



Authority for Electricity Regulation publishes a report of international best practices for electrical vehicles adoption in the Sultanate

Muscat, 19/December/2018- The Authority for Electricity Regulation (AER) publishes a report on international best practices for electrical vehicles and recommendations as Oman prepares for electric vehicle penetration. The report highlighted key developments in the market for electric vehicles that have an impact on the future design of the electricity sector regulatory frameworks as well as prioritized modifications for other sectors. The report also revealed observations on tariff evolution that might better enable the development of EVs in Oman and their potential impacts on government subsidy levels to the electricity sector.

Qais bin Saud Al Zakwani, Executive Director of AER, said; "I am pleased with the results highlighted in the report. The objective was to assess the suitability of the current framework as Oman prepares for electric vehicle penetration and learn from international best practices in this area. The work undertaken looked at a broad range of issues that covered sectors beyond the jurisdictional scope of the Authority such as data privacy and security concerns in relation to EVs adoption in other markets that must be addressed to ensure customers are adequately protected. Additionally, it is evident that the successful penetration of EVs in Oman is primarily dependent on the engagement of a broad set of stakeholders and not just the Authority. We intend to work on the issues specific to the electricity sector during the next year and will continue to coordinate and engage in an active debate with other entities to ensure a seamless transition."

It is worth mentioning that EVs will reduce carbon dioxide emissions, improve local air quality, and reduce noise pollution. The Authority will remain dedicated to promote active cooperation in relation to EVs penetration with the concerned government entities and plans to undertake further work in this area during 2019.

A copy of the report is available at www.aer-oman.org.

1. Executive Summary of Key Issues

The Authority for Electricity Regulation, (the Authority) engaged Energy and Environmental Economics, Inc. (E3) and its subcontractor Baringa Partners (Baringa) to report on international best practices for plug-in light-duty vehicles (PEVs) and provide a series of recommendations as Oman prepares for electric vehicle penetration. The findings of this report are summarized below.

Though PEVs currently carry a higher upfront cost than conventional internal combustion engine (ICE) vehicles, this report suggests that:

- Even at cost reflective electricity prices, PEVs are expected to have lower fuel and maintenance costs relative to ICE vehicles and are likely to be attractive to drivers on an economic basis;
- If PEVs are encouraged to charge during off-peak periods there could be benefits to all electricity ratepayers through enhanced efficiency in the use of the electricity networks; and
- PEVs can reduce carbon dioxide emissions, improve local air quality, and reduce noise pollution.

The value proposition of PEVs is improving fast. Falling battery prices are reducing upfront costs and electric driving range is increasing. Automakers plan to begin selling more than 120 PEV models by 2020, and vehicles with an electric range exceeding 320 kilometers are already on the market. These include the first plug-in electric sports utility vehicles (SUVs), a popular vehicle segment in Oman. Reasonable forecasts (such as those from Bloomberg New Energy Finance) suggest PEVs will reach upfront price parity with ICE vehicles by 2025 and PEV adoption forecasts continue to be revised upward, with forecasts of between ten and fifty percent of new vehicle sales expected to be PEVs by 2040.

Though wide-scale adoption may lag other markets, Oman will not be immune to these forces, regardless of whether Oman implements clear PEV policy targets. As PEV adoption increases in Oman, appropriate public and private charging infrastructure must be available.

PEV charging technologies are also improving. At present, PEVs charge at 3 “levels.” Level 1 uses a regular electric outlet and the charging connector, provided with the vehicle, provides up to 8 km of range per charge hour. Level 2 uses higher powered (7 to 22 kW) electric vehicle service equipment (EVSE) and is popular for home, work, malls, cinemas, parks and hotels. Level 2 charging provides up to 100 km of range per charge hour. Level 3 (DC fast charging or DCFC) achieves an 80% charge in under 30 minutes. Recently, “ultra-fast” DCFCs have been developed that can support 350 kW charging and are claimed to provide “200 km [of electric range] in 8 minutes.”¹ DCFC equipment has so far mainly been installed for public charging of personal vehicles and re-charging of electric rental car/taxi fleets.

¹ Fred Lambert, April 2018, “ABB unveils its 350 kW electric vehicle charging tech, claims 200 km of range in 8 minutes,” <https://electrek.co/2018/04/24/abb-electric-vehicle-charging-tech/>

Even with these improvements PEVs face barriers such as:

1. Lack of suitable PEV models (potentially a significant issue for Oman due to the preference for larger vehicles, the small size of the market and extreme heat conditions);
2. Insufficient charging infrastructure and driver range anxiety;
3. Limited awareness and enthusiasm;
4. Upfront cost premium of PEVs compared with internal combustion engine vehicles; and
5. Lack of dealer incentives to sell PEVs.

