

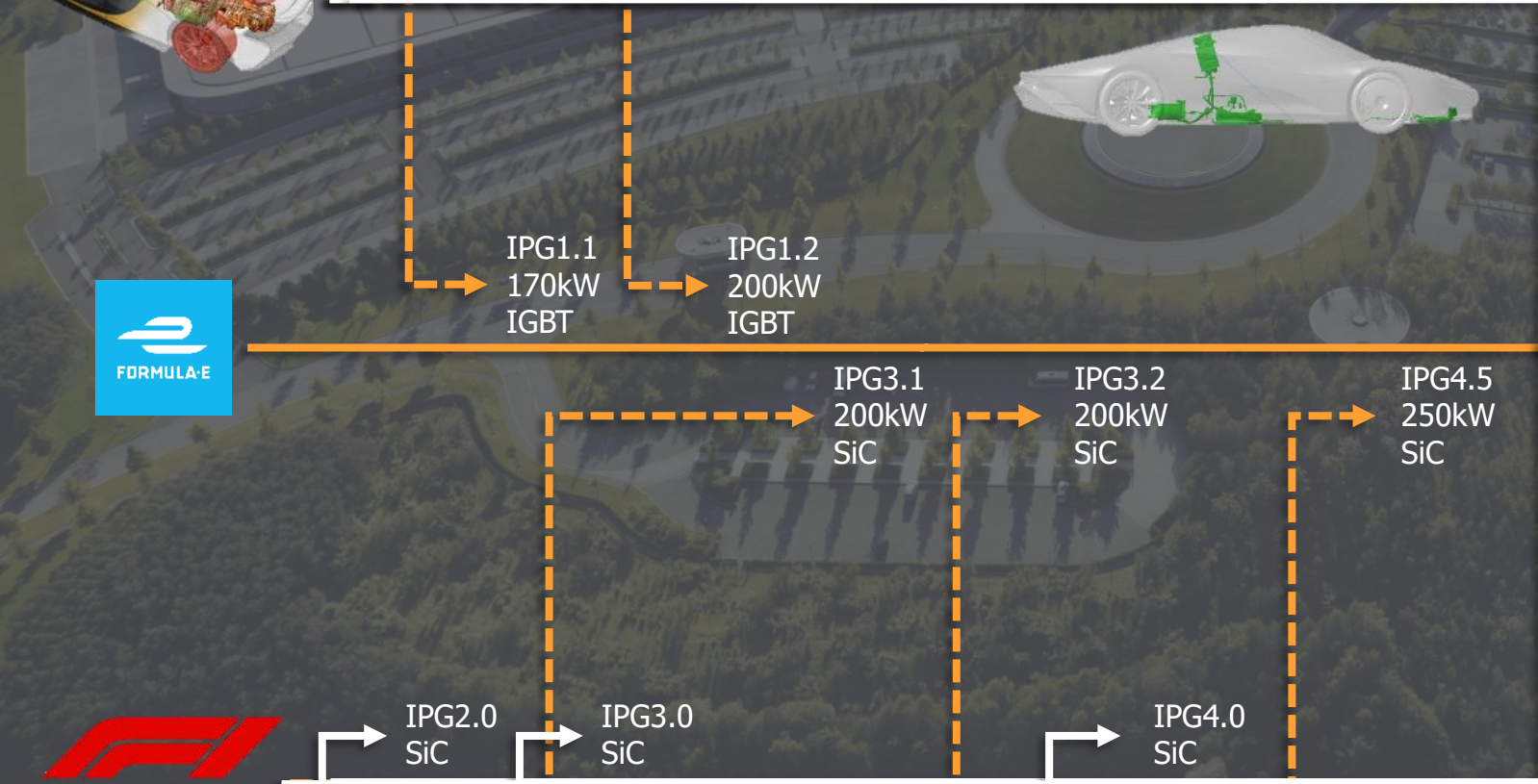
How inverter technology can help differentiate in a maturing EV market

