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8 November 2011

Mr John Pierce
Chairman
Australian Energy Market Commission

Via email: submissions@aemc.gov.au

Dear Mr Pierce

Re: AEMC Approach Paper - Energy Market Arrangements for Electric and Natural Gas Vehicles – Project reference code: EMO0022

Ausgrid appreciates the opportunity to comment on the AEMC Approach Paper "Energy Market Arrangements for Electric and Natural Gas Vehicles". Ausgrid supports the development and adoption of Electric Vehicles (EVs) and is actively monitoring progress to assess their likely impacts on electricity networks, particularly for peak demand and the development of Smart Grids.

Electric vehicles have been the "car of the future" for over 100 years but are now poised to have a significant impact on both the transport and energy sectors. The cost and capacity of batteries remain their major weakness. This is predicted to change but we expect change will be slow. Despite enormous interest and expectations, it could be at least 5-10 years before there are significant numbers of EVs in Australia and, if rapid EV sales do eventuate, they are not expected to have a significant impact on the distribution network until perhaps 2020-30.

While the prospects for EV are the most promising they have been for a century, Ausgrid believes there still remains substantial inherent uncertainty about the future uptake and energy market impacts of EVs. This is because EVs are a new and potentially disruptive technology facing significant engineering, market and customer acceptance challenges. Unless a major technology breakthrough or major government incentives appear, we expect that adoption of EVs will be slow enough to allow networks sufficient time to plan and cope with this uncertainty in the near term.

In the medium to long term, flexible pricing and load control of charging are expected to be key elements in managing the impact of EVs. EVs may create increased peak demand leading to investment for network augmentation, but at the same time EV's flexible charging and storage capacity can also smooth peaks, flatten load profiles and assist in managing intermittent

generation from renewable resources such as wind and solar. Smart Grids and Time of Use tariffs are natural complements to EV development and, while we believe EVs are unlikely to be the major driver of smart grid or overall network investment in the short to medium term, Ausgrid is investigating the potential impacts of EV through of our Smart Grid programs.

As part of the Federal Government's Smart Grid Smart City (SGSC) project Ausgrid has been operating a fleet of 20 Mitsubishi iMiEVs, currently the largest fleet of EVs in Australia, for around a year. As the first mass produced electric vehicles available in Australia, the iMiEVs have already demonstrated the reliability and practicality of EVs as company fleet vehicles. While 20 fleet cars are not a sufficient basis for understanding future market responses, this trial combined with SGSC trials of stationary batteries will provide valuable inputs into the modelling of EV impacts on electricity distribution networks. Stationary batteries will also help explore Vehicle to Grid (V2G) potential, however, Ausgrid believes flexible charging is more likely to deliver benefits in the foreseeable future than the two-way flows of V2G. Preliminary data analysis from the SGSC EV trial has been provided as an attachment to this submission together with the project measurement and management report and the AEMC has also been added to the SGSC distribution list and will receive regular updates of all SGSC project developments and findings.

As well as installing chargepoints and monitoring EV charging, the SGSC project is also exploring an alternative "roaming NMI (National Meter Identifier)" model for EV charging and market settlements. In the roaming NMI model the EV has its own NMI which, unlike existing NMI specifications, does not have a fixed address and moves with the vehicle. We would welcome the opportunity to discuss the operation of the roaming NMI model with the AEMC as part of this review.

The energy market arrangements created when the NEM was established did not envisage the development of EV charging. Whether changes will be required to market arrangements will depend on the business model or models adopted for supporting EVs. At present the shape these business models will take remains unclear as:

- world wide EV numbers are still too small to provide guidance on future developments;
- both vehicles and chargepoints are in their early stage of development and, while improving, the specifications and performance of mature products remain unclear;
- without clear product specifications and few privately owned EVs operating in the market, customer behaviour, preferences, the customer value proposition and likely adoption rates remain uncertain; and
- given the above, how, when, where and how much EVs will charge, the nature and extent of supporting charging infrastructure and the impacts on network demand remains unclear.

