The Royal Academy of Engineering

Call for Evidence – Electric Vehicles

The Royal Academy of Engineering seeks your input to our recently launched Electric Vehicles Study. This is your opportunity to shape the focus of this important study into how the development and mainstream adoption of electric vehicles can be achieved by 2050.

We welcome evidence, data and case studies in response to the questions below, as soon as possible, and before Tuesday 10th November 2009. Please see below for response details.

Background to Electric Vehicles study

The UK is committed to hugely challenging targets for the reduction in greenhouse gases over the next four decades. Over recent years, some progress has been achieved in stabilising emissions from homes and industry but emissions from transport continue to rise. Electric vehicles are often held-up as the solution but there has been little analysis of the barriers to a sufficiently high take-up to make a significant difference to UK carbon emissions.

The Royal Academy of Engineering has initiated a study to identify such barriers and what actions have to be taken for electric vehicles to make a major contribution to a reduction in greenhouse gases.

The study will be led by Professor Roger Kemp FREng and will draw on the expertise of study working group:

Chris Brace	Bath University
Davy Thielens	KEMA Consulting
Gareth Evans	OFGEM
John Urry	Lancaster University
Pete James	Prodrive
Phil Blythe	Newcastle University
Richard Parry-Jones CBE FREng	RPJ Consulting
Richard Wenham	Ricardo plc
Martyn Thomas CBE FREng	Martyn Thomas Associates Ltd

Call for Evidence

This is your opportunity to shape the focus of this major study, which will be published in the spring of 2010.

This call for evidence seeks input in the form of ideas, evidence and suggestions from all organizations and individuals with an interest in the development, use and support in the field of electric vehicles, and the associated infrastructure requirements. We are particularly interested in receiving evidence on the topics listed below and we welcome comments and views on other issues that you think we should consider.

Questions on battery technology

Thinking about batteries for electric vehicles (up to about 3 tonne GVW requiring stored energy in the range 10 – 50kWh) what battery types are available today and what other types could be coming onto the market in the next 20 years?

For each of these technologies, please could you indicate the current and likely future performance, including the specific energy (kWh/tonne), specific power (kW/tonne) maximum recharging rate (e.g. 80% capacity in 1h), charge/discharge efficiency, cycle life (e.g. number of cycles to 70% to initial energy storage capacity) and cost (€/kWh).

For each type, it would be useful to describe any particular features that might influence their appropriateness for EVs, such as susceptibility to vibration, operating temperature range, toxicity of component chemicals and availability of materials. (When considering availability, we need to be thinking about the situation of up to 300 million batteries worldwide – say 6 TWh total energy storage capacity.)

How easy is it to recycle the materials that make up the battery? Do recycling facilities already exist or would some have to be developed?

Questions on motors and materials

What do you see as the main types of motors likely to be used in EVs? (note – continuous ratings are likely to be in the range 10 to 40kW with the ability to produce several times full-load torque during acceleration.) Please give an indication of specific power (kW/kg), efficiency and price to OEM (€/kW).

What are the limitations to mass production of each type of motor – at the scale of perhaps 1 million units per year from one factory? With manufacture of this type of motor running at 10 million/year, what would be the annual demand for any special materials, such as rare earths for the magnets, and how does this compare with known reserves?

Questions on power electronics

For choppers and inverters in the range 20kW to 100kW (peak), what types of power semiconductors do you envisage being used over the next 20 years?

When used in EV drive systems (ambient temperature from -20 degC to +40 degC, highly "peaky" load, high vibration, condensing atmosphere) what do you see as the likely life of the power electronics devices?

What developments can you foresee that would allow the reliability to be increased to ensure than at least 95% of inverter control systems reached the equivalent of 200,000 km or 10 years life?

Questions on support in the field and infrastructure

What changes in public expectation and the "ownership experience" are required for EVs to become truly mainstream? What sort of performance do EVs need to attain and in what situations to become a genuine competitor for conventional vehicles and how do different ownership models (leasing in whole or just batteries, service provision as opposed to outright ownership) enhance or detract from the EV offering? How could such EVs fit into and become part of current or future forms of social life?

What adaptations will be required to support networks to deal with breakdown services and maintenance of EVs?

What is the likely impact of widespread EV use on electricity generation capacity requirements and margins? How can infrastructure be provided for charging points in both public and private parking places?

How will EVs interact with a smart grid? What are the possibilities and consequences of using EVs connected to a smart grid to contribute peak shaving? How could charging structures deal with EV recharging at home and out and about?

Thinking about the power requirements of a whole housing estate recharging, say, 100 EVs overnight, how would this affect the distribution networks? What are the significant difference between cross connected distribution network in cities and more rural networks for this type of scenario?

How to respond

Responses should be sent by 10th November 2009 to responses@raeng.org.uk and marked "Electric Vechicles"