

High Performance 800V Silicon Carbide Inverters for Automotive Applications The Next Step in Electrification

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Tier 1 supplier developing and manufacturing future-focussed, sustainable products

Greybull
Capital

McLaren
Group

McLaren
Applied

Technology & Products Business

McLaren
Racing
F1 and IndyCar

McLaren
Automotive
Supercar Manufacturer



Applied's automotive journey

1993



Automotive
pinnacle
product
supply

Automotive
controllers

2000



World-class
Auto
standards
adopted

Ancillary
controller

2008



Safety
critical
application
development

FAA
accredited
controller

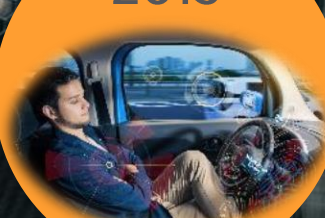
2013



Automotive
pinnacle
product
supply

Automotive
inverter and
motors

2015



World-
leading AV
competence

Dual-lane,
safety critical
controller

2016



Commercial
Vehicle BEV
competence

EV
supervisory
controller

2020



Automotive
pinnacle
product
supply

Automotive
powertrain



Key trends and issues for EV development for OEM's



EV product volumes are rapidly accelerating



Improving powertrain efficiency is key to competitiveness



EV Infrastructure is changing and improving, however...



...charge and range anxiety and cost remain the common concern for consumers



Cost



Weight



Packaging



Range



Thermal Mgt.



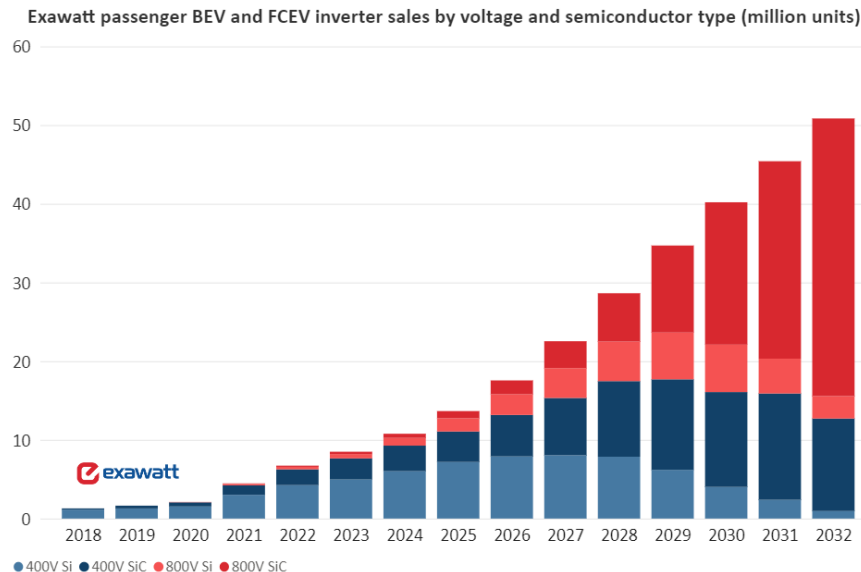
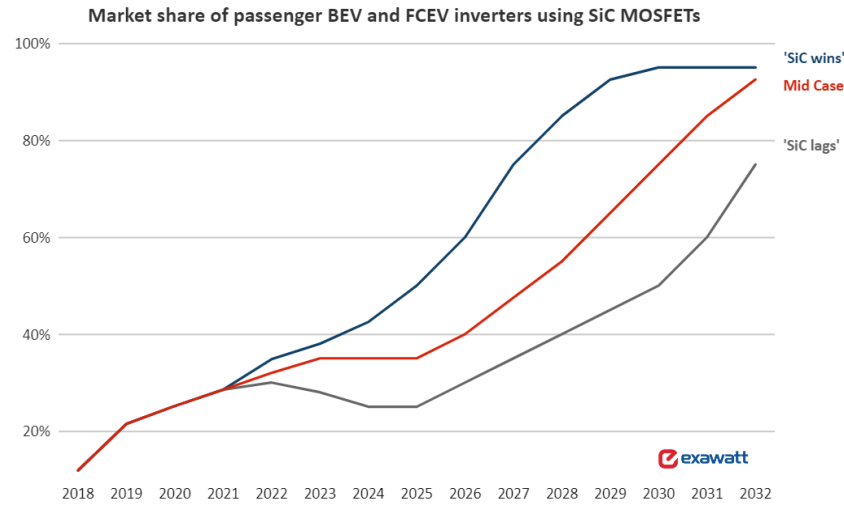
Reliability



