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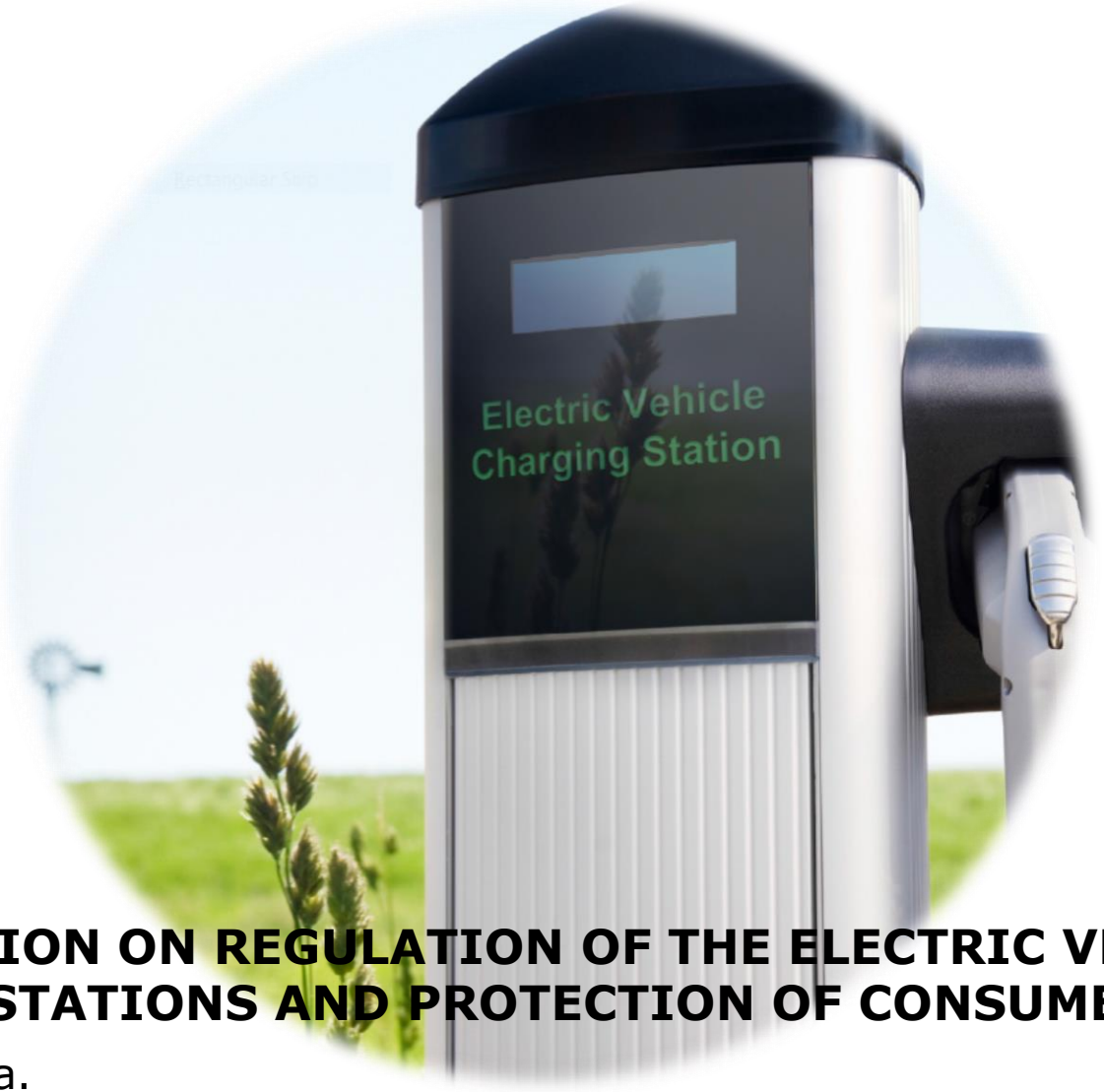

CONSULTATION ON REGULATION OF THE ELECTRIC VEHICLE CHARGING STATIONS AND PROTECTION OF CONSUMER RIGHTS

PUCSL, Srilanka.

October 2017

1. Requirement of maintaining and updating a register of authorized EVCS

- For setting up Electric Vehicle Charging Station(EVCS), registration with respective utility is required.
- The process followed in US and European countries for EVCS set up is:

- Permit System

- Compliance to applicable safety and quality regulations.
- Administer flow of any government subsidies applicable for such consumers.

May increase red-tapism.