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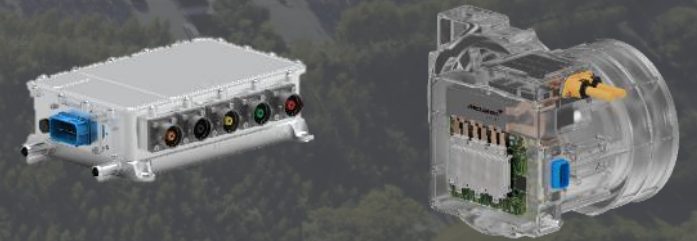
McLaren Applied's inverter journey



800V SiC Automotive Inverter Platform

IPG5
Standalone

IPG5-x
Integrated Inverter



Automotive Optimised

ISO 26262, ASIL-D
APQP
IATF 16949

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

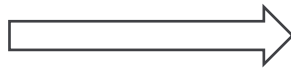
Technical Consultation & Hardware Testing



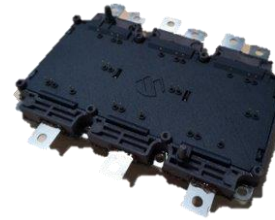
Hardware Development & Manufacture



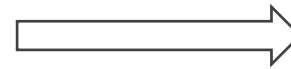
Epilayer Growth



Device Fabrication



Component Manufacture



Tier-1 Manufacturers



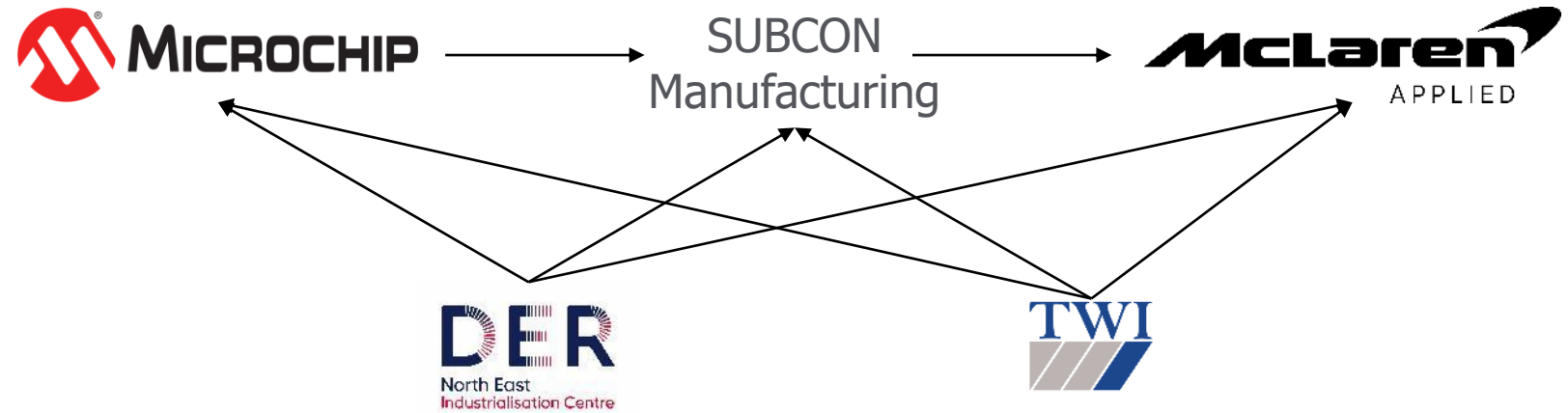
Technical Acceleration & Market Engagement





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



Product Manufacturing
Supply Chain Development

The SCIENZE Project

Supply Chain Innovation
Engineering for Net ZEr0





We're at a critical stage in the electric revolution, with the upcoming 4th wave focusing on product differentiation