The McLaren Applied 800V SiC Inverter addresses these issues



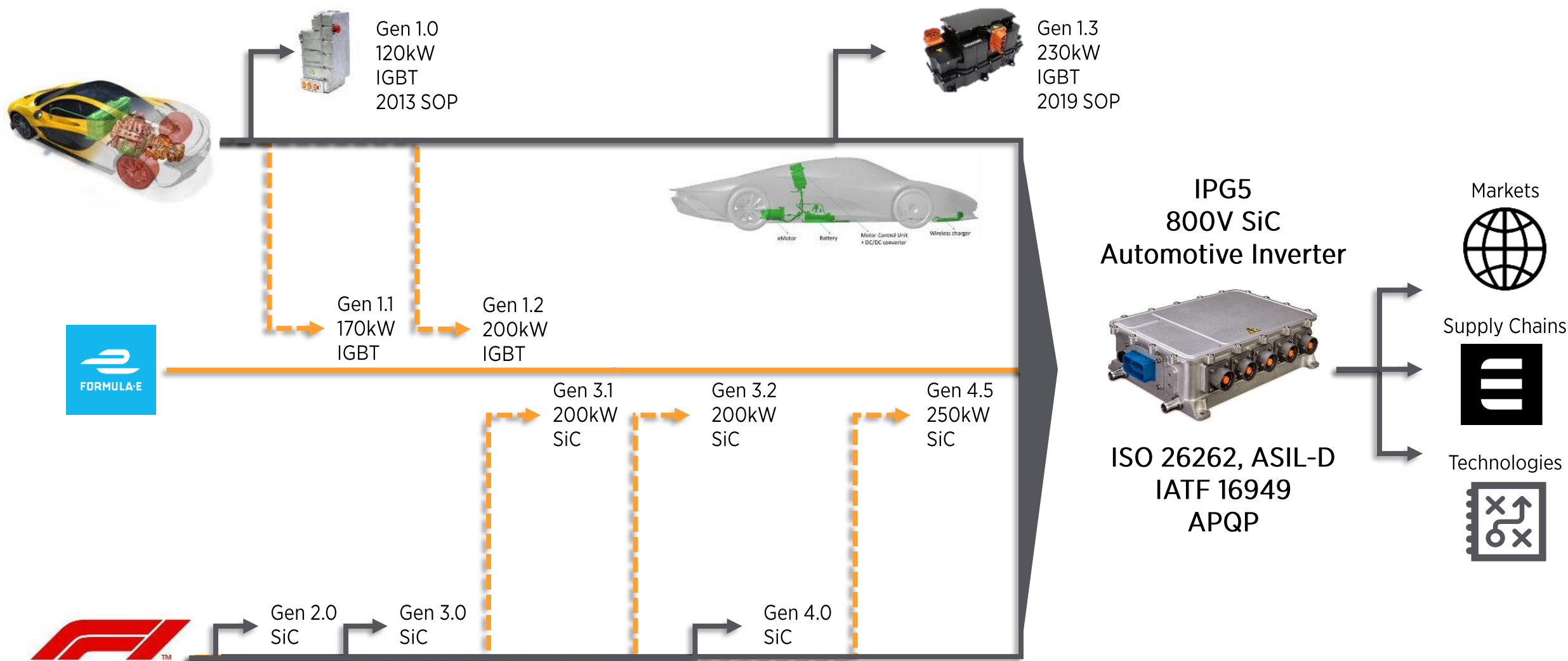
EV Industry has reached an inflection point



