THE SENATE

SENATE SELECT COMMITTEE ON ELECTRIC VEHICLES

Public Hearing – Brisbane, 27 September 2018
Questions Taken on Notice – Fast Cities Australia

1. HANSARD, Pages 24-25

Senator KIM CARR: Thank you very much. So you need 42 chargers. That gets you basically the Pacific and the Indian Ocean Rim, doesn't it?

Mr Fox: It is 42 sites. Each of those sites should have two charging heads. You saw those. They're like a bowser. Two of those—

Senator KIM CARR: Sure. Would the 42 facilities basically get you the main highway links on the coast?

Mr Fox: It gets you from Adelaide to Cairns, it gets you a bit of Tassie, which the senator from Tasmania would like to know, and a bit around Perth as well, so that we—

Senator KIM CARR: But it doesn't get you up through the north-west?

Mr Fox: No. That would take 100 sites. Our current vision is to get 100 sites—

Senator KIM CARR: I just want to get an idea of what it means. That's essentially the largely populated coastal strip?

Mr Fox: Yes.

Senator KIM CARR: And it doesn't cover the less populated coastal strip of the north-west?

Mr Fox: No.

Senator KIM CARR: Or the gulf?

Mr Fox: It would basically follow highway 1, if you like—the main routes in Australia. Once we get to 100 sites we start to cater to some of the secondary routes—New England, inland Victoria and so forth.

Senator KIM CARR: So, the hinterland doesn't get covered under this model?

Mr Fox: Not under the 42, but under 100.

Senator KIM CARR: So, 100 gets you—what, is it out the back of Queensland?

Mr Fox: It doesn't necessarily get you the back of Queensland. I can probably take it on notice. I think we did supply a map—

Senator KIM CARR: Yes, if you would, please. I just want to see this, because one of the issues that does occur to me is the regional disparity.

2. HANSARD, Page 28

Senator BUSHBY: Mr Whitby, you were talking about a one-only demand tariff charge. Just explain to me why they would be paying more than one if they went to different places I mean it's not a single payment, is it? It's an additional charge that is attracted whenever you use energy.

…

Senator BUSHBY: If you are able to put anything to assist further—

Mr Fox: That does sound arcane. It is. We had a tariff specialist who suggested it to us; at first, we were quite lost. It is arcane. We've made some submissions to networks that kind to lay it out in a little bit more plain English, and we can share those.

Senator BUSHBY: Thank you.

Senate Select Committee on Electric Vehicles

Answers to Questions on Notice at Public Hearing in Brisbane on 27 Sep 2018 - Fast Cities Australia

Number of Chargers required for Coverage and potential Regional Disparity

Hansard Pages 24-25

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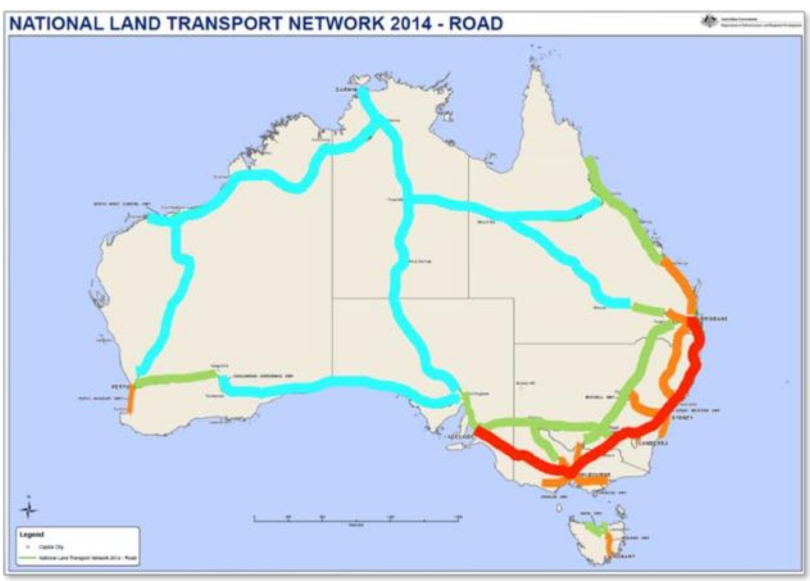
- Mr Fox: It doesn't necessarily get you the back of Queensland. I can probably take it on notice. I think we did supply a map—
- Senator KIM CARR: Yes, if you would, please. I just want to see this, because one of the issues that does occur to me is the regional disparity.

