Source: Developing a New Climate Change Strategy for South Australia – Reduce Consultation Paper

Reduce – Opportunities to Substantially Reduce our Emissions via a Greener Public Transportation System

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For great things to happen, leaders have to first have big and bold vision as well as set the right goals to get things going. For that, we would like to congratulate the South Australian Premier Jay Weatherill for having such a bold vision to transform Adelaide into the World's first "Carbon Neutral City". No great achievements are realised without a Big Hairy Audacious Goal (a term coined by James Collins and Jerry Porras in their book titled: Built to Last-Successful Habits of Visionary Companies). We do sincerely hope that many more people will start contributing ideas and provide feedback to make this vision an astounding success. To achieve the vision of being the World's first "Carbon Neutral City" is indeed a huge goal and comes with many challenges. However, we do believe that the journey of a thousand miles does begin with the first step and the good news is that the first step has been taken!

Question 1: Which industry to target to have the biggest impact or result?

In order to achieve this Carbon Neutral City status we must first identify which are the items that are currently contributing the most CO2 emissions and what does it take to clear these biggest contributors. In our personal opinions, it would be easier and better to eliminate the single biggest contributor than to work on 10 other projects concurrently that may only result in minimal impact to the CO2 emissions. From the below table which was taken from the Reduce consultation paper – Developing a New Climate Change Strategy for South Australia, we can see that the biggest contributor is from the Energy(fuel consumption and fugitive emissions) which contributed about 75% of the overall CO2 emissions for 2012/2013.

Industry	Major Sources	Total 2012/13 (Mt CO2e)	Percentage %	Total 1989/90 (Mt CO2e)	Percentage difference to 1989/90
Energy (fuel consumption and fugitive emissions)	Energy industries Manufacturing and construction Transport	21.8	75	21.5	+1.5%
Industrial Processes	Mineral products (e.g.steel) Cement production Refrigerants	3.7	13	2.8	+32.9%
Agriculture	Livestock Farming practices	5.7	19	6.6	-13.8%
Land use	Afforestation and reforestation Deforestation Forest management Cropland management Grazing land management	-3.0	-10	0	-n/a^
Waste	Solid waste Wastewater	1.0	3.0	1.4	-27.7%
TOTAL (rounded)		**29.2**	**100**	**32.3**	**-9.4%**

^Due to LULUCF switching from an emissions source before 1990 to a significant emission sink since, the percentage decrease is very large in numerical terms and therefore is not included in this table.

Table 1 - Detailed table of South Australia's emissions by sector. Source: Dept. of the Environment, 2015

Question 2: Which sub-sector of the Energy industry can we target to have the biggest bang for the buck?

According to a research report from the US in 2013, the greenhouse gas emissions from transportation accounted for about 27% of total U.S. greenhouse gas emissions, making it the second largest contributor of U.S. greenhouse gas emissions after Electricity generation. We are already doing a lot of things in the electricity generation space which will contribute to the reduction in the CO2 emissions like the installation of Solar PVs etc. So, the other low hanging fruit that we can potentially target to substantially reduce the carbon emission is in the Transportation sub-sector.

The Transportation sub-sector includes the movement of people and goods by cars, trucks, trains, ships, airplanes, and other vehicles. The majority of greenhouse gas emissions from transportation are CO_2 emissions resulting from the combustion of petroleum-based products, like gasoline, in internal combustion engines. The largest sources of transportation-related greenhouse gas emissions include passenger cars, buses and light-duty trucks, including sport utility vehicles, pickup trucks, and minivans. These sources account for over half of the emissions from the sector. The remainder of greenhouse gas emissions comes from other modes of transportation, including freight trucks, commercial aircraft, ships, boats, and train.

Now, that we have zoomed in to the Transportation sub-sector, the next question that we need to logically ask is.....

Question 3: How can we improve the Transportation sub-sector to reduce the carbon emission?

The simple and easy answer to the above question is of course in the adoption and deployment of more electric vehicles (EV) on our roads. Electric vehicles include electric trams, electric trains, electric buses, electric vans, electric cars, electric scooters, electric motorbikes as well as electric bicycles. By the mass adoption of the EV on our roads, it can result in substantial reduction in the CO2 emissions.

If it is that simple to have a substantial reduction in the CO2 by the adoption of more EVs on our roads, why is it not happening as quickly as we would like it to be? So, this brings us to the next question as we drill down into more specifics on what are the challenges that are currently preventing the EV adoption from taking off in a major way.

Question 4: What is preventing the Electric vehicles from kicking off in a major way?