Headwinds are well known...
800V and SiC adoption is the future

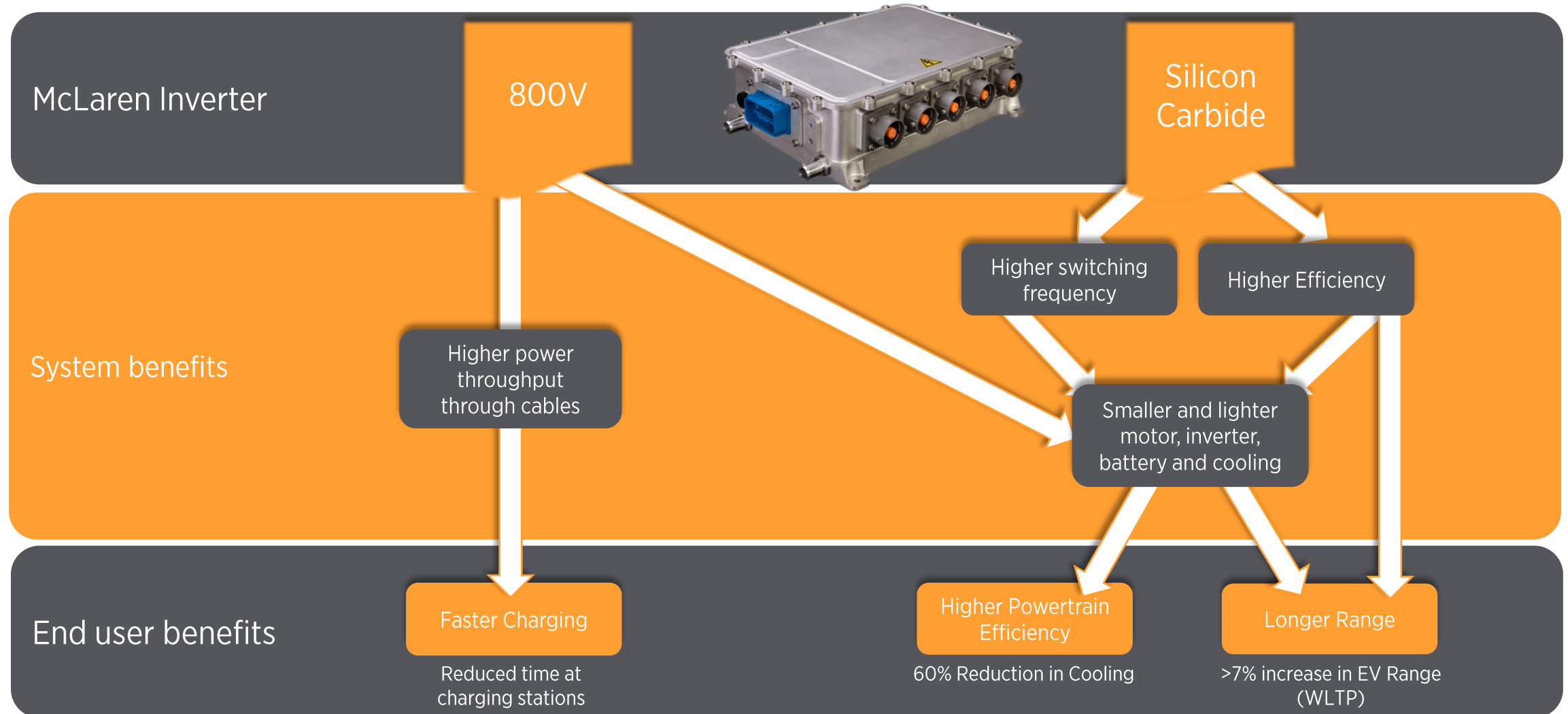


Applied's inverter journey: past, present and future





