Submission to the Review of Energy Market Arrangements for Electric Vehicles

27 October 2011

Australian Energy Market Commission

PO Box A2449

Sydney South NSW 1235

Contact person for submission

Tim Watts
Better Place Australia
114 Balmain St
Richmond VIC 3121
Tel: (03) 8679 0800
Email: tim.watts@betterplace.com
Website: www.betterplace.com.au

Contents

Executive Summary

Australia will be at the forefront of electric vehicle (EV) adoption globally. We forecast rapid take-up of EVs from 2012 and beyond based on the evidence in four key areas:

- **Economics** – As the price of the Renault Fluence ZE shows, EVs sold without battery will be priced competitively with similar internal combustion engine (ICE) cars in the dealer show room. The operating costs of EVs (batteries, charge network usage and electricity) are already cheaper for drivers with high petrol bills, and will get cheaper over time as batteries fall in price and petrol prices rise.
- **Strong interest in EVs from new car buyers** – Extensive market research within Australia shows both fleet operators and individual consumers have strong interest in buying an EV due to their performance, convenience and zero emissions profile.
- **Availability of cars –** Every one of the largest 20 carmakers globally has an electric car in production or coming into production. From 2012, Australians will have an expanding range of electric car brands, models and vehicle formats from which to choose.
- **Availability of charge networks** – Australia will be only the third market globally after Israel and Denmark to have a Better Place charge network in place offering range extension from battery switch stations and quick charge stations in convenient locations across the road network.

Recommendations

Changes to regulations on (I) metering and (II) electricity pricing are needed to ensure that the uptake of electric cars occurs in the most economically efficient manner:

> **(I) The introduction of new sub-metering protocols for electric car charging at homes and workplaces is required.** Establishing on-market metering for EV chargers at residences and workplaces is very costly, involves lengthy delays and is impossible at many corporate carparks. California's electricity regulator has already directed utilities in that state to introduce sub-metering for EVs. Development and implementation of sub-metering protocols in Australia can be achieved at low cost.
>
> **(II) Distributors and retailers and need to be authorised to offer network and energy tariffs for EV charging load with structures such as time-of-use and critical peak pricing.** EV charging is a highly flexible category of consumption, well suited to time-shifting in response to pricing signals. With such tariff structures, EV charging load can be managed to help deliver more efficient utilisation of existing network and generation capacity, and to help defer investment in new network and generation capacity.

The costs if these regulatory changes are *not* made will be high. Without these changes, the uptake of EVs will result in further deterioration of system load shape problems, and unnecessarily contribute to upward pressure on electricity prices for all consumers.

A. What role does Better Place play in the National Electricity Market (NEM)? What type of market participant are we?

Better Place is a customer in the NEM. We buy our electricity from existing retailers. We have no desire to be a retailer, unless the retail market cannot meet our requirements.

Our electric car chargers are our loads. Wherever they are installed – drivers' workplaces or residences or at carparks in public locations such as shopping centres – Better Place pays for the electricity drawn at that point. We own the chargers. Drivers and site owners do not.

We do not sell electricity to our drivers. We sell kilometres of driving. Electricity is just one of the inputs to the product package we sell. The package also includes provision of batteries and chargers, and use of our battery switch stations and quick charge stations across the road network.

We wish to have choice of retailer wherever we install charge infrastructure. We don't wish to have any particular relationship with the existing retailer at the workplaces or residences where our chargers are installed. However the current rules are forcing us into a relationship right now (see Section D below).

We expect to sell demand response services to retailers in the NEM. We may also offer distributors network support ancillary services.

A profile of Better Place is provided in Appendix I.

B. AEMC Question 1 - What are the key drivers and likely uptake of EVs in the NEM?

We forecast rapid growth in the number of electric cars on Australian roads starting from 2012. This view is grounded on the strong fundamental cost advantages of electric cars:

- **The competitive purchase price of electric vehicles** – With the arrival in Australia in 2012 of the Renault Fluence ZE, Australians will be able to purchase an electric car at a price which is very competitive with similar ICE vehicles. We expect that other equally well-priced electric cars will follow the Fluence ZE. We also expect electric car prices to fall over time as manufacturing volumes increase.
- **Low and steadily falling operating costs of electric vehicles** - The operating costs of electric cars are already lower than petrol for around 15% of drivers. (More detail below.)

There are two schools of thought among forecasters of electric car take-up rates. The first school – which predicts that EVs will sell at fairly low volumes - typically makes the same two flawed assumptions: (I) There will be no providers of battery finance – this means that the sticker price for an electric car will include the battery and will therefore be much higher than comparable ICE cars; and (II) There will be no EV charge networks – so prospective EV purchasers will perceive the car as a range-limited vehicle which is less convenient than comparable ICE cars. These are flawed assumptions because Better Place will offer Australian drivers both services and we expect competitors to do the same.

The second school of thought on electric vehicle take-up factors in both the provision of battery finance and the presence of charge networks and forecasts significant adoption of electric vehicles over the next decade, especially in markets where drivers have high petrol bills, like Australia.[1]

Better Place's modelling of electric car market penetration is built upon four parameters:

A. Economics – "I don't have to pay any more for an electric car – either upfront or in operating costs."
B. Customer attitudes – "I am prepared to consider an electric car for my next car."
C. Car availability – "I'm looking for a mid-size sedan and there are plenty of electric versions to choose from. "
D. Coverage of charge networks – "There are charge spots and battery switch stations in my city and along the highways where I go on longer drives."

