



EVO ELECTRIC
the evolution of power

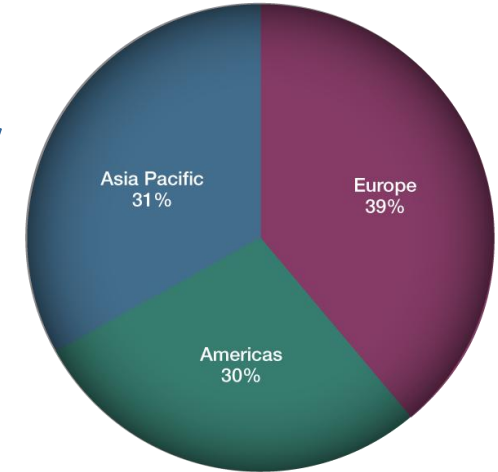
electrified thinking.

GKN EVO eDrive Systems

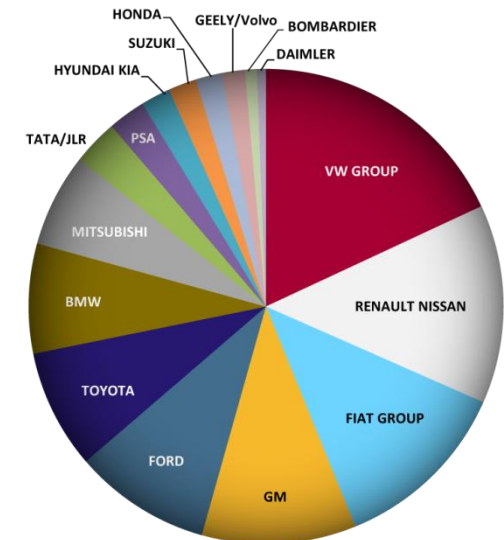


GKN Driveline

- > Largest business of British global engineer GKN
- > Broadest global footprint
- > Market leading driveline technologies
 - CVJ Systems
 - AWD Systems
 - Trans Axle Solutions
 - eDrive Systems
- > Established long term global relationships
- > Focussed engineering resource providing driveline solutions
- > Expert customer specific account teams



Sales per region



Sales per customer



EVO Electric

- **Originally a spinout from Imperial College London (est. 2006)**
- **Developer of high-performance axial flux electric motors**
- **Operating in automotive, motorsport, off-highway and power generation markets**
- **Achievements**
 - London Taxi – demonstrated vehicle 56% improvement in fuel economy
 - Development Projects with Jaguar, Lotus and Nissan
 - Growing order book
 - Major OEMs and end-users fully engaged
 - Formation of partnership with GKN Driveline



GKN Driveline & EVO Electric

➤ June 2011:

- GKN acquires 25.1% stake in EVO Electric - UK based developer of axial flux electric motor technology
- GKN and EVO form 50:50 Joint Venture – GKN EVO eDrive Systems – to industrialise and commercialise EVO's Axial Flux motor technology for Automotive market



Electric motors in the market

- **Hybridisation & Electrification driving demand for advanced electric motor & powertrain technology**
- **Electric motors and Drives are 40% of value in Electric Vehicle**
- **Existing technology has limited scope for improvement and is too expensive**
- **A step-change in motor technology is needed to power the new generation of vehicles**



Why EVO?

