Mr Tyson Self, Manager Projects,

Economic Regulation Authority,

Dear Sir,

My name is Andrew Went, and I am making this public submission on behalf of our research group at Curtin University Sustainability Policy Institute (CUSP). We have been investigating the unique potential for Smart Grids, in conjunction with Electric Vehicles and Renewable Energy to enable the rapid decarbonisation of both stationary energy generation and transport related emissions for a number of years now. I am currently in the third year of my doctoral research program on this topic.

This submission is divided into 5 sections. We firstly illustrate an aspirational vision of what a fully realized Smart Grid could be like, and suggest this as a guiding principle of what the ultimate goal of our energy infrastructure should be. We then make some general comments on Western Power's Smart Grid proposal, followed by a discussion of the Cost Benefit Analysis, with particular emphasis on EV implications and the need for further study of their impacts. We pay particular attention to one aspect of the CBA we felt required greater emphasis in the next section, before some concluding remarks regarding the magnitude of the missed opportunity should this chance to modernize the grid be missed.

Please feel free to contact me should you have any further questions. Sincerely,

Andrew Went

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CUSP's Smart Grid Vision

The benefits of adopting Smart Grid technologies extends far beyond the already substantial justifications for doing so, i.e. optimizing the existing infrastructure assets, using electricity more efficiently, as well as enabling a quantity of renewable and distributed generation sources to supply our energy needs.

However, when combined with Electric Vehicles, Smart Grids offer the tantalizing possibility of significantly accelerating the decarbonisation of both stationary and transport related emissions by enabling a much higher reliance on renewable energy sources of generation than was traditionally thought possible.

Briefly, this opportunity exists by realising that, since electric vehicles can only recharge when not being used (i.e. when parked), they allow the fundamental axiom of electricity networks - that supply and demand must be balanced on a moment by moment basis - to be approached by utilizing the greater level of flexibility and control of vehicle charging loads on the demand side (e.g. Smart Charging), to counteract the increase in fluctuating output and uncertainty on the supply side that results from a large increase of intermittent renewable generation. Even more renewable generation could be accommodated by also allowing EVs to supply energy from their batteries, in what is known as Vehicle-to-Grid (V2G).

This is made possible by the advanced communication and control capabilities enabled by Smart Grid technologies to intelligently control the rate at which EVs connected to the grid are charged and discharged at. The vital importance of Smart Grids as an essential element in achieving the society wide reduction in carbon emissions necessary to avoid the worst impacts of climate change cannot be overstated.

The crucial first step in this transition is to ensure that the introduction of EVs occurs as smoothly as possible, and any potentially negative impacts they may have on the electricity grid be managed as effectively as possible.

Overview of Western Power's Smart Grid proposal

Considering how essential the smooth introduction of EVs are to an optimized Smart Grid, we are pleased that EVs have received explicit consideration in Western Power's Smart Grid proposal, especially as they constitute a large and unique new type of load that has not been planned for in traditional demand growth forecasts.

The gradual roll out strategy Western Power proposes appears to be a well balanced and reasoned compromise between the scales of economy of a rapid deployment, without undue over commitment to any one particular set of technologies, while also providing for valuable lessons and insights learnt from the roll out during AA3 to be applied to the full scale smart grid implementation during the AA4 period.

Western Power should be commended in its recognition of the importance of customer engagement and education as a core component of its Smart Grid strategy. Feedback from the Victorian Smart Meter deployment suggests that this was an under looked aspect of their program, and subsequently resulted in significant public outcry with potentially significant political backlash.

Comments on the Cost Benefit Analysis

After reviewing Western Power's CBA in detail, we are of the opinion that the conservative approach taken towards quantifying the costs and benefits, reflect positively on the final outcome that there is significant potential benefits to be achieved from adopting this Smart Grid proposal.

However, we also feel that there are a number of costs that may have been underestimated in the BAU scenario, while the Smart Grid scenario did not highlight the potential value of vast amounts of renewables being feasibly integrated into the grid as described earlier, as strongly as it could have (albeit though that might be some years away).

It is widely considered unlikely that EVs will be spread throughout the network in a homogenous, evenly distributed pattern. Rather, it is likely that there will be pockets of higher income early adopters that will result in a high density of EVs on certain segments of the network than the overall penetration would suggest. The consequence of this, especially in the BAU case, would be sooner and greater network augmentation being required earlier than would be expected if assuming they were spread out evenly, as would likely be the case in an initial, high level CBA modeling exercise such as this.

To demonstrate this, we have attached a copy of a work in progress on likely locations of where clusters of EV early adopters may live in Perth. The darker areas represent concentrations of people who meet the set of socioeconomic and demographic criteria, as suggested by the literature, as being indicative of the type of people likely to purchase an EV in the short term. The data used was obtained from the ABS Census.

In addition to the spatial clustering of EVs, the temporal clustering of when EVs charge will also contribute to the overall impact on the network. The general pattern of residential daily demand fluctuations is largely a function of the presence of people in their homes. When people arrive home from their daily activities, such as work or school, they start turning on appliances and demand increases. Thus, there will be a natural tendency for EV charging to coincide with when the existing daily peaks in demand occur.