A. Economics

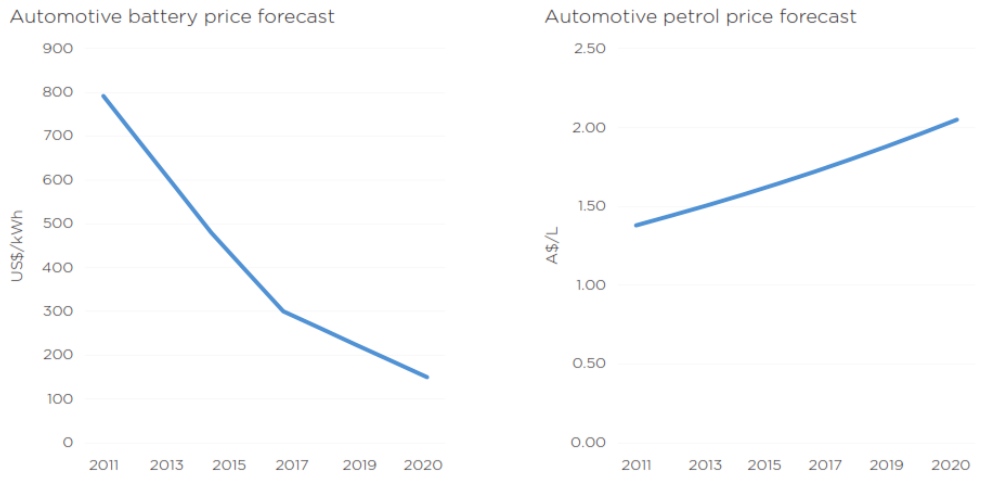
With the arrival of the Renault Fluence ZE in 2012, Australian drivers will be able to purchase an electric car from the dealer showroom at a price which is competitive with petrol vehicles of similar size and features. While Renault Australia is yet to announce the local price of the Fluence ZE, in the UK it is priced at £22,850 ($A32,500). We expect the Fluence to be followed by the launch of other

[1] One such study focusing on the US is: Becker, T. et al, *Electric Vehicles in the United States: A New Model with Forecasts to 2030, Center for Entrepreneurship and Technology – Technical Brief*, University of California, Berkeley, August 24, 2009.

equally well-priced electric cars in different formats from other car makers (including those from China) from 2013and beyond. (See Appendix II for more detail).

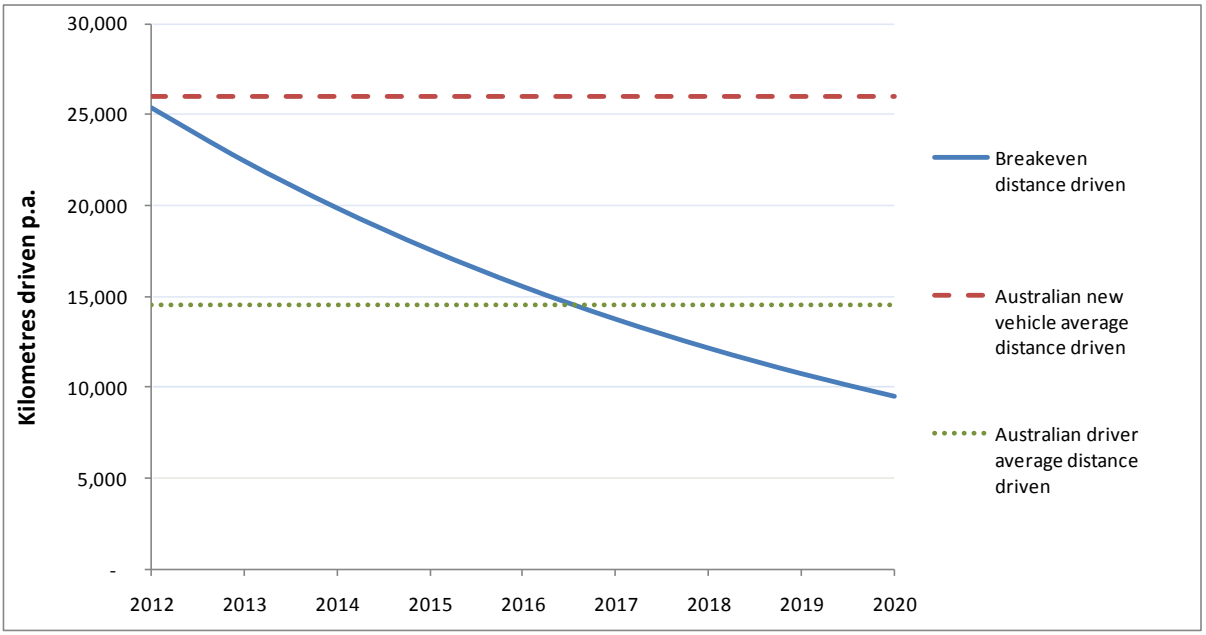
With regard to operating costs, we estimate that about half of new car buyers and around 15 percent of all drivers would save money right now by switching to an EV. In the next decade, more and more drivers will save money by switching to electric cars as the price of batteries falls and the price of petrol continues on its historical trajectory of around 4.5% growth per year. See Figures 1 and 2 below.

Figure 1: Battery prices going down, petrol prices going up[2]



[2] Sources: US Department of Energy, *Transforming America's Energy Sector: Batteries and Electric Vehicles,* 14 July 2010. Petrol prices are assumed to increase at 4.5% p.a. from 2011.

Figure 2: Annual mileage at which it is cheaper to switch to an electric car



Note: Compares cost of running a petrol car to cost of running an electric car. For the purposes of this analysis, electric car running costs include electricity, battery, and the per vehicle share of capital and operating costs for an electric car charging network like Better Place

B. Customer attitudes

The market research we have commissioned and the fleet manager discussions we have undertaken directly, indicates strong interest among purchasers of new cars in going electric. Better Place hired First Point Research to survey 1,000 new car purchasers in NSW, Victoria and Queensland in 2010. Respondents were asked to rate their interest in purchasing an electric car which is priced competitively with equivalent petrol vehicles with a subscription package containing the same elements as the subscription offered by Better Place. 40% of respondents indicated they were 'very interested' or 'quite interested'.

In the fleet market, Better Place has met with 120 of the largest fleet managers in Australia over the past year. 91% of fleet managers indicated they would be interested in trialling an electric vehicle. In addition, 70% of fleet managers have an emissions reduction target. Petrol price volatility is an ongoing issue for many fleet managers, so the certainty of a fixed price electric car subscription product had strong appeal.