Faster Charging, Longer Range with Powertrain Efficiency



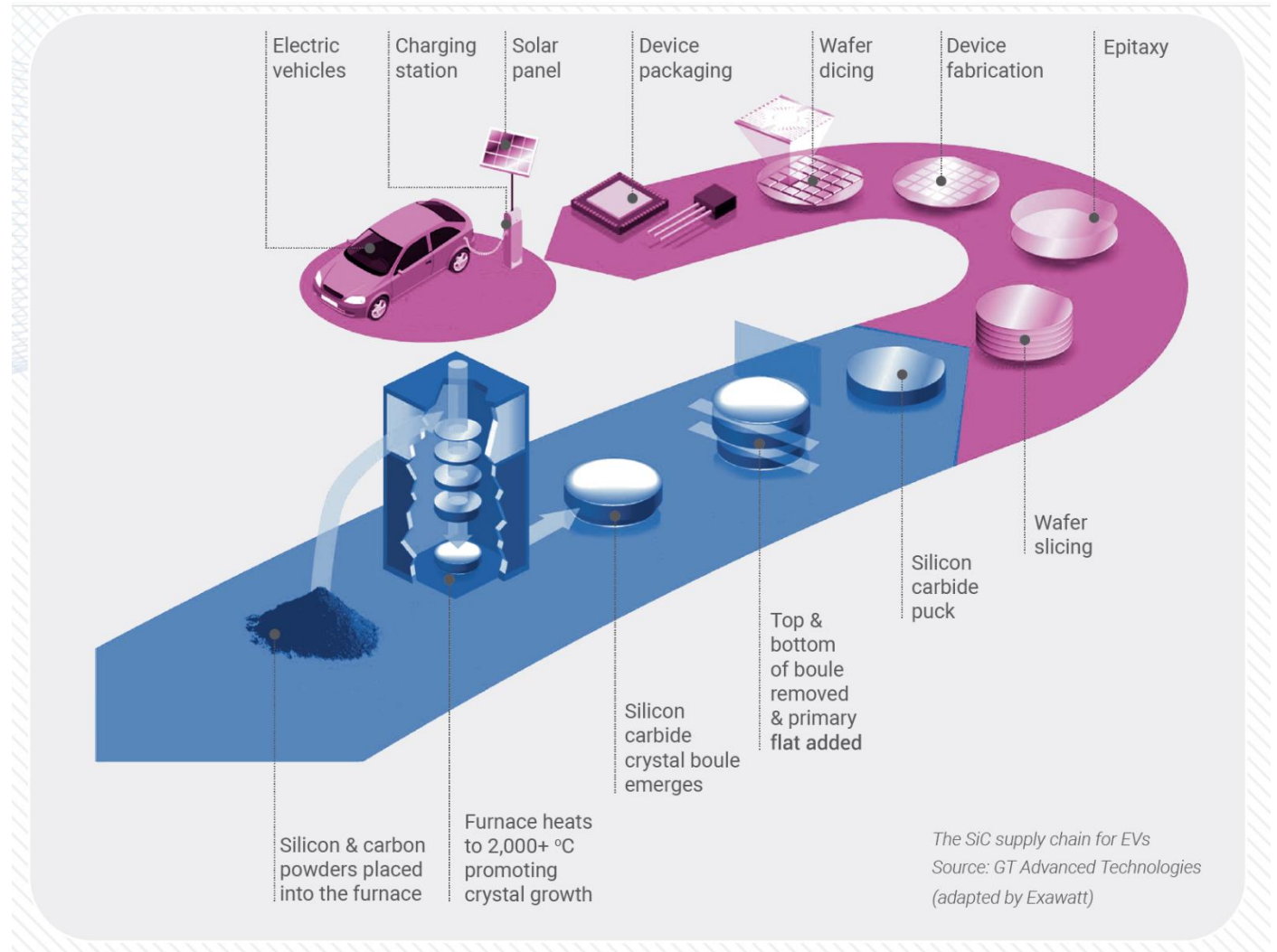


The Silicon Carbide Supply Chain



Where does the UK have a role in the SiC Supply Chain?