1 c. 2008



Pioneering Innovation

2 c. 2018



OEM rush to market

3 Today



Dedicated EV architectures, focusing on efficiency

4 The future



Differentiating the customer experience as the EV market matures

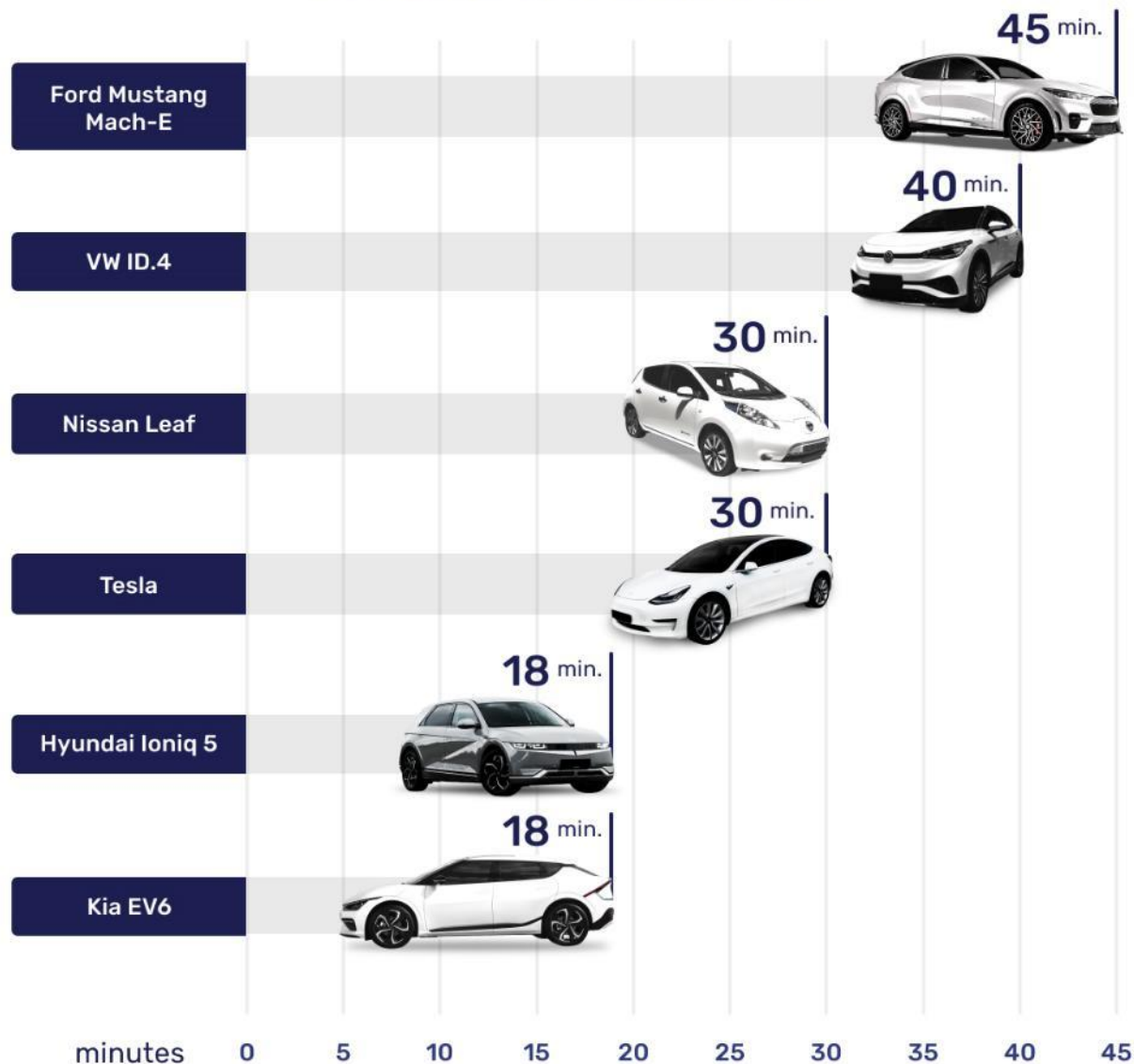


800V
architecture
enables ultra-
fast charging

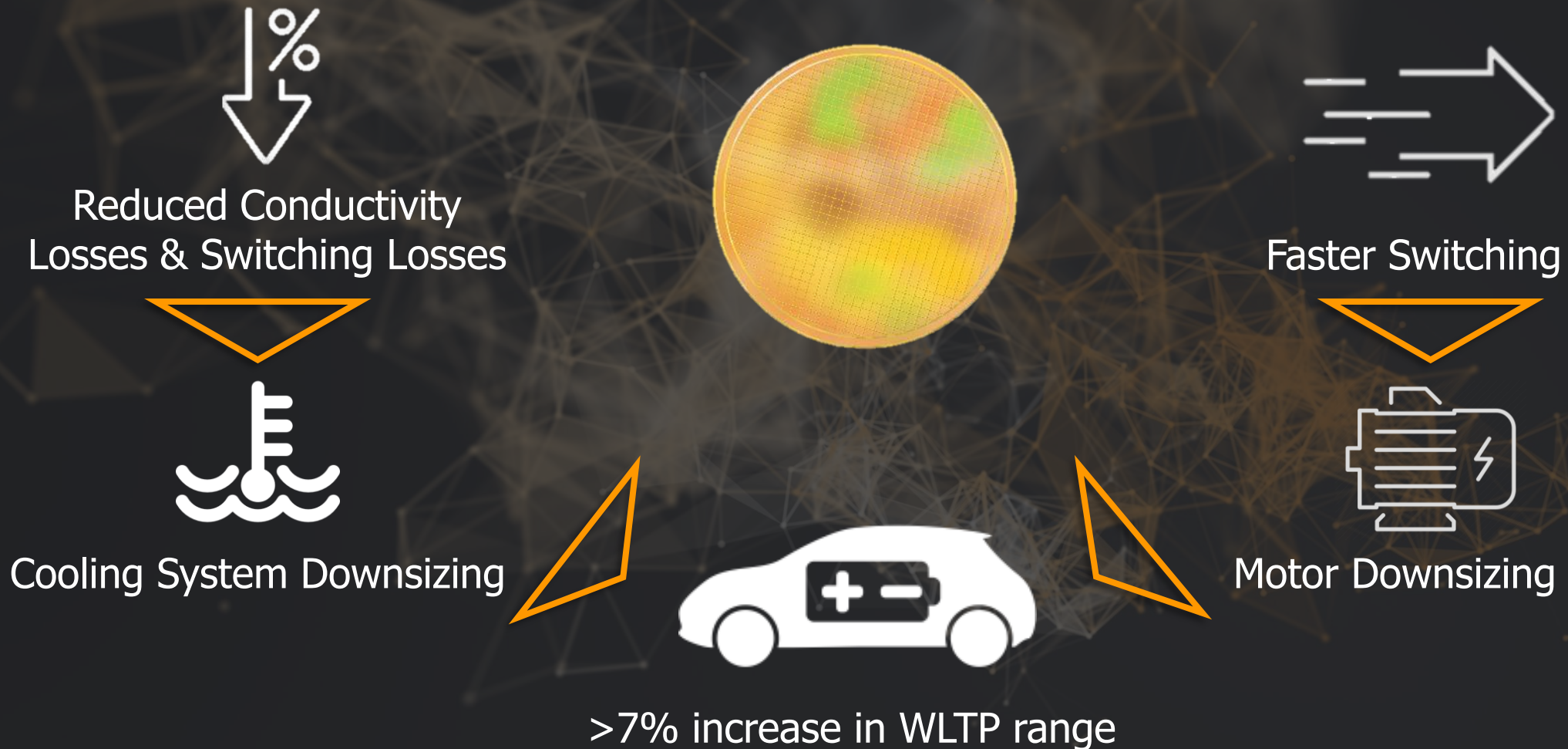


Fastest Charging EVs

DC charge speeds up to 80%



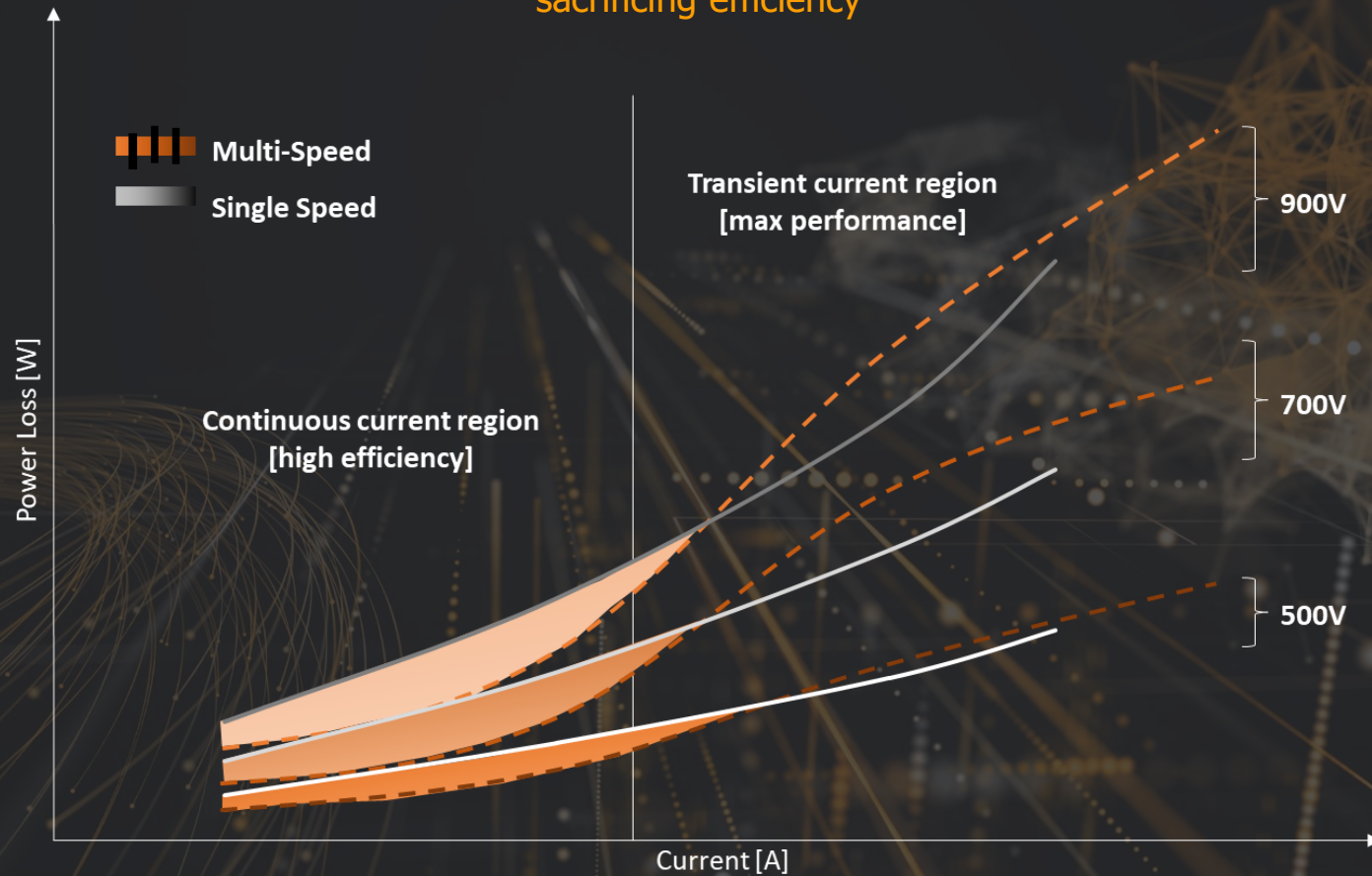
Silicon Carbide drives a domino effect of efficiency benefits





Combining SiC with multi-speed gate driver technology is an additional hardware advancement to improve inverter performance