Existing energy market arrangements can cope with the charging of EV from standard plug points, as they have historically done with forklifts and other mobile electrical equipment. If trickle charging from existing household or business power supplies remained the dominant form of EV charging then it is not clear what changes would be required to energy market arrangements. Fast charging supported by pricing signals and load control is also possible under existing market rules.

In its submission to the AEMC's "Power of Choice - Stage 3 DSP review" Better Place has suggested that Parent and Child NMI arrangements be used for settlement of EVs (as has been proposed in California). Ausgrid believes careful consideration should be given to the market implications and B2B (Business to Business) consequences of specific Parent and Child NMI

proposals. Parent and Child NMI situations currently operate in a small number of cases. Widespread adoption of embedded networks as commonplace across the NEM has the potential to create issues with customer protection and settlements (both on and off market).

Ausgrid has previously pointed out issues with the current operation of Parent Child NMIs in the market and the assignment of the role of Responsible Person to NMIs in embedded networks.

There is no specific regulatory recognition of embedded networks in either the Electricity Supply Act or the National Electricity Rules, and therefore they are currently accommodated under the general provisions relating to connecting to networks. Embedded networks are effectively a conceptual arrangement developed by the Australian Energy Market Operator (AEMO) (formerly NEMMCO) to facilitate customers who are connected to an embedded network to obtain supply from a retailer of choice and to this extent embedded networks are recognised in AEMOs National Electricity Market (NEM) Systems and Procedures, including the Metrology Procedure. An outline of this issue and accompanying legal advice has been provided as an attachment to this submission, and we would welcome the opportunity to discuss the matter in more detail.

Ausgrid believes that separate metering and control of EV charging is highly desirable and should not be prevented or inhibited by electricity market regulatory arrangements. This is best addressed through an overall market framework that supports demand side participation rather than specific policies to accommodate EVs.

Responses to specific questions made in the approach paper are provided below. Comments have not been made about the Western Australian market or Natural Gas Vehicles (NGVs). The emergence of low cost, low emissions NGVs with a wide network of refuelling points will reduce the appeal and adoption rate of EVs. It is worth noting however that NGVs and EVs are competitors with both internal combustion Engine (ICE) vehicles and each other and should be considered within the context of broader transport policy issues including urban planning, congestion, urban air quality, road infrastructure funding and greenhouse gas emissions.

Ausgrid looks forward to discussing these and other issues which emerge as part of this review. If you wish to discuss any aspect of this submission please do not hesitate to contact me or Mr Keith Yates, (Acting) Executive Manager – Regulation and Pricing on 02 9269 4171.

Regards,

Peter Birk
Executive General Manager System Planning & Regulation

Attachments

1. Responses to specific question
2. Smart Grid Smart City, Electric Vehicles, Preliminary Data Analysis, July 2011
3. Smart Grid Smart City, Monitoring and Measurement Report, June 2011
4. Response to Second Stage Consultation National Electricity Arrangement – Rule 2010

AEMC Approach Paper

Energy Market Arrangements for Electric and Natural Gas Vehicles - Responses to specific questions

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?

Ausgrid agrees that there is a "*high degree of uncertainty*" which makes it difficult to forecast the potential penetration of EVs in Australia's transport mix. In general, these uncertainties suggest a slower rather than a rapid adoption is more likely in the short to medium term. The AECOM, CSIRO and McLennan Magasanik Associates reports quoted in the approach paper provide useful background to estimating uptake but by necessity rely heavily on assumptions which cannot be validated without experience.

Comments on the variables affecting EV uptake identified in the approach paper are outlined below.

- The global production of EVs and other vehicles

Current shifts in the nature of global car market, especially the emergence of China as a major market and producer, add complexity to the forecasting of EV production and supply. Australia appears unlikely to be a major producer of EVs or batteries with China and the USA liable to be major markets and producers.

As there is excess capacity worldwide in vehicle production, it is expected that, if demand exists, production of EVs can increase in the near term with conversion of manufacturing from ICE (Internal Combustion Engine) to BEV (Battery Electric Vehicles) or PHEV (Plug in Hybrid Electric Vehicle) once vehicle designs and battery technologies are bedded down. Battery supply may be an issue as production increases however concerns of "peak lithium" shortages appear unfounded.

