INFORMATION

Energy market arrangements for electric and natural gas vehicles

Summary of AECOM's final advice

We commissioned AECOM (an economic consultancy) to report on the likely uptake of EVs and NGVs and their impact on the electricity and gas system, respectively. This Information Sheet provides a summary of AECOM's findings.

Uptake of Electric Vehicles

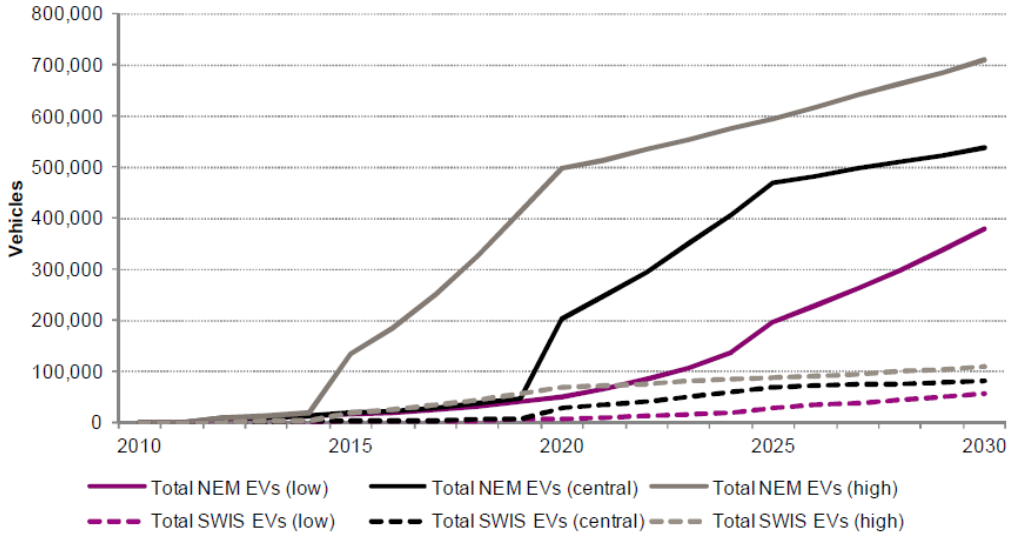
To estimate the uptake of EVs, AECOM applied a vehicle choice model incorporating a range of factors affecting a consumer's decision to purchase a vehicle. These factors include vehicle purchase cost, fuel cost, vehicle range and availability of refuelling/charging infrastructure.

AECOM analysed the uptake of EVs under three scenarios: low, central and high uptake. AECOM estimated uptake of Plug-in Hybrid EVs (PHEVs) and Battery EVs (BEVs).

AECOM made estimates for both the National Electricity Market (NEM) and Western Australia's South-West Interconnected System (SWIS).

The Figure immediately below sets out the estimated annual sales of EVs in the NEM and the SWIS. Also, the next figure (Figure 2) below sets out the estimated number of EVs in the NEM and SWIS.

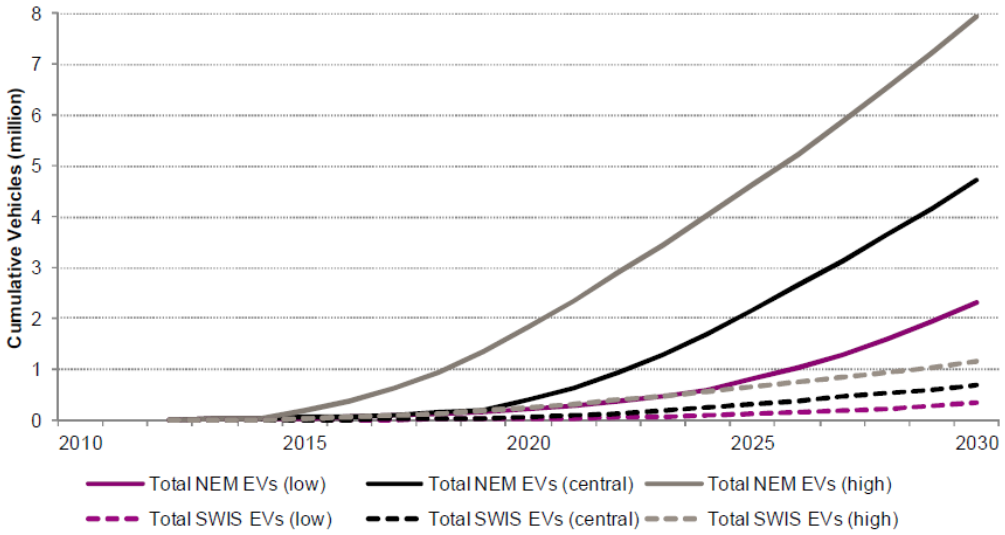
Figure 1: Estimated annual sales of EVs in NEM and SWIS