The electric vehicle (EV) is not a new concept in the automotive industry. They have been around for some time but the adoption rate has been quite slow. We also know that there are many advantages of adopting the EV for our roads which are listed below (in no particular order of importance):-

1. No gasoline required – EVs are run entirely on electricity. Electricity cost is way cheaper than gasoline cost and hence EV owners can save a substantial amount of savings in the long run from the difference in the prices between gasoline and electricity.
2. More environmentally friendly – EVs are eco-friendly as they run on electrically powered engines. It does not emit toxic gases and smoke to the environment as it runs on clean energy source. Hence, it is much more environmentally friendly compared to the gasoline powered vehicles.
3. Lower maintenance cost – EVs run on electrically powered engines and therefore has fewer parts and does not need lubrication. Hence, the maintenance cost of EVs is lower compared to the conventional gasoline powered vehicles.
4. Reduced Noise Pollution – The electrically powered engines are quieter and provide a smoother ride compared to the gasoline powered vehicles.

With so many advantages provided by the EV, one may ask why is it that the take up rate for EVs are still very low compared to their gasoline powered counterpart? Why is it not kicking off in a major way?

Well, apart from the benefits, there are challenges as well. The challenges that are preventing the EVs from being mass adopted are as follows:-

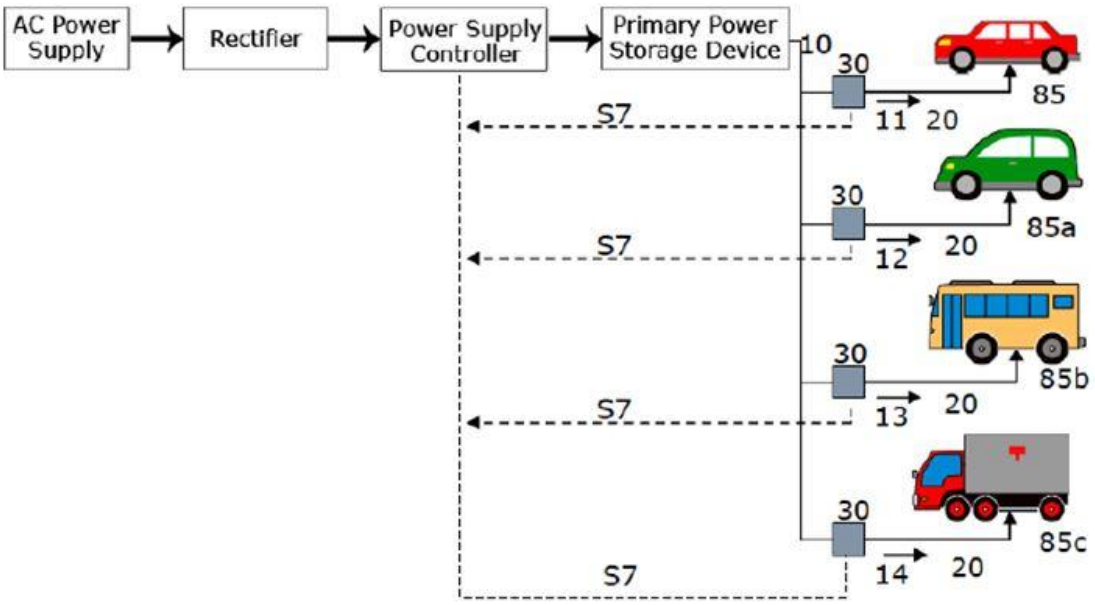
1. High quality battery – The entry price for EVs are currently higher compared to their gasoline powered counterpart. Although EVs have fewer parts, a good quality energy storage or battery of the EV is still rather expensive. To have a good quality battery which can pack sufficient energy to power up the EV and to have a high enough capacity for the EV to travel the required distance(upon full charge) will make the cost of battery to be substantial. The safety of the battery is also another consideration as typical Lithium Ion batteries may catch fire upon strong impact. There are already cases of fires and explosion (reported in the media) from the heavy impact of EVs during accidents.
2. Range Anxiety – The infrastructure readiness for the charging stations are still non-existent. There are far fewer charging stations compared to the gasoline stations. In order to travel to a far distance, the EV owners have range anxiety as they would not want to be caught in a situation where their EV runs out of battery and they are not within the reach of the nearest charging station.
3. Long Charging Time – Even if there is availability of charging stations infrastructure, the typical charging time for an EV will still take a long time to complete. Typical charging time for an EV is between 1 to 8 hours for a full charge. While a partial charge will take up to 30 minutes. This is still much longer compared to the re-fuelling time for the conventional gasoline powered vehicle.

4. The impact of mass charging on the grid – Since huge amount of electricity is being drawn during the process of charging multiple EV simultaneously; it will greatly impact the stability of the grid power.

Question 5: How do we solve the challenges highlighted above in order to still make it a viable project to switch our current transportation system from gasoline powered vehicles to EV?

To solve the issues, let's tackle each and every challenges highlighted above one by one.