C. Car availability

Every one of the world's largest 20 carmakers now has an electric model in production or coming into production. A wide range of electric models for different consumer segments will be available, including SUVs, luxury saloons, light commercial vehicles, people movers and sports cars. (See Appendix II for more detail.) There can be no doubt that these cars will be produced at high volumes and be very serious competitors in the automotive marketplace given the billions of dollars of capital investment in electric car manufacturing, battery manufacturing and charge networks which

has now been made globally from successful, proven players such as Renault-Nissan, GM, Ford, General Electric, Siemens, NEC and Toshiba.[3] Recent announcements include:

- The Chinese government decreed in 2010 that 1 million electric cars will be on the road in that country by 2015.[4]
- GM will increase US production of the Chevrolet Volt to over 45,000 per year by 2012.[5]
- General Electric has committed to purchase 25,000 electric vehicles by 2015.[6]
- Better Place has ordered 115,000 Fluence ZE electric cars from Renault.
- PSA Peugeot-Citroen has ordered 100,000 electric vehicles from Mitsubishi for sale under its brands in the European market.[7]

Australia is the third market globally in which Better Place is building a charge network, after Israel and Denmark. The presence of the Better Place Australia charge network will be an important factor in encouraging carmakers to supply competitively-priced electric vehicles into Australia ahead of other countries.

D. Coverage of charge networks

Australia will be one of the nations' best-served by EV charge networks globally. Better Place has commenced building its Australian charge network starting in Canberra with other capital cities and interconnecting highways to follow. Our public network will initially include 3.7 kW charge spots in carparks at shopping centres, sporting venues, train stations, university campuses and other public venues; 50 kW Quick Chargers at roadside locations and Battery Switch Stations which allow drivers to replace a depleted battery with a full one in less than 5 minutes. A range of other charge infrastructure providers are also active in the Australian market including ChargePoint, ECOtality, E-Station, Siemens, and GE.

Conclusion – Australia will be at the forefront of EV adoption

One million new cars are sold in Australia each year. For the reasons outlined above, we expect rapid growth in the share of this market held by electric cars from 2012. Now is the time to ensure that EV charging load is integrated into the NEM in the most economically efficient manner.

---

[3] The investment in China alone in the electric vehicle value chain is estimated at $17 billion (Dumaine, B., 'China Charges into Electric Cars, *Fortune*, 19 October 2010.) Renault-Nissan has committed $5.6 billion in its vehicle electrification program (Squatriglia, C., "Renault-Nissan CEO Pledges $5.6 Billion for EVs", *Wired,* 16 June 2011.

[4] Dumaine, 2010.

[5] Centre for Automotive Research, Ann Arbor, Michigan, *Deployment Rollout Estimate of Electric Vehicles 2011-15*, January 2011.

[6] Ibid

[7] Hammerton, R., 'Mitsubishi left at the altar – again', *GoAuto,* 10 March 2010.

C. AEMC Question 2 - What are the costs and benefits that EVs may introduce into Australia's electricity markets?

There are several important parameters to understand when forecasting the potential costs and benefits of electric vehicles in the NEM:

- The rate of charging – Kilowatts of consumption of the installed electric car chargers (often referred to as EVSE – Electric vehicle supply equipment)
- Volume of electricity consumed – Volume of kWh required to meet drivers' needs.
- When charging occurs – Are electric car chargers used when there is spare network and generation capacity available or are they used at periods of peak demand and capacity constraints?

The rate of charging

Chargers provided by suppliers such as Better Place for these 2012 vehicles draw a maximum of 3.7 kW, but faster home and workplace charging is coming. Chargers for the 2013 electric cars from Ford and BMW will draw 7.4 kW.[8] Three-phase chargers are also emerging. For example, in February 2011 Siemens announced its new three-phase charger, the CP700A which can deliver 22 kW of charging power. At a given price, consumers clearly have a preference for higher capacity batteries (to deliver more driving range) and faster fill-ups (to reduce waiting time). One would expect that today's 3.7 kW home and workplace chargers will be supplanted over time by devices which can draw higher and higher volumes of electricity. For comparison, we understand that a typical household connection in the NEM has a maximum draw of between 60 and 120 amps (or between 14 and 28 kW).

Volume of electricity consumed

This depends on a range of factors including fuel economy of the vehicle, driving patterns (i.e. city-highway mix), individual driving style, and mileage levels per annum. Better Place forecasts assume an average of 3.5 MWh per vehicle per year.

When does charging occur - Two scenarios

Decisions on regulatory settings will have significant influence over when charging occurs. If the right policy and regulatory settings are put in place now, electric car charging can be harnessed to improve the efficiency of the grid and the generation sector, and to help put downward pressure on power bills rather than worsening load shape and further pushing up electricity prices. The choice that the AEMC faces with regard to electric car charging is between two possible future scenarios.

Future Scenario 1 – Electric car charging worsens load shape and increases the burden of investment in network augmentation and additional generation	
Detail	In this scenario, electric car chargers are purchased as an appliance based on price and performance from traditional appliance retailers such as Bunnings, Harvey Norman and so on. Drivers install chargers at their homes and workplaces and are billed by retailers for the electricity they use in charging their cars under the same tariff structure which applies to the rest of their home or workplace. This tariff is

[8] *Ford Focus Electric Home Charging Station Certified*, Press Release, Ford Inc, Melville, New York, October 11, 2011.

	typically flat or a moderate peak/off peak structure. Most consumers do not want heavy penalties for electricity consumption at peak times because their lighting, heating, cooking and IT system use is hard to time-shift without impacting their amenity. Under this scenario, electric car owners will plug-in and immediately commence charging when they arrive at home or work due to its convenience. A small number may elect to use timers to delay their charging but, in general, charging will commence when the driver arrives at work or gets home in the evening. The result is that this charging will add to peak demand levels. Higher peak demand levels will require capital expenditure by distribution networks on network augmentation and higher network tariffs to pay for this expenditure. Higher peak demand will also tighten the supply-demand balance in the wholesale market resulting in increases in the average cost of energy.
Precedent	Air conditioners: • The worsening of the load shape in the NEM due to the market penetration of air conditioners over the past decade is well documented. • Under this scenario, electric car chargers would have similar results to air conditioners, but perhaps even stronger effects given car chargers have a higher (and increasing) rate of maximum demand.