> Patented World class performance

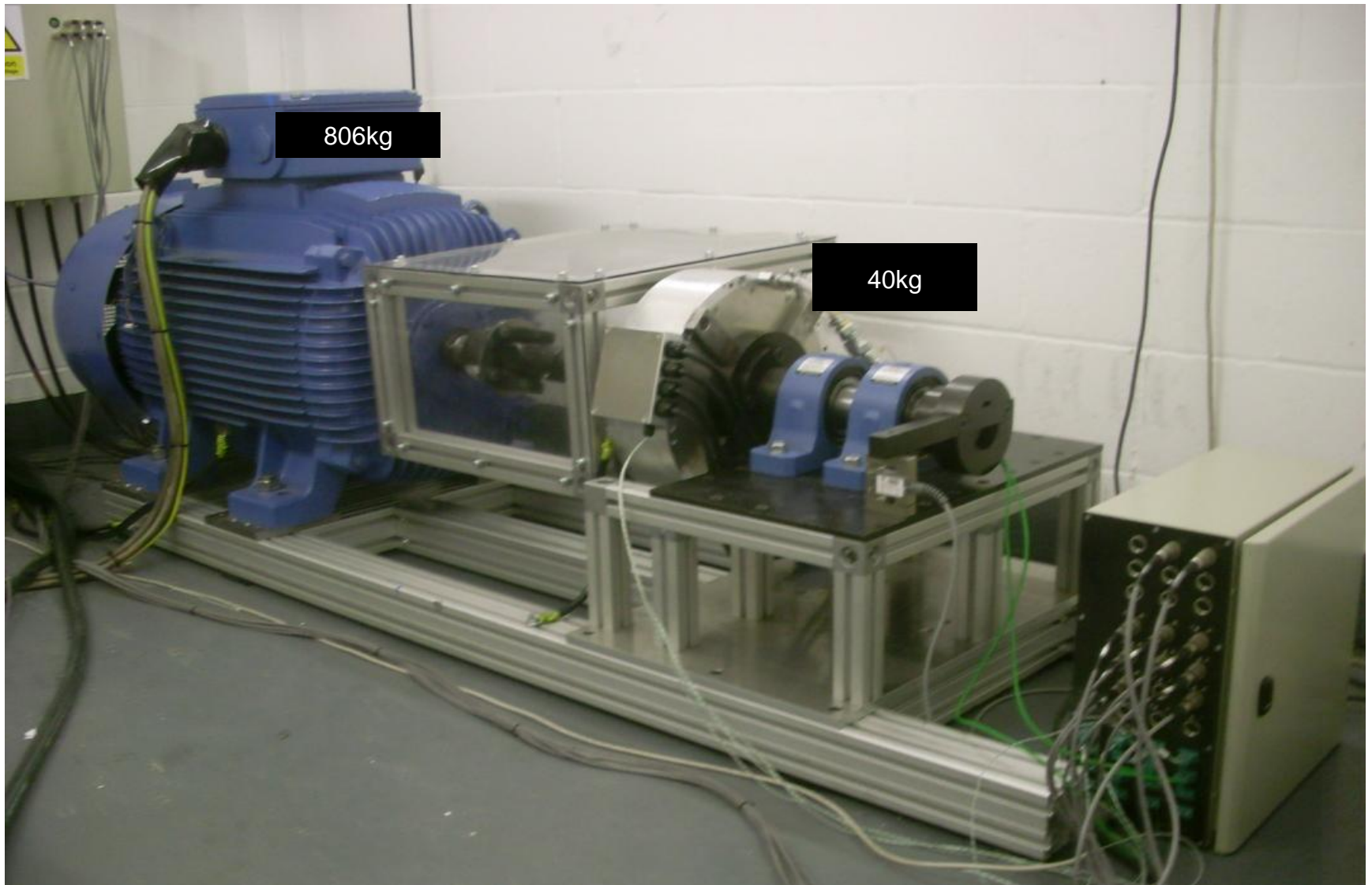
- High power density (30% better than conventional)
- High torque density

> Lower weight = Lower material bill = Lower cost

> Proven Technology



Why Axial Flux?



Racing Green Pan-American Highway record: Powered by EVO



Toyota Motorsport lap record at Nürburgring: Powered by EVO



SIA Trophy winner: Powered by EVO



First Electric Vehicle at Dakar Rally



REEvolution TSB Project

A £20.5 million TSB funded Low Carbon Vehicle Project to assist with the development of Range Extender Series Hybrid Vehicles and associated supply chain

> Duration

- **Project Start Date:** 1st September 2010
- **Project Finish Date:** 31st August 2012

> Partners

- **EVO Electric Ltd:** Electric motors and generators
- **Jaguar Land Rover:** Project Leader
- **Nissan Motor Co. Ltd:** Has sub-contracted vehicle build work to Lotus
- **Lotus Engineering:** Co-ordinating vehicle build
- **Axeon Ltd:** Battery (for JLR only)
- **Xtrac Ltd:** Gearbox



TSB Project - Lightweight Electric Vehicle

Intelligent Energy and Revolve are developing an all new lightweight, electric-hybrid, light-commercial vehicle for global fleet operators, named the T-001