SiC Supply Chain



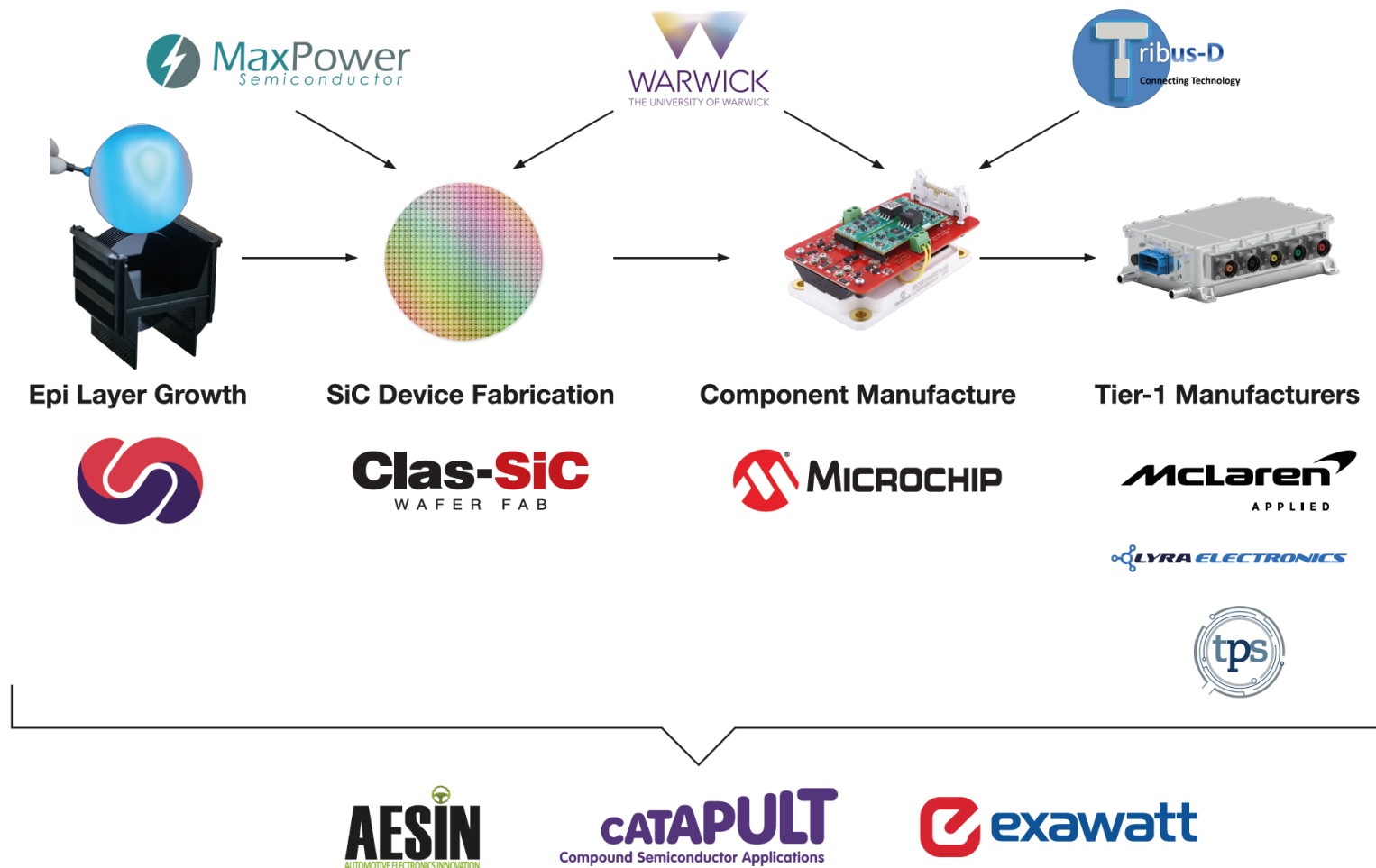


End-to-end Supply Chain Development for Automotive Power Electronics
Securing a complete supply chain for next generation silicon carbide power electronics in the UK