Future Scenario 2 – Electric car charging promotes efficiency in the NEM	
Detail	In this scenario, electric car charging is separately metered and exposed to different tariff structures than the rest of the home or workplace consumption. Customers (such as charge network operators like Better Place or individual drivers who have secured their own 'EV tariff' from a retailer) schedule the charging of electric cars (A) to align with off-peak pricing periods and (B) to respond to dynamic signals from the market such as critical peak prices or demand response payments. The net result is that as the overall load from electric car charging grows, the scheduling of this load serves to improve load shape, puts downward pressure on network tariffs and shaves peaks in the wholesale spot market.
Precedent	Electric hot water systems: • These hot water systems were introduced into the market at volume from the 1950s and state-owned electricity corporations imposed compulsory load control, separate metering and discounted off peak tariff structures which resulted in improvements to system load shape. • We are **not** advocating for this 'command-and-control' approach to management of electric car chargers from 2012. Consumers require more flexibility in their use of electric car chargers than hot water systems. As well, we now have access to information and communications technologies (such as those developed by Better Place) which enable dynamic balancing of customers' charging needs with grid constraints. These technologies were not available in the 1950s. • However, this precedent does provide an example of how a new consumer appliance can be introduced into the electricity market in a manner which

	promotes more efficient use of generation and grid assets.

Potential cost of inaction on management of electric vehicle charging load

There are potentially very significant costs in additional investment in distribution networks and the generation sector if electric vehicle charging load is introduced to the NEM at large volumes without management. One way to think about this is to assess the cost of the additional capacity that would be required under a scenario where:

- There was a high rate of take-up of electric vehicles;
- A high proportion of electric vehicle drivers elected to install powerful chargers drawing 10 kW or more; and
- These chargers were used at the same time as peak demand in the NEM.

If this scenario were to eventuate, the result would be a rise in the growth rate of maximum demand across the power system requiring yet more investment new generation in plant and distribution networks. Recent papers by AGL's Dr Paul Simshauser have highlighted the vast costs for consumers and businesses in higher electricity prices which occur when system load shape worsens in this way.[9]

Potential benefits of 'Smart charging' of electric vehicles

Some preliminary research on the potential benefits of a managed approach to electric vehicle charging load has been undertaken. A range of analysts have concluded that with the right regulatory settings managed EV charging has the potential to improve utilisation rates of distribution and generation assets putting downward pressure on electricity prices.[10],[11]

[9] Simshauser, P. et al, "Limited-form dynamic pricing: applying shock therapy to peak demand growth", A*GL Applied Economic and Policy Research Working Paper No.24 – Dynamic Pricing,* February 2011. Simshauser, P., Nelson, T. and Doan, T. *"The Boomerang Paradox Part I: how a nation"s wealth creates fuel poverty – and how to defuse the cycle", The Electricity Journal, 2011*

[10] Scott MJ, Kintner-Meyer MCW, Elliott, DB and Warwick WM. 2007. "Economic Assessment and Impacts Assessment of Plug-In Hybrid Vehicles on Electric Utilities And Regional U.S. Power Grids." Online Journal of EUEC 1: paper #5.

[11] Kiviluoma J, Meibom P, 'Methodology for modelling plug-in electric vehicles in the power system and cost estimates for a system with either smart or dumb electric vehicles', *Energy* (2011), doi:10.1016/j.energy.2010.12.053

D. AEMC Question 3 - What are the appropriate electricity market regulatory arrangements necessary to facilitate the efficient uptake of EVs?

To deliver on the National Electricity Objective, the AEMC should establish regulatory arrangements that **support the development of an open and competitive market place for electric vehicle charging services.** Current regulatory settings in the NEM do not do this. There are two key regulatory barriers which limit access to the market and which create advantages for specific classes of market participant, to the detriment of end customers:

1. Establishing a new market meter and NMI at drivers' homes and workplaces incurs very high costs and lengthy delays
2. There are regulatory constraints on the network and energy tariffs that can be applied by distributors and retailers to EV charging load

D1. Establishing a new market meter and NMI at drivers' homes and workplaces incurs very high costs and lengthy delays

The price Better Place pays to establish a new market meter and NMI for each electric car charger is **$1,000 to $8,000 per workplace or residence** and installation frequently takes **2- 4 months**. Why? The cost driver is the requirement for physical access to the unmetered mains (i.e. to the electricity distributor's wires upstream of all existing meters at a site).

To establish oneself as a separately metered customer in the NEM currently requires this access. All work involving the unmetered mains is subject to extensive regulation for a host of sensible safety and fraud-prevention reasons. The work practices established under this regulation generate the extra costs and delays.

The specific steps which must be followed now to establish a new meter and NMI vary state by state. The Figure below outlines the process in Victoria and illustrates the extent of the inefficiencies involved.

Table - The process of establishing a new meter and NMI for an electric car charger in Victoria

Step	Notes
1. Registered Electrician (RE) installs wiring for electric car charger to switchboard at the site but does not energise.	
2. Better Place enters into a supply agreement with its chosen Retailer for the site (Retailer A)	Only a retailer is permitted to engage with a distributor to establish a new meter and NMI. Customers and REs are not permitted to do so, which introduces complexity into the process.
3. RE completes and sends an Electrical Work Request (EWR) form to Retailer A	
4. RE completes and sends an second EWR form to the Retailer for the residential or commercial customer at the site (Retailer B)	Both the existing meter and new meter will share the same service line to the premises so existing meter customer will be de-energised in the process of establishing the new meter. Retailer B must be sent an EWR so it can formally instruct the Distributor to de-energise the site.
5. The Retailer A sends the EWR form to the Distributor	
6. Retailer B sends the EWR form to the Distributor.	

Step	Notes
7. RE arranges for an Energy Safe Victoria accredited inspector to visit the site to inspect wiring and issue Certificate of Electrical Safety (COES).	Inspections cost an average of $285.
8. Inspector and RE meet at the site to complete the inspection, and the Inspector provides the RE with the COES.	
9. RE sends the COES to Retailer A	
10. Retailer A sends COES to the Distributor	
11. Distributor schedules first truck visit to the site and communicates this date to Retailer A who then communicates the date to the RE.	It takes 4-6 weeks between provision of EWR and CES forms to Retailer A and Retailer B and the date of the truck visit from Distributor is scheduled.
12. Distributor truck visit occurs and the RE is present when the truck arrives. If the meter board and meter panel at the site are deemed by the Distributor's service technician to be non-compliant for a second meter the RE must upgrade the meter board first, before the Distributor can install the new meter and fuse. The Distributor service technician de-energises the site using the service fuse.	Some distributors just nominate the date of the visit and state the visit will occur sometime between 8am and 4pm on that date. Some distributors offer a shorter 4 hour window in which their visit may occur. The RE must be at site waiting for the arrival of the Distributor trucks during these 4 and 8 hour windows, which is costly. At 90% of Victorian sites Distributors require upgrades to the meter board and meter panels.
13. While the site is de-energised, the RE upgrades the meter board and meter panel. The distributor truck may wait while this is done or leave to do other work and return when requested by the RE to re-energise the site.	Upgrading of a meter board and meter panel costs around $1000 in parts and labour. Depending on the site and the schedule of the Distributor technicians, they may stay at the site while the meter board and meter panel work is undertaken or they may schedule another visit. Distributor truck appointments are billable in 15 minute increments.
14. Second Distributor truck visit occurs to install the new meter, and disconnection fuse, and to reenergise the site. RE must be present at the visit.	Average cost of meter installation and meter test is $550.
15. Distributor allocates a National Metering Identifier (NMI) to the newly installed meter and communicates this NMI to Retailer A and Retailer B.	Turnaround time is 1-2 weeks.
16. Retailer B commences billing cycle for customer on the new NMI.	
TOTAL COST AND DELAYS	**$1000-$8000 in costs and 2-4 months.** This cost includes only the fees, material costs and labour costs which are required to secure a separate meter and NMI. It does not include costs of wiring for the electric car charger on site.

