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Alternative Fuels are on the Industry Agenda

Electric buses have been around for generations in the form of trolleybuses. They are popular in Russia and several central European countries, where they were, and still are, an important part of the public transport strategy.

Although the doom-mongers predict that the world will run out of oil one day, the human race is remarkably inventive and keeps finding new sources of energy. A prime example is the recent development of fracking in the United States, making the country much less dependant on imported oil.

One of the concerns about oil is that the largest and most accessible reserves are often in countries where the political situation can be volatile or unpredictable. The dispute between Russia and Saudi Arabia led to a massive collapse in the price of oil in the first half of 2020, bringing the price of a barrel below the cost of extraction per barrel in the United States.

The vast majority of interurban, express and touring coaches will continue to be powered by diesel fuel for the next 20 years at least. There are a few Scania coaches that are powered by liquefied natural gas which is carried in a tank similar to that of a diesel coach. There are also small numbers of electric coaches, mainly Yutong, but they are not suitable for all kinds of work because the batteries are located under the passenger floor in lockers that are normally used to hold luggage.

The main pressure for alternative fuels is in city buses, principally from politicians, but also from anti-diesel lobbies. Although buses form only a tiny percentage of the traffic using urban centres, they are highly visible because of the frequency of services.

In many countries, transport is the highest single source of carbon emissions. The largest single contributor in transport is the car, because of the large volumes in circulation. Bus companies have lobbied over the years about needing special bus lanes or even their own roads to make their services faster, more comfortable and more attractive to car users.

In the old days, buses were noisy and emitted visible and noxious exhaust fumes. That situation has improved greatly, with successive reductions in emission levels under European Union, Japanese and North American legislation. There are relatively minor differences between those three standards, sometimes due to testing procedures. That is unfortunate because they are all trying to reach similar limits of emissions.

It is a major cost for manufacturers who want to sell in two or three of those markets. Many other countries around the world have adopted EU standards, often two or three stages behind the EU. The mandatory introduction of ultra low sulphur diesel was also a significant contributing factor in achieving cleaner emissions.

Compressed natural gas has been a popular alternative in some countries for many years. At one time, the emissions were considerably lower than diesel, but that gap has almost been closed. Gas still makes sense where the level of taxation is significantly lower than for diesel but gas buses incur the costs of refuelling facilities and the additional weight of tanks that are usually located on the roof of the vehicle.

At one time, liquefied petroleum gas was another alternative, but only a few manufacturers, in the United States, offer this alternative in engines of the size necessary to power a bus. LPG is also more dense than air, therefore

special precautions must be taken in maintenance facilities. Furthermore, CNG and LPG are fossil fuels.
More recently, initially in Sweden, there has been strong interest in biogas, a completely renewable fuel. This is obtained from sewage plants, animal waste and surplus food from hotels and hospitals. The Swedes consider it to be a win-win situation because the emissions are very low and the residue is more easily disposable.

Scania has worked with ethanol as an alternative fuel for more than two decades. It is produced from the sap in timber, and is used in more than 700 buses in Stockholm. It can be carried in a similar size of tank to diesel. The emissions are extremely low, but engines run hotter than normal, therefore require very high quality lubricating oil. Like gas, ethanol only makes economic sense if the level of taxation is much lower.

Hydrogen is a source of energy which might in the long term play an important part in the transport industry. It has been described as the world's most abundant fuel, but one of the toughest to produce. It is currently used as a raw material in some industrial processes, but refuelling infrastructures will need to be installed and thoroughly tested before hydrogen can be used on a large scale. Buses are ideal candidates for hydrogen power, because they return to the same depot for refuelling each evening, and that takes a similar time to refuelling a diesel bus.

MAN, a German company with a very solid engineering pedigree, converted conventional diesel engines to run on liquid hydrogen some years ago. They built a number of buses and persevered while standard diesel engines were being updated to lower emission levels. In 2009, MAN decided to abandon the hydrogen programme, because of a number of technical problems.

Mercedes-Benz has been developing fuel cell buses for more than 25 years. It can only justify this work because other parts of the Daimler Group are working with fuel cells for cars and vans. The latest generation of fuel cell buses are much more efficient. They require fewer stacks and consume considerably less hydrogen, which is stored in tanks at roof level.

Although emissions are zero, the unit cost of each vehicle is still extremely high. Purchases can only be justified if they are substantially supported by public funding. The challenge for Mercedes-Benz is to bring prices down and get volumes up to much more economic levels. The company has said that it is developing its next generation of city buses and that platform will be capable of accommodating diesel, gas, electric and hydrogen fuel cell systems. It has also said that it will offer a fuel cell from 2022 as a range extender in an electric bus.

A very significant development took place in April 2020 when Volvo and Mercedes-Benz announced their intention to form a 50:50 joint venture to develop and manufacture fuel cells for installation in trucks and buses. A formal agreement is likely to be signed before the end of 2020. The scale of the project can be assessed by the fact that Volvo will contribute more than 600 million Euros and Mercedes-Benz will include its current fuel cell designs, development and manufacturing facilities.

There has been considerable development of hybrid buses over the last fifteen years. They use a smaller diesel engine to power a generator. That in turn provides current to storage batteries or super capacitors. When a bus pulls away from a stop, it can do so on electric power alone. When it slows down or descends hills energy is regenerated and recuperated in the batteries or super capacitors, which are also kept charged by the small diesel engine, running at a much more constant speed, with minimal emissions.

Hybrid buses have demonstrated savings on fuel consumption of 30-40% compared with standard diesel buses. There

have been some interesting developments, including the use of GPS systems to shut down the diesel engine before the bus enters a sensitive area, such as a city centre or a hospital, and restarts the engine after leaving the area.

However, to a large extent, hybrid buses have been overtaken by electric buses because battery technology has improved, with greater energy storage for a given size of batteries. Some suppliers are now willing to provide batteries on a mileage rental basis, similar to tyres.

Volvo has progressively developed its hybrid system. The electric hybrid option takes a fast five to six minute charge at each end of the route from an overhead gantry that enables it to run up to 70% of the route in all-electric mode, especially in sensitive areas. The diesel engine is retained, acting as a generator, and usually only running when the bus is in suburban areas.

The next stage was the launch in June 2015 of an electric vehicle running solely on electric power at all times. Since then, there has been further refinement including the introduction of articulated electric buses. Volvo is therefore able to supply electric buses that require regular recharging to smaller urban areas which can accept recharging gantries all around their areas or electric buses with sufficient energy storage to run for a full day on an overnight charge. Major cities have made it clear that they do not want fast charging facilities at the end of each route.

The electric revolution is coming fast, but if electricity is produced from fossil fuels, it rather defeats the object. Read about the electric developments in another hot topic on this website.

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Van Hool Hydrogen Fuel Cell Bus in Oslo

Caetano eCitygold H2 at Busworld 2019

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Iveco Crossway LE CNG at Busworld 2019

Solaris Urbino 12 Hydrogen at Busworld 2019

Alexander Dennis' Enviro400FC is a Zero-Emission Bus Powered by Hydrogen Fuel Cell

Van Hool Trolley-Hybrid