

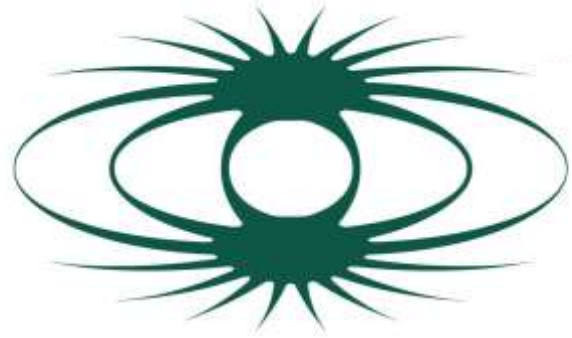


Development and Test of MAGSPLIT Dedicated Hybrid Transmission (DHT) for Vehicles Cross-Platform Application

Gboyega Oshin
Project Manager – Magnomatics

LCV2019 Event Sponsor:

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management by measurement

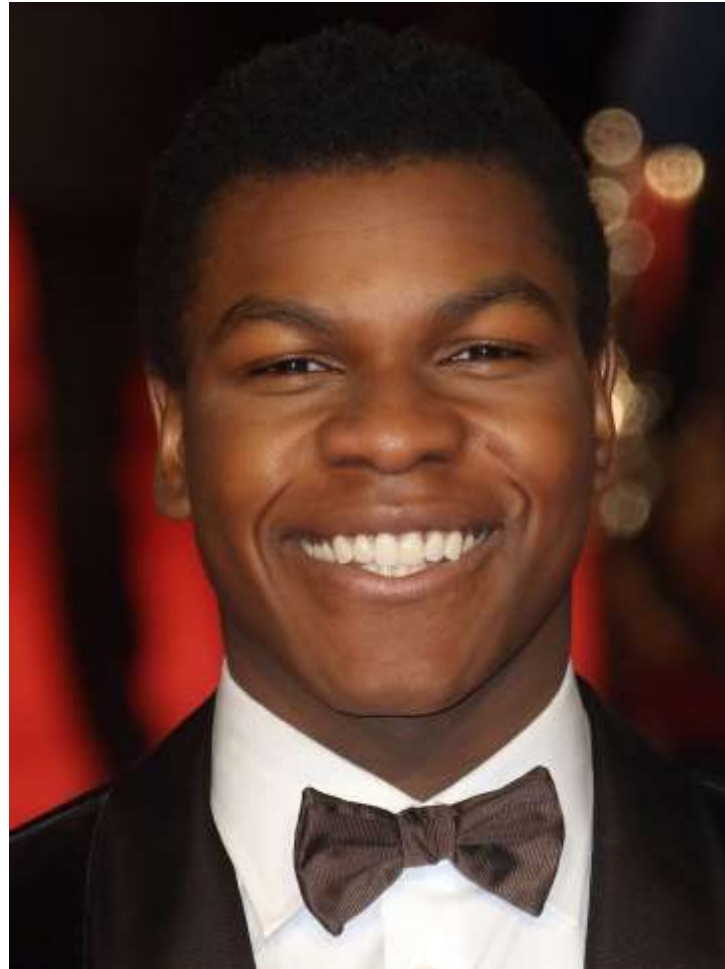


Magnomatics[®]

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DEVELOPMENT AND TEST OF MAGSPLIT DEDICATED HYBRID TRANSMISSION (DHT) FOR CROSS-PLATFORM APPLICATION

Gboyega Oshin, Stuart Calverley, Jeff Birchall
Magnomatics Ltd, UK



John Boyega

MAGSPLIT Dedicated Hybrid Transmission Unit

Magnomatics®

MAGSPLIT - Combining engine and electrical power to provide highly efficient powertrain

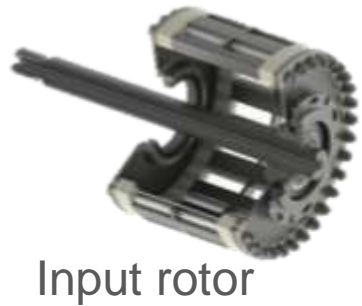
- Dedicated hybrid transmission for passenger cars, buses and trucks
- Low cost, high efficiency transmission
- Simple, proven and flexible



Innovate UK sponsored project – Magnomatics Limited, Romax Technology, Changan UK, CMCL

Simple Concept

- One input shaft and one output shaft, with electronic ratio control
- Magnetic interaction of the input rotor, output rotor and the stator changes speed ratio of input/output