> Partners

- Intelligent Energy Ltd: Project Leader
- Revolve Technologies Ltd: Co-ordinating prototype vehicle build

> Sub-contractors

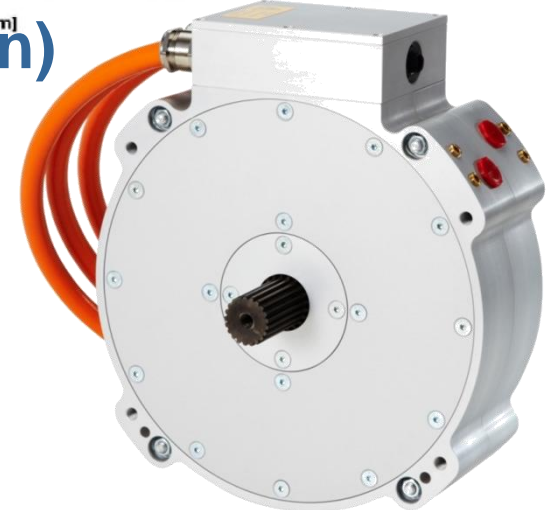
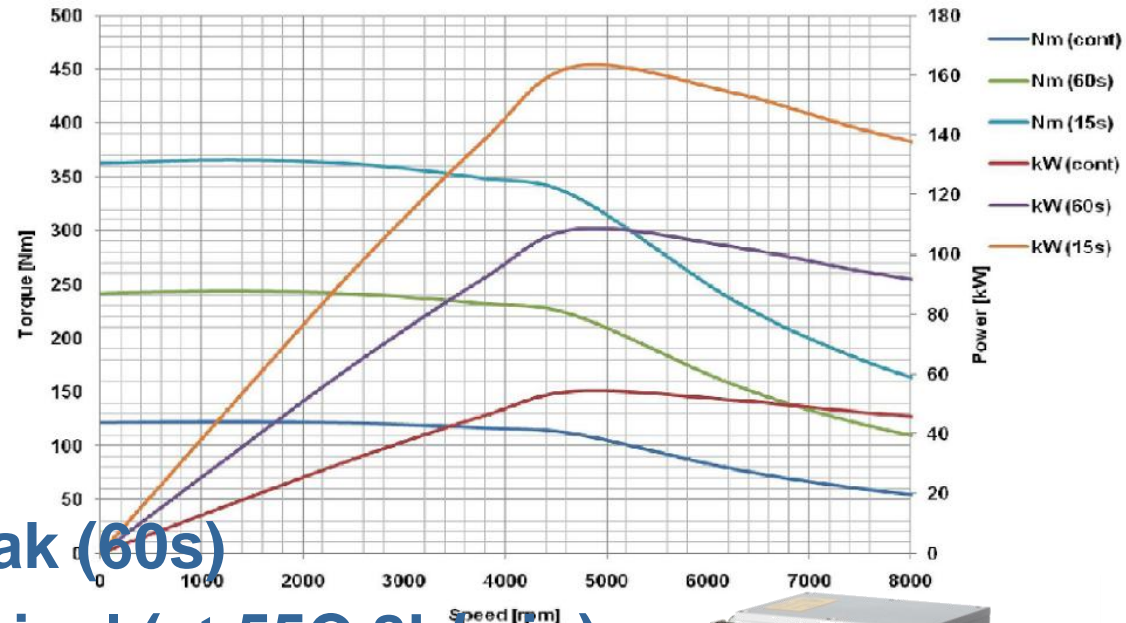
- EVO Electric Ltd: Electric motors and generators
- Ricardo UK Ltd: Vehicle Control System
- Penso: High Voltage Cables
- Axeon Ltd: Battery



