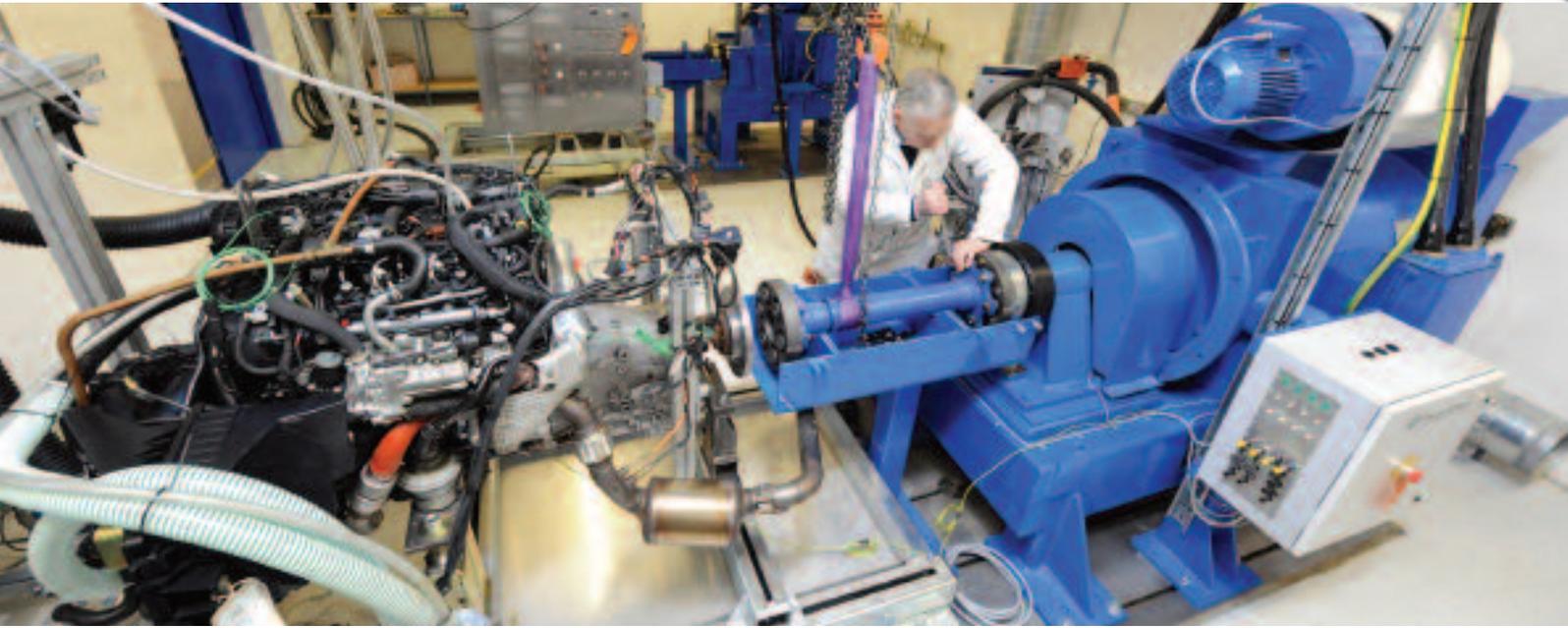


SCIENCE CITY RESEARCH ALLIANCE

UNIVERSITY OF  
BIRMINGHAM

THE UNIVERSITY OF  
WARWICK



# ADVANCED HYBRID ELECTRIC POWERTRAIN RESEARCH

## The Vehicle Energy Facility



The Vehicle Energy Facility (VEF) is a new state-of-the-art hybrid electric powertrain research facility providing un-rivalled capabilities and flexibility for the testing and characterisation of hybrid powertrains, components and control systems. The VEF supports research on hybrid architectures, as well as conventional and pure electric vehicle powertrains. Though it has been purpose-built to be used for the whole spectrum of vehicle types from passenger car through to heavy duty applications, it can be used to test the performance of any internal combustion engines or electric machines, for example, electrical generators for the wind turbine industry.