It may be difficult to regulate a permit system for EVCS for home/ personal use, there should be clear guidelines for setting-up and declaring EVCS for home/ personal use

Permit system may be limited to dedicated or commercially operated EVCS.

2. Code of practices for EVCS

- EVCS rollout may require significant updates to many codes, regulations and standards. These can be classified in 3 categories:

Regulatory	EVCS Hardware	Process
• Tariff • Building Code • Safety & Protection • Environmental • Charges collection • Cable quality, rating • Pedestrian safety	• Socket/Connector type • AC/DC connection • Lighting • Accessibility • Mounting structure • Charger protection • Interoperability	• Installation Procedure • Inspection procedure • Signage and path to reach

- Few recommendations to prioritize focus are:
  - Safety & Protection
  - Interoperability
  - DC Output at DC Fast Charging
  - Smart Grid Infra Integration

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3. Determination of end user tariffs, safety and other technical standards for EVCS

Whether to use time of use or flat rate structure or allow both?

Common Tariff Structures and its impact on EV Charging and EV User

Flat Rate	Time of Use (TOU)	Tiered
• User will pay the same rate for any additional energy used for EV charging. • It could get expensive depending on flat rate and how much EV is used. • It is a non-equity tariff each consumer has to pay the same regardless of his usage pattern, No incentive to EV User.	• Encourage to shift energy use, including charging, to off-peak hours. • Time-of-use plans are good for EV User who have the flexibility to shift their energy use.	• The energy required for EV charging could bump the consumer up into the next tier and increase rates. • Tiered plans are good for EV Users who have less control over when they use energy, but do not exceed a certain amount

3. Determination of end user tariffs, safety and other technical standards for EVCS

Whether to use time of use or flat rate structure or allow both? (Contd.)

Tariff recommendations

- TOU Tariff
- Special EV Tariffs
- Low fixed charges
- Earn credit for providing grid services
- Limited or no demand charges

Tariff strategies

- Tariffs based on Charging Behavior
- Incentivized Tariff for Distributed Energy Resources (DER) integrated charging
- Locational marginal pricing

Special EV tariffs

Approaches for segregation electricity consumption from over all home consumption

Separate Meter	Separate Connection
• May cost less. • Billing system will need modification to accommodate this differentiated arrangement. • load enhancement will become more cumbersome.	• Easy to implement, existing home connection will not be disturbed. • No changes are required in billing software. • Easier to implement government incentive schemes. • Ready system for Smart Charging.

3. Determination of end user tariffs, safety and other technical standards for EVCS (Contd.)

To which extent the investments should be promoted, with respect to specific policy objectives of the government?

- Government/Regulators should create a conducive environment for private investors of charging infrastructure. Participation of private investors in the EV charging infrastructure market requires a viable business case.
- Availability of EVCS is imperative to entrust end users confidence in transitioning to EVs. EVCS network can be developed by
  - Private Investors
  - Developing a supportive Eco System by EV value chain players.

- Cost of EV Charging Station *(Source: US Department of Energy)*

Type of Charging Station	Minimum	Maximum	Mean
EVCS-Residential	A few hundred dollars	$8,000	$1,354
EVCS-Public	$624	$5,960	$2,223
DC Fast Charger	$8,500	$50,000	$22,626

- Commercial EVCS will be used only if they provide DC Fast charging, To make a viable business case for investors there can be following approaches
  - Bottom up approach for Tariff determination
  - Mandatory renewable source for Commercial EVCS, (Incentives can be in the form of FIT)

3. Determination of end user tariffs, safety and other technical standards for EVCS (Contd.)

Discriminate fast charging and normal charging

- Normal Charging and fast charging with AC supply are relevant only in countries where supply is at 120 voltage which is not the case in Sri Lanka where supply is at 240 voltages.
- In Sri-Lanka it can be easily discriminated with AC charging (normal charging) and DC charging (fast charging).
- AC EVCS for pubic charging at parking, work place and other places like mall, railway station etc. is feasible.
- EVCS-Commercial will be used by EV users only if these are able to provide DC fast charging.

Charging Mode	Applicable for	Time Required for Full charge
AC (Normal)	EVCS-Residential, EVCS-Public	~8 hours
DC (Fast)	EVCS-Commercial	~30 Minutes
DC (Fast)	EVCS-Battery Swapping	~30 Minutes

3. Determination of end user tariffs, safety and other technical standards for EVCS (Contd.)

Discriminate EV charging networks from individual charging stations

- Mandate *Open Charge Point Protocol (OCPP)* for establishing EVCS network, an international standard for enabling communication and networking of charging station infrastructure.
- Service Level Agreement that can be signed with utilities by any third party who wishes to establish EV charging network.
- Incentivising these networks is good practice as they are providing additional services and may attract investors.
- May promote subscription model for Commercial EVCS Usage.