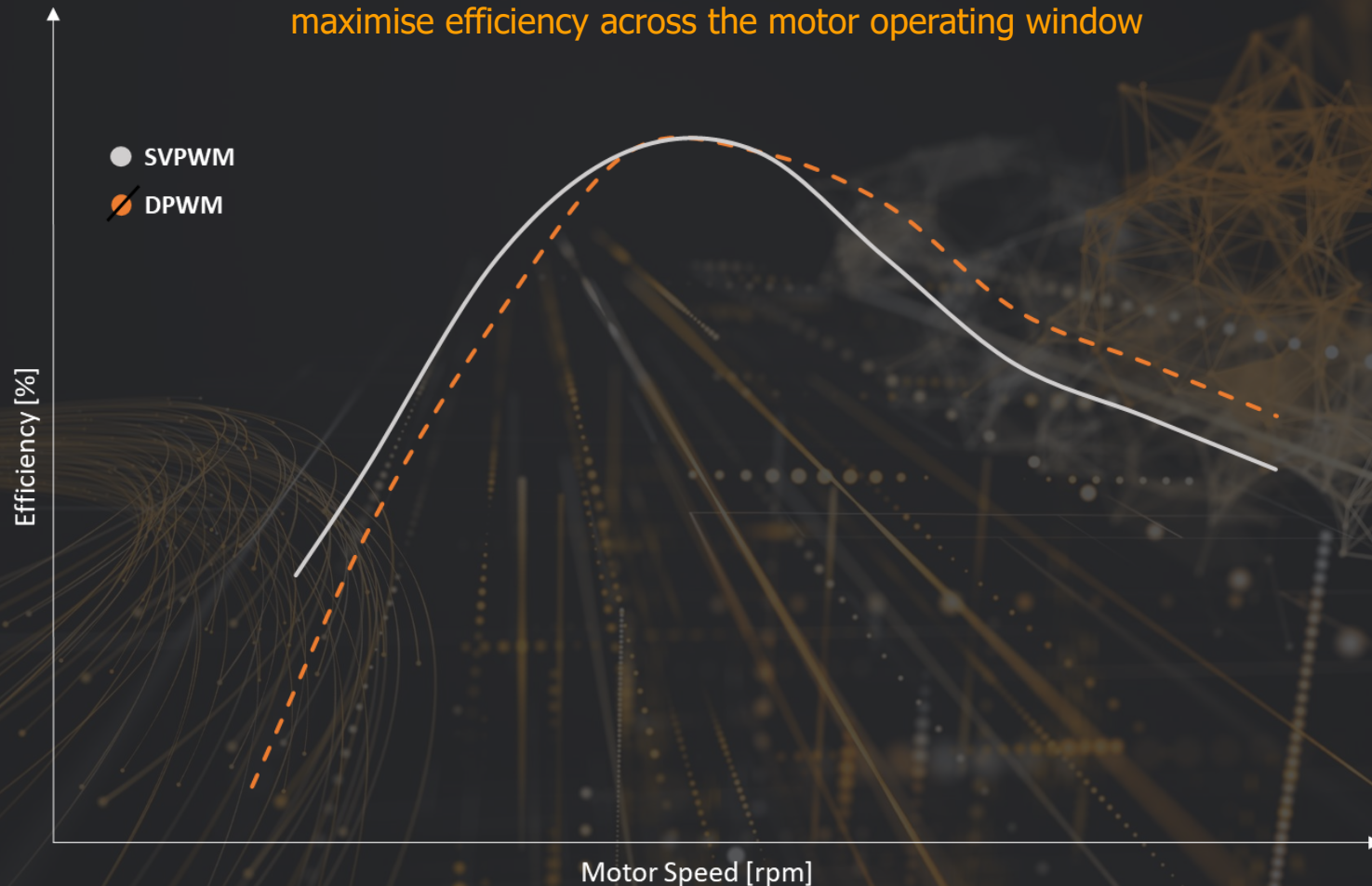
Multi-speed switching to broaden performance without sacrificing efficiency





The latest hardware provides a platform from which to deploy advanced motor control software to maximise performance & efficiency