Silicon Carbide Supply Chain Development

ESCAPE

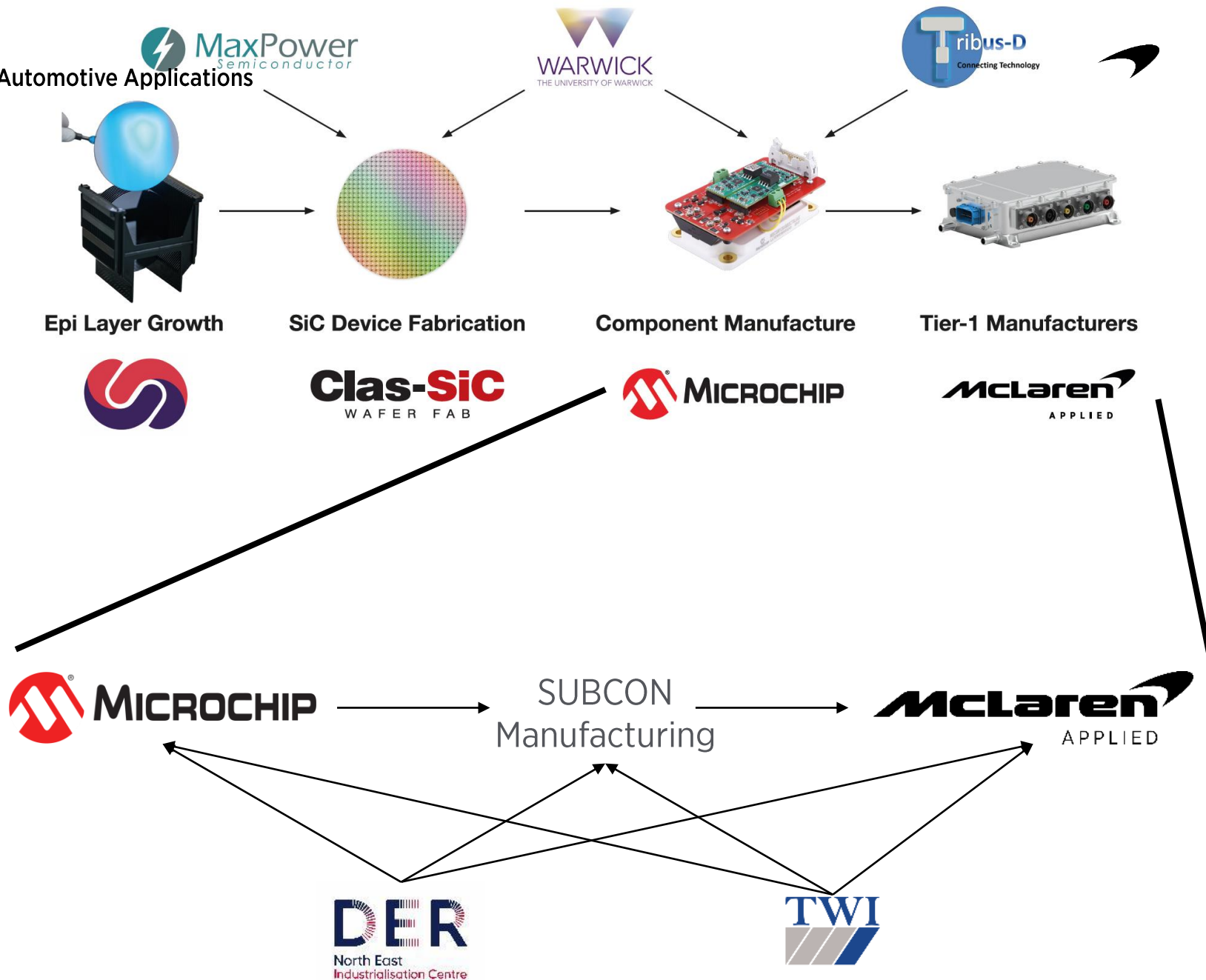
End-to-end Supply Chain development for Automotive Power Electronics