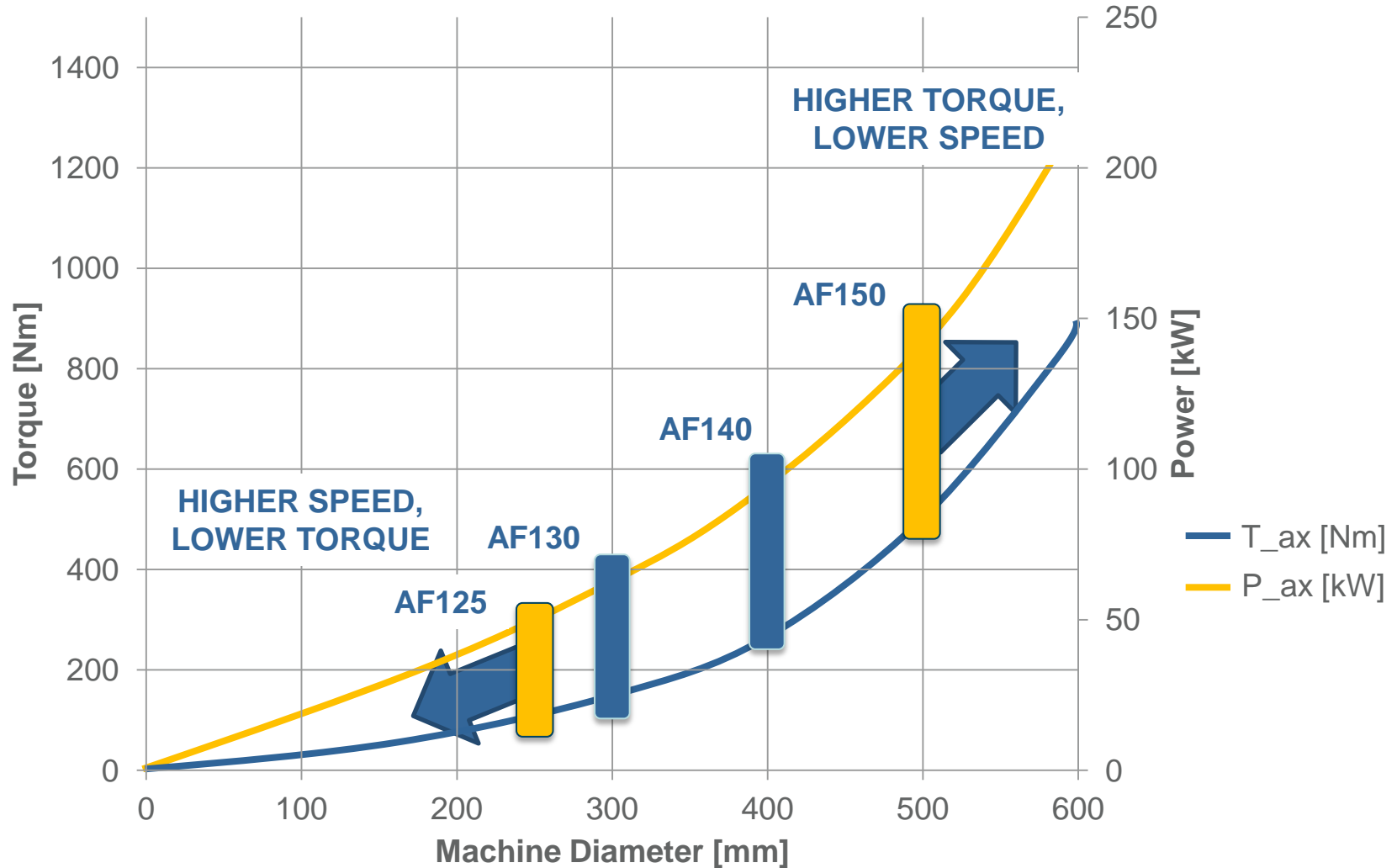
Example: AF-130

- > 300mm diameter
- > 115mm length
- > 28kg

- > 100kW / 240Nm peak (60s)
- > 64kW / 145Nm nominal (at 55C 8L/min)
- > 0...8,000rpm



Product Family



Range Extender Engine

> Compact range extender engine with integrated EVO motor

- Horizontal or vertical installation capability
- Weight 50 kg (70 kg with generator)
- Compact design
- 4-stroke gasoline engine
- 900 cc twin cylinder
- 30 kW output