At some commercial sites we have found we cannot establish a new meter at all. The reasons for this are:

1. *Local distribution network capacity constraint* – At some sites, the distributor will not authorise the installation of a new meter and NMI for an electric car charger without a very costly upgrade to the capacity of the local distribution network and the service line to the building. When we apply for a new connection to the unmetered mains, the distributor will do a re-design of the local network. This can trigger extensive network upgrade work to meet design criteria. Installation and use of the charger without the new meter and NMI would **not** require the upgrade. Of course, at any time any customer can buy and install a charger and plug it into existing site wiring without informing the distributor.

2. *No access to unmetered supply due to design of main switch room* - In some commercial premises, the main switch room has been configured so there is no way to physically access unmetered mains supply. Changes to the main switch room to open up access to unmetered supply in a large corporate premises typically cost in excess of $10,000.
3. *Connection and metering configuration at the site* – At some commercial premises, we are advised by the local distributor that we cannot get access to the unmetered mains supply without de-energising the entire site, e.g. a high-rise building. This effectively means it is not possible to install a meter because of the significant disruption this would cause to the business operations of the multiple occupants of the site.

The requirement to access the unmetered mains in order to establish a new meter and NMI generates cost, complexity and delays in a variety of ways. It disadvantages some electric car owners compared to others. This requirement is a substantial barrier to the economically efficient uptake of electric cars.

Why separate metering for EV charging is needed

Separate metering for EV charging at homes, workplaces and other parking locations on the road network is needed for several reasons:

1. Separate metering is essential to ensure the benefits of off-peak charging of EVs are realised
2. Electric cars are a mobile device not tied to a specific premises like most appliances. Separating the billing of EV electricity consumption from the premises consumption is therefore needed.
3. To promote consumer choice and business model innovation in the electric vehicle charging services market

1. Separate metering is essential to ensure the benefits of off-peak charging of EVs are realised

As the Californian Public Utilities Commission recently noted in their 2011 Rulemaking on electric vehicles:

> "... the benefits of off-peak Electric Vehicle charging are manifold and accrue to the Electric Vehicle owners and non-Electric Vehicle owners alike."[12]

We estimate that 90% of electric car charging will occur at home and workplaces, with kerbside or public charge spots and battery switch stations providing range extension on the less-frequent, longer than usual trip. As flagged above, a high proportion of this charging can be time-shifted away from peak demand periods without inconveniencing the driver. However, this won't occur unless this load is separately metered and exposed to time-of-use, critical peak or other such pricing structures which reward consumers or charge networks for scheduling EV charging away from peak periods. (See Section D2 below for more detail.)

CSIRO are conducting a major trial and research project on electric cars called the Electric Driveway. Its 2011 project report highlighted the need for separate metering of electric car charging load to facilitate realisation of benefits from demand-side participation .[13]

---

[12] California Public Utilities Commission, Phase 2 Decision Establishing Policies to Overcome Barriers to Electric Vehicle Deployment, 25 July 2011. Page 14.

2. Electric cars are a mobile device not tied to a specific premises like most appliances. *Separating the billing of EV electricity consumption from the premises consumption is therefore needed.*

While most electric appliances are owned, operated and enjoyed by the occupant of the premises in which they are installed, this is not the case with electric cars. Electric cars move from place to place and the party paying for their operating costs is often not the occupant of the site where they are charged. Better Place has met with over 100 of Australia's largest fleet managers and conducted extensive market research with thousands of Australian drivers over the past two years. A range of common scenarios where separate billing is essential have consistently emerged from this research:

- **Vehicles provided to employees for work purposes** (eg – sales reps, couriers) are commonly parked at their homes at night. The employer needs to be billed for the EV charging not the employee.
- **Vehicles provided to employees as part of salary package** typically include fuel too. The employer needs to be billed for the EV charging at the employee's home, not the employee. Important for FBT reporting too.
- **Self-employed people** need to be able to separate vehicle fuel costs from their home electricity costs for tax purposes.
- **Employees bringing their own EVs to work** and wishing to charge them at their employers' office or factory car park. The employee needs to be billed for the EV charging not the employer.
- **Renewable energy accountability** to prove zero emissions motoring. For example, many corporate and government fleets have CO_2 abatement objectives. Metering of their electric car fleet's charging is needed to ensure it is from 100% renewable electricity.

For these drivers and fleet operators, unavailability of cost-effective, quick-to-implement metering for electric car chargers is a major barrier to adoption of electric cars.

3. To promote consumer choice and business model innovation in the electric vehicle charging services market

The California Public Utilities Commission undertook an extensive Review into electricity market arrangements and EVs in 2010-2011.[14] While submissions to the Review from large, incumbent electricity utilities argued that traditional metering approaches were adequate for the purpose of electric car charging, CPUC concluded that to maximise consumer choice and to promote a competitive and efficient market, reforms were necessary. In its July 2011 Final Rulemaking , it directed utilities to develop protocols for separate metering of electric car chargers, including submetering.[15]

---

[13] CSIRO Electric Driveway Project, *Plugging-in: A Technical and Institutional Assessment of Electric Vehicles and the Grid in Australia – Phase 1 Report,* 2011. Page 55.