3. Determination of end user tariffs, safety and other technical standards for EVCS (Contd.)

Whether to regulate end user tariffs by PUCSL or to simply control pass through tariffs

Unregulated Market	Regulated Market
Competitive markets • Competitive pressures set prices and quantities at efficient levels • Socially optimal	• Regulators set prices • Prices are set to equal average costs. • Ensures producer recovers costs • Improves consumer welfare
Monopolies • Incentive to raise prices and restrict quantities to maximize profits • Not socially optimal	

- Unregulated Market is good if it is competitive but worst if it becomes monopolistic, EV in Sri-Lanka is in its infant stage, thus it is better if PUCSL regulate the tariffs in order to protect investors and consumers.

- Another option is PUCSL can define ceiling values for tariffs.

4. Rights and Obligations Statement for consumers of EVCS

- **Safety first:** Practice safe charging.
- **Parking:** Use parking slots designated for plug-in cars only if charging of vehicle is required.
- **Signage:** Electric vehicle drivers must adhere to posted signs.
- **Workplace charging is a privilege, not a right:** EV driver should follow the policies laid by employee for work place charging.
- **Minimum Facilities at Public EVCS**

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5. Issues faced by EVCS and consumers at such centers

- **Demand Charges:** Regulators and local utilities need to find ways around to optimize demand charges in order to make the system more efficient.

- **Adaptation of Utilities:** High quantum of DERs (including EV charging) is posing different challenges to utilities. Utilities need massive investments which sometimes are difficult to pass-through in tariff in a short time-frame.

- **Compatibility/Interoperability** of components between EV of different manufacturers.

- **EVCS-Battery Swapping:**
  - Establishing Battery swapping centers may become costly as battery of different manufacturers can't be used interchangeably. Proper policy should be drafted to support financially feasible rollout.
  - There is a need for policy and systems to regulate and monitor EVCS-Battery Swapping otherwise these may turn up into battery upgradation centers.

- **Payment Settlement:** Implementing proper payment settlement mechanisms.

- **EVCS Maintenance:** EVCS's periodic inspections shall be conducted to ensure that all parts remain in good working order.

6. Issues related to residential charging facilities

- Possibility of sudden high demand or peaked demand curve with the increasing number of EVs.
- Proper protection schemes required for personal safety of users and domestic household electrical network.
- Safety of EVCS hardware is another challenge in certain type of residential units without a proper garage.
- Managed or Smart Charging (one-way) and Vehicle to grid (V2G) features may be enabled in EVs and charging infrastructure may be capable of delivering power back to the grid. However, this will need imposition of regulation of domestic charging.

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7. Other Challenges

- Battery Cost & Disposal:
  - A significant portion of the cost of the battery may need to be subsidized, potentially by industry or government, if EVs are to be cost competitive with traditional ICE vehicles.
  - There should be proper battery disposal mechanisms also after usage without causing effects of natural resources mainly.

- Integration of electric vehicles within product portfolios of OEMs: OEMs have greater pressure to standardize core components to comply with government regulations, grid infrastructure restrictions etc.

- Formulating innovative financial & business models: To promote the growth of EV market, business & financial models should be in supportive for collaboration among value chain players.

- Smart grid platform integration to EV implementation required as ICT platform can be easily accessed for the information exchange especially for Vehicle range control, Locate charging station, Recharging costs information and payment, Monitoring & Managing EV network etc.

- Reduction of customer anxiety: Proper initiatives to address current consumer concerns about EVs and enhance their eMobility experience. Prior focus on Range/ Efficiency, Charge time, Purchase price, Fuel price.

- Better transport infrastructure: Development of transport infrastructure to accommodate vehicles if huge rollout happens.

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EVCS Standards

Standards of Electric Vehicle Charging Stations (EVCS)

- Different type of standard is being used across the globe for charging of EV formulated by International Electro technical Commission (IEC), International Origination for Standards (ISO) and Society of Automotive Engineers (SAE).

✓ **IEC 61851**: The IEC 61851 standard covers the overall EV conductive charging systems.