Fast Cities does not reveal the proprietary site selection criteria used to determine the 42 sites in the initial roll-out. However, we can share our analysis for the entire National Land Transportation Network (NLTN), i.e. the Federally funded highway system. Our analysis shows there is risk of regional disparity.

Lack of highway charging is a major barrier to the uptake of passenger and light commercial electric vehicles. This analysis considers ultrafast chargers on highways and the outskirts of cities and large towns, but does not include ultrafast chargers in urban and sub-urban environments. Eventually there will be thousands of chargers on highways, urban areas and workplaces.

The following map shows the National Land Transportation Network (NLTN) colour coded according to population density and remoteness from other population centres.



To estimate the number of highway charging sites, Fast Cities defined the network in terms of links and nodes. Nodes are population centres, popular day trip destinations, and/or major intersections (e.g.

Tarcutta on Hume Highway). While the highway network has thousands of nodes and links, we simplified the network to create a manageable number of links. The total highway distance is 22,336 km comprising 41 links of between 55 and 2,100 km in length, with an average link length of 545 km.

We assumed that cities and major towns have a charging station on edge of town in each direction. We further assumed that smaller towns would have a single charging station. We have taken two approaches to the spacing between the charging stations. The first is to adopt the “best practice” used by policy makers around the world, which is 75 km intervals (recommendations range from 50km in Norway to 50 miles in the US). The second basis for spacing is 150km based on the range of affordable electric vehicles (e.g. Nissan or Hyundai) and safety considerations, i.e. that drivers should rest every two hours.

The following table shows the results of the analysis. Note these numbers may vary as we improve our analysis in the future.

Scenario	**Average Spacing**	**Number of Sites**	**Notes on Coverage**
World best practice of 75km for entire NLTN.	75km	~268	Entire NLTN (Red, Orange, Green and Blue).
Coverage assuming capability of “affordable” EV and safety.	150km	~160	Entire NLTN (Red, Orange, Green and Blue).
Fast Cities mid-term vision, i.e. 100 sites	150 km	100	Routes coloured in Red, Orange and Green with in-fill sites.
Fast Cities “minimum viable network” to catalyse the EV market.	150km	42	Primary routes, day-trip and some regional coverage, i.e. Red routes plus about half the Orange routes and several Green sites.

In answer to the Senator’s question, 100 sites would give coverage on primary and secondary NLTN routes through regional areas, especially in the South East. However, coverage would hug the coast in North Queensland. The initial 42 sites needed to kick-start the market are focused on primary routes and “day-trips” radiating out from the main population centres.

Currently highway charging is not commercially viable on any route as there are very few electric vehicles on the road. This is the “chicken and egg” market failure that Fast Cities is trying to solve in partnership with government.

Even when there are large numbers of EV on the road there will still be a market failure. Naturally sites closer to cities and well positioned sites on the higher volume routes will be more commercially attractive. Similar to wireless telecommunication networks, the network must provide both capacity (on the high-volume routes) and coverage (across all but the most remote routes). In a well designed network the high-volume sites help pay for the lower volume sites.

However, like wireless and broadband networks there is a danger that some routes will not be commercially viable for many years, if ever. Therefore, there is a market failure in provision of fast charging in regional areas that will require government support, particularly during the early years of EV adoption.

Demand Charge Exemption for Public Fast Chargers in Plain English

Hansard Page 28

- Senator BUSHBY: Mr Whitby, you were talking about a one-only demand tariff charge. Just explain to me why they would be paying more than one if they went to different places I mean it's not a single payment, is it? It's an additional charge that is attracted whenever you use energy.
- Senator BUSHBY: If you are able to put anything to assist further—
- Mr Fox: That does sound arcane. It is. We had a tariff specialist who suggested it to us; at first, we were quite lost. It is arcane. We've made some submissions to networks that kind to lay it out in a little bit more plain English, and we can share those.
- Senator BUSHBY: Thank you.

In Attachment 1 our tariff consultants have interpreted the application of the National Electricity Rules (NER) 6.18.5 "Pricing Principles" to electric vehicle charging to show that a demand charge exemption is the simplest and most equitable solution. However, that analysis still requires an understanding of electricity pricing policy, pricing practice, probability & statistics, and the usage patterns for fast chargers.

Therefore, we've taken on the challenging task of explaining in plain English below. Readers who are experts in the field, which we are not, are requested to forgive the following gross simplifications.