Source: AECOM

AUSTRALIAN ENERGY MARKET COMMISSION LEVEL 5, 201 ELIZABETH STREET SYDNEY NSW 2000
T: 02 8296 7800 E: AEMC@AEMC.GOV.AU W: WWW.AEMC.GOV.AU

Figure 2: Estimated number of EVs in NEM and SWIS



Source: AECOM

AECOM's key findings are that:

- there is likely to be higher uptake of PHEVs in early years which will reduce the impact on the electricity market;
- there is likely to be higher uptake of smaller vehicles in early years which will minimise impact on the electricity market;
- there is likely to be a higher uptake of EVs in NSW, Victoria and Queensland; and
- the uptake of EVs in early years will be concentrated or clustered at particular locations.

Impact of Electric Vehicles on electricity consumption and peak demand

Given the uptake of EVs, AECOM estimated the impact that EVs could have on electricity consumption and peak demand on the electricity system.

Electricity consumption

The Table below sets out the energy consumption and additional peak demand if charging is unmanaged under low, central and high take up scenarios. Unmanaged charging refers to when people charge their EVs at times which coincide with the peak period (estimated on the basis of around 50 per cent of EV consumers coming home and charging at peak periods).

Table 2: Impact of EVs on the energy market in selected years with unmanaged charging

EVs	2015		2020		2030	
	NEM	SWIS	NEM	SWIS	NEM	SWIS
Central take up scenario						
Energy consumption (MWh)	88,300	10,400	648,800	80,900	8,536,700	1,173,800
% of total MWh in NEM	0.0%	0.0%	0.2%	0.2%	2.2%	2.6%
Increase in peak load if unmanaged charging (MW)	95	10	730	100	8,595	1,260
% increase in additional peak load	1.8%	1.0%	7.3%	4.8%	36.5%	27.2%
Low take up scenario						
Energy consumption (MWh)	66,400	7,800	323,700	38,900	4,039,300	545,800
% of total MWh in NEM	0.0%	0.0%	0.1%	0.1%	1.1%	1.2%
Increase in peak load if unmanaged charging (MW)	80	10	385	50	4,210	605
% increase in additional peak load	1.9%	1.1%	5.0%	3.1%	24.3%	17.2%
High take up scenario						
Energy consumption (MWh)	273,100	32,600	3,035,400	389,000	14,261,400	1,948,700
% of total MWh in NEM	0.1%	0.1%	1.1%	1.0%	3.7%	4.3%
Increase in peak load if unmanaged charging (MW)	325	40	3,435	470	14,220	2,065
% increase in additional peak load	5.1%	2.8%	25.5%	18.3%	43.8%	33.8%

Source: AECOM

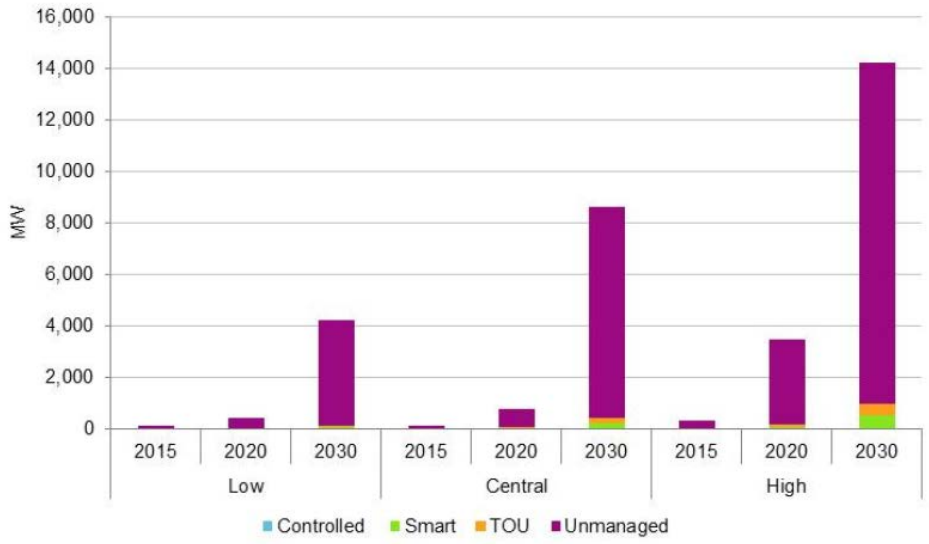
Peak Demand

The impact of EVs on peak demand depends upon the type of EV charging behaviour. AECOM's study examined three types of EV charging designed to encourage off-peak charging in addition to the base case of unmanaged charging:

- Controlled charging – charging occurs in off-peak periods, where the consumer, through a commercial arrangement, assigns the right to charge its EV to a energy market participant (such as a retailer or network)
- Time of Use (ToU) charging – EV consumers are subject to a tariff that changes depending on the time of consumption and is designed to incentivise a proportion of consumers to charge during off-peak periods.
- Smart charging – EV drivers have smart chargers that respond to signals such as real time pricing and provide better incentives than ToU pricing.

In the NEM, AECOM estimated the additional peak demand caused by EVs under the low, central and high scenarios of EV uptake. This is depicted in the Figure below.

Figure 3: Estimated additional peak demand in NEM (MW)



Source: AECOM

The following Table sets out the additional peak demand in the NEM for the central scenario only.

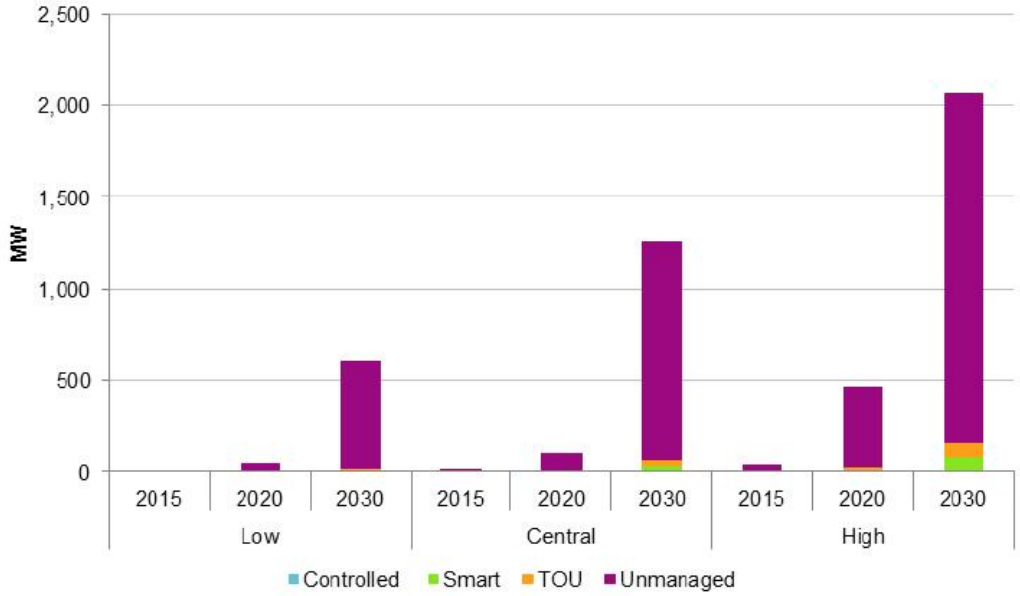
Table 30: Estimated additional peak demand in the NEM for various charge management options under the central take up scenario

	Estimated additional EV related peak demand			
Charge management option	2020 (MW)	As a percentage of estimated growth in overall peak demand in 2020	2030 (MW)	As percentage of estimated peak demand growth in 2030
Unmanaged	730	7.3%	8600	36.5 %
Time of use	50	0.5%	410	1.7%
Smart charging	25	0.2%	205	0.9%
Controlled charging	0	0%	0	0%

Source: AECOM, MW values rounded to nearest 5MWs

In the SWIS, AECOM estimated the additional peak demand caused by EVs under the low, central and high scenarios of EV uptake. This is depicted in the Figure below.

Figure 4: Estimated additional peak demand in SWIS (MW)