- *IEC 61851-1:* This standard defines three cables and plug setups which can be used to charge EVs:
- *IEC 61851-23:* This standard defines the requirements for DC fast charging stations in terms of electrical safety, harmonics, grid connections and communication architecture.
- *IEC 61851-24:* This standard defines digital communication for DC charging control between the charging controller in the EV and the charging controller in the Electric Vehicle Supply Equipment.
-

✓ **IEC 62196:** The IEC 62196 is the latest standard for EVs by IEC which is based on the IEC 61851 standard.

- *IEC 62196-1:* This standard contains the general requirements for EV connectors.
- *IEC 62196-2:* It standardizes three types of mains connecting systems, known as Types 1, 2 and 3 that are applied only to modes 1, 2 and 3.
- *IEC 62196-3:* This standard defines connectors and inlets for fast DC charging to be used with mode 4 charging according to IEC 61851-1

✓ **IEC 60309:** An international standard from the IEC for 'plugs, socket-outlets and couplers for industrial purposes'.

- *IEC 60309-1:* General requirements
- *IEC 60309-2:* Dimensional requirements

Standards of Electric Vehicle Charging Stations (EVCS) (Contd.)

- ✓ **IEC 60364:** IEC 60364 'Electrical Installations for Buildings' is the standard on electrical installations of buildings.
  - *Part 1:* Fundamental principles, assessment of general characteristics, definitions
  - *Part 4:* Protection for safety (including sections on electric shock, thermal effects, over current, voltage disturbances and electromagnetic disturbances).
  - *Part 5:* Selection and erection of electrical equipment (including sections on common rules, wiring systems, isolation, switching and control, ear thing and safety services).
  - *Part 6:* Verification.
  - *Part 7:* Requirements for special installations or locations (for range of locations such as bathrooms, swimming pools, rooms/cabins, construction sites, caravans, external lighting, mobile units and others).

- ✓ **SAE J1772:** This document defines a common EV/PHEV and supply equipment vehicle conductive charging method including operational requirements and the functional and dimensional requirements for the vehicle inlet and mating connector.
  - *IEC 60309-1: General requirements*
  - *IEC 60309-2: Dimensional requirements*

- ✓ **CHAdeMO:** CHAdeMO is a trade name for global quick charging method that is proposed by the CHAdeMO Association as an industry standard (CHAdeMO, 2012).

- ✓ **Open Charge Point Protocol (OCPP):** OCPP is an international standard for enabling communication and networking of charging station infrastructure.

Standards of Electric Vehicle Charging Stations (EVCS) (Contd.)

✓ **Other Applicable Standards**

- ISO6469, ISO TR11955, ISO/IEC15118, ISO14443
- IEC 61851, IEC TR60786, IEC61968, IEC61800, IEC62576, IEC60364, IEC60369, IEC1980
- SAE J551/5, J2836/1-5, J2847/1-5, J2894/1-2, J2931/1-2, J2953, J1733, J2293/1-2, J2495
- AS/NZS3000, AS/NZS4755, AS/NZ3112
- JEVS C601, G101 – G109, G901-85

✓ **IEC EV charging modes based on IEC 61851-1**

Mode	Supply	Type	Charger Configuration	Example
Mode-1	AC	Slow (at 120 volt)	Standard household-type connector	1- or 3-phase plug
Mode-2	AC	Slow (at 120 volt)	Standard household-type socket-outlet with an in-cable protection device	
Mode-3	AC	Slow (at 120 volt) Fast (at 120 volt)	Specific EV socket-outlet and plug with control and protection function permanently installed	SAE J1772 and IEC 62196
Mode-4	DC	Fast	External charger	CHAdeMO

✓ **Levels of EV charging according to SAE**

Level	Supply	Phase	Voltage (Volts)	Max Current (Amps)	Max Power (kW)	Duration (hrs.)
Level-1	AC	Single	120	16	1.9	6-24
Level-2	AC	Single	240	80/40	19.2	2-8
Level-1	DC	--	200-450	<=80	<=19.2	~20 min
Level-2	DC	--	200-450	200	90	~15 min

Standards of Electric Vehicle Charging Stations (EVCS) (Contd.)

✓ **Coupler/Connector**

Type	Coupler	Example
Type-1	Single-phase vehicle coupler (vehicle connector and inlet)	Yazaki (Japan) or SAE J1772-2009 (North America)
Type-2	Single- and three-phase vehicle coupler and mains plug and socket-outlet without shutters	VDE-AR-E 2623-2-2
Type-3	Single- and three-phase vehicle coupler and mains plug and socket-outlet with shutters	SCAME plug developed by the EV Plug Alliance