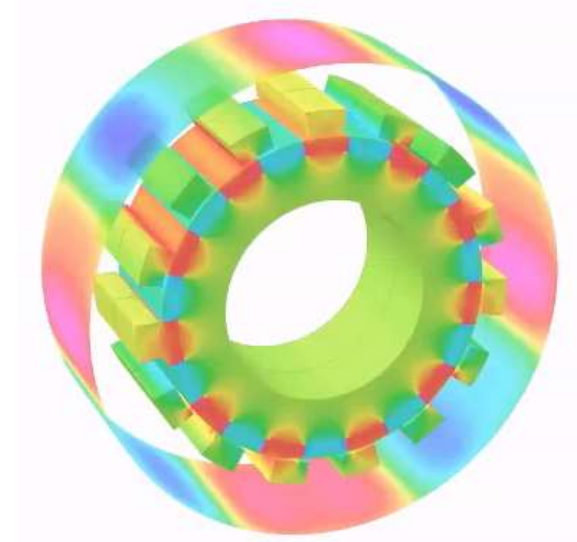
Input rotor



Electronic ratio control

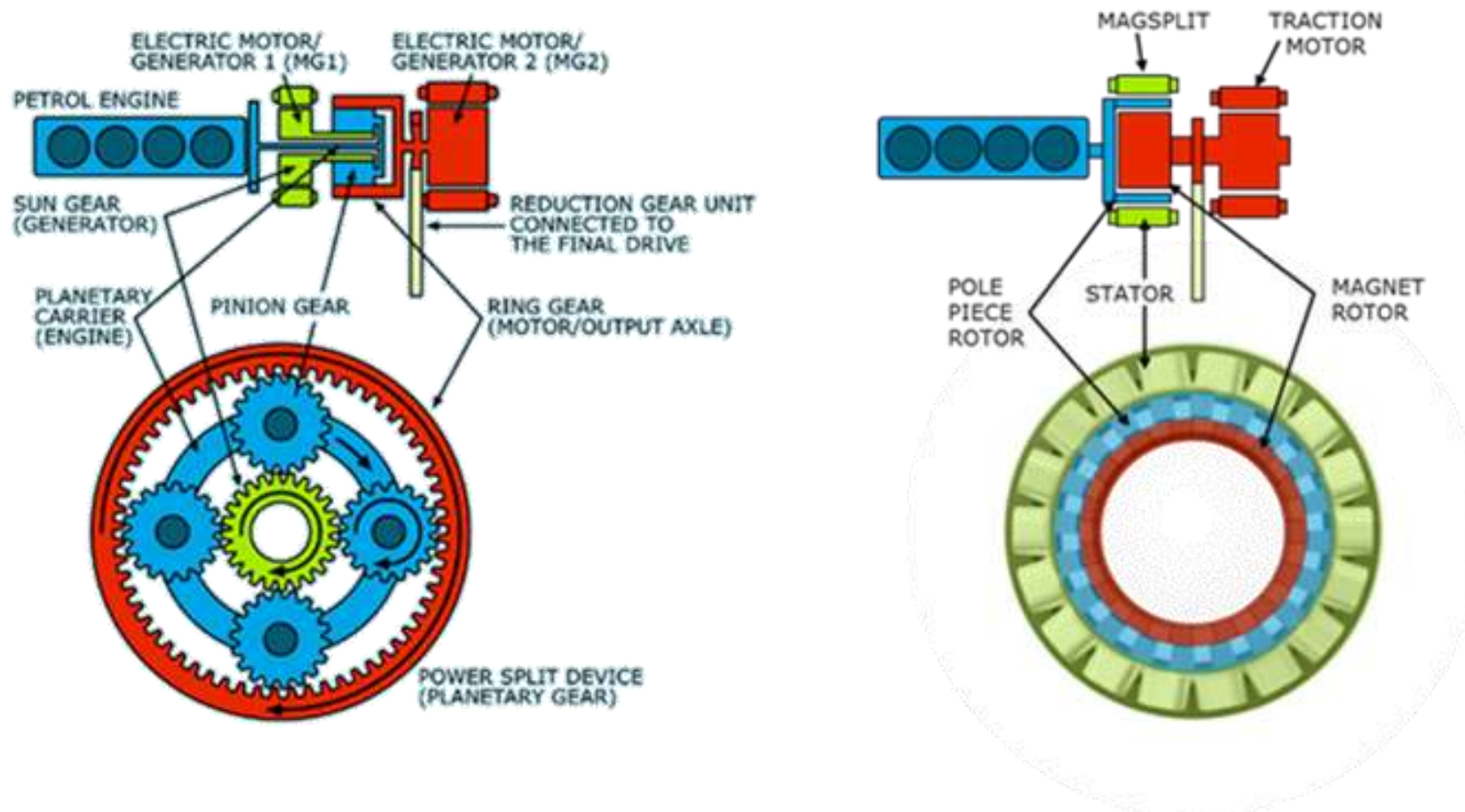


Output rotor



Typical Powersplit Architecture

- Magsplit replaces planetary gear and a motor/generator in a typical powersplit
- There is still a need to add electrical power boost into the drivetrain using a second electrical motor



Cross-Platform Application

- Machines sized to meet requirements for performance (Vmax, 0-50 kph and 0-100 kph) and gradeability for both HEV and EV modes
- Transmission sized for two vehicles: C/D segment passenger and Sports Utility Vehicle platforms
- Engine and transmission assessed for sport, mid-range and entry level, PHEV and HEV variants