The first of these will likely delay widespread PEV adoption in Oman for at least a few years, but is expected to diminish as larger vehicles become available in the GCC region.

PEV charging involves four key functions: service connection, make-ready (panel plus customer wiring), provision of EVSE activities (equipment selection, investment, installation, ownership, hosting, and maintenance), and billing. The distribution utility typically provides the service connection, including metering. Entities carrying out the other functions differ by charging location and level.

PEV customers charging vehicles in private locations typically pay regulated electricity rates. Some utilities in Europe and North America offer PEV-specific time-of-use (TOU) rates designed to be more attractive than default rates if charging is carried out during off-peak periods. In the Middle East, there are no specific rates for PEV usage, though TOU rate structures are used to provide similar load signals for large industrial and commercial customers.

Public charging facilities have been delivered by both public and private investment, with the latter provided by site hosts, automakers, or specialist electric vehicle service providers (EVSPs). In order to promote competition and innovation and reduce stranded cost risks regulators have largely concentrated on enabling private sector investment, though public sector investment has been used in some areas to stimulate initial adoption. The outcome for a given jurisdiction is driven by the regulator's views on competition; the availability of government and utility capital; the utility's ability to raise the necessary funds; and the presence of committed EVSPs that are expected to maintain installed assets over the long term. In this respect, policymakers and regulators should take care to ensure incentives for on-time build, sufficient power levels, ongoing maintenance, plans for eventual removal or replacement and safety standards, as summarized below.

Public PEV charging facilities may be provided free of charge, for example, as an employee benefit, or as an incentive to shop or eat at a retail location. Alternatively, charging hosts may charge a flat monthly fee, or engage EVSPs to bill drivers on the basis of kWh used, parking time, or a combination of both. Most commonly, for example in Europe, California, New Jersey, Pennsylvania, Hawaii, Ontario, Jordan and Abu Dhabi, the charging fees of EVSPs are not licensed or economically regulated. There is no

evidence of regulation of the price EVSPs charge for parking spaces. In China, Beijing originally capped the fee EVSPs may charge for *charging services* but has now liberalized these fees.

Despite the general absence of economic regulation of EVSPs, there are detailed international best practices promoting safety. Though Level 1 and Level 2 EVSEs have risks similar to those associated with installing and using large household appliances such as microwave ovens and air conditioning units, installation must comply with local electrical and building standards. International jurisdictions have required a variety of additional safety measures for public EVSE installations such as signage, disabled access, collision protection, power terminal voltage drop limits, testing, and distribution company notification of installation. Abu Dhabi issues a Quality Control and Conformity certification for EVSE requiring achievement of several requirements including the ISO 9001 manufacturer certificate of quality management requirements, the ISO/IEC 17025 test certificate, an EVSE installation agreement with a contractor licensed by Abu Dhabi or Al Ain Distribution Company, and payment of fees.

Jurisdictions actively promoting PEV adoption do so in a variety of ways. Some have established PEV adoption targets; others have proposed bans on the sale of new internal combustion vehicles by a future date. China and a number of US states have introduced targets (i.e., ZEV mandates) requiring manufacturers to ensure a minimum number of credits earned by selling vehicles that are defined as zero-emission under the program. A number of governments also provide rebates, tax credits or tax exemptions for PEVs. PEVs may also be exempted from vehicle registration or other government fees. In addition, access to dedicated high occupancy vehicle (HOV) lanes, waived bridge or road tolls, waived congestion fees, free or discounted parking, and preferential treatment in vehicle registration lotteries have also been used by Governments and related agencies to spur PEV adoption.

Cities, municipalities and states have also implemented building codes in relation to PEV readiness that have typically required home and/or commercial builders install conduit, wiring and electrical capacity sufficient to support Level 2 charging, though stop short of requiring installation of the EVSE itself.

Limited awareness and familiarity with PEVs can be a major barrier to consumer adoption. Many jurisdictions have therefore made educational efforts through public agencies, automakers or non-profit organisations. 'Ride and Drive' events, dealership training, and programs to expand EV exposure through taxis, rental cars and government and commercial fleets have all played a role in this respect. For example, Japan, France, UK, US, China, Canada, Norway and Sweden all signed a Government Fleet Declaration in Morocco in 2016 to commit to varying levels of ZEV procurement, whilst Amsterdam and Dubai have recently incorporated PEVs into their taxi fleets.