Imagining that electricity is like water can help because most of us are more familiar with water flow than the invisible flows of electrons. The size of a pipe is a determined by how much water we need (usage), and how quickly we need it (demand).

If we need a lot of water very quickly, then we need a big pipe. At home during most of the day we only draw a little water. But first thing in the morning and around dinner time we need more and we need it faster. Once a year we have a big family celebration, when all our friends and relatives visit. On that day we will use a lot and we'll need it very quickly. We need to have a big enough pipe connected to our home to meet the demand of that single day, even though most times we use very little water. Now imagine Christmas Day, when a significant portion of the entire population is drawing their maximum demand of the year on the same day. The whole water network needs to be big enough to supply that total demand, even though it might only happen for one or two days in the year.

While electricity is invisible, and flows through different sized wires rather than different sized pipes, the principle is the same.

The cost stack for energy for a home or business is made up of wholesale energy, *network costs*, retail costs and a small portion of additional fees. The network cost typically includes components based on the actual energy used (energy usage in kWh), a connection cost (i.e. cost incurred for having a connection, even if no energy used), and any demand charges. For a consumer these different costs are generally dandled together, but for a business customer they are more likely to be separated out.

A demand charge reflects the maximum demand in kilowatts (kW) the customer puts on the network during a peak period defined by the network businesses, i.e. the size of the "pipe" required. The introduction of demand charges recognises that a quarter of all network investment in poles, wires and transformers is to service a peak demand that only occurs in the busiest 40 hours in a year. In Australia these critical peak hours generally occur during a handful of the hottest days of the year, due to large air-conditioning loads. Demand charges are intended to be a price signal to customers to minimise their peak demand and therefore the cost of the network.

Specific network tariffs for business (including the demand charge) are typically based on the level of the grid connection, i.e. low voltage (smaller pipes) or medium voltage (bigger pipes), and the amount of energy used by the business.

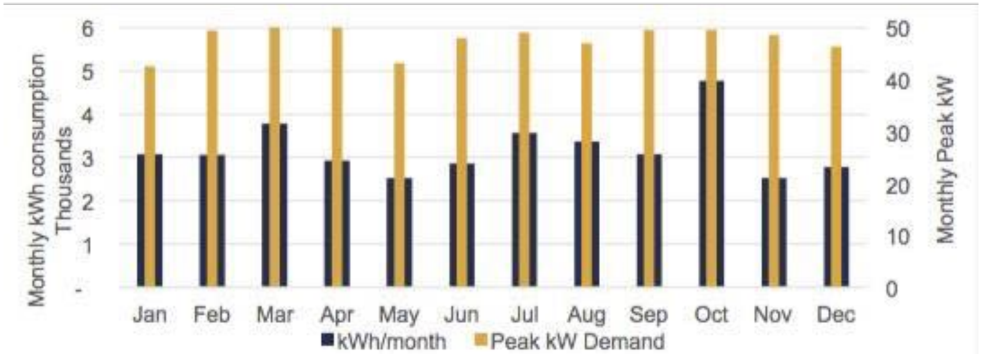
However, public fast chargers behave quite differently than the typical small or medium business.

Small to medium commercial or industrial customer	**Public fast electric vehicle charger**
Predictable stationary load driven by mix of production equipment and air-conditioning.	Connection point for mobile loads which typically (85% of time) charge at home or work and may arrive at a public charge point at any time.
High ratio between energy (usage) and power (demand).	Very low ratio between energy (usage) and power (demand), i.e. more like a microwave oven than an air conditioner or manufacturing machine.
High asset utilisation, i.e. the equipment is productive almost continuously during 8 to 12 hour shifts.	Low asset utilisation, i.e. typically used only for 2 to 4 hours per day. Utilisation is capped because higher utilisations lead to additional wait time for drivers leading them to go elsewhere to charge.
Owner has the discretion to shift load and demand, e.g. stagger the start of machines to reduce the peak, or turn-off half the chillers during peak times.	Limited ability to shift load and demand. Drivers arrive when they arrive and desire a fast charge when they arrive.
Maximum daily or monthly demand may have correlation with coincident network peak demand.	Maximum daily or monthly demand unlikely to have correlation with coincident network peak demand.
Energy costs are a small component of overall cost of goods sold.	Energy costs are most of the cost of goods sold.