EADO



CS75

Vehicle	Variant		
EADO	1✓	2✓	3✓
CS75	1✓	2✓	3✓

← Increasing Performance

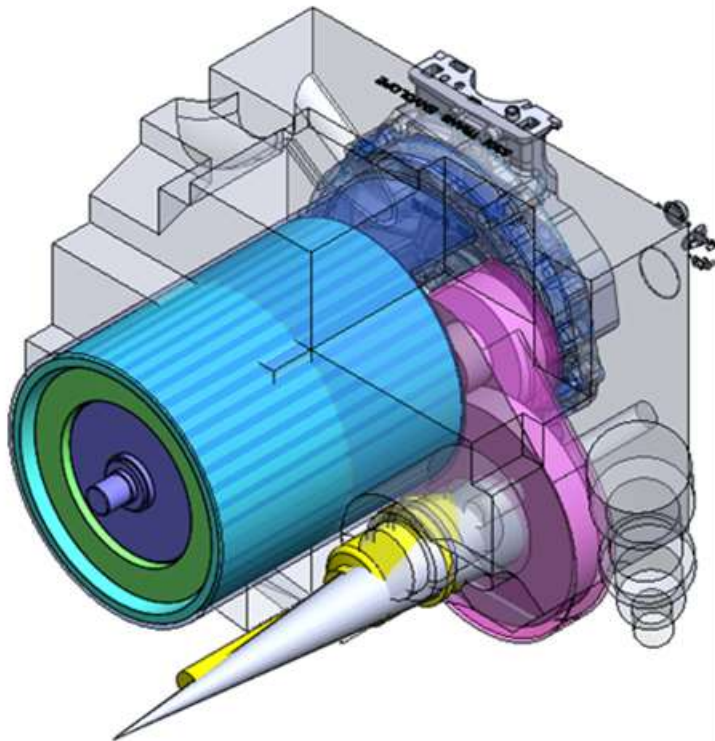
↓ Increasing Mass

✓ with ERAD

Concept Evaluation – Coaxial vs Parallel Layout

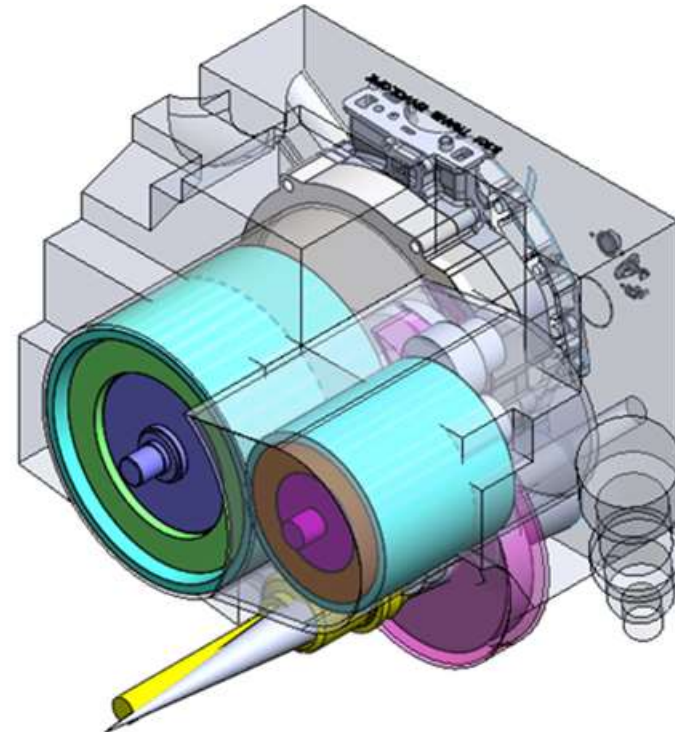
Coaxial:

- Simpler machine with fewer parts
- Larger traction motor diameter
- Packaging more challenging



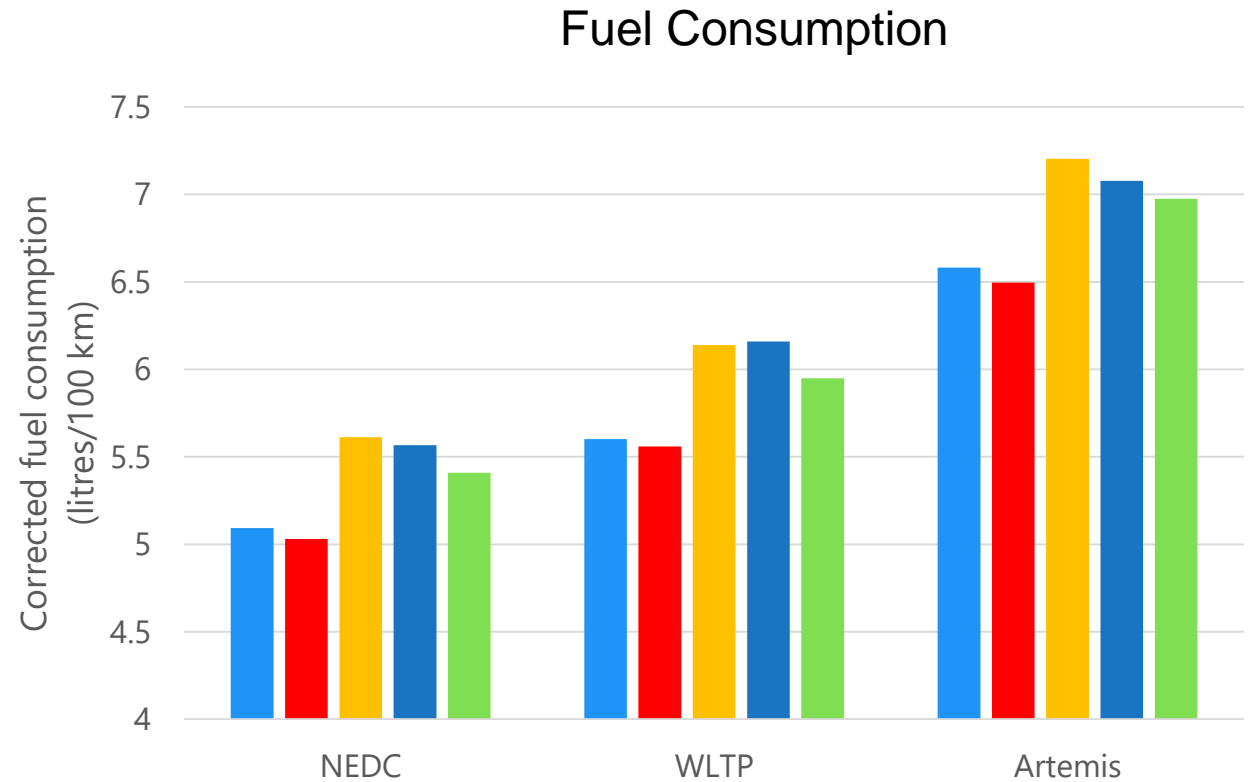
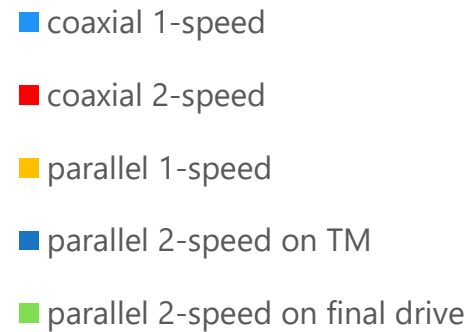
Parallel axis:

- Separate gear stage allows for smaller and faster traction motor
- Easier to package



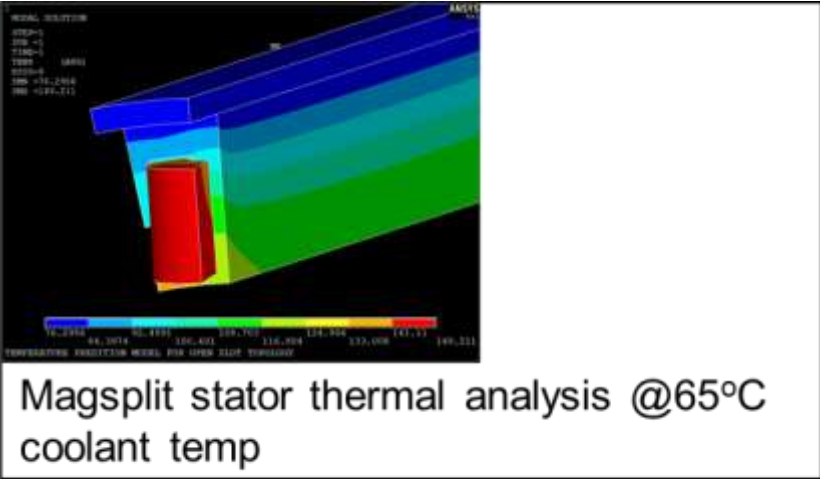
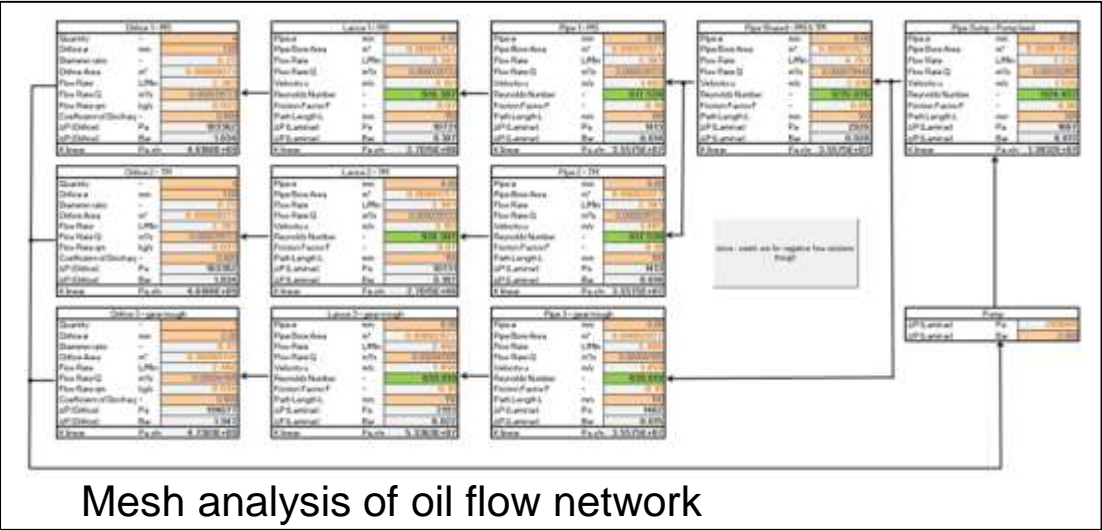
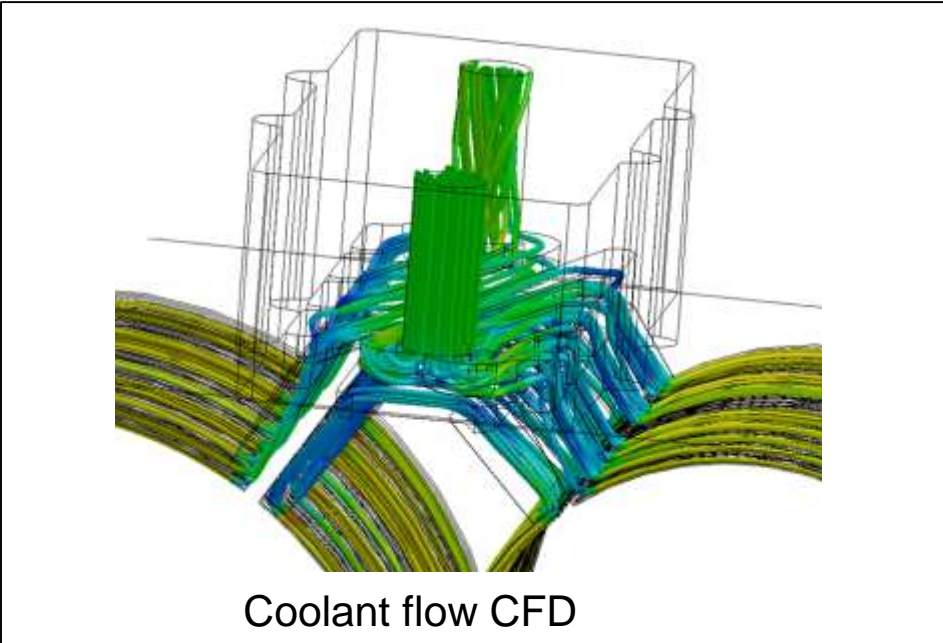
Concept Selection additional considerations