Product Manufacturing Supply Chain Development

The SCIENZE Project

Supply Chain Innovation Engineering for Net ZErO





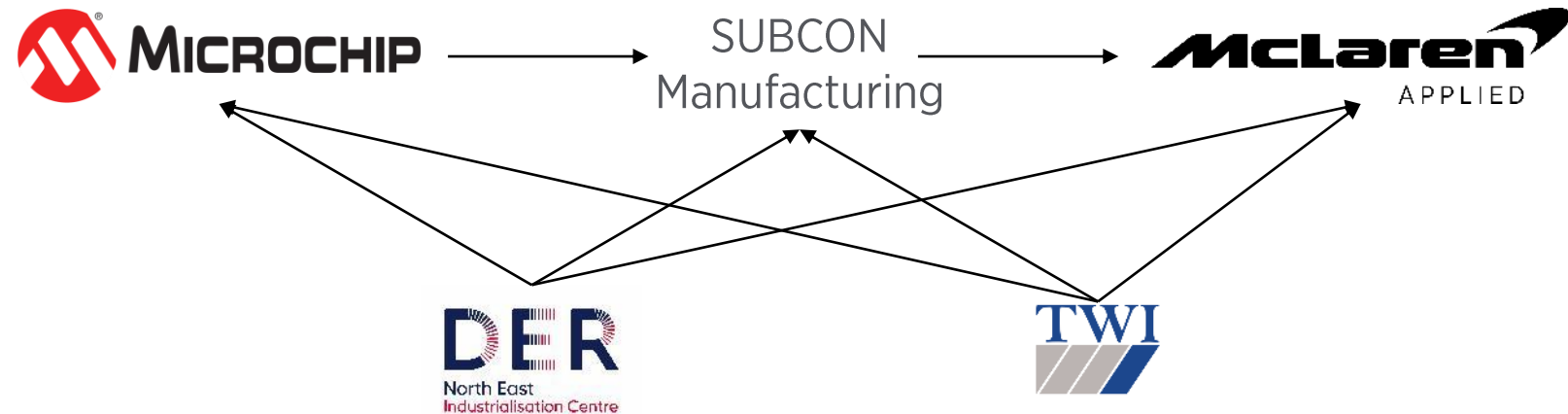
Product Manufacturing Supply Chain Development

The SCIENZE Project

Supply Chain Innovation Engineering for Net ZErø

SCIENZE

To establish a sustainable and secure UK based supply chain capability for the manufacture of complex automotive power electronics products at volume and be able to compete globally