> UK-built demonstrator vehicle available early 2012



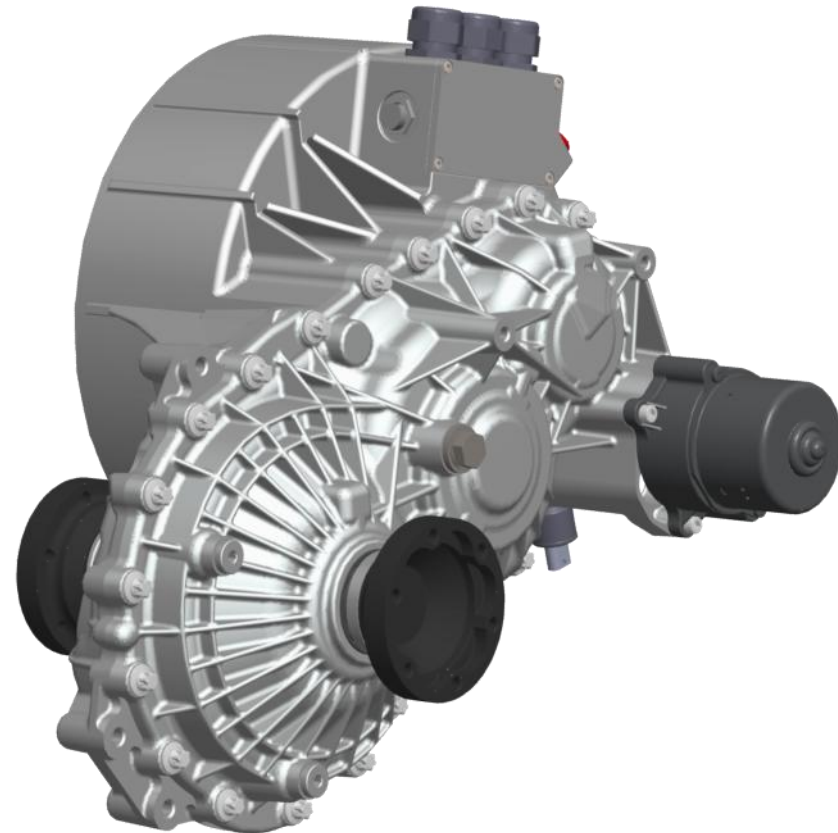
Integrated eDrive System

> Model; G-VO130-S2

System	
Maximum drive torque	3955Nm
Differential	Open differential
Disconnect	Optional (by synchroshift)
Park Brake	Optional
Weight	approx. 58 kg (dry)

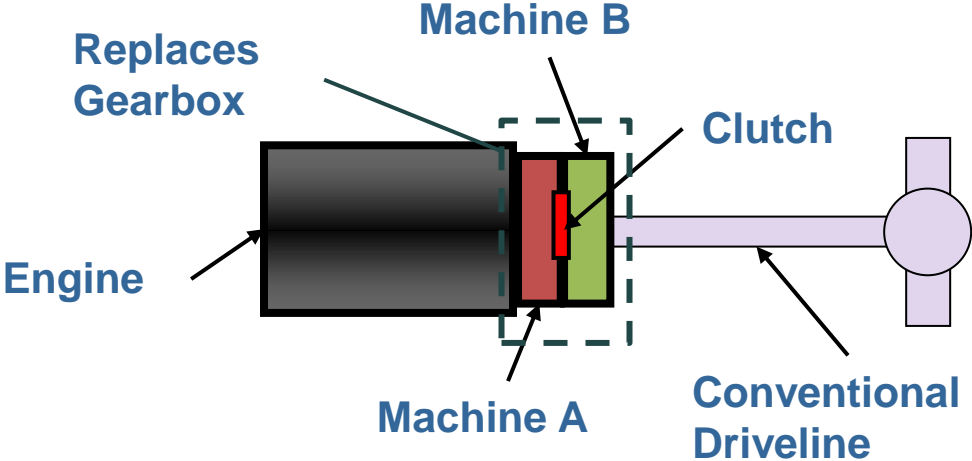
Motor Spec	
Type	Permanent Magnet Axial Flux
Maximum Speed	8000 rpm
Peak Torque (for up to 20 sec)	350 Nm
Peak Power (for up to 20 sec)	140 kW
Nominal Torque	145 Nm
Nominal Power	64 kW
Peak Efficiency	95.1%
Cooland Medium	Water/Glycol (50/50)

Transmission Spec	
Number of Gears	2
Number of Gear Stages	2
Overall ratio	1st Gear:11.3 ; 2nd Gear: 5.9
Efficiency	97%



