The Chairman

Australian Energy Markets Commission

PO Box A2449

Sydney South NSW 1235

8th November, 2011

Reference: EMO0022

Dear Chairman,

Thank you for the opportunity to provide input to the AEMC in reference to the Approach Paper EMO0022, Energy Market Arrangements for Electric and Natural Gas Vehicles.

Blade Electric Vehicles believe we have valuable input to offer on this topic due to our experience base as an all-electric vehicle manufacturer, coupled with a keen awareness of global R&D in the electric vehicle sector.

We are happy to provide additional input on request.

Yours sincerely,

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Director and CEO

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Energy Market Arrangements for Electric Vehicles

A contribution by **Blade Electric Vehicles**
to the Australian Energy Market Commission
Approach Paper Reference: EMO0022

Overview

Blade Electric Vehicles is appreciative of the opportunity to contribute to discussions relating to the impact of Electric Vehicles on Australian electricity network infrastructure. A future with significant uptake of electric vehicles is foreseen. It is believed that electric vehicles are verging on the cusp of this mainstream uptake at present and improvements in capabilities appearing over the next couple of years is likely to result in substantial changes to Electric Vehicle usage patterns, allowing general purpose use.

This contribution discusses the issues Blade Electric Vehicles foresees in relation to the electrical generation and distribution networks. The prime issue is the emergence of ultra-fast charge capability. This capability is at the cutting edge and the full breadth of possible solutions do not appear to be appreciated by most within the electricity network space. The thoughts outlined here are but one conception of the future, but they emerge from a solid history of involvement in the Electric Vehicle market and a keen appreciation of where key technologies are heading in terms of R&D activities globally.

Individual questions from the Approach Paper are discussed briefly below after the primary document conclusion section.

Blade Electric Vehicles

Blade Electric Vehicles is a small Australian electric vehicle manufacturing company. The company's flagship product is the Electron DG, an all-electric 5-door and 3-door car with a maximum range of 300km. Blade has been producing electric cars for a significantly longer period than the large multi-nationals. The future of the electric vehicle market is far from obvious in terms of take-up rates and which technologies will reach widespread adoption. However, Blade has a reputation for strategic thinking ahead of what has been shown by some of the larger companies. Many companies are only now coming to the realisation that multi-speed transmissions are important for electric vehicles, while this has been present in commercially available Blade Electron vehicles since early 2008. Blade has also led the way with advanced Lithium Ion Phosphate battery application in the EV market.

Blade is likely to remain as a niche player in the highly competitive global market for

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Electric Vehicles, but is committed to being forward-thinking and progressive.

The Fast-Charge Future for Electric Vehicles

30 minute fast charge capability is a reality now for many electric vehicles. Charging infrastructure to support this capability is yet to be seen in any significant deployment levels. Future vehicle charging capabilities are clearly inside the 15 minute barrier, as there are no present technical limitations preventing this. The outlook for ultra-fast charging is incredibly exciting, with many research efforts around the world focussed on the ability to perform charging in the sub six minute area. It is important to note that while a large variety of research and development efforts are under way globally, at least some of these efforts are closer to the development end of the R&D spectrum. Hence it is not unrealistic to assume a vehicle product will be on the market within the next two years which will be fully capable of a sub six minute charge.

The competitive nature of the global electric vehicle industry almost ensures that once one vehicle is capable of this level of rapid charge, others will soon follow. The key point is that from Blade's perspective we are on the cusp of ultra-fast charging for electric vehicles.

Grid Implications for Ultra-fast Charging

30 minute charge capability implies energy transfer rates of around 50 kW. Reducing the charging time by a factor of five multiplies this by the same factor to an energy transfer rate of 250 kW. If we add the prospect of improvement in battery storage technologies allowing up to a factor of two increase in electric vehicle storage capacity, transfer rates of 500 kW may not be impossible for vehicle charging in the future. Clearly here currents and voltages within the vehicle are well outside of anything which existing electric vehicle designers are contemplating. However, the 250 kW charging rate is not outside of existing possibilities given the interest in reducing vehicle charge times.