[14] California Public Utilities Commission, Phase 2 Decision Establishing Policies to Overcome Barriers to Electric Vehicle Deployment, 25 July 2011.

[15] California Public Utilities Commission, Phase 2 Decision Establishing Policies to Overcome Barriers to Electric Vehicle Deployment, 25 July 2011. Page 41.

The advantages of submetering

More cost-effective and fast-to-implement metering approaches than are currently used in the NEM by distributors are available. One such option is submetering or parent-child metering.

In contrast to the current meter establishment process outlined above, connecting a meter and charger downstream of existing metering can be done quickly and cheaply by any registered electrician and is equivalent to connecting any other appliance. There is enough embedded digital intelligence in today's meters to establish a new, separately-billed customer in the NEM without accessing the unmetered mains. Meter data can be collected in digital form, repackaged to reflect, for example, a time-of-use tariff structure or the presence of a parent-meter-to-child-meter relationship, and then be communicated electronically to market participants. If we make use of available modern technology, it is not necessary to incur the extra costs and delays involved in physically accessing the unmetered mains.

Below is a diagram outlining how subtractive or parent-child metering is configured in the case where an electric vehicle charge network such as Better Place installs a charger at a customer's residence as part of an 'electricity included' bundled subscription package. Two NMIs – a parent and child NMI – are in place with the electric car charge network being the customer for the EV charger consumption and the resident being the customer for all other load at the site.

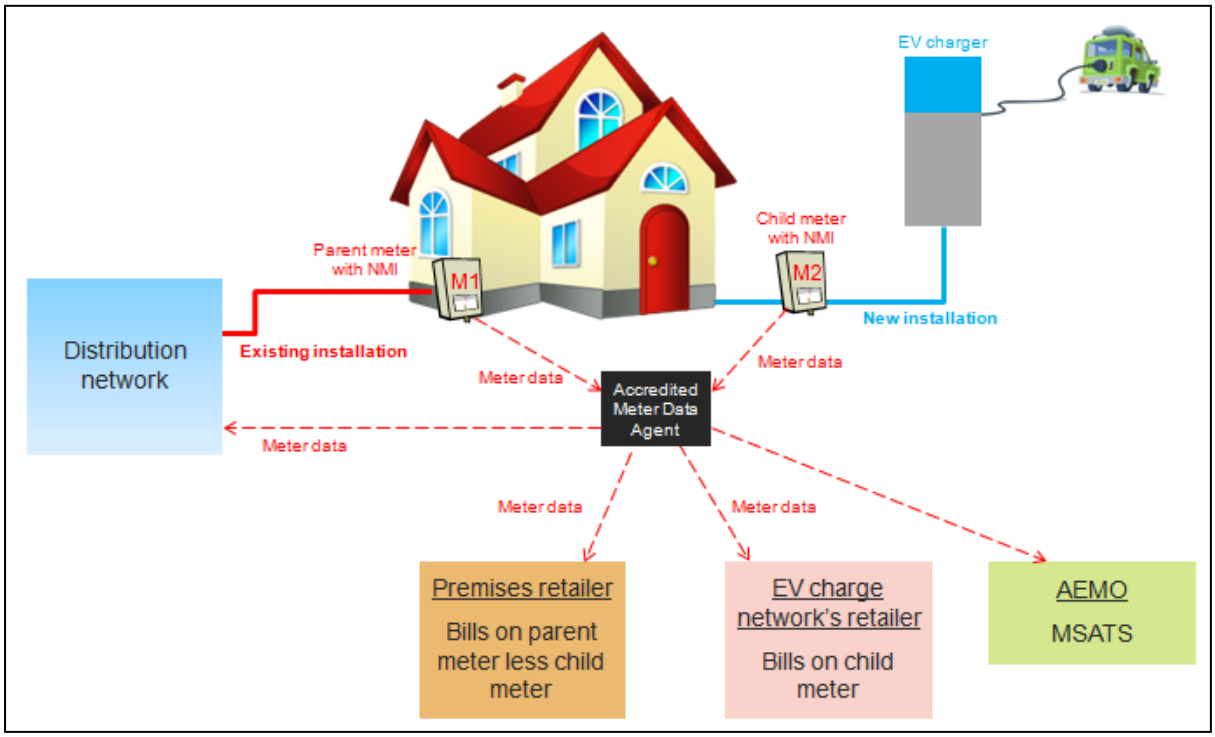


Figure 3 – Submetering configuration with parent and child NMIs

The advantages of the submetering approach include:

- Lower cost and quicker to implement than traditional metering model:
    - No need to establish a new physical connection point to the distribution network with all the attendant costs and delays. The existing connection point is shared by the new child meter customer, and tracking of consumption for settlement and

billing purposes is achieved via an automated subtraction of the two meter data streams.
    - Wiring work and meter installation can be undertaken on a single visit by a Registered Electrician.
- Already permitted by AEMO metering rules[16]
    - While it is permitted by the rules, a submetering configuration with a Parent NMI and Child NMI cannot be established at a site unless the distributor and the current site retailer consent. Better Place's experience is that distributors in the NEM do not support it and major retailers do not support it either.
- Supported by international precedent - California's Public Utilities Commission recently directed utilities to develop a sub-metering protocol for electric vehicle chargers.[17]
- Compatible with many brands of electric car chargers which are built with utility-grade meters inside them (examples include products from GE, ChargePoint, ECOtality, Leviton and Better Place)

D2. There are regulatory constraints on the network and energy tariffs that can be applied by distributors and retailers to EV charging load

The second market condition which needs to be in place is tariff structures from retailers and from network businesses which incentivise the dynamic timeshifting which electric car charging can provide. Such tariffs could include time-of-use tariffs, critical peak tariffs and other dynamic tariff or payment structures.

Under current state electricity pricing regulations, sites with small loads (such as the 3 to 5 MWH per annum we would expect a charger installed at a residence or workplace to consume) are generally not legally able to be offered time-of-use energy or network tariffs. These regulations exist to protect small consumers from high peak pricing for 'essential', non-discretionary electricity consumption such as heating, lighting or cooking. However these rules also prevent consumers (including Better Place) from obtaining the sorts of tariffs which are well-suited to the highly-flexible characteristics of electric vehicle charging load.