Therefore, demand charges have a disproportionate impact on public fast chargers. For example, a site in Queensland with good utilization would have the following cost of goods sold:

- Energy usage $0.18 / kWh (i.e. the energy pumped into electric vehicles)
- Network Demand charges $0.22 / kWh
- Network Fixed charges $0.03 / kWh

In this case, the network demand charges are 52% of the cost of goods sold for the public charge point operator. Moreover, the demand charge from month to month would be relatively static (even though coincident network peak demand actually only occurs in summer month) while the energy served to customers will vary considerably. The following chart from Rocky Mountain Institute shows the impact of high demand charges a public fast charging site in California.

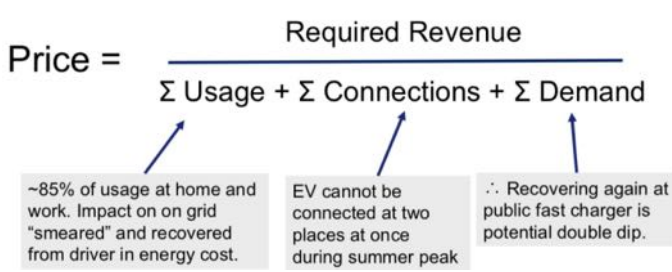


In reality, each public fast charger site would have a different demand charge and different utilization, resulting a different COGS for each site. The impact on the commercial viability of charge point operators is obvious and even more significant for sites in regional areas with relatively low utilization.

The next important concept to understand is how network pricing is determined in aggregate and smeared across all customers on the network. Essentially, the electricity network price is based on the required revenue needed to make a regulated return on all the capital invested in the network. The required revenue is spread across the aggregate usage, aggregate connections and aggregate demand. Conceptually represented like this:

$$\text{Price} = \frac{\text{Required Revenue}}{\Sigma\ \text{Usage} + \Sigma\ \text{Connections} + \Sigma\ \text{Demand}}$$

Unlike the traditional loads on the network, electric vehicles are mobile loads. Most of the time they are not charging. When they are charging, an estimated 85% of that charging will be at home or work. Each kWh purchased at work or home includes a network charge intended to recover the impact of that electric vehicle on the grid. However, an electric vehicle cannot be in two places at once. Moreover, the chances it is charging at a public charger during one of the ~40 hours of coincident network peak demand per year is very low. Levying the driver a demand charge at a public charger represents a very high risk of double charging the driver for the impact of their vehicle on the network. This concept can be illustrated as follows:



In theory, a special demand charge could be designed for public fast chargers that takes into account these factors and the probability that an EV is connected to a fast charger at the time of coincident network peak demand. Such a calculation would result in a significantly reduced demand charge. However, it would likely be quite complex and still result in significant chance of over recovering the impact of an electric vehicle on network costs. Jurisdictions around the world have recognized the issue and taken steps to reduce or exempt demand charges, for example California is introducing a 10 year exemption. However, given the significant benefits to society, drivers and the networks themselves of electrification of transportation, we believe the fairest and most equitable approach is a demand charge exemption for public chargers.

Attachment 1 – Application of NER 6.18.5 Pricing Principles to Electric Vehicle Charging

Extract from NER:

> *(e) For each tariff class, the revenue expected to be recovered must lie on or between:*
>
> > *(1) an upper bound representing the stand alone cost of serving the retail customers who belong to that class; and*
> >
> > *(2) a lower bound representing the avoidable cost of not serving those retail customers.*

Application to public fast charging:

- The standalone cost of only serving public EV charge points would be quite high as they are geographically distributed across the whole network. As a result, it is the geographic dispersion rather than the capacity that would drive the majority of the standalone cost.
- The avoidable cost of not serving public EV charge points is very low as the distribution network is already required across the network service area and connection charges recover the incremental cost of capacity to accommodate the connection. Therefore the avoidable costs are simply the ongoing administration of the connection and a small incremental operating and maintenance (O&M) cost.
- Therefore it is appropriate that the tariff for public EV charge points is set at a level that is closer to the avoidable cost than the stand alone cost. This is reflected in a standing charge (administration) and volumetric contribution to O&M

Extract from NER:

> *(f) Each tariff must be based on the long run marginal cost of providing the service to which it relates to the retail customers assigned to that tariff with the method of calculating such cost and the manner in which that method is applied to be determined having regard to:*
>
> > *(1) the costs and benefits associated with calculating, implementing and applying that method as proposed;*
> >
> > *(2) the additional costs likely to be associated with meeting demand from retail customers that are assigned to that tariff at times of greatest utilisation of the relevant part of the distribution network; and*
> >
> > *(3) the location of retail customers that are assigned to that tariff and the extent to which costs vary between different locations in the distribution network.*

Application to public fast charging:

- The typical network pricing method is essentially based on dividing the required revenue for the network across the demand (demand charges), volume of connections (standing charges) and usage (volumetric charges). The proposed exemption from the demand component of costs for public EV charge points recognises that the majority of demand attributable to EV charging (when considered over the duration of the SPW) would occur at ‘slow’ charging points at fixed addresses (i.e. effectively stationary loads), likely 85-95%.