Provision of a charging station capable of 250 kW of power delivery direct from the grid would imply a network of dedicated charge stations not unlike our experience with petrol stations. The limited range of electric vehicles compared to petrol vehicles however requires that these charge stations must be close to regular commute routes. It is hence reasonable to assume that many motorists will pass charge stations on their way to and from work, and this will be when a peak of charging occurs.

Some drivers may still prefer to charge their vehicles at home overnight, but vehicle usage patterns may dictate that fast charging at a public charge station is preferred. We must consider the case where an electric vehicle has a significant portion of its energy storage capacity depleted during the day, but there are plans to head out for dinner, a movie, shopping, or shuttling children to and fro. The future of the electric vehicle is not in a limited-use second car or fleet vehicle, but in a primary use household vehicle.

As vast differences between overnight charging at home and ability to rapid charge at a public charge point accumulate, it is reasonable to expect an increased desire to utilise the public rapid-charge network. The ultimate result would surely seem to be chaos for electricity grids without massive over-engineering on the generation capability and transmission capability side. Energy storage technologies would appear to be the only mechanism to avoid this catastrophic impact on the grid.

Battery Swapping as a "Solution"

Battery swapping technology as a primary charge mechanism for electric vehicles has the ability to mitigate the demands on the electricity grid if charging is only performed during off-peak times. However it is important to note that even the leading proponents of the battery swapping concept suggest that battery swapping would account for perhaps only 10% of the overall charging solution.

Blade electric vehicles does not envisage a strong future for the battery swapping concept. The strength of conviction here is based on knowledge of progress in ultra-fast charging R&D within the global electric vehicle industry. Battery swapping as a business model has some appeal. It offers drivers the potential for a reduction in up-front vehicle costs through effectively renting batteries. The negative aspect is the result of being tied to a single company for charging services. From this perspective battery swapping is inherently a monopolistic business model. There is limited scope for competition within the battery swap market without novel legislation. Customers will hence be wary of the battery swap model and the capability of ultra-fast charge may ultimately spell doom for the battery swapping methodology. With declining battery prices the force of potentially reduced vehicle purchase prices to draw people to the battery swapping method becomes ineffective.

Should battery swapping networks become a reality, there is nothing to compel charging to occur entirely at off peak times. Market electricity rates would appear to be necessary to encourage this, as limiting charging during peak periods requires additional investment in spare battery packs and additional investment in local electrical connection infrastructure (as the same amount of charging occurs over a shorter period of the day).

Battery swapping is consequently not a panacea for mitigation of peak electricity generation demands. It is projected to account for only 10% of all electric vehicle charging, and consequently must be assumed to be of little overall direct potential benefit to the grid even if the business model survives.

Distributed Battery Storage as "Grid Salvation"

The capability for electric vehicles to allow ultra-fast charging is almost assured within

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the next few years. We can effectively also guarantee that drivers will wish to utilise this capability where feasible. Presently a major limiting factor is the need for major upgrades to supply connections in order to allow 50kW or higher charging rates. Battery storage technologies however provide the ability to remove this limitation. Downward pressure on battery prices is expected to ensure that affordable fast-charge solutions are available even in domestic settings within the next few years.

We can thus imagine battery storage implemented in residential settings and beyond which uses off-peak energy to allow fast and ultra-fast charging of electric vehicles on demand. This scenario limits the need for centralised fast-charge infrastructure in a rather major way, as even small businesses can offer similar rapid charging in car parking areas. The potential benefits of this approach are a widely distributed storage capacity within the grid, which when not used for electric vehicle charging purposes can be used to help alleviate the generic load shaping problem. This widely distributed storage capacity has the additional benefit of potentially greatly enhancing network reliability during storm or fire events which temporarily remove transmission infrastructure from the grid.