- Packaging
- Fuel consumption
- Durability
- Complexity
- Cost



Parallel axis with 1-speed offered the best trade-off

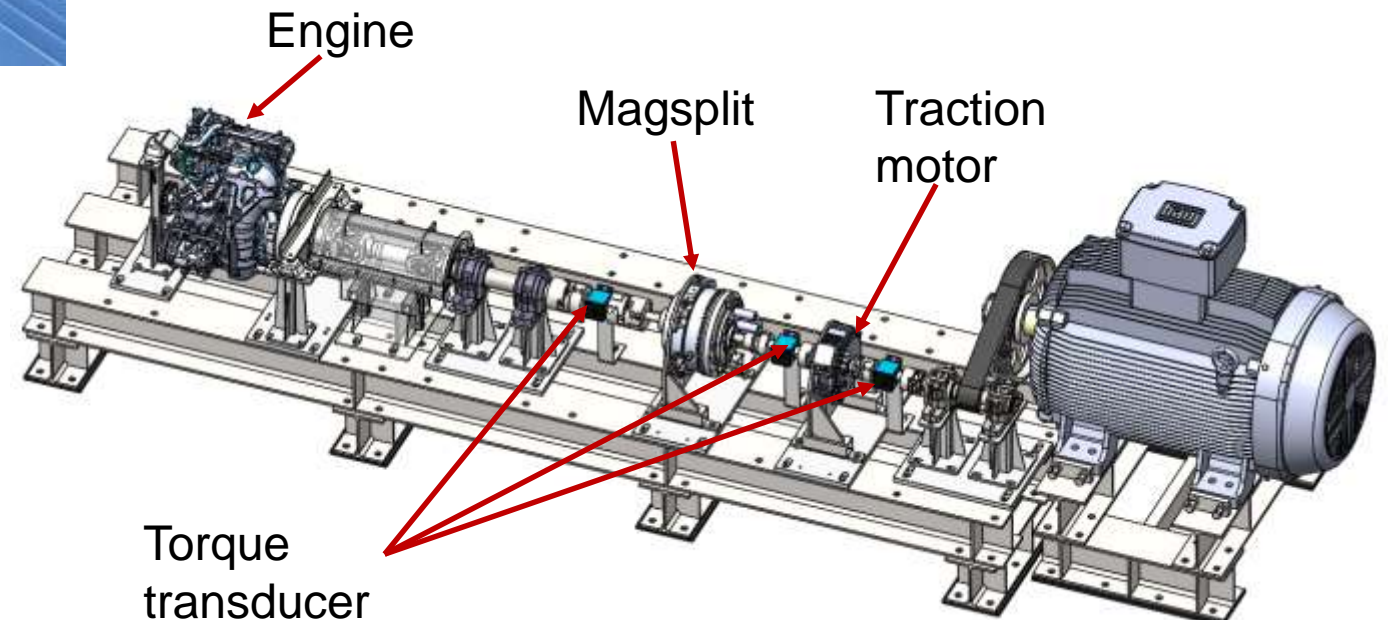
Detail Design - Analysis



Brass Board Testing and Controller Development



- Magsplit DHT system separated into main components for brass board testing
- Torque transducer between system components and current shunts connected to electric machine informs the power flow between components
- SIL, HIL and brass board testing used for controller development