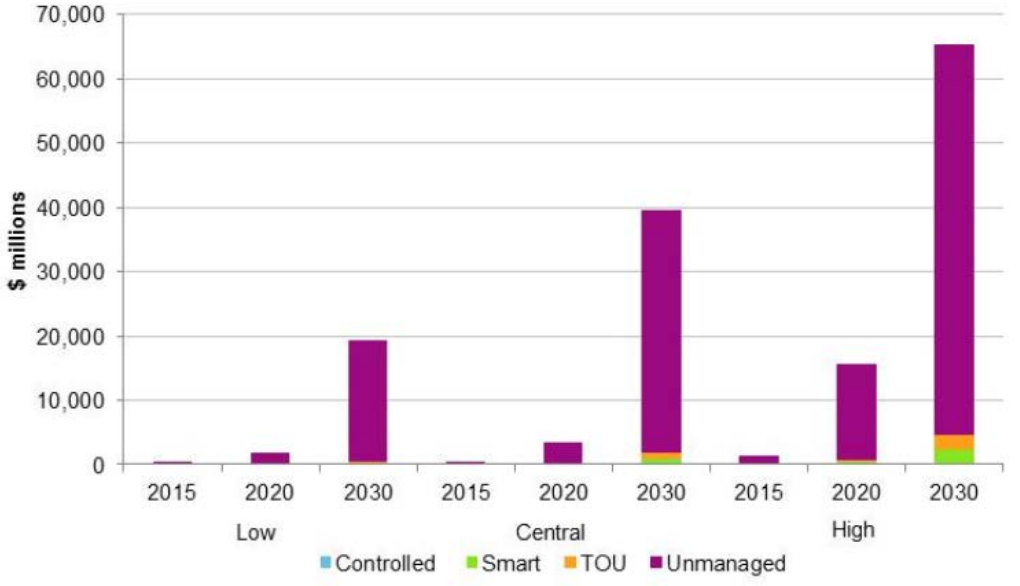
Source: AECOM

Impact of Electric Vehicles on costs to the electricity system

Given the impact of the various forms of EV charging on peak demand, AECOM estimated the cost to the electricity system of this additional peak demand. The cost was estimated in terms of network and generation upgrades to meet peak demand.

The following Figure sets out the estimated cost to meet additional peak demand in the NEM:

Figure 5: Estimated cost (for both generation and network upgrades) of additional peak demand in NEM ($ millions undiscounted)



Source: AECOM

The following Table sets out the estimated cost to meet additional peak demand in the NEM under the central scenario only.

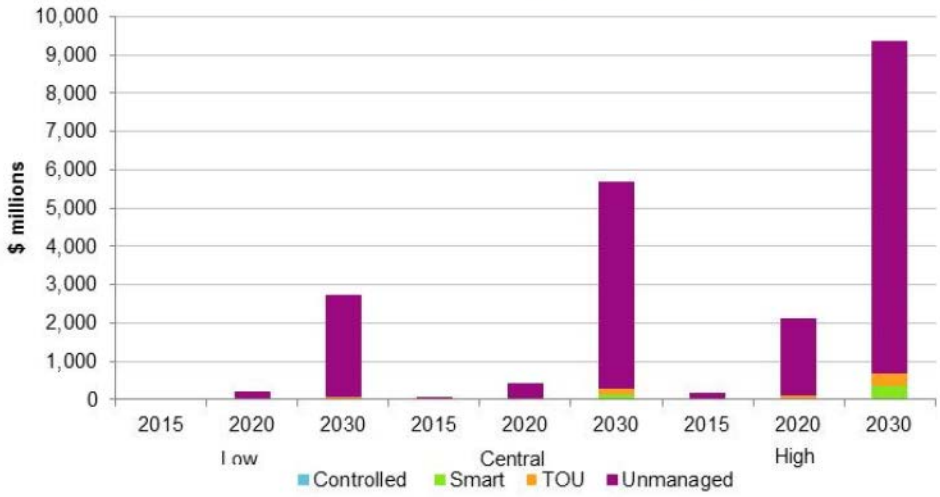
Table 32: Estimated cost to meet additional system peak demand in the NEM

	Estimated cost to meet additional system peak demand ($)	
Charge management option	2020	2030
Unmanaged	3.3 billion	39.5 billion
Time of use	220 million	1.9 billion
Smart charging	110 million	940 million
Controlled charging	0	0

Source: AECOM

The following Figure sets out the estimated cost to meet additional peak demand in the SWIS.

Figure 6: Estimated cost (for both generation and network upgrades) of additional peak demand in SWIS ($ millions undiscounted)



Source: AECOM

AECOM estimated that these costs would equate to about $10,000 per EV in the NEM or about $9000 per EV in the SWIS although the actual amount would vary by location and use profile.

AECOM considers that the electricity market design provides the right incentives and is capable of responding to the issue of system capacity, given the long lead times before there is significant uptake of EVs.

AECOM also considers that if majority of EV charging occurs in non-peak periods this will present significant opportunities for improving the efficiency of the electricity market. It can improve load factor and bring flexibility benefits, such as the more efficient use of renewable generation.

Uptake of Natural Gas Vehicles

AECOM estimated the uptake of NGVs – both vehicles running on compressed natural gas (CNG) and liquefied natural gas (LNG). This encompassed passenger NGVs, CNG buses and LNG trucks.