[16] See: AEMO Submetering or Embedded network establishment guidelines. http://www.aemo.com.au/electricityops/640-0169.html AEMO Submetering or Embedded network MSATS code allocation procedure, http://www.aemo.com.au/electricityops/0640-0003.pdf

[17] California Public Utilities Commission, Phase 2 Decision Establishing Policies to Overcome Barriers to Electric Vehicle Deployment, 25 July 2011.

E. AEMC 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?

E1. Metering

Changes to regulatory settings in this area are needed. The specific changes to regulations which are optimal ought to be assessed in detail through this AEMC Review.

Metering is an area of technical and regulatory complexity. A range of regulatory and legislative instruments govern business practices and options in this area. They include:

I. National Electricity Rules
II. AEMO Metrology Procedure
III. AEMO Embedded Network Guideline
IV. State legislation which underpins the licensing regime and service level obligations of distributors (For example, Victoria's *Electricity Industry Act 2000*)
V. State level Service and Installation Rules (SIRS) which govern business process and technical protocols for establishing connections to the distribution network and for metering. In Victoria, the SIRS committee membership is comprised of the five distributor representatives and Energy Safe Victoria.
VI. State legislative instruments such as the Orders in Council which govern the Victorian Advanced Metering Infrastructure Program

As the table below illustrates, no single stakeholder in the industry sees the whole picture. So we recommend that a consultative, cross-industry approach to regulatory change be undertaken.

Table – Stakeholders involved in establishing a new meter and NMI in Victoria

Stakeholder	Roles
Registered electrician	• Installation of compliant wiring, switchboard, and meter board and panel • Secure Certificate of Electrical Safety (COES)
Distributor	• Authorise connection to distribution network (unmetered mains) • Installation of service fuse for new connections • If the site is <160MWh, the distributor is the only authorised provider of metering services so it selects the Metering Provider and Meter Data Agent. • Issue new NMI. • Input change request to AEMO MSATS database to establish the embedded network, in the case of a submetering installation.
Accredited electrical safety inspector	• Confirm compliance of site wiring with safety regulations
AEMO accredited Metering Provider	• Install, activate and maintain a pattern-approved meter
AEMO accredited Meter Data Agent	• Collect, process, adjust and deliver meter data
Current site retailer (Retailer B)	• Serve as customer agent for site owner/resident in communications with distributor • Issue Electrical Work Request to distributor • Authorise de-energising of site by Metering Provider. • Consent to MSATS change request issued by distributor • Billing of site owner
Child meter retailer (Retailer A)	• Serve as customer agent for electric car charge network in communications with distributor

	• Issue Electrical Work Request to distributor • Billing of electric car charge network

E2. Tariff regulations

Amendments to state electricity pricing regulations which cover sites with small loads are needed to ensure that service providers such as Better Place and other types of consumer are not blocked from obtaining pricing offers from retailers which significantly incentivise electric vehicle charging at off peak periods.

Action from the Australian Energy Regulator (AER) to prompt distribution businesses to design and implement network tariffs for electric vehicle charging is also needed.

Appendix I - Profile of Better Place

Better Place is the world's leading electric car charge network company and has raised over US$700M in venture capital in the last 2 years – most recently from a consortium of leading global banks led by HSBC. The company works with all parts of the transportation ecosystem, including automakers, battery suppliers, energy companies, and the public sector and therefore has a detailed and up-to-date knowledge of global developments in this rapidly moving space.

To accelerate the mass adoption of electric cars, Better Place is building an intelligent network of plug-in charge spots at private homes, corporate and public car parks, which will provide most of the energy required. For extended range we will also deploy battery switch stations that allow the driver to swap their depleted battery for a full one in under five minutes and, where applicable, high-voltage quick charge outlets.

Australia is the third country in which the Better Place solution will be deployed (following Denmark and Israel), while publicly announced partial deployments in Japan, the US and Canada presage wider implementation shortly afterwards. As such, Australia is well positioned to be at the forefront of the transformation from petrol to electric cars.

Better Place will begin rolling out the necessary charging infrastructure by the end of 2011 in Canberra, with the national rollout commencing in 2012. We are also already participating in trials and rolling out tailored charging solutions for early adopters in Australia.

For more information visit www.betterplace.com.au

Appendix II - Electric cars available in Australia in 2011-12 and models likely to be available from 2013

Driven by widespread customer interest, significant government subsidies in many countries, and big improvements in battery performance and price, carmakers globally have invested many billions of dollars in new electric car models. Every major carmaker now has an electric model in production or coming into production. Below are the specific models currently available in Australia in 2011-12 and some models likely to be available in Australia in the next 3-4 years.

Mitsubishi iMiEV

Mitsubishi have already delivered over 110 of these compact city-cars, built on the Colt platform, to the Australian market. Production iMiEVs are now available in Australia from select Mitsubishi dealers and are retailing for $48,800. All vehicles delivered to date have been secured by 'foundation customers' such as Google, AGL, Victorian Government, and Better Place. Peugeot Citroen has signed a deal for 100,000 iMiEVs to be distributed in the EU under Peugeot Citroen branding.

Nissan Leaf

Nissan have supplied a demonstrator fleet of Leafs to the Australian market in 2011, and has announced that the Leaf will be available for Australian consumers in mid-2012. It is manufactured in Japan, US and UK facilities, with specifications and performance to compete with the Toyota Corolla or Hyundai i30. In the US, the car is priced at US$32,500. Nissan have announced production capacity of 50,000 units in 2011 which will eventually grow to 500,000 units per year.

Renault Fluence ZE

Renault Australia have confirmed that the Fluence ZE will be available in Australia in 2012. A mid-size family sedan with performance and features to compete with the Toyota Camry and Mazda 6 sedan, and switchable battery for unlimited range. The Fluence ZE is built on the same platform as the Renault Megane, Renault Scenic, Nissan Dualis and X-Trail. Better Place globally has a contract for over 100,000 Fluence ZEs from Renault. The European list price for the Fluence ZE is just €26,000.

Renault Zoe ZE

The Zoe ZE is a mid-size hatch, 4.10 metres in length and powered by a 60 kW motor, with a switchable battery for

unlimited range. Renault expects this car to be the highest selling electric car in the world. Renault plans to produce the Zoe ZE in very large volumes (especially for the European market) at very a competitive price.