The success of vehicle models in global and local markets is difficult to predict as has been demonstrated recently by the slower than expected take-up of the locally assembled Toyota Camry hybrid and India's highly anticipated Tata Nano "one-lakh car".

NSW Roads and Traffic authority has 147 electric powered vehicles registered as at June 2011 of which 74 are passenger motor vehicles and 27 motor bikes or scooters. This compares with 7,487 electric/petrol hybrids of which 5,623 are passenger motor vehicles. Therefore, more than a decade after their introduction and without restrictions on supply, hybrid motor vehicles comprise only 0.19% of the registered vehicle stock in NSW. Based on this data EVs will need to achieve a much greater uptake than hybrids to have a material effect on the electricity market in the near term.

- The relative prices of these vehicles, both in terms of the purchasing costs and also in the fuel and maintenance costs;

EVs have a significant advantage over ICE vehicles in the cost of fuel. Charged at off-peak rates in Ausgrid's network area and based on the manufacturer's specifications, the electricity to run an EV can cost as little as 1 cent a kilometre. However high purchase costs negate this benefit.

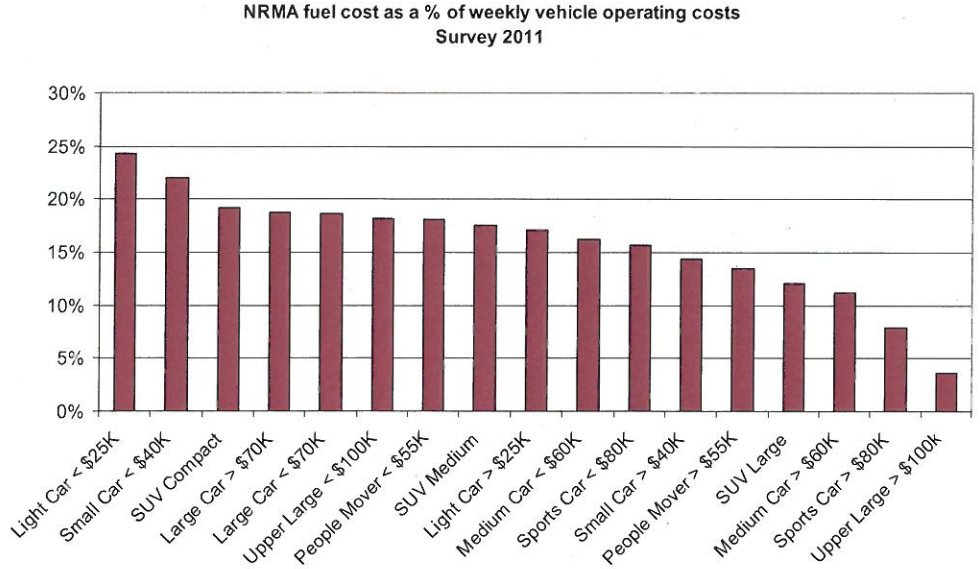
In their 2010-11 consumer survey "*Unplugged: electricity vehicle realities versus customer expectations*" consultants Deloitte reported "*When consumers actual expectations for range, charge time, and purchase price are compared to actual market offerings available today…no more than 2 to 4% of the population in any country would have their expectations met today*". This will change as products improve and prices fall but suggests a small initial base for sales.

Estimates from the ABS Household Expenditure survey confirm that purchase costs are the main component of households' vehicle operating costs and "*motor vehicle fuel, lubricants and additives*" is a relatively small component, around 30%, of vehicle operating cost for the majority of households.