The benefits of being able to incentivize people to delay charging their vehicles by a few hours to when there is more spare capacity in the network should be clear. What is less obvious however, is the magnitude and structure of the incentive mechanisms required to achieve a desired amount of demand response from deferred charging.

The effects of demand response programs for EVs will require special attention and consideration, as people will rightly be more concerned about the potential consequences of participating in a demand management program for their EV, if it might mean being stranded on the side of the road with an empty battery if they were to suddenly need to go somewhere.

In addition, since not everyone arrives home at exactly the same time, neither will every EVs be trying to charge at exactly the same time either. When predicting the impacts that new loads will have on the network, Demand Forecasters are less concerned by the maximum load that any individual appliance (in this case, an EV) will place on the grid; but rather, the more useful metric is the maximum demand that should be anticipated from a large number of them after taking into account the diversity of when and where they will appear as loads on the grid. This is known as the After Diversity Maximum Demand (ADMD).

Due to the mobile nature of EVs, and their unique characteristics, in terms of their spatial and temporal variability, it is apparent that the impacts of EVs on electricity networks under the Smart Grid paradigm will require significant amounts of further detailed study to assess all their complexities.

While it is generally agreed that the majority of charging will occur at the owner's premises/home once they arrive home in the evening, consideration must also be given to where else the ability to recharge their vehicle may be desired, and also what impact a large number of them charging at a single location, such as at a car park or shopping center, may also have on the network.

Existing travel data can provide a starting point for these studies, however, due to the comparatively short range of current models of EVs and subsequent "range anxiety" phenomenon observed, the nature of people's driving patterns will likely change as they adjust to the new paradigm of electric mobility.

Furthermore, even assuming a homogenous spread of EVs, it may well be that even the high growth rates used in the modeling could turn out to be understated.

The growth predictions for EVs are based on several well-researched reports, however, each of them largely considers adoption projections based on fairly standard models of technology adoption rates, and assume a gradual transition away from vehicles dependent on rapidly dwindling fuel reserves, with the inherent assumption of its uninterrupted supply during this transition.

There are, however, a number of plausible scenarios that could occur which may result in a much more rapid acceleration of EV adoption than even the optimistic projections used in the modeling accounts for.

Increasing geopolitical instability in many of the world's major oil producing regions is not an inconsequential triviality that can be discarded lightly. Less dramatically, for example, the advent of China as a major automobile manufacturer, coupled with its already poor air quality in its large cities, along with its stated goal of being a leader in EV production, it is not unlikely that the high price premiums currently on EVs will diminish more rapidly than predicted, due to scales of economy possible in China, leading to a much more rapid growth in global EV production than current projections assume.

While considering the likelihood of these scenarios is perhaps outside the direct scope of factors to be considered by the ERA in deciding whether or not to endorse Western Power's Smart Grid proposal, the point being made is that, should EVs be adopted at a greater rate than considered in the CBA, the costs of accommodating a much larger number of EVs under the BAU paradigm would increase significantly; whereas in the Smart Grid scenario, while costs may also increase, they would be to a lesser degree, and also be partially offset by an increase in benefits from the greater availability of ancillary services and energy storage for V2G applications.

<u>Comments on the voluntary nature of tariff adoption</u>

The conservative nature of Western Power's CBA is especially highlighted in the assumptions made in the modeling that tariff changes will not be mandatory, a point that, in our opinion, did not receive adequate attention.

Section 5.3 (pg 35), of the CBA states that "*Any mandatory implementation of these tariff or control options will greatly increase the take up rates and consequently the associated benefits*", and also "*The potential for price rises in Western Australia could be a significant driver in raising the take up level of many of these programs beyond that indicated.*"

However, considering the potential magnitude that these statements imply for the overall benefits of the Smart Grid should customer participation be greater than modeled for, we are of the opinion that this point should have been emphasized more explicitly in the Executive Summary or Conclusion, especially considering the importance that Western Power has placed on customer engagement, as demonstrated elsewhere in the report.

The breakdown of the NPV of Smart Grid Benefits (Figure 8-A, page 61) highlights the distinction between the benefits that would accrue regardless of any voluntary actions, and those benefits occurring as a result of voluntary actions taken individually by consumers to reduce the costs of their electricity bills (quantified as the value of avoided costs compared to the BAU scenario).

While there are many complex interrelations between some of these costs and savings, much of the value in the Avoided Capacity and the Customer Enablement categories can more or less be attributed to voluntary actions by consumers. This equates to approximately $658m of the $1088.8m expected benefits, or around 60% of total value.

Considering the modest estimates used for voluntary participation by customers of between 2 and 20% for the various programs (Table 5-E, page 36), the CBA may well end up even more favorable should greater customer participation occur, an outcome made more likely by core focus paid to customer engagement by Western Power.