1. High quality battery – There are many types of battery technologies available and the recent Australian Renewable Energy Agency's (ARENA) $1.4 million investment in the University of Adelaide's Energy Storage Test Facility and Knowledge Bank project which will see a new testing facility built that assesses the performance of battery energy storage systems is certainly a move in the right direction. Battery energy storage technology is expected to become a major industry within the next decade. Innovations in new battery technology e.g. the Nanocarbon Battery will be able to unlock the full potential of our resources, energy and renewable assets and will help in driving Adelaide to becoming a carbon neutral city. To solve the issue on having an affordable EV car with good quality battery installed, government incentives should also be considered to reduce the overall cost of ownership of EVs in order to provide the push needed to drive for a switch to EVs. On this end, there is much to learn from other countries who have implemented some sound policies to encourage more users to make the switch to the EV. References on this matter can be found here.
2. Range anxiety – The range anxiety posed by the unavailability of sufficient charging stations can only be resolved through the co-operations between government and private sectors. The entry cost to build charging stations are high and this has resulted in minimal private sectors who are keen to invest a substantial amount of money in this field as the returns on investment would take quite some time to recover. Some form of partnership between the government and private sectors may be the answer to this. If the government can provide some form of grants or funding to bridge the initial setup cost, this will eventually make the availability of more charging stations to be installed.
3. Long charging Time – There are 2 components that needs to be considered in order to solve the long charging time problem. Firstly, the availability of fast charging technology. The fast charging technology must be able to charge multiple EVs simultaneously. This fast charging technology which can simultaneously charge multiple EVs at the same time is already available. The technology is utilising DC-DC charging (US Patent 8183819). Secondly, the availability of a good quality battery that can be charged quickly without heating up substantially is also important. It takes 2 hands to clap. If you have a superior charging system technology but you do not have the good quality battery that can be charged quickly, it will be a futile attempt. With this fast charging technology coupled with good quality battery, the long charging time issue can be solved. Currently, multiple vehicles can be charged simultaneously in under 10 minutes using this the fast charging technology as shown on next page:-



4. The impact of mass charging on the grid – the above fast charging technology can also resolve the impact of mass charging on the grid as the rectifier and power supply controller are able to cut off from the grid during the time when EVs are being charged. In this way, the grid will not be impacted when high currents are drawn into the EVs during charging of multiple vehicles simultaneously.

Question 6: Is the technology already available and does it really work well?

The fast charging technology has been used in other parts of the world already. So, the answer is yes. To fully answer the question and to get the confidence that the fast charging technology can work locally within Adelaide City, the easiest way is to run a proof of concept or a pilot run on the technology. Using a real-life case study, data can be collected and results verified. It is best to get the public transportation like electric buses to be used for the proof of concept because if this fast charging technology can indeed work for buses, they should also work for any other smaller vehicles like the electric cars, electric scooters etc.

As a proof of concept, there are a couple of options that can be considered depending on the level of funding available.

Option 1: One to One Charging (1 Bus with 1 Rapid Charger) – This proof of concept can be implemented on the Airport <-> Adelaide CBD (J1X) route which has a roundtrip distance of approximately 16KM.

Option 2: Multi Bus Simultaneous Rapid Charging – This proof of concept can be implemented on the City Loop (99A/99C) and City & North Adelaide Loop (98A/98C) routes which have a roundtrip distance of 6KM and 14KM respectively.

The selection of the above routes as proof of concept will showcase the adoption of EV bus with zero carbon emission to residents and visitors to this visionary city.

In order for the fast charging technology to be implemented in an efficient and effective way, some form of standardization should be imposed on vehicle charging ports. This is because there are currently multiple standards of fast charging ports adopted in different countries. A step towards having a more unified and standardized electrical vehicle fast charging ports will go a long way in driving the mass adoption of the EV usage on the Australian roads.

Question 7: How is this proof of concept to be funded?

This is a very important question as no project will be successful unless it is properly funded. The rapid charging system energy source could be from renewable energy sources such as solar, wind, or geothermal connected directly to the rapid charging power supply controller and storage or via the power grid into the rapid charging system rectifier which in turn provides a sustainable carbon neutral charging station. With these renewable sources, this proof of concept project may qualify for the Australian Renewable Energy Agency's (ARENA) matching grant with the State Government, City of Adelaide and Private entities funding the remaining half of the project via the Public-Private Partnership (PPP) model.

Conclusion

In conclusion, the opportunity to substantially reduce our emissions is available and if all parties can come together to work with each other, the vision of transforming Adelaide to become the World's First Carbon Neutral City can be realised. Together, we can achieve a Cleaner, Greener, Healthier and Safer environment.

Should more information are required related to the methods or technology mentioned in this article, we are more than willing to contribute our ideas, expertise and even link up with the fast charging technology providers towards realising the vision of transforming Adelaide into becoming the World's First Carbon Neutral City. We do hope for more inputs and feedback from the community that can contribute to the achievement of this goal.