- This treatment of mobile loads ensures that both customers and the network can realise the potential benefits of accelerated uptake of EV’s, without imposing an inequitable charge on EV users by charging them twice for the demand attributable to their vehicle. Inequitably high ‘fast charging’ tariffs will impede the uptake of electric vehicles and subsequent customer, network and environmental benefits.
- Should a demand charge be necessary for public EV charge points, it should reflect only the incremental, aggregate, diversified component of demand on the network that is attributable to the operation of all public charge points. This would be much less than the undiversified sum of demand at each charge point. In inle with 6.18.5(f)(2) this ensures that public EV charge points only incur the <u>additional costs of meeting their demand</u>.

Extract from NER:

(g) The revenue expected to be recovered from each tariff must:

(1) reflect the Distribution Network Service Provider's total efficient costs of serving the retail customers that are assigned to that tariff;

(2) when summed with the revenue expected to be received from all other tariffs, permit the Distribution Network Service Provider to recover the expected revenue for the relevant services in accordance with the applicable distribution determination for the Distribution Network Service Provider; and

(3) comply with sub-paragraphs (1) and (2) in a way that minimises distortions to the price signals for efficient usage that would result from tariffs that comply with the pricing principle set out in paragraph (f).

Application to public fast charging:

- The total costs of serving public EV charge points are incremental to the costs already recovered for demand attributable to private EV charging. Charging the full demand tariff on public EV charge points would not distort the total revenue recovered (i.e. 6.18.5 (g) (2)), but would distort the price signals for efficient usage of the network by limiting the ability of public EV charging infrastructure to contribute to load balancing (e.g. solar soaking) during the day and restrict drivers’ ability to charge commuter vehicles using their own rooftop solar.
- This would have the unintended consequence of forcing greater EV charging at night – resulting in higher environmental costs due to the increased servicing of EV’s by fossil fuel power stations and fewer benefits to customers being able to be realised from their private solar PV investments.

Extract from NER:

(h) A Distribution Network Service Provider must consider the impact on retail customers of changes in tariffs from the previous regulatory year and may vary tariffs from those that comply with paragraphs (e) to (g) to the extent the Distribution Network Service Provider considers reasonably necessary having regard to:

(1) the desirability for tariffs to comply with the pricing principles referred to in paragraphs (f) and (g), albeit after a reasonable period of transition (which may extend over more than one regulatory control period);

(2) the extent to which retail customers can choose the tariff to which they are assigned; and

(3) the extent to which retail customers are able to mitigate the impact of changes in tariffs through their usage decisions.

Application to public fast charging:

- As EV's are an emerging technology, albeit with a high expected growth rate over the 2020-25 period, the need for separate treatment of public EV charge points is a new issue for networks. Therefore, a change in how the relatively few existing public EV charge points are treated is appropriate (and in fact desirable prior to the wide scale uptake of the technology). Given the emerging nature of EV influence on distribution networks, it may be appropriate to establish a 5 or 10 year transitional tariff for public EV charge points. This would allow the network tariff to be adjusted during the annual pricing proposal in response to actual market development over the regulatory period.

Extract from NER:

(i) The structure of each tariff must be reasonably capable of being understood by retail customers that are assigned to that tariff, having regard to:

(1) the type and nature of those retail customers; and

(2) the information provided to, and the consultation undertaken with, those retail customers.

Application to public fast charging:

- Imposing site specific demand charges on public EV charging points will cause significant variability in charging costs at each fast charger location. This is because each site will have a reasonably high variability in energy throughput – and subsequently the effective price per kWh of energy supplied. As a result the charges to EV customers would likely vary from site to site due to network and usage factors, causing increased customer confusion, a reduced fast charger network size and ultimately an artificially reduced uptake of electric vehicles.

Extract from NER:

(j) A tariff must comply with the Rules and all applicable regulatory instruments.

Application to public fast charging:

- Fast Cities has not identified any areas where the proposed solution would not comply with a network's regulatory obligations.