
Prototype of integrated inverter/motor

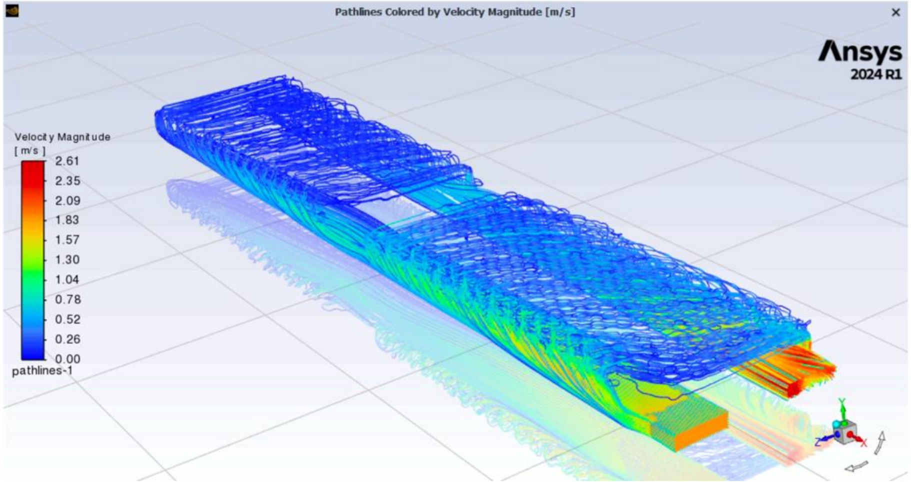
Inverter Switches and cold plate



Inverter Cap and Busbar



Thermal simulation



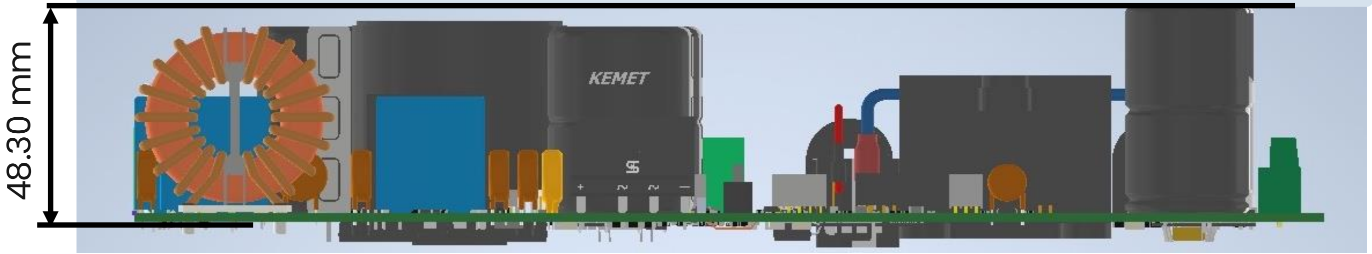
KPIc	Goal	HybridPack
Power density	26.4 kW/kg	48 kW/kg [450 kW]
	50.3 kW/L	44 kW/L [450 kW] 73 kW/L [580 kW] *
Efficiency	98.5%	98.5% [450 kW]