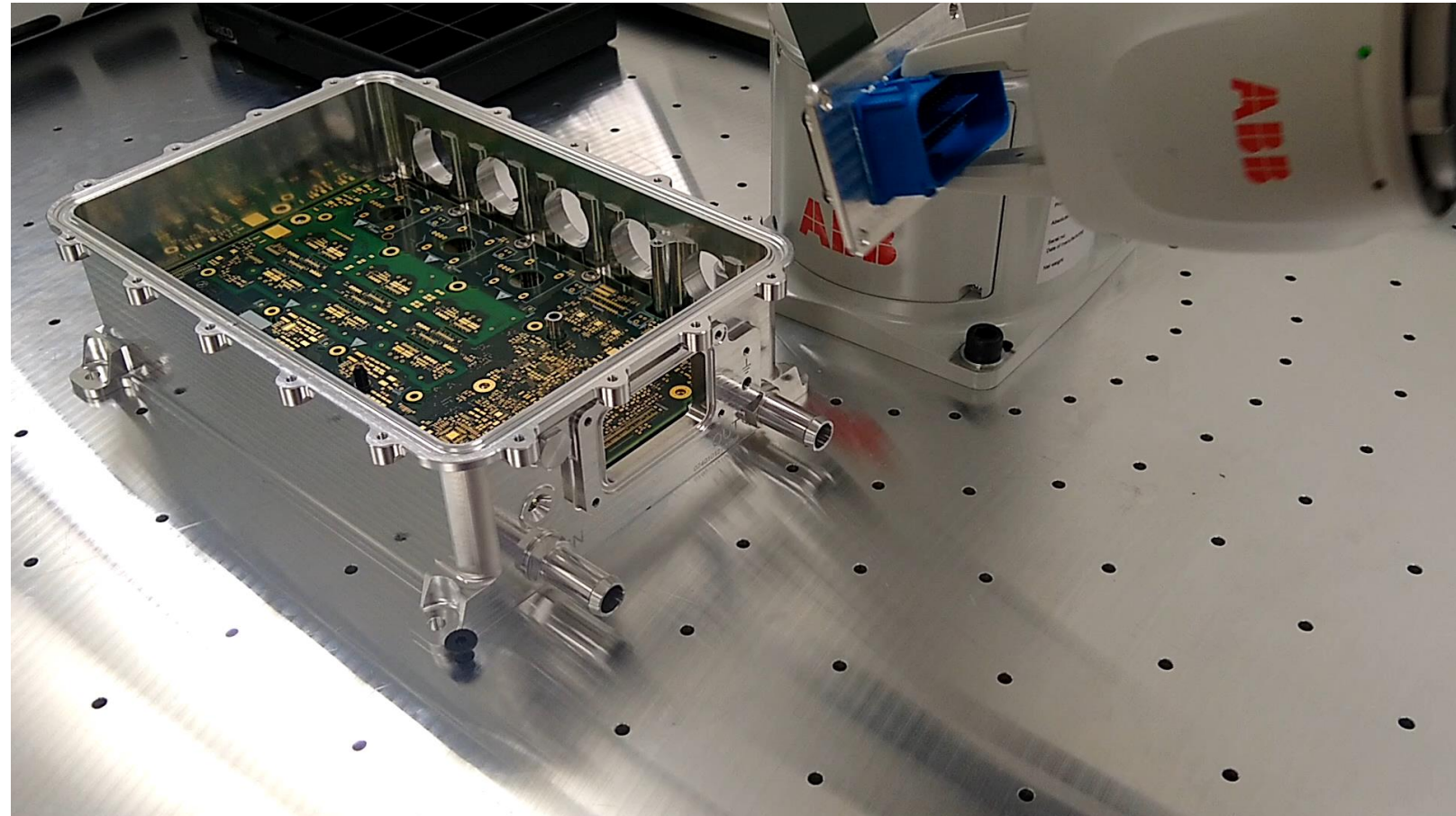


SCIENZE

Product Manufacturing
Supply Chain Development

The SCIENZE Project

Supply Chain Innovation
Engineering for Net ZErO





Wider Environmental Impacts

How Much of an Impact can an Inverter Have?



Embedded and Operating CO Benefits vs. Leading IGBT Inverter



Inverter Embedded CO₂

- >30% lighter and smaller^[1]
- Reduction of 2kg CO₂ per vehicle^[2]



Cooling System Embedded CO₂

- Lower demand with reduced waste heat from inverter
- c. 3kg cooling system reduction^[1]



Battery Embedded CO₂

- >7kWh downsizing opportunity^[1]
- >30kg weight saving (cells only)^[1]
- >850kg CO₂ saving per vehicle^[5]



Inverter Operating CO₂

- 60% reduction in inverter losses^[3]
- 95-98% incremental improvement over IGBT incumbent
- >7% more range per kWh^[3]
- >490kg CO₂ saved per 100,000km^[4]



Cooling System Operating CO₂

- Downsized pump will have less parasitic losses on system



Battery Operating CO₂

- 30kg weight reduction results in 0.67% range improvement
- >47kg CO₂ saved per 100,000^[4]

[1] Relative to Audi e-tron powertrain as per teardown data

[2] Lifecycle of semiconductors, Sarah Boyd

[3] McLaren Applied Test & Simulation Data

[4] Greenhouse Gas Reporting Conversion Factors, UK Gov

[5] Environmental Life Cycle Impacts of Automotive Batteries Based on a Literature Review, Energies Journal, Dec-20



800V SiC Inverters as an Enabler for Sustainability Improvements



Battery

System efficiency improvements allow OEMs to **downsize the battery c. 7% whilst maintaining range.**



Electric Motor

SiC has class-leading switching frequencies to enable **motor-downsizing.**

A **smaller, lower torque** output motor can be run at **higher speeds** to maintain power output.



Ancillaries

The efficiency improvements from the SiC (60% reduction in total inverter losses) & motor translate to **cooling systems downsizing.**

The **800V** system utilises **smaller, lighter HV cables** for a specific power.

The inverter has a knock-on and synergistic impact on making the entire drivetrain more sustainable by:

- **Decreasing operating CO₂** due to a lighter, more efficient end system
- **Decreasing embedded CO₂** as a result of:
 - Reduction in raw materials required
 - Reduced mining, processing and assembly
 - More efficient transport logistics



IPG5 800V Silicon Carbide Inverter

Specifications:

- <900V HV Input
- 5.5kg (83kVA/kg)
- 3.79L (120 kVA/L)
- 480A_{rms} Peak
- 320A_{rms} Continuous
- 70°C Max Coolant
- Efficiency 97% typical, 99% peak

Interfaces:

- 3 x CAN (2X CAN FD)
- 1 x Ethernet

Safety features:

- ISO26262 to ASIL D
- Integrated HVIL
- Active Short Circuit
- IEC60664, ISO6469 etc
- AUTOSAR 4.3 Compliant



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Contact us to find out how we can help you

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