	GROSS HOUSEHOLD INCOME QUINTILE					
	Lowest	Second	Third	Fourth	Highest	All
Motor vehicle fuel, lubricants & additives	$20.69	$34.71	$51.28	$63.21	$85.30	$51.02
Motor vehicle purchase & interest payments	$12.85	$24.36	$48.56	$67.80	$109.20	$52.55
Vehicle registration & insurance	$12.85	$19.23	$27.52	$35.78	$47.49	$28.57
Motor vehicle parts & accessories purchased separately	$4.81	$7.79	$9.89	$9.88	$20.03	$10.48
Vehicle charges (excluding hire)	$13.55	$13.49	$12.38	$12.43	$10.61	$12.49
Vehicle hire & leasing expenses (non-holiday)	$1.14	$1.10	$7.73	$18.50	$63.10	$18.31
Vehicle operation	$65.89	$100.68	$157.36	$207.60	$335.73	$173.42
Motor vehicle fuel, lubricants & additives	31%	34%	33%	30%	25%	29%

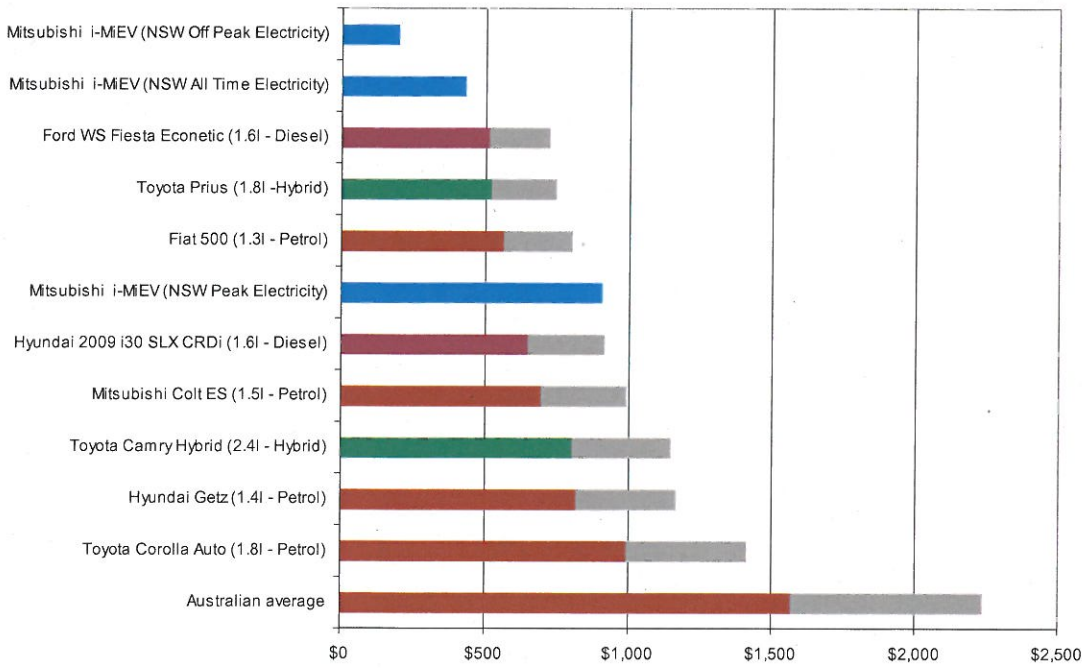
Source: ABS 6530.0 Household Expenditure Survey, Australia: Detailed Expenditure Items, 2009-10

This is supported by the NRMA survey of new car costs "*2011 Private Whole of Life Fixed Vehicle Operating Costs*" which are estimated on 15,000 kilometres per annum over an ownership cycle of 5 years. NRMA estimates fuel cost as less than 20% of operating costs for most vehicle types over the first 5 years of operation.



Low fuel costs are a key marketing point for EVs. The comparison of operating costs for ICE and EVs below shows EVs have a clear cost advantage over ICEs when charged on off-peak tariffs. EV fuel costs at off peak rates are well below the Australian ICE average and lower than the most efficient petrol, diesel and hybrid cars. However, this is partly due to the 38 cent per litre excise placed on ICE cars (shown in grey on the graph below) which will eventually need to be included in the cost of EV.

Estimated Yearly Fuel Cost (15,000 km pa)



Australians have a track record of early adoption of innovative technologies. While high purchase prices will not be a barrier to early adopters, in the longer term the high upfront costs of batteries may prove a barrier to acceptance, for private buyers, businesses and fleet operators. EVs low fuel costs are currently likely to be outweighed by their higher capital cost (purchase costs and resale value).