*considering the active part

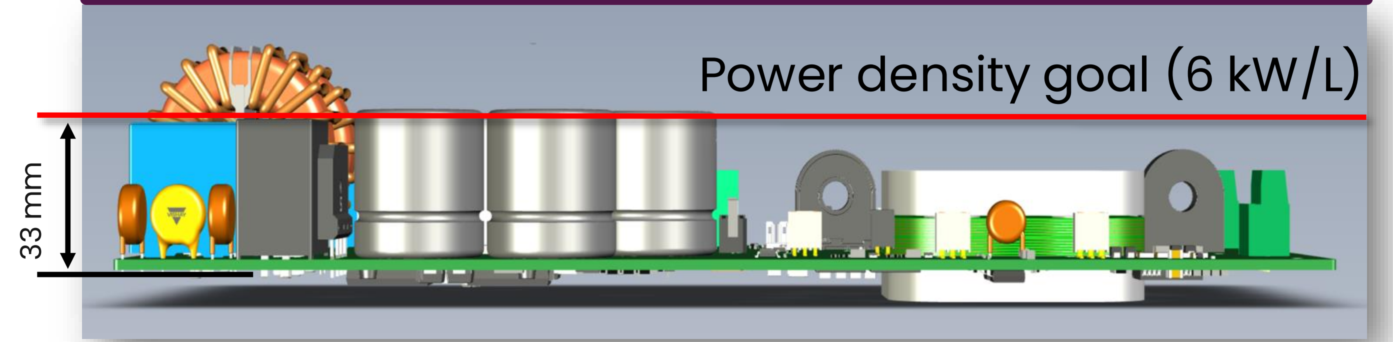
800 V OBC and LV Battery Charger

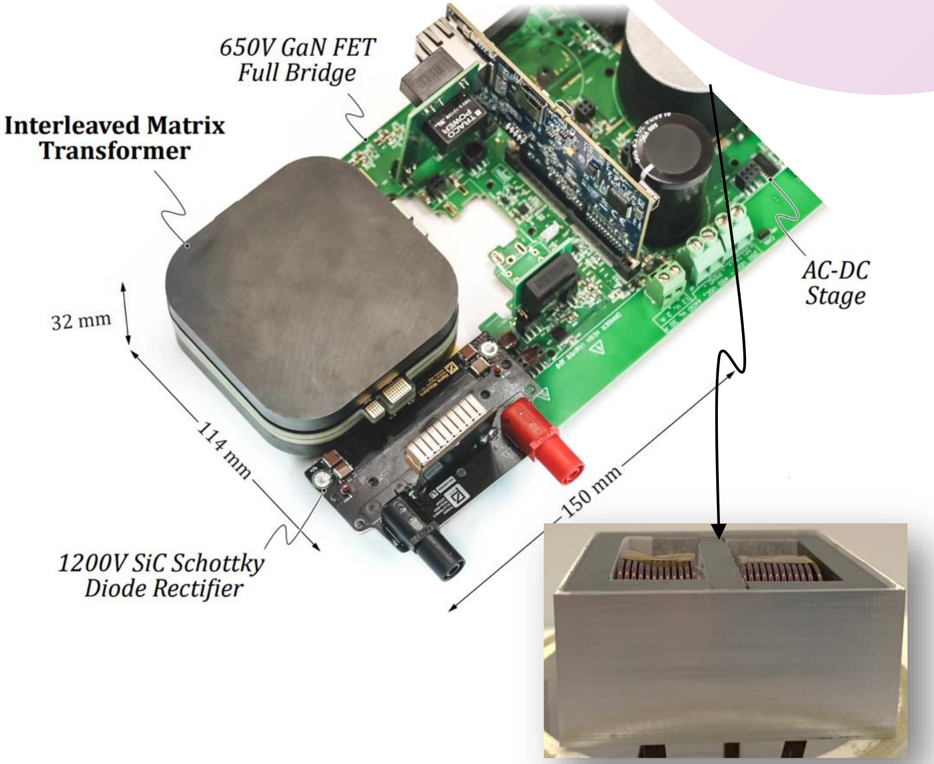
Low profile magnetic components and circuit reconfiguration for Improved power density

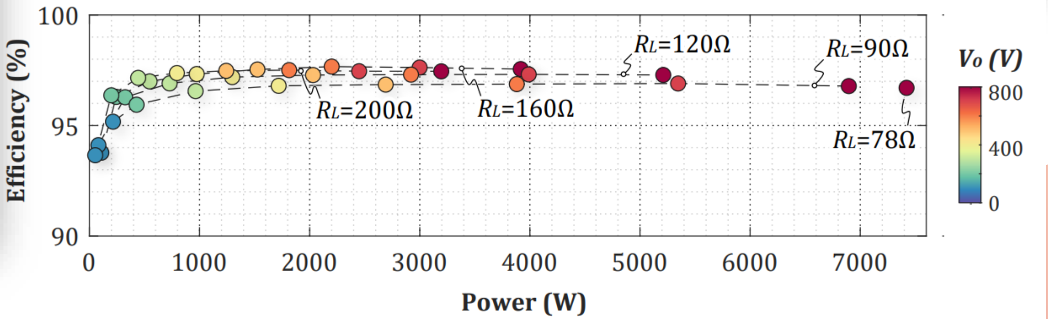
BENCHMARK: 6.6 kW 400V OBC



Power Drive: 7.4 kW 800V +LV Batt Charger







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Mid to long term expected impacts of the project

