Vehicle Technologies:

Emerging Fuels and Technologies

Overview

Almost any energy source could, in theory, be used in the transport sector. This fact sheet highlights a few possible fuels and associated technologies that could emerge in South Australia.

Some options could increase transport-sector emissions, if widely adopted and not offset by improved vehicle efficiency or carbon capture and storage.

Hydrogen

Hydrogen is a promising, particularly in electrochemical fuel cells. Fuel cells are used to drive electric motors in a fuel cell vehicle, or FCV.

Hydrogen fuel cell vehicles have been demonstrated in Australia, and some global car manufacturers have stated they will pursue commercial FCV models.

Most hydrogen used in Australia is produced using steam methane reformation of natural gas. This is relatively emissions intensive.

It is possible to produce hydrogen from low emission sources. Biological processes can be used, or water can be electrolysed (using renewable or low emissions electricity).

Electricity can be used directly in vehicles, with a higher overall efficiency. The advantage of hydrogen fuel cells is the ability to quickly refuel, combined with larger range.

Hydrogen can be used in an internal combustion engine, however it is unlikely to be cost-competitive – hydrogen compressed to 70 MPa has only 15% of the energy density of conventional fuels.

Storing and handling hydrogen presents some challenges, and widespread use will require significant infrastructure investment.

Compressed Air

Compressed air engines and energy-capture systems are emerging, though the technology is not yet mature.

It can be argued that compressed air represents an alternative approach to electrically-powered transport: The energy is in the compression rather than the air itself.

The advantages are that air compression technology is relatively simple, refuelling is quick and, importantly, lightweight engines are possible. Of course, the medium is readily available, everywhere.

Further information:
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Compressed air essentially eliminates toxic emissions, and lifecycle greenhouse gas emissions could be nil if compression relies on renewably-generated electricity.

At this stage, compressed air may enter the marketplace as an on-board energy capture and re-use system, in a manner similar to hybrid electric drivetrains, to improve the efficiency of otherwise conventional vehicles.

Synthetic Fuels

Synthetic fuels are chemically similar to conventional fuels, however the cost and emissions tend to be higher due to the energy required for processing.

The key difference to conventional fuels is that synthetic fuels are produced from mineral feedstocks other than crude oil, such as coal or natural gas. Diesel and petrol can be produced in this method.

There are a range of ways to synthesise fuels; below are examples of gas-to-liquid (GtL) and coal-to-liquid (CtL) processes.

Indirect Production (Gas to Liquid)

The first step in indirect production is to convert the feedstock to Syngas, a mixture of hydrogen (H_2) and carbon monoxide (CO). This is achieved via gasification of coal or steam methane reformation of natural gas.

Syngas is converted to diesel using *Fischer-Tropsch synthesis*, then wax hydrocracking.

Alternatively, syngas is converted to petrol by methanol synthesis and then methanol to gasoline conversion (*the Mobil process*).

Direct Production (Coal to Liquid)

It is possible to convert coal to liquid fuels without intermediate gasification, through either pyrolysis and carbonisation, or hydrogenation.

Alternative sources, such as bitumen from oil sands, and oil shale, can also be converted to synthetic fuels.

Emissions Intensity

Synthetic fuels behave much like conventional fuels in the vehicle, though could offer air toxic emissions reductions.

They generally have higher greenhouse gas emissions upstream, however, and production without carbon capture and storage would increase the transport sector's emissions intensity.

Fuel Diversification and Efficiency Gains

Our energy markets are dynamic, and different fuels and blends may become available as economic and environmental circumstances change.

Established fuels could be displaced or surpassed in years to come.

Opportunities remain for refinement and broader adoption of innovative technologies in internal combustion engine vehicles that improve efficiency and lower emissions.

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See Also:

- *Transport Fuels*
- *Transport Fuels: Conventional Fuels*
- *Transport Fuels: Liquefied Petroleum Gas (LPG)*
- *Transport Fuels: Natural Gas (CNG and LNG)*
- *Transport Fuels: Ethanol (E10 and E85)*
- *Transport Fuels: Biodiesel (B5, B20 and B100)*
- *Transport Fuels: Electricity*

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