Ultimately it is customers' preferences that will determine the path of EVs. Private cars are bought based upon a range of characteristics with fuel efficiency being only one component. Experience with energy efficient product, such as lighting and star rated household appliances, suggests that lifetime cost of operation are not a dominant consideration in purchases and pay-back periods required for efficiency investments by both businesses and consumers are short.

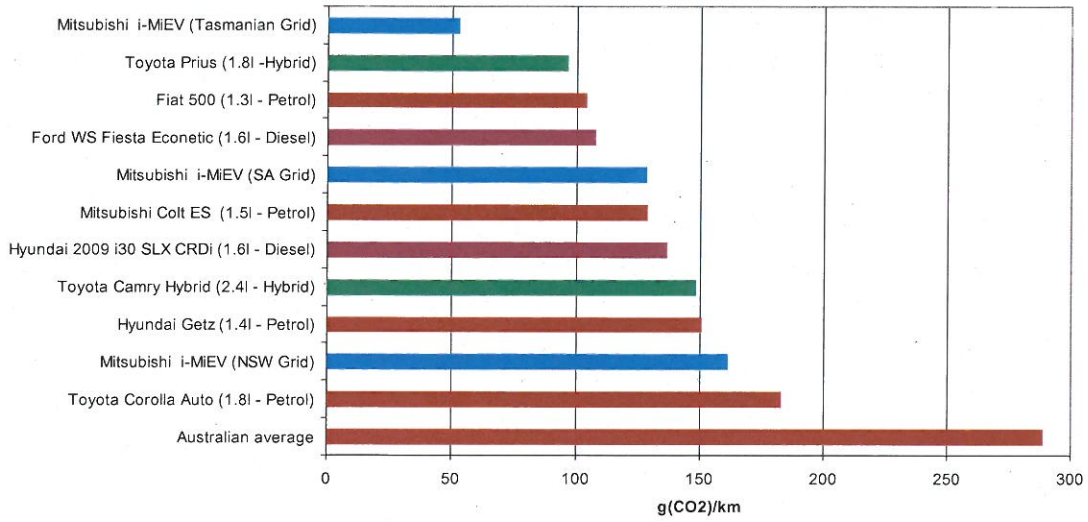
- Efficiency improvements in current technologies

As EVs develop they will be competing in a dynamic marketplace where there will be continuing improvement in the efficiency of existing technologies including hybrid and clean diesel vehicles. International analysis by consultants McKinsey lists EVs as one of the least cost effective options for greenhouse gas reduction for passenger vehicles. According to the McKinsey "*Roads toward a low-carbon future: Reducing CO2 emissions from passenger vehicles in the global road transportation system*" report, substantial cost savings are currently possible with changed driver behaviour and improvements based on existing technologies. The

availability of these untapped opportunities is evidence that EVs will be operating in a market where efficiency is only one of the criteria for success.

The changing efficiency of technologies also has a direct impact on the relative greenhouse gas abatement impacts of technologies. As the zero emission potential of EVs is a major marketing point the relative environment impact of other vehicles has a material impact on the uptake of EVs. This remains relevant where renewable energy purchases are used to ensure EVs provide low or zero carbon transport as similar offsets are equally possible for other vehicles which have similar or lower initial greenhouse footprints, as shown below.

Greenhouse Comparison (including Scope 3 emissions)



- the relative price of batteries;

The future of battery technologies and costs remains uncertain. The US Department of Energy (DOE) have made optimistic forecasts:

> *"Before the Recovery Act, the only highway-enabled electric vehicles on the road cost more than $100,000. This high cost resulted in large part from the high cost of batteries — a car with a 100-mile range required a battery that cost more than $33,000. Between 2009 and 2013, the Department of Energy expects battery costs to drop by half as Recovery Act-funded factories begin to achieve economies of scale. By the end of 2013, a comparable 100-mile-range battery is expected to cost only $16,000. By the end of 2015, Recovery Act investments should help lower the cost of some electric car batteries by nearly 70 percent to $10,000. The same cost improvement applies to plug-in hybrid – cars that can travel roughly 40 miles on electricity before their gasoline engine kicks in. The cost of a 40-mile range battery is falling from more than $13,000 in 2009, to roughly $6,700 in 2013, to $4,000 in 2015. "*

The DOE further predict battery costs of a comparable 100-mile-range battery to fall to US$5,000 in 2021 and US$3,000 in 2030 where EVs should become cost competitive with ICE vehicles. If these forecasts are proved correct there will be substantial time to anticipate the changes and their impacts.