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Scientific Impact

- **Strong visibility at top-tier international conferences:** Leading presence at APEC 2024, PCIM Europe 2024, TRA 2024, and electronica 2024, positioning PowerDrive at the forefront of power electronics and zero-emission transportation research.
- **Scientific excellence and recognition:** Best Presentation Award at APEC 2024 awarded to KU Leuven–EnergyVille for work on interleaved PCB windings, underlining the project's high scientific quality and innovation.
- **Active engagement with strategic European ecosystems:** Continuous interaction with the E-VOLVE Cluster and the 2Zero Partnership (EGVIA), including live dissemination during the E-VOLVE Webinar, fostering knowledge exchange across EU-funded projects.
- **High-impact knowledge dissemination:** 19 open-access publications to date (with more under review), presented at leading conferences and journals, enabling broad scientific outreach and reinforcing PowerDrive's research leadership.

Social and Industrial Impact

- **Growing societal engagement and visibility:** PowerDrive's results are disseminated through workshops, conferences, publications, events, the project website, and social media, reaching a broad and diverse audience beyond the research community.
- **Active public interaction and outreach:** The project has built a strong online following, with consistent engagement (likes, comments, participation) on social media and website traffic exceeding initial expectations
- **Strengthened industry collaboration and synergies:** PowerDrive has fostered meaningful collaboration among industrial and academic partners, stimulating knowledge exchange and alignment across the electric powertrain value chain.
- **Catalyst for industrial innovation:** Early outcomes are already encouraging partners to rethink processes and explore new technologies for electric powertrains, laying the foundation for long-term industrial impact.

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PowerDrive's Impact Strategy

Final Results

- Integrated solution for reducing losses, size, and cost of electric powertrains of both high-performance and high-volume passenger BEV
- EV test data of the developed powertrain with advanced power electronics under real driving
- Ultracompact and integrated SiC Inverter
- Ultracompact on-board charger
- Controllable transformer for on-board charger
- Low resistance SiC Module with integrated sensors
- Ultra low inductance busbar connectors
- Optimised cooling circuit
- Holistic reduced model of the powertrain
- Datasets of real driving profiles

Expected Outcomes

- Cost reduction (affordability)
- Efficiency (range, charging, thermal performance)
- Size and weight reduction
- Easier integration in batteries and motors
- Increased reliability and availability (diagn. & control)
- Higher quality levels (functionalities and materials)

Expected Impact(s)

Transforming road transport to zero-emission mobility (…) ensuring that **Europe remains world leader** (…)

- a. Accelerated uptake of zero tailpipe emission, affordable, user-centric solutions
- b. Increased user acceptance, improved air quality, a more circular economy and reduction of environmental impacts.
- c. Affordable, user-friendly charging infrastructure concepts and technologies that include vehicle-grid-interactions.
- d. Innovative use cases for the integration of zero tailpipe emission vehicles, and infrastructure concepts for the road mobility of people and goods.
- e. Effective design, assessment and deployment of innovative concepts in road vehicles and mobility services thanks to life-cycle analysis tools and skills, in a circular economy context.

Requirements/Barriers to impact

- Innovation capacity & lack of components from OEMs
- BEV manufactures development strategies
- TSO/DSO/CPOs operational capacity
- End-user behavioral change & driving habits
- Regulatory Framework & public incentives schemes for renewing car fleets
- Availability of EV drivers data

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Wilmar Martinez
wilmar.martinez@kuleuven.be

With the support of