Submission No 5

ELECTRIC BUSES IN REGIONAL AND METROPOLITAN PUBLIC TRANSPORT NETWORKS IN NSW

Organisation: ARCC Pty Ltd

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Electric Powered Public Transport - Buses

Introduction

This paper will attempt to highlight the advantages of using Electric powered vehicles in Public transport

Basics

For many years, Diesel and to a lesser degree, Liquid Propane Gas (LPG) have been used to power public transport vehicles (buses). With the ever increasing need to reduce tail pipe emissions and reduce the cost of operating buses, the future needs to be Electric power. Buses can be driven by one or more motors and powered by various battery configurations, the most popular two being park and charge and fast Charge. Park and charge allows a larger battery pack to be used enabling the bus to travel a minimum of 250km on one charge. Fast charge allows a smaller battery pack, increasing payload but only allowing a short range of say 50km. This is offset though by the fact that the bus can charge up at various stops on route to lengthen the distance.

Park and Charge

- Large capacity battery packs with a more basic chemistry
    - allow long charge times
    - overnight and off peak
    - low infrastructure costs on route
- Longer distances can be covered (250 – 600km)
- Reduced payload for passengers – 58 to 60 passengers on a 12.2m bus

Fast Charge

- Smaller capacity battery packs with an advanced chemistry
    - Fast charge times (1-10 minutes)
    - Can be charged at bus stops during change overs or rest periods
    - Can use an offboard charge system
    - Infrastructure cost high due to pantograph poles, Battery packs, chargers at each charge point
- Shorter distances
- Increased payload for passengers 60+ on a 12.2m bus

Hydrogen

- Hydrogen Fuel Cell used to produce Electricity on board
- Hydrogen stored in pressurised tanks similar to CNG
    - Refuel in less than 15minutes dependant on capacity
- Directly replace Diesel buses to eliminate range anxiety
- Currently higher cost than Battery Electric due to the technology but this is falling with more buses being sold

Electric public transport is in use in parts of the world and in particular in Europe, where more cities are becoming fossil fuel free. This reduces the emissions from tail pipes which is one of the most polluting emissions especially for general public in towns and cities. Of course, the power for the Electric Bus must come from somewhere and this utilises already cleaner power stations and of course can be improved by using renewable energy such as Solar and Wind. Renewables can also be used to charge battery banks either at the depot or on route to enable charging of the vehicles.

It has been shown that Electric public transport is more enjoyable due to noise and fume reduction for both the passengers, driver and pedestrians. No noisy Diesel Engines, no smelly fumes, places to charge up your phone – an overall more enjoyable Public transport experience.

Costs

Even though electric powered buses are more expensive than Diesel or LPG, the cost of ownership is reduced, due to the reduction of maintenance and service costs. Electric motors require no oils and therefore no filters, no gearboxes, no fuel tanks, a smaller air compressor, a smaller heat exchanger (if required at all). When looking at the price of Diesel and LPG and the cost of power to charge the battery and considering the reduced service costs, payback for a new bus is generally around 3 years purely based on the savings made for running the bus. Prices will come down; the more buses are bought and so the cost of ownership and payback periods will also reduce.

Local Manufacture

There are many Electric bus manufacturers around the world and very few in Australia. Opportunities will be sure to arise once the local state and federal governments start on the road to using Electric Buses. Many areas are trialling buses in Australia including Canberra, NSW and QLD. It is the goal of this company to have facilities in the state where buses are being purchased, to be able to manufacture and assemble Electric buses. These will potentially be from kits with parts sourced from worldwide and local suppliers to ensure the best quality components are used.

Not only chassis but Bus Bodies can be easily built from CKD kits using local labour content. Many local suppliers should also be capable of manufacturing parts for the bus body. There are holes in the capability for the local manufacturing industry to produce electric components and these are generally sourced from overseas. (Items such as motors and Batteries and control units.)

Around the world

Electric and hydrogen buses are being used around the world with Australia being one of the last economically stable countries to take up this cleaner technology. China have well over 300,000 electric buses. Europe are working on a program called JIVE2 to build 600 hydrogen Fuel celled electric buses. New Zealand has more electric buses than Australia! So far there is only one company to build more than one electric bus for operation in Australia and that is Gemilang Australia, our sister company, with over 20 electric buses operating successfully in 3 capital cities in Australia.

Summary

Advantages of Electric vehicles

• Electric drive motors run quieter than internal-combustion engines. The noise emissions from electric vehicles is very low. At high speeds, the rolling noise from the tires is the loudest sound.
• Electric vehicles produce no harmful emissions nor greenhouse gases while driving. If the high-voltage battery is charged from renewable energy sources, an electric vehicle can be run CO2-free.
• In the near future, if particularly badly congested town centres are turned into zero-emissions zones, we will only be able to drive through them with high-voltage vehicles.
• The electric drive motor is very robust and requires little maintenance. It is only subject to minor mechanical wear.
• Electric drive motors have a high degree of efficiency of up to 96% compared with internal-combustion engines that have an efficiency of 35–40%
• Electric drive motors have excellent torque and output characteristics. They develop maximum torque from standstill. This allows an electric vehicle to accelerate considerably faster than a vehicle with an internal combustion engine producing the same output.
• The drive train design is simpler because vehicle components like the transmission, clutch, mufflers, particulate filters, fuel tank, starter, alternator and spark plugs are not required.
• When the vehicle brakes, the motor can also be used as a generator that produces electricity and charges the battery (regenerative braking).
• The high-voltage battery can be charged at a depot, at a bus stop using pantograph fast charge and by using any accessible sockets. The charging connector on the vehicle and on public charging stations has been standardized across Europe and is used by all manufacturers.
• The energy is only supplied when the user needs it. Compared with conventional vehicles, the electric drive motor never runs when the vehicle stops at a red light. The electric drive motor is highly efficient particularly in lines and bumper-to-bumper traffic.
• The electric vehicle does not require any lubricating oil.
• Hydrogen/Electric buses are cheaper to run than diesel and or Battery Electric but more expensive
• Hydrogen is cleaner and abundant making the whole operation green if it is produced using green energy
• Hydrogen can be produced at the depot

Disadvantages of Electric Vehicles

• Electric vehicles have a limited range due to battery size and construction.
• Charging a high voltage battery can take a long time, depending on the battery charge and power source.
• The network of electric charging stations is sparse.
• Current cost of infrastructure
• Lack of infrastructure
• Getting the power to where it is needed and the cost of this

WHY ARCC?

ARCC will be the first all Australian design and built bus to be powered by battery or Hydrogen. It will be lighter, cleaner and greener than any other bus around the world.

There are many publications from other studies around the world and we have attached these to our information submission.

Attachments included with submission:

Fuel cell electric buses: a proven zero-emission solution, the Clean Hydrogen in European Cities (CHIC) Project, 2010-2016

Energy savings by light-weighting – 2016 update, Institut Für Energie-Und Umweltforschung Heidelberg (IFEU), H. Helms and J. Kräck, December 2016

Delivering Integrated Transit, Land Development and Finance – A Guide and Manual with Application to Trackless Trams, Sustainable Built Environment National Research Centre, Peter Newman et al., 2018

eBus Report #2: An updated overview of electric buses in Europe, Zero Emission Urban Bus System (ZeEUS), 2017.