Other measures taken to improve the experience of PEV drivers include:

- Standardizing roadway signage and development of public databases to help drivers (and app developers) to locate public charging facilities;
- Regulations requiring that all charge points accessible to the public be usable by anyone without the need to enter into a pre-existing contract, offer non-discriminatory prices, and be compatible with all vehicles; and

- Restrictions on the use of PEV parking areas by ICE drivers and arrangements to ensure that PEV drivers only occupy spaces for the necessary or reserved period of charging time.

With respect to vehicle compatibility in Oman, the GSO Final Draft of Standards document lists the Type 2 European connector as the standard for AC connectors and it is likely that this will be deployed in Oman. Connectors utilized for DCFC are CHAdeMO, CCS, Tesla, and the Chinese GB/T connector. Because these differ by automobile manufacturer, the availability of both CHAdeMO and CCS EVSE will be necessary in Oman.

Lastly, technology plays a prominent role and light-duty transportation is likely to be affected by two trends that are intertwined with vehicle electrification: shared mobility (the increasing share of passenger kilometers coming from shared, on-demand travel modes such as those provided by Uber, Lyft and Scoop); and automation (the increasing market share of driver-assist and self-driving vehicle features).

These have the potential to dramatically change the transportation and energy sectors. The outlook for Oman is however unclear and they are not yet being tested. The Supreme Council for Planning (SCP) is investigating their long-term potential but in the short term, SCP, Municipalities, the Ministry of Transportation and Communication, the Authority and others should focus on learning from experiences in other jurisdictions.

In some markets there are concerns in relation to the impact of PEV charging on power quality, such as harmonic distortion, phase unbalance, and transformer overloading. However, phase unbalance is not significant where load is primarily connected on 3-phase service, as in Oman, whilst transformer loading issues can be reduced with careful planning and off-peak charging.

Data privacy and security issues arise in PEV charging, though these are not unique to PEVs. In all vehicles, including PEVs, the CAN bus and telematics are avenues through which malware can infiltrate a vehicle. If PEVs are infected, they have the potential to affect the electricity grid and/or charging infrastructure.²

Lastly, there are safety and environmental issues with PEVs related to lithium ion batteries, which once ignited can be difficult to extinguish and first responders must receive special training in dealing with such matters. Environmental issues surround lithium-ion battery end-of-life treatment with some scope for second-life use of batteries in providing grid services.

This report sets out a prioritised list of preparations that can be made by the Authority and other Oman government entities during the next 1-3 years, whilst attractive PEV models for the Oman market continue to be developed. In summary, those are as follows:

² <https://www.iea.org/media/topics/transport/VehicletogridCybersecurityBrief.pdf>

1. The Authority should continue to promote a high quality and active stakeholder debate in relation to PEV adoption in order to ensure that measures taken in the electricity sector are timely and appropriate;
2. The Authority should confirm that the roll-out of EVSE infrastructure will not require EVSPs to be licensed and that prices charged by EVSPs will not be regulated, subject to adherence to appropriate safety and technical standards, which will be discussed with the Ministry of Commerce and Industry;
3. The Authority should further assess the plans of EVSPs in relation to entry to the Oman market and, dependent upon those discussions, should further assess the costs and funding of a limited roll-out of public charging DCFC infrastructure on a demonstrator strategic corridor route;
4. The Authority should review the options in relation to charging for electricity provided to residential users with separately metered PEV charging facilities, including the potential benefits of TOU pricing signals designed to minimize the impact on peak generation and network capacity;
5. The Authority should encourage Distribution companies to assess and prepare for the impacts of PEVs on their networks, including through staff development and awareness raising, development of load growth forecasts and preparation of customer guides in relation to connection, installation and safe use of private and public charging facilities; and

The Authority should continue to monitor data privacy and security concerns in relation to PEV adoption in other markets and ensure that Oman's electricity networks and customers are adequately protected.

To view the full report of Regulatory Frameworks for Electric Vehicles in Oman International Best Practices Findings and Prioritized Recommendations please click the following link

[http://www.aer-oman.org/pdfs/PEV Best Practices and Recommendations.pdf](http://www.aer-oman.org/pdfs/PEV_Best_Practices_and_Recommendations.pdf)

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