Intelligent Energy

Development of Fuel Cells for Automotive Applications

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Introduction to Intelligent Energy

• An independent British technology development company commercialising fuel cell technology

• A global operation – over 400 staff worldwide across the Group

• Headquarters and main operation in Loughborough, UK with other satellite offices in the UK, India, Japan and the US

![Map showing Intelligent Energy locations around the world](image)
Introduction to Intelligent Energy

World’s largest independent FC technology company, floated 2014

Core expertise in research, engineering and manufacturing of world-leading fuel cell systems:

- Over 400 patent granted, with 600 pending
- Proven, de-risked, technology platforms
- Develop cost effective and fast to market fuel cell systems
- Flexible business models
- OEM level of capability. Tier 1.
- Global footprint, partners, customers and industry recognition
- Supporting technology development for a number of automotive OEMs
Current Focus on 3 Markets, 3 Business Divisions

**Motive (Automotive):**
Passenger cars, powered two wheelers, LCV’s and CV’s, Off-Highway: motive power, range extenders and APU’s

**Consumer Electronics (CE):**
Portable devices: un-tethered and extended operating power

**Stationary Power (DP&G):**
Telecommunications, emergency power, CHP: on-demand, backup power
Motive Division – History of Commercialising Fuel Cells

1838

Intelligent Energy Formed

Invented Welsh Barrister and Physicist William Grove

1995

UK’s First PEM Fuel Cell

Worlds First Fuel Cell Motorbike

2000

ENV

2005

Fuell Cell Taxi Unveiled

PSA Range Extender Demonstrator

2010

Non Exclusive Licence with Suzuki

2011

Whole Vehicle Type Approval for Fuel Cell Suzuki Burgman

2012

Fuel Cell Pilot Line (Japan)

2013

100kW FC Supercar
30kW RE Pass-car
8kW RE Van programme
Why are we developing Fuel Cells for Automotive?

Only FC can really give the consumer and legislator what they want:
- Zero emissions
- A range that doesn’t make them change their driving habits, or damage their business.
Why are we developing Fuel Cells for Automotive?

• The auto industry is committed to achieving fleet average 80% reduction in CO2 emissions by 2050 (CAFE)

• It is highly unlikely that improvements in internal combustion engines alone can provide this

• Fuel cells offer the required mix of emissions reduction and range, particularly when the hydrogen is from a clean source

• Fuel cell vehicles are technology ready and are a strong substitute for internal combustion engine family cars, responsible for 75% of automotive carbon dioxide emissions in Europe

• So why aren’t we all driving them right now?

  • Commercialisation of FCs and hydrogen
  • Hydrogen infrastructure development
Hydrogen Fuel Cell – The Electrochemical Process

Key
- Red: Hydrogen
- Green: Proton (+ve)
- Blue: Oxygen
- Yellow: Electron (-ve)

Diagram:
- Hydrogen (H₂ Fuel) enters at the anode.
- Oxygen (O₂) and water vapour enter at the cathode.
- H₂ Recycling loop indicated.
- Proton Exchange Membrane separates the anode and cathode.
- Catalysts enhance the reaction at both electrodes.
Motive FC Technology - Products

Modular, Scalable Power Systems

Air Cooled

Low Power
- Material handling
- 2/3 wheelers
- Small interurban range extenders vans or
- Passenger cars

Mid Power
- Range extenders for urban applications (commercial vehicles or passenger cars)

High Power
- Full FCEV for commercial vehicle or passenger car applications

Evaporatively Cooled
- Range Extenders for Trains
- Or full FCEV Bus or Passenger car application
Summary

Fuel Cells are ‘Technology Ready’ for the automotive industry.

• Hydrogen FCS have already achieved automotive industry performance requirements. Focus is now on driving down costs, driving up volume.

• Hydrogen FCS have achieved the necessary durability, validation and safety. Now the industry has to prove their utility in the real world under all conditions, gain mainstream acceptance of the technology, and the fuel.

• Hydrogen FCS have shown that they can achieve the decarbonisation of road transport. Cost effective fuel cell vehicle deployment depends on OEMs, Tier 1’s, technology houses, governments, consumers – all collaborating to create demand and volume through technology, subsidy, legislation, infrastructure etc.

The potential applications and volumes of FCs are huge... and not just automotive.

It’s an exciting time to be developing FCs... and UK engineers are out the front.
Thank You

Adam Huckstep, Director Motive Engineering