Missed opportunities by not adopting the Smart Grid Proposal

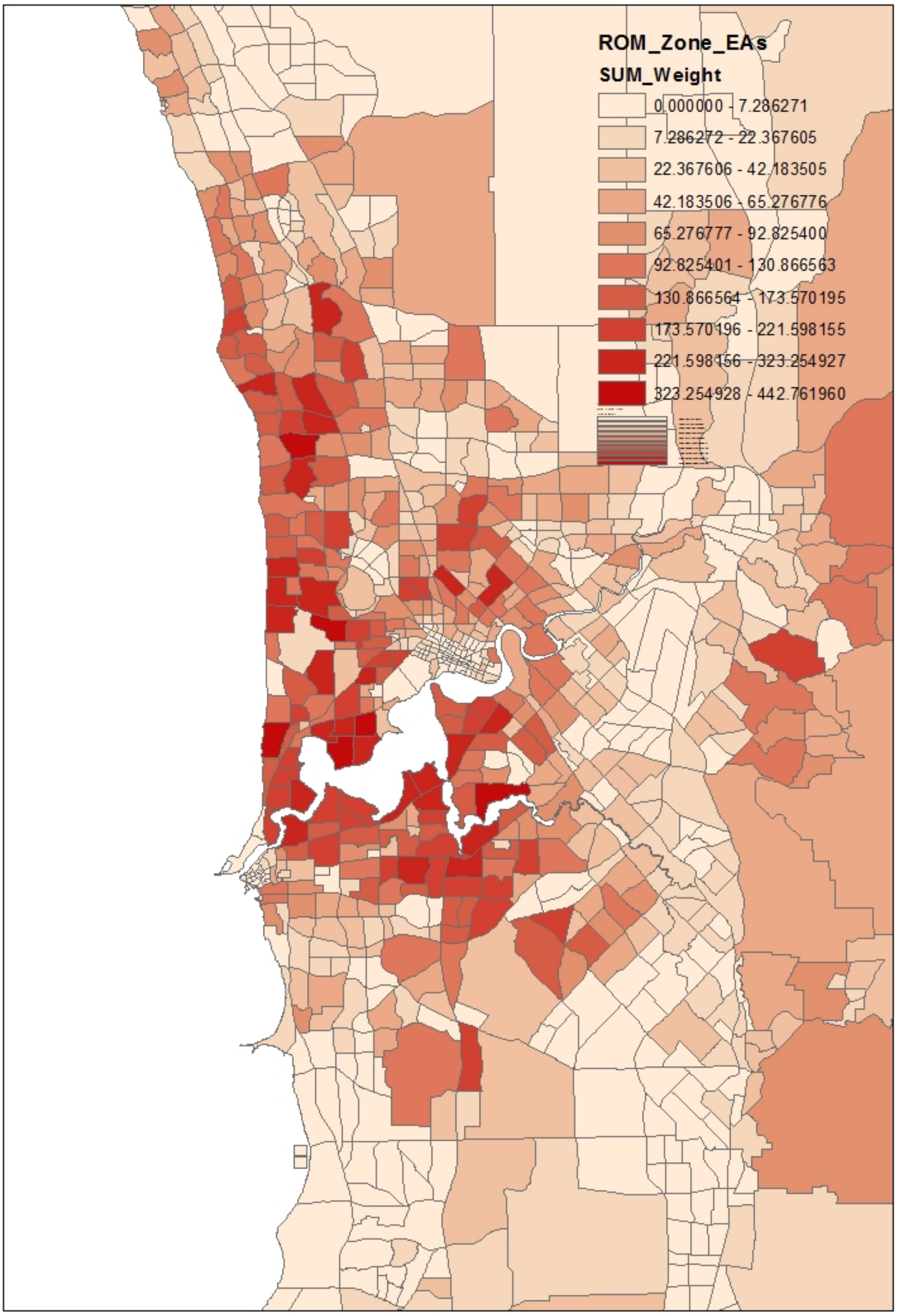
Finally, a comparison between the justifications for committing to the NBN at the national level, and the Smart Grid at the state level may be worth mentioning.

The enabling potential that the smart grid has for the energy industry is comparable to that which the NBN has for the ICT industry. The Smart Grid will provide the essential backbone ICT capabilities required to enable a whole new industry focused around the smart and efficient use of electricity using products and technologies that haven't been invented yet, by companies that haven't been founded yet. A similar argument was made when defending the decision to go ahead with the NBN.

To consider whether or not to support Western Powers Smart Grid proposal from a different perspective, it is important to realize the magnitude of the missed opportunity that would result should the ERA decide not to endorse this proposal, and instead encourage the continuation of a Business as Usual approach to the operation of the electricity network, especially when considered in the context of the state's MRET commitment to 20% of its electricity being generated by renewable sources by 2020. The cost of managing the grid with such a large share of intermittent generation, using traditional techniques of balancing supply and demand will be significant, and require additional investment in fast responding OCGT generation and other ancillary service provisions to mitigate fluctuations in renewable output. Considering the expected life of these assets, a missed opportunity here could have ramifications for several decades to come.

In conclusion, I would just like to reiterate our wholehearted endorsement of Western Power's Smart Grid proposal, and would just like to emphasized the need to make provisions for detailed studies of the unique characteristics and impacts that Electric Vehicles will have on the Smart Grid, especially in light of the tremendous benefits they add to the already highly beneficial Smart Grid proposal. Thank you for taking the time to read this. Sincerely,

Andrew Went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