Importantly, price reductions of this magnitude potentially change the economics of batteries not just in EVs but across the energy market. Inexpensive storage could have much larger

implications for the design and operations of the market and distribution networks than the uptake of EVs alone.

The approach paper notes the possibility of EV V2G capabilities. As electric vehicles are expected to be parked the majority of the time, the idea of using their batteries as distributed storage naturally arises. With high battery cost a major barrier to adoption of EVs, the prospect of gaining an additional benefit from the batteries at little or no marginal cost is very attractive as a means of improving the economics of EVs. For example, one widely referenced US estimate has the value to utilities of V2G substantially higher than most household electricity bills.

> *Since most vehicles are parked an average of 95 percent of the time, their batteries could be used to let electricity flow from the car to the power lines and back, with a value to the utilities of up to $4,000 per year per car.*1

Widespread deployment of V2G capacity would be an exciting development and could provide benefits to the market in peak reduction. However, it is unlikely that V2G will emerge as a viable option in the next 10 years because:

1. V2G functionality is not part of major EV models currently planned for production;
2. V2G functionality is not costless, requiring investment in equipment to allow energy exports and manage flows as well as potentially reducing the battery's capacity and life;
3. V2G involves losses both in storing energy to and exporting from the battery, so the net efficiency is liable to be less than 80%;
4. When battery prices fall stationary batteries may compete with EV batteries for grid support; and
5. Even where V2G creates value for customers the pay back periods required by customers for energy efficiency and distributed generation investments are extremely short.

Based on current regulated EnergyAustralia residential Time of Use tariffs for default customers in Ausgrid's area, the net benefit of substituting one kWh of consumption at peak time on working weekdays with one kWh of stored off-peak energy is just under 31.5 cents, and using one kWh of off-peak energy at shoulder time on weekends and public holidays is just under 7.5 cents. Over a year shifting one kWh of demand a day translates to bill savings of just under $100, around $80 at peak times on working weekdays and $19 in shoulder times on weekends and public holidays. These same benefits can be achieved through load switching of charging without V2G capabilities.

There are network benefits to be had without V2G capacity if charging of EV batteries can be controlled to manage peaks and smooth intermittent supply from distributed renewable generation such as wind and solar. These benefits may be easier to access for particular types of EVs such as PHEV's (Plug-in Hybrid Electric Vehicles) rather than BEVs (Battery Electric Vehicles) and are likely to be accessible prior to the emergence of V2G capabilities thorough flexible charging and Smart Grid developments.

- transport policy;
- consumers' preferences and incomes; and
- the availability of electric charging infrastructure

[1] http://en.wikipedia.org/wiki/Vehicle-to-grid accessed 17-10-2011

Transport policy, consumers' preferences and incomes and the availability of electric charging infrastructure are closely interrelated issues with a substantial potential impact on the future uptake of EVs. Ultimately it is customers' preferences that will determine the path of EVs. In establishing transport policy and influencing the direction of electric charging infrastructure Ausgrid supports the establishment of trials and pilots to test customer responses rather than attempting to pick technology "winners" or shape the direction of the market before it has time to develop and evolve.

Question 2: What are the costs and benefits that EVs may introduce into Australia's electricity markets? Please provide evidence if available.

The costs and benefits of EVs for networks are dependant on the scale of adoption, customer charging behaviour and the availability of load control. This will also depend on the level of interaction of EVs with Smart Grid technologies, battery storage, renewable and distributed generation. Evidence on this issue is being collected though the trials conduced as part of the SGSC project.