Renault Kangoo ZE and Kangoo Maxi ZE

Renault Kangoo Express ZE and Renault Kangoo Maxi ZE are light commercial vehicles aimed at business users. They will be released in Europe in 2011, with Australian availability expected in around 2013. The vehicle is available in 2 or 5 seater form, with the Kangoo ZE including 3.5m^3 of carrying space and the Kangoo Maxi ZE 4.6m^3 of carrying space. The 22 kWh battery sits underneath the floorpan of the vehicle and provides 170 kilometres of range.

Holden Volt

Chevrolet Volt is the General Motors (GM) mass market range extension mid-size electric car. Launched in 2010, it is already selling in the US and will be released in Australia as the Holden Volt in mid-2012. The vehicle has a 16 kWh battery which is used to drive an electric motor for up to 80 km. It is estimated that GM has invested over $1 billion in development and tooling of the Volt which has similar features to the Holden Cruze. In 2011, Volt won both North American Car of the Year and Green Car of the Year awards.

Toyota Plug-In Prius

Toyota has been the market leader in hybrid vehicles for over a decade, with 2 million units of the Prius sold globally. The Prius Plug-in Hybrid EV is the next generation and will be released in a variety of models including an extended hatchback wagon and a 7-seater for Europe. The Prius Plug-in Hybrid EV will go on sale globally in 2012. Previously using older Nickel Metal Hydride technology, Toyota has moved to Lithium Ion batteries for its current generation vehicles. A higher specification “i-Tech” model features sav-navigation, leather seating and remote climate control.

Luxgen7+ SUV & MPV

Taiwanese car maker Yulon is manufacturing two electric vehicles under the Luxgen brand which will be targeted for markets including Australia. The Luxgen7+ people-mover and SUV are 4.8m in length and seat seven passengers. The SUV will have a 150kw motor and advanced telematics systems displayed on a 10 inch in-car colour screen. Yulon group is one of the largest manufacturers in the region with

over 500,000 units production capacity in Taiwan and China.

Tesla Roadster & Model S

Tesla successfully launched the Roadster in Australia in 2010 as a low volume super-car matching traditional petrol vehicles in performance and style. Tesla will launch the Model S family sedan in 2013 in Australia and will compete directly with BMW 5-Series and Mercedes E-Class. The Model S is the first fully electric sedan with a very innovative 7 seat configuration. It has a fully removable battery, and Tesla will offer a variety of battery options giving the car a range of up to 480 km. The Model S also features the largest touch-screen telematics and multimedia unit (at 17 inches), which replaces the traditional vehicles instrument panel layout.

Ford Focus EV

Virtually identical in appearance to the petrol-powered Focus, the electric variant has a 91 kW motor and a 23 kWh battery which delivers 160 km of range. Ford has actively promoted the vehicle's low servicing costs, and estimates that savings on maintenance and parts will be $1000-$1200 over the life of the vehicle. Service items required in the petrol Focus that are not required in the electric model include oil and filter changes, spark plugs, and drive belt replacement.

Volvo DRIVe C30

Based on the petrol C30, the two- door electric coupe has a range of 150 km and was one of the first electric cars to achieve excellent safety results in crash testing. This included safely de-coupling the battery from the powertrain on impact. With the batteries situated underneath the vehicle, the coupe retains all its previous luggage space. Production began in June 2011 with the US targeted as the first market. It is anticipated that the C30 will be launched in Europe in 2012, alongside larger electric Volvo models.

Hyundai BlueOn i10

Hyundai has been developing their bestselling small car as an electric car for the past two years and is currently testing pre-production vehicles in South Korea. With a 16.4 kWh battery, Hyundai's first electric production car will have a range of 140 km. Sales will be limited to the Korean market in 2012 before Hyundai releasing a global car in 2014.

Mercedes E-Cell B-Class

Mercedes have launched the E-Cell sub-brand for their electric cars. They have announced production of no less than 7 hybrid versions of their vehicles. The SLS AMG Gullwing E-Cell super-car will debut the range in limited production numbers before global release of more affordable versions based on A & B Class vehicles. The hybrid and all-electric B Class is anticipated to go on sale in 2014.

Mercedes Vito Van

Mercedes have also announced a full-size 900kg payload electric version of their best selling van, the Vito. Already in trials across Europe, the Vito retains all of its payload capacity thanks to the underbody mounting of the battery and front wheel drive motor. Mercedes is evaluating the vehicle through various market trials ahead of small scale procution.

BMW i3

BMW recently announced production intent of their i3 city car. The i3 is a small electric vehicle that will compete against the Nissan Leaf and similar sized vehicles such as their own 1-series. BMW will invest more than €400 million in developing electric vehicles by 2013 including additional manufacturing capacity in Germany. The i3 has a 125kw motor and range of between 130 to 160kms.

Toyota RAV4

In conjunction with technology partner Tesla, Toyota has begun the program for production of the RAV4 as an electric compact SUV. The vehicle will use carry-over technology from previous Tesla and Toyota programs and is reminiscent of the original EV – the Toyota RAV4 of the early 1990s. It is anticipated to follow the Prius PHEV into global markets.

Volkswagen Golf

The third best-selling car in history, the Volkswagen Golf will be manufactured in two electric versions; a pure EV (Blue-e-motion) and a PHEV (TwinDrive). Both variants are anticipated to be launched in Europe in 2013 followed by other markets. The Blue-e-motion hatch is powered by a 26.5 kWh battery, has a range of 150 km and is already in field testing in Germany.

Audi E-Tron R8, A3, & A1 PHEV

Like Mercedes, VW's Audi brand has announced a pure electric sub-brand called E-Tron, which currently features three vehicles. The super-car R8 based E-Tron is under production development and will feature two electric motors attached to the rear wheels, with power output that will drive

the vehicle from 0-100kph in less than 6 seconds. The more mainstream A3 E-Tron production design was recently launched and will contain all features associated with the luxury Audi brand. A PHEV version of the A1 is in field testing in Germany and may be the first electric Audi to reach the Australian market.

Coda Automotive

Coda Automotive is a start-up manufacturer based in California, their first vehicle offering, the Coda Sedan is already on sale in the US for $44,900. Coda recently signed an MOU with Chinese manufacturer Great Wall Motors to develop further EV technologies. The Coda Sedan is a mid-size vehicle with a 33.6 kWh battery pack given 240 kms range and will compete against similar size cars such as the Toyota Corolla and Mazda3.