

ELECTRIC VEHICLES

In 1899, an electric vehicle held the world land speed record. However, over the following two decades, Internal Combustion Engines (ICEs) came to dominate the motor vehicle sector. Through the remainder of the 20th century, ICE vehicles were refined through engine, material and fuel technology advances to become the powerful, efficient and reliable cars that motorists world-wide depend on now.

Types of Electrified vehicles

Hybrid vehicles use two or more distinct power sources, generally an internal combustion engine and an electric motor. In Australia, Toyota and Honda have released hybrid vehicles.

Plug-in hybrid vehicles have increased energy storage capacity (designed to be charged from the electricity grid). This extends the range and power of the car, allowing greater use without the ICE.

Electric vehicles (EVs) have only one energy storage system and no on-board generating capacity. The Tesla Roadster is an EV.

Electric bicycles have an attached electric motor and rechargeable battery to assist pedalling for those who want the flexibility and convenience of cycling, without the physical effort.

Electric mobility scooters provide independent mobility for those unable to walk long distances. Some models can be registered for on-road use.

Electric trains account for all Citytrain services in south-east Queensland and many of the locomotives for coal haulage are also electric. Some other cities have electric trams, buses and even delivery trucks.

The 21st century presents a number of energy security, economic and environmental challenges for which it appears the electric vehicle is well suited. Automobile manufacturers are engaged in development that will bring electric cars on to our streets again.



Why go electric?

Electric vehicles provide a more energy efficient alternative to the ICE. A comparative study of the well-to-wheel efficiency in the Netherlands found the electric car is twice as efficient as the ICE-powered vehicle (see: www.peakoil.nl/wp-content/uploads/2009/01).

The efficiency advantage is for two main reasons. Firstly, electric motors and the conversion of chemical energy to electricity in batteries are now very efficient. Secondly, by generating electricity at a remote power station instead of combusting the fuel in the vehicle, much higher temperatures can be obtained, leading to a higher proportion of the fuel's energy being useful.

If renewable electricity is used, then greenhouse emissions can be dramatically reduced. Other electricity storage devices may be competitive with batteries in the future. Examples include fuel cells, flywheels and ultra-capacitors.

Electric vehicles are likely to be very reliable: they will be easier to maintain because there are fewer moving parts. The electricity flows will need to be well designed and managed to limit dangers.

What are the challenges to an electric fleet?

A major advantage of ICE vehicles has been the high energy density and relative ease of refuelling with petrol or diesel liquid fuels.

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Battery Electric Vehicles (EVs) are not expected to achieve the same range of travel as ICE vehicles until their weight and capital cost is further reduced. So it's likely that early production EVs will be targeted at the urban market or as second family cars where extended range is not necessary.

Charging the batteries will need to work differently from liquid refuelling. Overnight charging while parked in the garage at home is an efficient and convenient solution that suits existing electricity distribution technology. A mobile charging system or battery replacement sites will be required for those who can't make it to their destination.

For car manufacturers, the challenges are to provide a range of electric vehicles for consumers at a viable price. The new technologies and production lines will require significant capital investment. Government leadership is needed to support the car industry to make the required investments and to provide purchase incentives for early adopters.

The Solutions

Industry and governments are considering many solutions, including:

New battery electric vehicles – Tesla and i MiEV

No doubt the Tesla challenges the image of the lean and green electric vehicle. With a maximum speed of 200km/hr and a battery capacity of up to 390 km, the Tesla Roadster is now being sold in the United States as a viable sports car. With a right-hand drive model being released later this year, we may see them in Australia. The Roadster is only one of Tesla's fleet, with orders now open for the Tesla S – an all-electric saloon car with a 480km range and a 45-minute quick charge.

The Mitsubishi i MiEV is scheduled for release in 2010. With torque output equivalent to a 1.5 litre Mitsubishi Colt, the i MiEV delivers 160km per charge.

New systems for electrification

Better Place Australia is a global company working with suppliers of renewable energy and car producers to provide infrastructure and services to make transition to electric vehicles easy, affordable and attractive. The system is to be implemented in Israel, Denmark and then Australia.

Better Place Australia will provide and maintain the battery packs for EVs, reducing the upfront cost of the car and incorporating vehicle and electricity network management to minimise grid impact. The Better Place system incorporates the installation of standard charge spots in home garages, offices and retail carparks; provision of in-car information services providing automatic energy management for drivers (i.e. information about the number of kilometres until recharge required and recharge locations) and range extending battery switch stations so that drivers can replace batteries during longer journeys.

Government supporting development

The Green Car Innovation Fund is a key element of the *New Car Plan for a Greener Future* initiative, announced by the Australian Government in November 2008. The fund provides \$1.3 billion over 10 years from 2009-2010, for projects that enhance the research, development and commercialisation of Australian technologies that significantly reduce fuel consumption and/or greenhouse gas emissions of passenger motor vehicles.

This provides an opportunity for Australian manufacture of electric cars. However, it does not address the cost of electric vehicles to consumers and the need for direct subsidies during the early adopter phase, such as those provided by the US and Chinese governments.

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Useful websites www.racq.com.au/about_us/lobbying_for_road_users; : www.teslamotors.com; www.betterplace.com; www.ausindustry.gov.au/Manufacturing/GreenCarInnovationFund