Costs and benefits are dependant on how EVs develop. Unrestricted charging of EVs is likely to lead to an increase in peak demand and create the need to bring forward network augmentation capital expenditure and add to price rises. Concentration of EVs in particular "Prius Cluster" neighbourhoods could further increase cost pressures bringing forward requirements in specific locations. Conversely, large increases in electricity demand from EVs concentrated in off-peak periods could potentially counteract current falling energy consumption levels and lessen pressure on price rises by spreading costs over a larger load base.

Non-electricity market impacts are likely to be important in determining the economics of EVs. In the medium term, the main societal benefits from EV may be in improved air quality. The AECOM 2009 report for the NSW Department of Environment, Climate Change and Water "*Economic Viability of Electric Vehicles*" puts the value to NSW of improved air quality from EVs as $261m to $1,256m by 2040. This is more than 5 times their estimated greenhouse gas benefits from EVs. Urban air quality issues are also a major factor driving the Chinese government's push for the mass take-up of EVs. Air quality could therefore be a more important policy driver for EVs than electricity market impacts, climate change or fuel security issues.

Question 3: What are the appropriate electricity market regulatory arrangements necessary to facilitate the efficient uptake of EVs?

Ausgrid believes that the "efficient uptake of EVs" implies that electricity market prices and incentives for EVs reflect their overall costs and benefits to the market. In this respect EVs are no different from other parts of the market where efficiency is desirable. This issue should therefore be considered as part of the broader framework of appropriate customer choice, which is being addressed in the AEMC's review of DSP.

As discussed in Ausgrid's submission to the AEMC's "Power of Choice - Stage 3 DSP review" the National Electricity Market has not brought forward an economically efficient level of demand-side participation. Opportunities to deliver lower energy service costs to consumers are being missed. Cost reflective prices to customers are a necessary background element to DSP, but fully cost reflective prices are not practical and so a regulatory response is required to bolster demand-side participation in the NEM.

Providing DNSPs with a business incentive to pursue broad-based demand side participation and unlock benefits across the energy supply chain is the most efficient practical option to expand the use of DSP in the NEM to more efficient levels. DNSPs are in the best position to act on society's behalf to implement demand side measures, integrate the full range of benefits and share them with customers as they have a physical long-term relationship with customers, are already regulated, and manage the most localised and complicated element of the demand management value chain.

While EVs have unique characteristics, fundamentally they represent a load in the market in the same way as other equipment.

Ausgrid believes that separate metering and control of EV charging is highly desirable and should not be prevented or inhibited by electricity market regulatory arrangements. This is best addressed through an overall market framework that supports DSP rather than specific policies to accommodate EVs.

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?

As discussed above, with the high levels of uncertainty about developments specific proposals are required to understand the impact of EVs in the market. However, the use of an embedded network framework with parent and child NMIs, as has been proposed by some service providers, should be carefully reviewed as Ausgrid has already highlighted problems with the current regulatory arrangements and Retailer of Last Resort provisions.

Question 5: Are there any electricity market regulatory arrangements that affect EVs which may also apply to NGV

We are not presently aware of any electricity market regulatory arrangements relating to EVs that may also apply to NGVs and will consider this issue further after reviewing the discussion paper.

Question 6: What are your views as to the projected uptake of NGVs? Please provide views and evidence if available.

We have no comments on this question.

Question 7: What are the costs and benefits that NGVs would introduce into Australia's natural gas markets? What are the impacts that NGVs may have on Australia's electricity markets? Please provide evidence if available.

The widespread uptake of NGVs has three possible impacts on Australia's electricity markets:

- changing the uptake of EVs as a competing transport mode;
- changing the demand for and cost of gas supplies, both as a source of electricity generation and a substitute for electricity in major customer end-uses (heating, hot water, cooking, fuel cells and co and tri generation); and
- adding a new electricity load for gas transport and refuelling, depending on how this is managed.

We would welcome the opportunity to consider this issue further after reviewing the discussion paper.

Question 8: What are the appropriate natural gas market regulatory arrangements that would facilitate the economically efficient uptake of NGVs? Please specify for CNG vehicles and LNG vehicles, respectively.

We have no comments on this question.