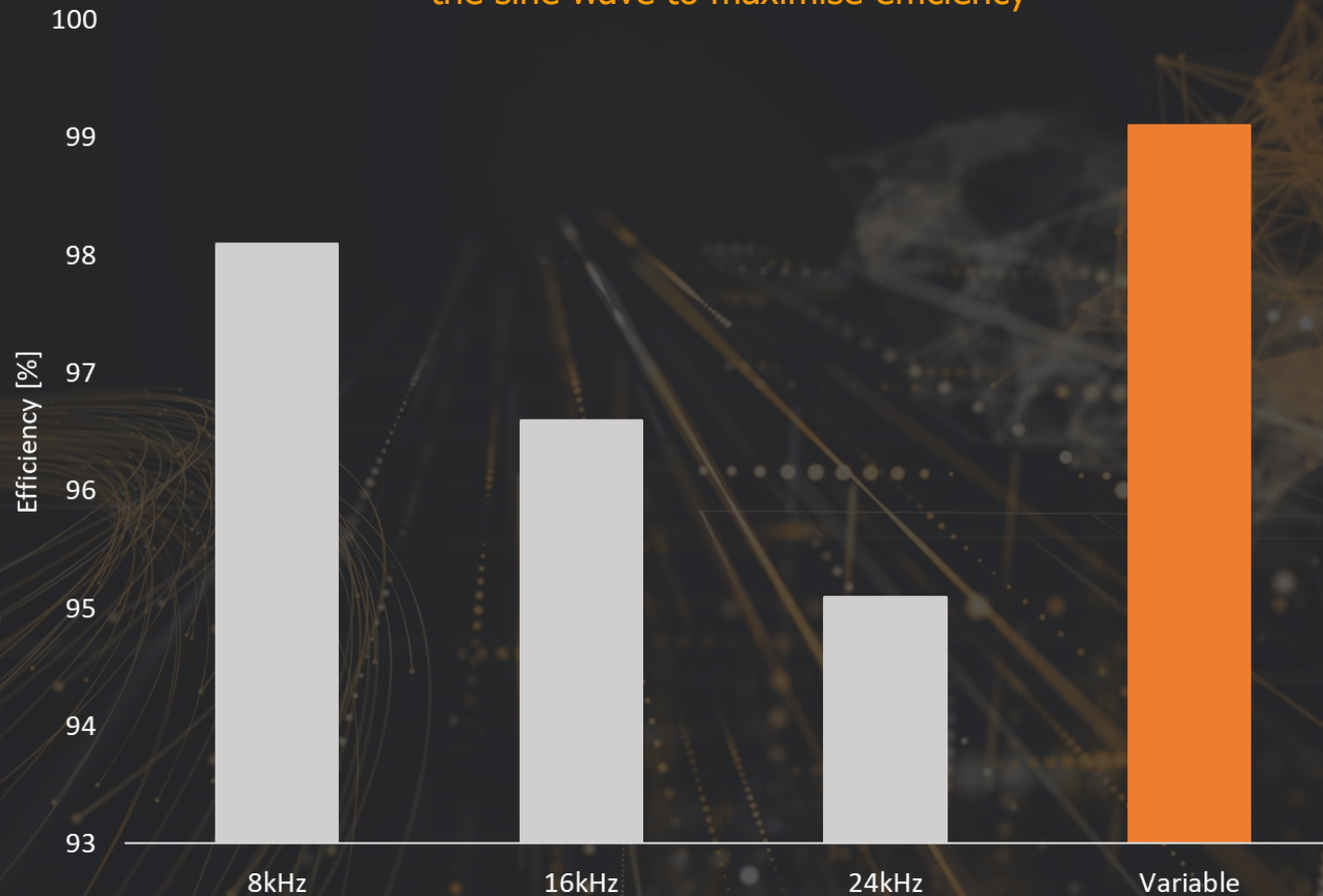
Seamless hybrid switching between SVPWM and DPWM control to maximise efficiency across the motor operating window





Pushing the 3rd wave of electrification further by leveraging pioneering motorsport-derived motor control knowhow to deliver best-in-class efficiency

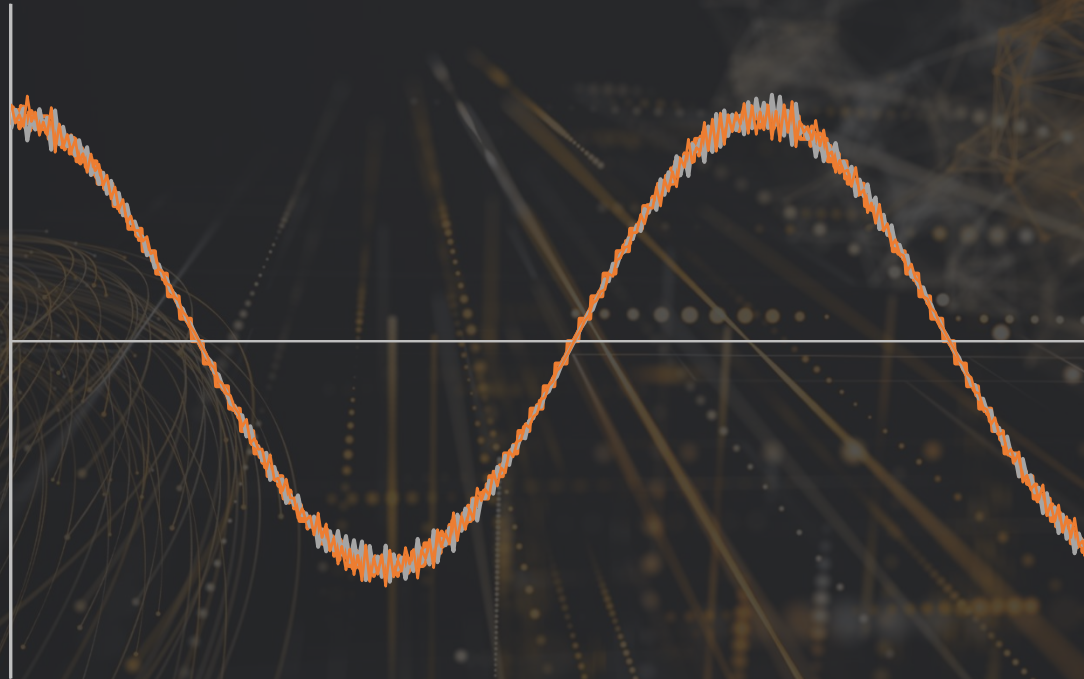
Dynamically and continuously variable switching frequency over the sine wave to maximise efficiency