Transmission build

Stators and sleeves in case



MAGSPLIT Input and output rotor assembly

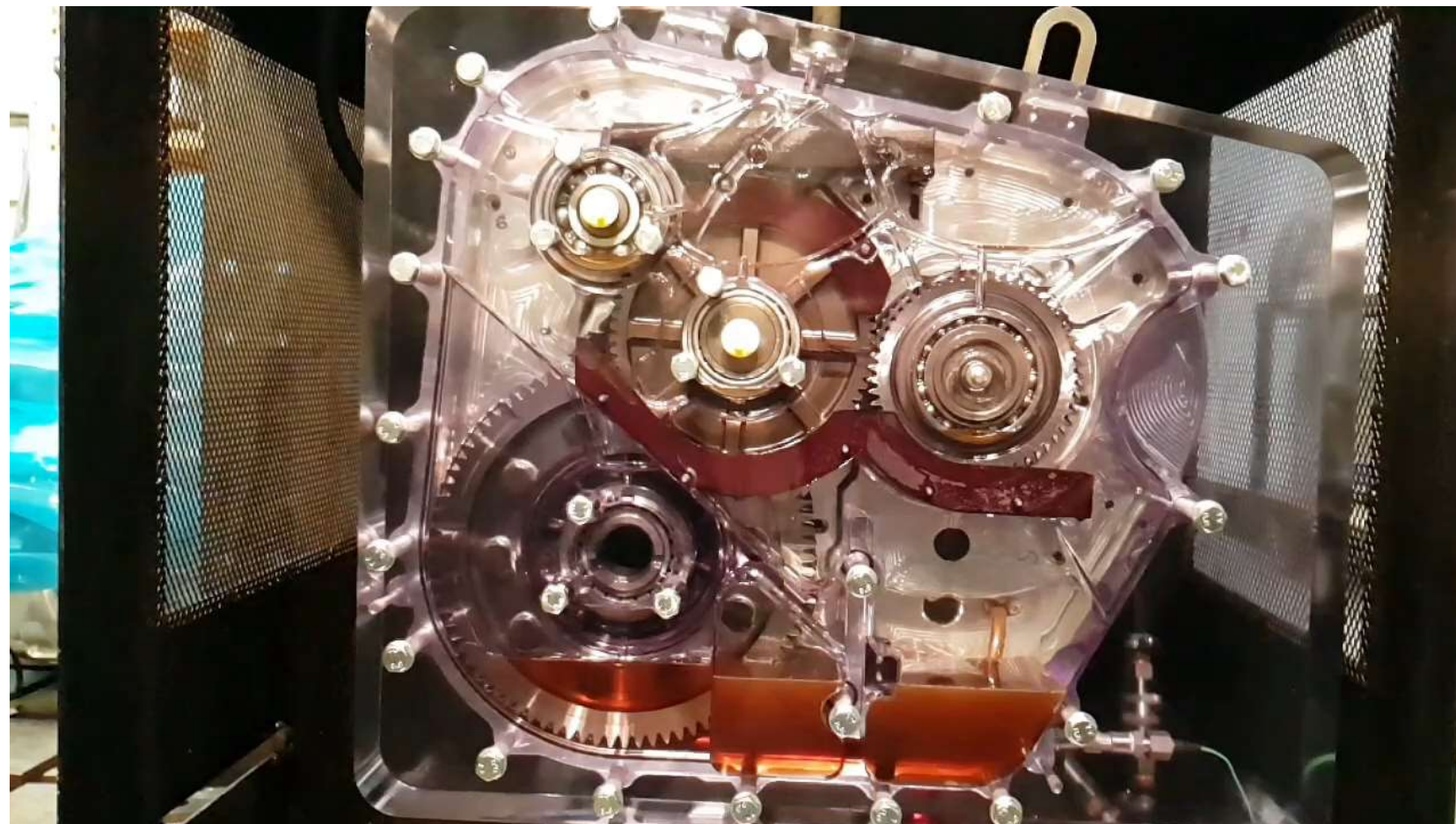


Geartrain Dry Build



Lubrication system testing

Gearbox drag loss testing

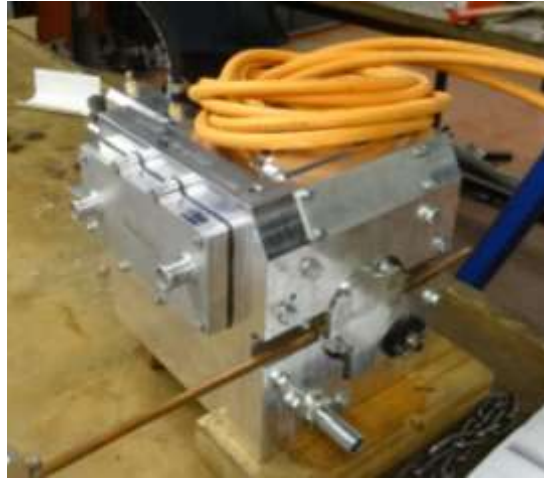


Sub-system Testing – Traction Motor

TM rotor



TM in case for sub-system testing



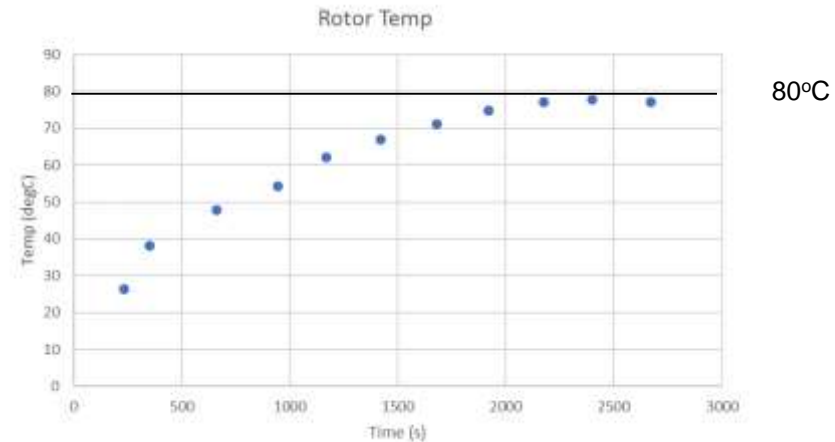