Allowing individuals to benefit from widespread engagement in the energy storage market ensures a significant source of investment in storage technology, not only supporting electric vehicle uptake, but alleviating peak load stresses in the process. It is a win-win for all concerned, but needs careful consideration from a regulatory standpoint in order to ensure optimal implementation.

Conclusion

Ultra-fast charge capability is the major factor which is going to affect the impact of electric vehicles on national electricity networks.

The capability of ultra-fast charging being present in vehicles changes significantly the way electric vehicles are likely to be used.

Electric vehicles with ultra-fast charge are likely to become a significant part of the motoring mainstream.

Charging demands might then be expected to have some similarity to refuelling demands for petrol vehicles, although fast charge capability at home alters this picture.

Without localised energy storage technologies, the consequence for the national electricity network is potentially catastrophic.

Distributed energy storage technologies have the potential benefit of facilitating the uptake of electric vehicles without unduly stressing the grid, and can actually reduce the generic peak load shape problem.

Question 1

What are the key drivers and likely uptake of EVs in the NEM? Are there any differences in these drivers between NEM and WA?

Blade Electric Vehicles is convinced that ultra-fast charge capabilities for electric vehicles is a key factor which will impact on uptake of electric vehicles.

Question 2

What are the costs and benefits that EVs may introduce into Australia's electricity markets? Please provide evidence if available.

As discussed above, distributed energy storage as a way of providing for ultra-fast charge both mitigates the impact of energy use by electric vehicles, and provides a mechanism for improving general load shaping characteristics in relation to national electricity networks.

Without distributed energy storage, the capability of ultra-fast vehicle charging is likely to lead to significant changes in electric vehicle usage patterns and could potentially spell chaos for electricity generation networks.

Blade Electric Vehicles is already involved with a research project in partnership with Deakin University aimed at providing necessary evidence to enable informed decisions related to distributed energy storage solutions. We are happy to provide the results of such federally-funded research when it becomes available.

Blade Electric Vehicles notes that V2G (Vehicle to Grid) is not likely to offer a primary source of distributed energy storage capacity in terms of reduction of peak load shaping. Driver behaviours, usage patterns, and desires, limit the ability of residual vehicle storage capacity to be used at the end of the day to coincide with peak electricity supply demands.

Question 3

What are the appropriate electricity market regulatory arrangements necessary to facilitate the efficient uptake of EVs?

Blade Electric Vehicles believes that ultra-fast charging will result in extreme demands on the electricity grid without complementary distributed energy storage technologies. Distributed storage implementations can best be facilitated by ensuring all classes of electricity customers can benefit directly by trading off-peak energy into peak periods. Market energy rates must be available to individuals and small businesses, including being able to benefit financially by critical peak pricing.

The cost of necessary changes to billing systems within distribution companies must be taken into account. Clearly a long-term focus is required so regulatory changes are not mercurial in nature. Ultimately flexibility is needed. Individual electricity customers and small businesses must be allowed to fully participate in the energy storage market. Large implementation of distributed energy storage technology may additionally best be facilitated by pooled capital investment schemes, and these third parties must be allowed the ability to participate effectively.

Mechanisms allowing an individual energy storage unit to know when to optimally deliver energy to the grid need to be developed. Blade Electric Vehicles is willing to participate with other experts to help fully define desired features of such a "decision" system. Indeed, Blade Electric Vehicles is already endeavouring to more fully develop concepts in this area as it relates to what is seen to be a crucial part of the future of the electric vehicle industry.

Question 4

What are the required changes to the current electricity market regulatory arrangements and suggestions for reform to facilitate the efficient uptake of Evs?

Any input Blade can provide on this question is effectively already provided in the contribution to the question above coupled with an offer to more fully contribute to definition of the needs for workable distributed energy storage solutions.

Question 5

Are there any electricity market regulatory arrangements that affect EVs which may also apply to NGVs?

Blade Electric Vehicles can not foresee a connection here, but NGVs are outside our direct experience base.