As we enter the 4th wave of electrification, motor control software will play an increasingly important role in differentiation going forward

High fidelity switching over the sine wave enables tuning of the motor harmonic resonance & distortion





OEMs can hone a variety of powertrain attributes to align to their brand character

Noise, vibration & harshness



- Suppression of harmonics for refinement
- Injection of harmonics for augmentation

Driveability



DC & AC power measurement with closed loop control for minimised torque ripple

Anti-lash Transmission Control



Forward prediction on 0 speed crossing to reduce transmission gearset backlash



IPG5 Standalone & IPG5-x Integrated 800V Silicon Carbide Inverters



Supports ultra-fast charging:
<900V HV Input

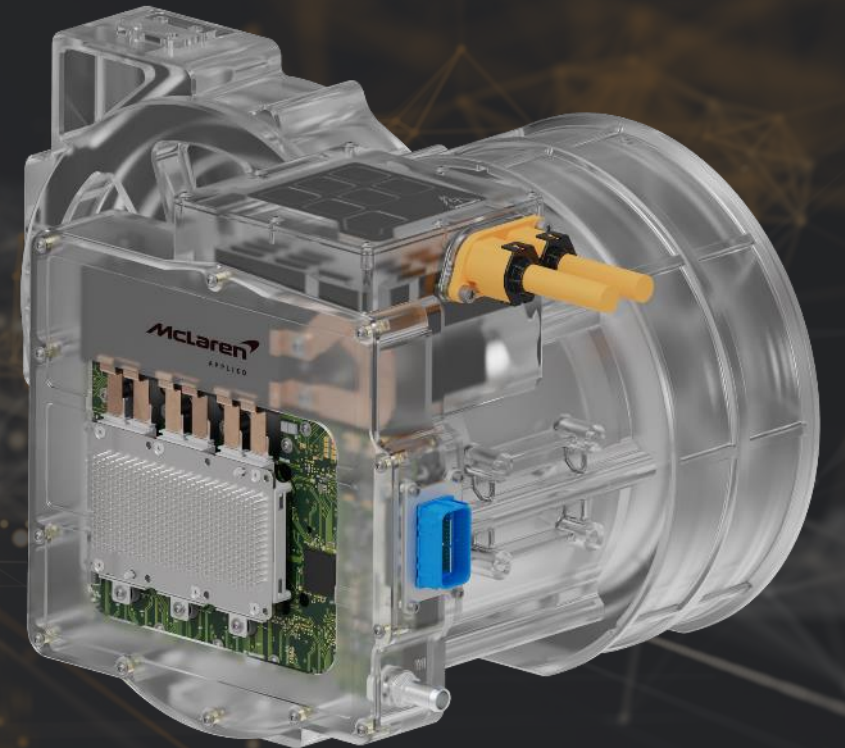
Lightweight & compact¹:
5.5kg & 3.88L

Class-leading power density¹:
>90kVA/kg >130kVA/L

High Efficiency:
97% typical, 99% peak

High Current Capability:
540A_{rms} Peak & 320A_{rms} Continuous

Advanced SW control:
Variable Switching Frequency 1 – 32kHz



¹ For standalone IPG5 inverter, weight & volume reduced by 50% compared to IPG5-x



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