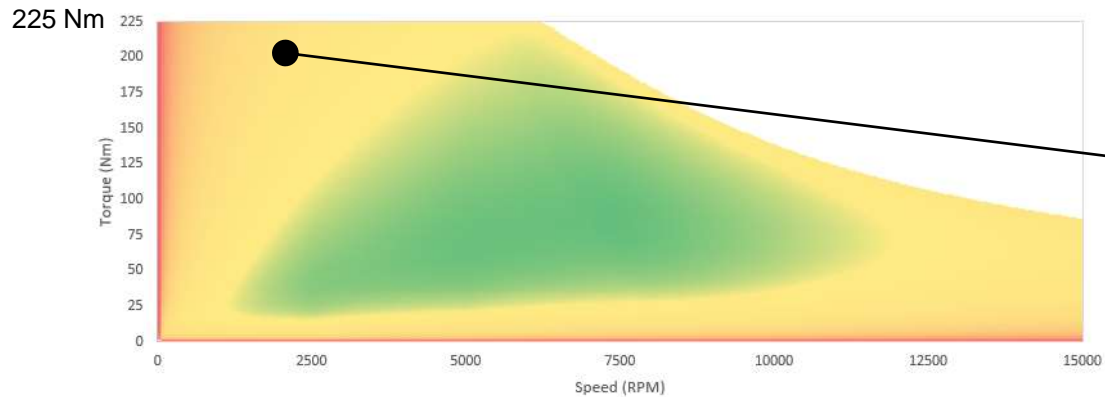
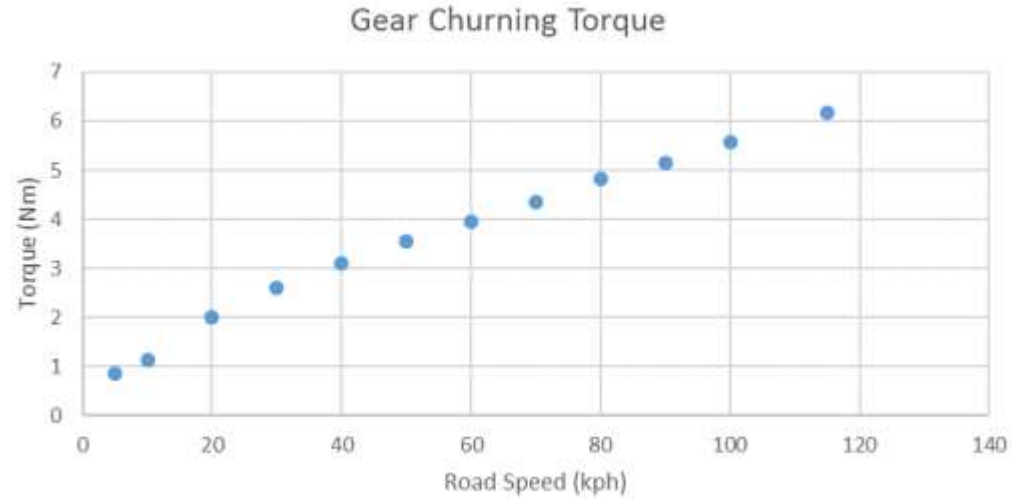
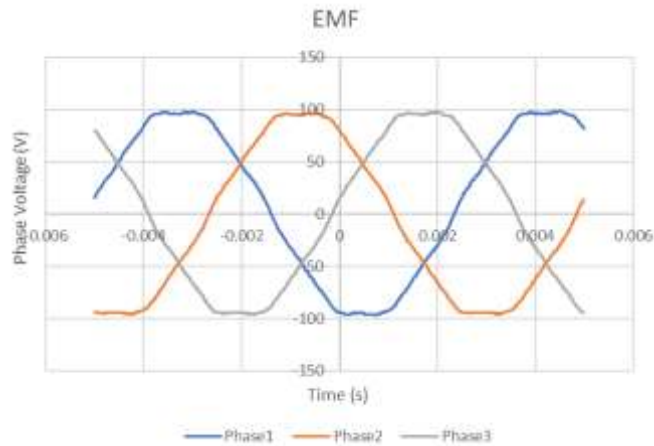
- Very capable EV mode – high power density and high efficiency

- Back-to-back testing allows full range testing of traction motors (14,500 rpm and 225 Nm)
- Thermal mapping; heat soak test
- Oil distribution and coolant flow rate
- Machine loss map at two temperatures