## KEY FEATURES

- Unique synchronised dual dynamometer architecture
- Supports EV, HEV and conventional IC engine powertrain testing
- Full legislative, or real-world/user-defined drive cycle capability
- Multiple engine fuelling options: Gasoline, Diesel, Ethanol, and Special Bio-fuels
- Full gaseous and particulate exhaust emissions measurement
- High power vehicle battery simulation and battery cycling
- Simulation platforms for early lifecycle development and testing of virtual components and/or control strategies
- Robot driver.

## TYPICAL USAGE

- Hybrid vehicle architecture testing
- Powertrain component testing and characterisation
- Control strategy development and refinement
- Fuel economy and emissions testing
- Electric motor testing and characterisation
- Electrical energy storage testing and characterisation
- Real world performance testing of bio-fuels
- Optimised energy management for HEVs
- Determination of the effects of driver behaviour on hybrid and conventional vehicles over a wide range of drive cycles
- Determination of local emissions in conjunction with CO<sub>2</sub> emissions for different control strategies
- Plug-in HEV leading to V2G research.

## WORLD LEADING EXPERTISE

The VEF research is led by Professor Paul Jennings who with 20 years of experience in automotive research leads the University of Warwick's research on hybrid and electric vehicle technologies and the factors affecting their successful introduction. The team also includes: Dr Peter Jones, a Reader in Systems Engineering with nearly 30 years of experience in the application of system modelling and control techniques to automotive systems; Dr Andrew McGordon, an expert in driver modelling and vehicle modeling; and Mark Amor-Segan, a Principal Engineer specialising in automotive electronics and software. The VEF complements the Hybrid Vehicle Research Group's existing modelling and simulation capabilities. This includes a hybrid powertrain simulation model called WARPSTAR (Warwick Powertrain Simulation Tool for Architectures) which can be used to model any hybrid vehicle architecture. The model includes a library of real world component data for the main powertrain components, and can be used in conjunction with any velocity-time drive cycle profile.

## TECHNICAL SPECIFICATIONS

### Dynamometers

- Large Dynamometer (high dynamic drive)
  - 570kW maximum power
  - 5,000rpm maximum speed
  - 3,200Nm maximum torque
  - 7,300rpm/s dynamic performance
  - 0.2% full scale load accuracy
- Small Dynamometer
  - 320kW maximum power
  - 10,000rpm maximum speed
  - 550Nm maximum torque
  - 15,000rpm/s dynamic performance
  - 0.2% full scale load accuracy
- Fully Synchronised operation
  - Both dynamometers can act as if they are on the same shaft in the vehicle
- Absorbed energy recycled to local electrical grid
- Capable of testing engine alone, or engine and gearbox
- Engine and electric machine can be tested on either dynamometer

### Drive Cycles Supported

- Any legislative or user-defined drive cycle profiles including real-world dynamic

### Fuel Types Supported

- Gasoline, Diesel, Ethanol, bespoke bio-fuels

### Battery Simulator and Cyclers

- Pack-level battery tester
  - 900V
  - 500A
  - 250kW maximum (with future expansion capability up to 500kW)
- Simulation of different energy storage technologies, e.g. alternative battery chemistries, super-capacitors interfaced to local electrical grid
- Vehicle-to-grid applications

### Emissions Measurement Equipment

- Full transient Gaseous measurement capability for NO<sub>x</sub>, CO, CO<sub>2</sub>, THC, O<sub>2</sub> etc.
- Diesel particulate measurement

### Simulation Platforms

- For simulation and virtual testing of Engine/Transmission, Vehicle Dynamics/Driveline and Electric Drive/Energy Storage components

For further information and enquiries, including access to the facilities, research consultancy or collaboration:

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The Vehicle Energy Facility is part of the Science City Energy Efficiency and Demand project funded by Advantage West Midlands and the European Regional Development Fund. The project is part of a wider investment in research infrastructure of the West Midlands region, which unites the Universities of Birmingham and Warwick in the newly-formed Science City Research Alliance.

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