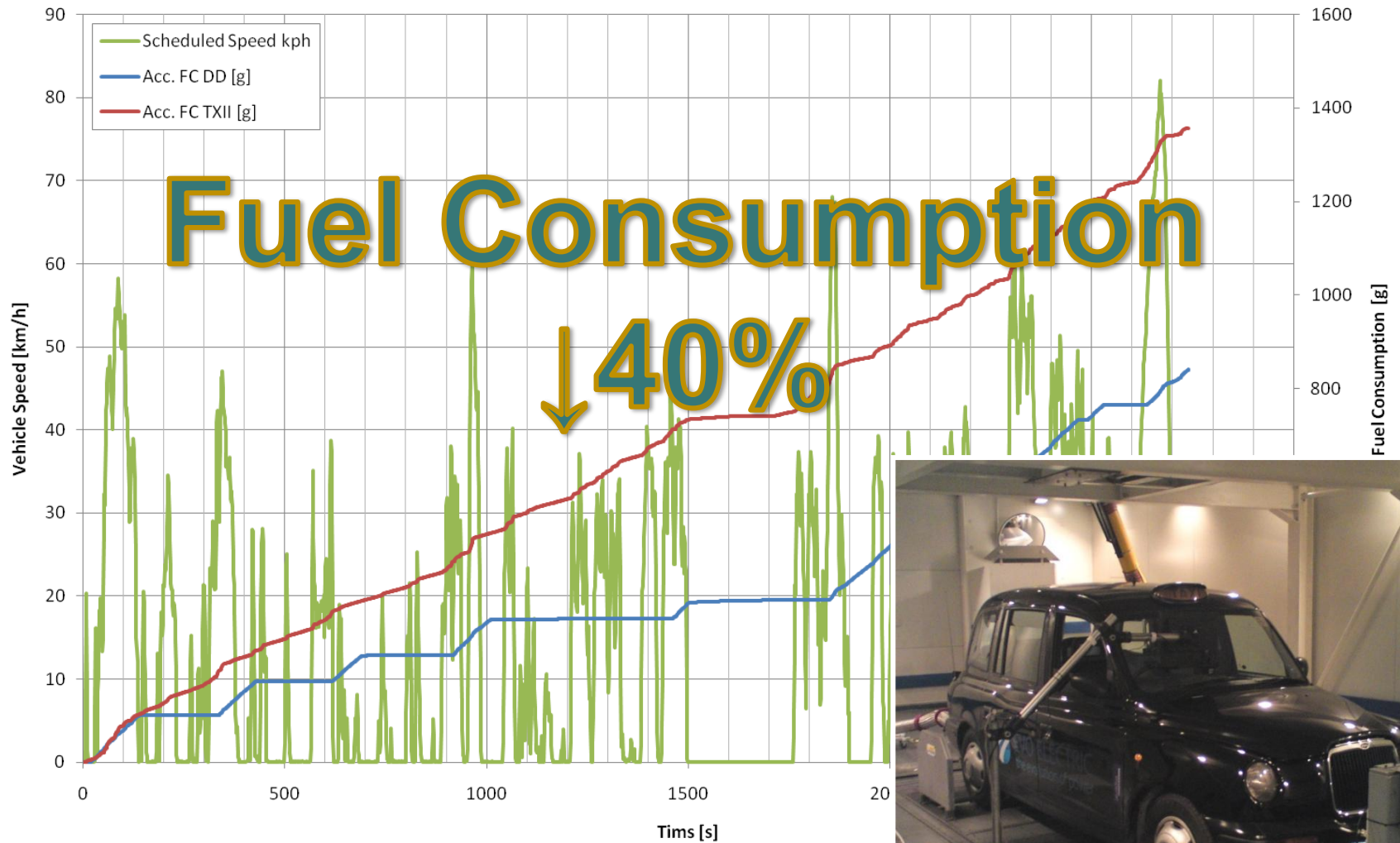
EVO Electric DuoDrive

- > Switchable:
Series/Parallel/Electric
- > 2x AF-140



Mahle Dynamometer Results

Fuel consumption profile



The future of eDrive

- UK-developed Technology
- Class-leading Torque and Power Density
- Proven product performance
- Modular, scalable design
- Numerous customer engagements
- Clear route to industrialisation
- World-class interdisciplinary team





**re-thinking
tomorrow.**

GKN EVO eDrive Systems