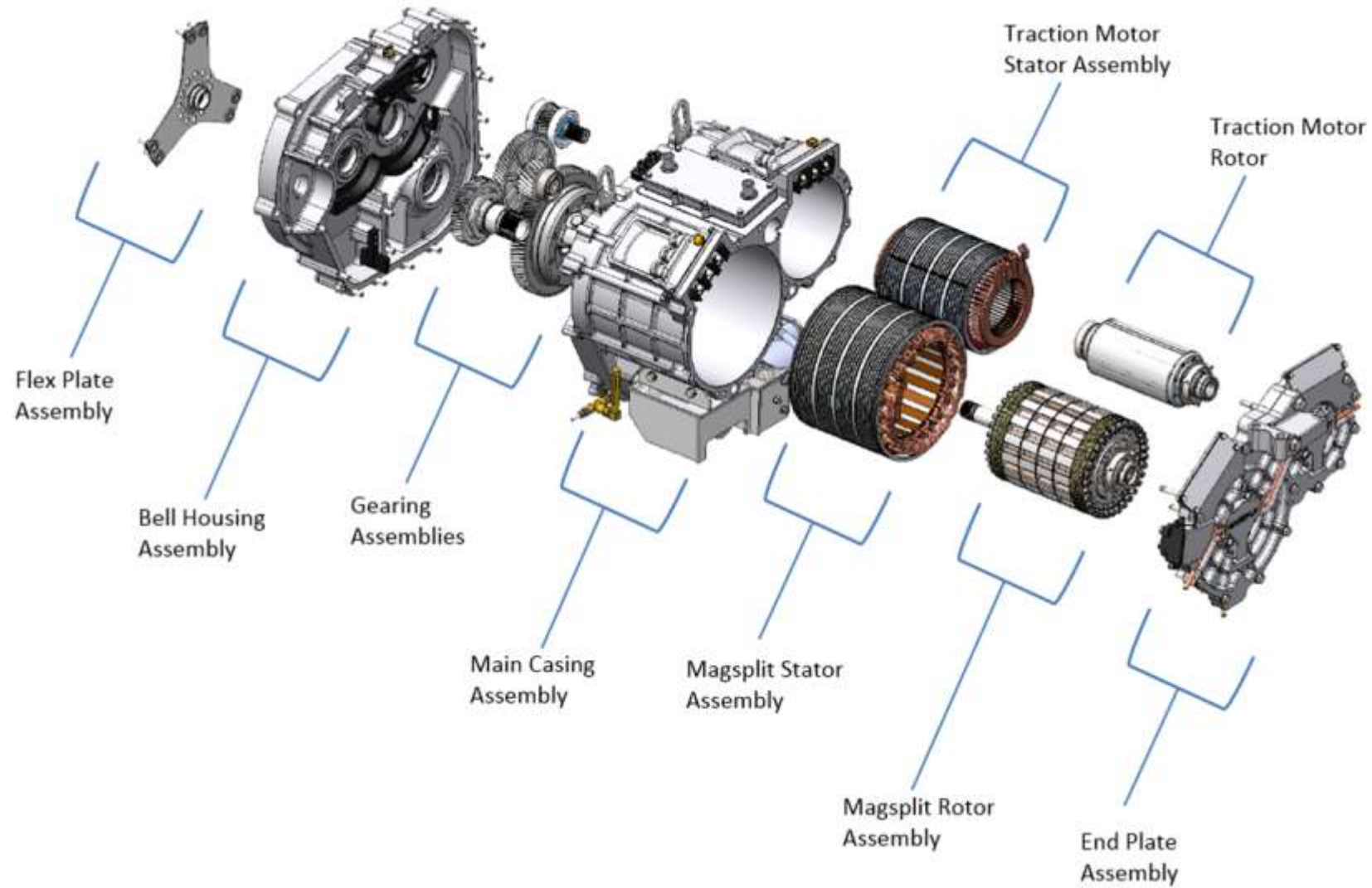


Testing Results

- Factory Acceptance Tests
- Loss measurements
- Thermal Performance



Transmission Assembly

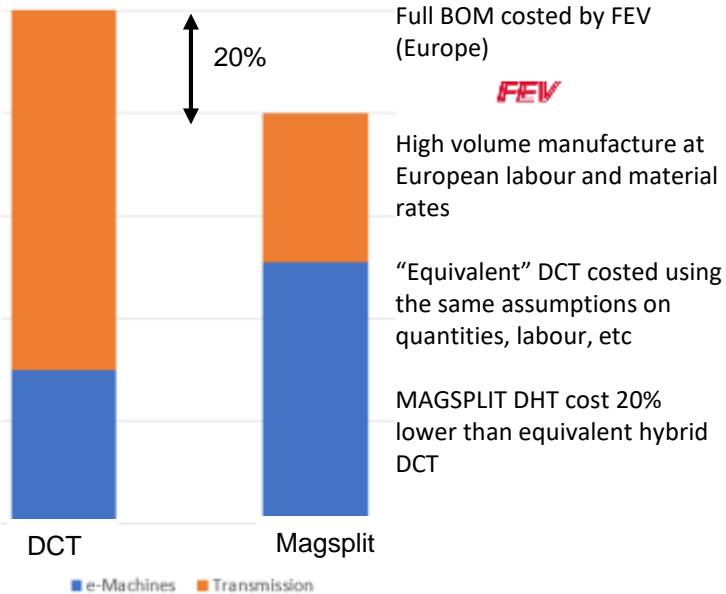


Transmission Cost and Fuel Economy Walk



Building fully complaint transmission with Changan for EADO and another fleet model (Innovate UK project)

Cost comparison with DCT



Fuel Economy: Changan Eado l/100km (NEDC)