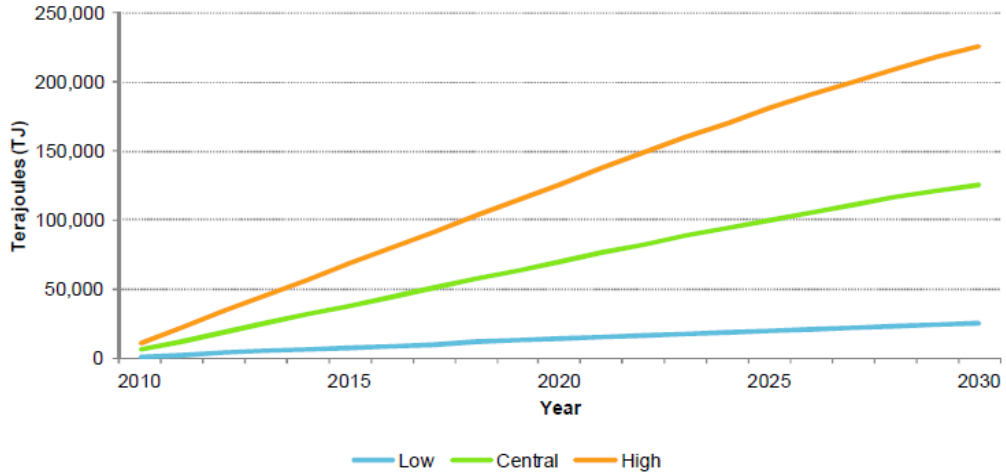
AECOM analysed the lifecycle costs of NGVs compared to other vehicle types. AECOM found that demand for passenger NGVs is likely to be minimal in all segments of the passenger market except for those that travel long distances. This advantage may erode once the relative competitiveness of EVs improves. However AECOM notes this is an emerging market and it is uncertain how the market will evolve.

In relation to CNG buses and LNG trucks, AECOM found that on purely financial grounds, the take up is expected to be low. But there may be other factors such as greenhouse gas emissions reductions objectives that may mean uptake is higher than otherwise expected.

Impact of Natural Gas Vehicles

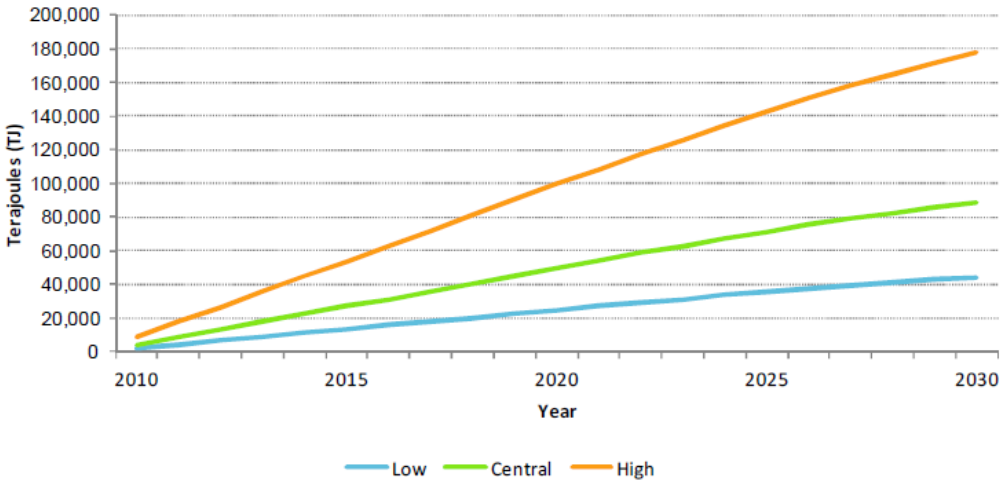
AECOM used three scenarios (low, central and high) to estimate the amount of gas consumption required by the uptake of CNG buses and LNG trucks. This is depicted in the following Figures below.

Figure 12: CNG bus gas consumption



Source: AECOM

Figure 13: LNG truck gas consumption



Source: AECOM

AECOM found that the uptake of NGVs is not expected to cause significant issues with eastern or western Australian gas markets because gas networks can generally balance on a daily basis and any additional load is likely to be relative predictable on a daily basis.

For information contact:
AEMC Senior Director, **Rory Campbell** (02) 8296 7800
AEMC Director, **Eamonn Corrigan** (02) 8296 7800

Media: Communication Manager, Prudence Anderson 0404 821 935 or (02) 8296 7817

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