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Rapid Progress Towards All-Electric Buses

All-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.

In Western Europe, the main concentration is in Switzerland, which has abundant supplies of hydro-electric power. Although they are more expensive than diesel buses, they are very quiet and totally emission-free. The main objection to them is the necessity for complicated and unsightly over-head wiring which requires regular maintenance.

Several manufacturers have developed all-electric buses powered by batteries. The first of these were small vehicles, used on short distance inner-city services with narrow streets. Their weakness was limited range on a fully charged set of batteries.

The Chinese encouraged the development of full sized all-electric buses ahead of the World Expo in Shanghai in 2010. Most of those vehicles used lithium-ion batteries which are expensive, but hold a good charge for their size. Even so, designers were faced with a major challenge. If a bus needed a range of 250-300km on a full charge, it required many batteries which not only occupied a lot of space, but added so much weight that only a limited number of passengers could be carried. There was also the challenge of locating the batteries in a vehicle whilst still keeping the benefits of a low floor, only one step above the ground.

Any reduction in the number of batteries will lead to a limited range, making the vehicle unsuitable for all-day operation. The solution to this problem is to provide fast charging of the batteries for a few minutes at each end of the route. There are two main systems. Inductive recharging can be carried out when a receiver on the underside of the bus makes a contactless connection with a plate on the road service or with wiring buried just beneath the surface. Conductive charging takes place when a pantograph or collector on the roof of the bus physically connects with an overhead charging station. More recently, Volvo has made the pantograph and integral part of the charging station, saving the weight of the equipment on the bus and the number of pantographs required in a fleet.

Bombardier has opted for inductive charging, using wires under the surface of a street. These are harmless to other traffic and only become live when a bus with an under-floor charging unit parks above the wiring. Bombardier suggests that its system can be installed not only at each end of the route, but also at the stops when several passengers are getting on and off. They also envisage that the system could be used by other electric vehicles, such as taxis, municipal trucks and local delivery vehicles. Users would be charged regularly for the amount of electricity consumed.

Another company, Conductix Wampfler, uses plates, approximately 1.0 x 1.5 metres, laid in the surface of the road, again usually at each end of a route. The plate only becomes live when a suitably equipped bus parks above it.

Conductive charging systems first appeared in China shortly before the World Expo. A fleet of buses could take fast charges of electricity not only at each terminus, but also at busy stops on their route. Buses are heavily used in China with passengers getting on and off at the busiest of stops, therefore there was sufficient time for fast charging.

Overhead charging systems have been installed on an experimental basis in a number of European cities and further projects are in the course of development. The gantry is approximately 3.5-3.7m above the road surface, therefore it

has to be located in a lay-by or restricted road so that it cannot be hit by trucks running at maximum legal height. The gantry system has only limited commercial potential, because it is too high to re-charge cars and light commercial vehicles.

There is a risk that each manufacturer will adopt its own system of overhead charging and that could in future create problems for operators of mixed fleets. UITP, (the International Union of Public Transport) is managing the ZeEUS project that is largely funded by the European Union. This is seeking to establish common standards for electric vehicles and their support systems. The project also involves utility suppliers, because they have to consider the impact on the grid of the large fleet of buses being recharged in the depot overnight.

At the UITP Congress and Exhibition in Geneva in May 2013, the Swiss TOSA consortium exhibited what was believed to be the world's first all-electric articulated bus. It was built by Hess, a Swiss company that has long experience of manufacturing trolleybuses, and has also more recently developed hybrid vehicles.

A laser-controlled collector on the roof towards the rear of the bus connected with an overhead gantry to take a 3-4 minute recharge at each terminus. ABB, one of the partners in the consortium, believed that it would be possible to provide ultra-fast charges at each stop on a route. They would give a 15 second boost while passengers got on and off the bus, and would therefore not interrupt the vehicle's schedule.

The TOSA system created great interest in Switzerland, because it gives the cities the opportunity to continue with all-electric vehicles, but without the overhead wiring systems.

One of the most progressive manufacturers of all-electric buses is the Chinese builder, BYD (Build Your Dreams). They have supplied many vehicles in China, but have also sold some units in European cities that want to gain practical experience with the new technology. Their largest order to date has come from Schipol airport in Amsterdam for 35 vehicles. All-electric buses are ideally suited for airport applications because there are frequent opportunities to recharge batteries.

The development of electric cars will benefit the bus industry. Car manufacturers will drive demand for the most efficient battery technology whilst keeping down weight and increasing vehicle range. All-electric buses have a promising future. Although all-electric vehicles are more expensive than diesel city buses, operators stand to make a considerable saving in the cost of fuel. The pay-back period is typically 5-6 years but the vehicle should have at least twice that life. The progressive Polish manufacturer, Solaris, demonstrated the comparative costs of diesel, hybrid and electric buses in a presentation at the UITP Congress Exhibition in Milan in June 2015.

Bozankaya Electric Bus

BYD and ADL Co-operate on 12m Electric Bus

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Irizar Electric Bus in San Sabastian

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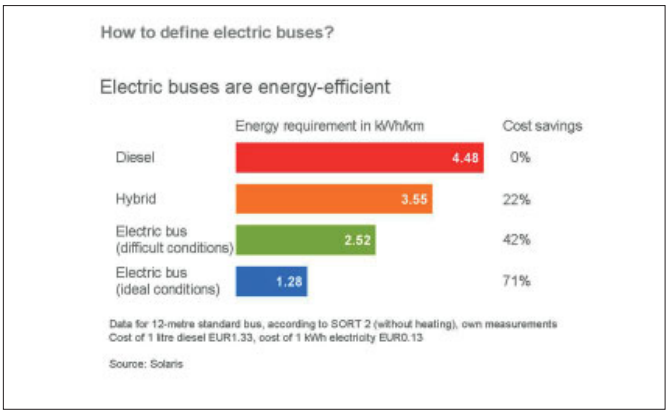
Silence in a Gothenburg Library



How to Define Electric Buses : Solaris Comparitive Chart

Volvo Electric Hybrid being Charged-Up