Study on Infrastructure and Enabling Environment for Road Electric Transport in SAARC Member States

Date: 5th May 2020
About ISGF

A Public Private Partnership initiative of Ministry of Power, Government of India – since 2011

Responsible for accelerated development of smart grid technologies in the Indian power sector

200+ members comprising of ministries, utilities, regulators, technology providers, academia and research

Evolved as a Think-Tank of global repute on Clean Energy, Smart Grids, Smart Cities and Clean Transportation
ISGF Credentials on E-Mobility

- Development of implementation roadmap for electrification of public transportation in Kolkata
- Establishment of charging stations for deployment of 80 electric buses (FAME- I) in Kolkata
- Advisory Services on scaling up of electric mobility deployment for the Transport Department of West Bengal, India
- Study on Infrastructure and Enabling Environment for Road Electric Transport in SAARC Member States
- Feasibility study on introduction of electric vehicles in the Sundarbans mangroves with special focus on the forest fringe parts of Indian Sundarbans
- Detailed Planning Studies for installation of Electric Vehicle Charging Stations and network upgradation in Bangalore City (on going)
- Preparation of proposal for Alfanar Energy Pvt. Ltd., Saudi Arabia for allotment of Charging Stations under Fame II Scheme in Cities
- Active participation and contribution in BIS ETD-51 Committee for preparation of Indian standards for EV Charging Infrastructure (IS:17017 series)
- Advised/ Advising several states on formulation of EV Policies (Karnataka, Kerala and West Bengal)
ISGF Credentials on E-Mobility

- Worked with Forum of Regulators (FOR) and several State Electricity Regulatory Commissions for creation of separate electricity tariff slab for EV charging – presently 16 states have special EV tariff
- Conducted a series of brainstorming sessions with different stakeholders and submitted the recommendations to Ministry of Power (MoP), based on which MoP issued order clarifying that EV Charging Business does not require separate license
- Published following White Papers:
  - Electric Vehicle Policies and Electricity Tariff for EV charging in India (2019)
  - Electric Vehicles: A Sustainable Solution for Air Pollution in Delhi (2016)
  - Policy Framework for Electric Rickshaws in Delhi (2014)
ISGF Credentials on Smart Grids, RE etc

- Smart Grid Vision and Roadmap for India (2013)
- Smart Grid Roadmap for Perusahaan Listrik Negara (PLN), Indonesia (2019)
- Smart Grid Roadmap for Bangalore Electricity Supply Company (2017-18)
- Energy Storage System Roadmap for India (2019)
- Peer to Peer (P2P) Trading Platform on Blockchain Technology for Trading of Solar Power at Customer Premises in Uttar Pradesh, India (ongoing)
- Designing of Time of Use Electricity Tariff in the State of Gujarat (ongoing)
- AMI Rollout Strategy and Cost Benefit Analysis in India (2016)
- Next Generation Smart Metering – IP Metering (2016)
Study on Infrastructure and Enabling Environment for Road Electric Transport in SAARC Member States
SAARC Energy Centre has been awarded the project “Study on Infrastructure and Enabling Environment for Road Electric Transport in SAARC Member States” to India Smart Grid Forum on 1st June 2018.

**Project Brief and Objectives**

- **Project Purpose**: Readiness assessment for transition to electric mobility and subsequent formulation of EV implementation plan for the SAARC member nations

- **Key Focus Areas**
  - Global EV Scenario
  - EV infrastructure & policy requirement
  - Global best practices for EV adoption
  - Readiness assessment for SAARC countries
  - Policy & regulatory
  - Business model & tariff design
  - Electric grid upgradation
  - Institutional development

- **Key Interventions**
  - Creation of enabling environment for EV adoption in each SAARC member nation.
Approach and Methodology

- Review of global EV deployment in terms of technology trends, market evolution, vehicle stock etc.
- Assessment of EV infrastructure requirement in terms of charging technology, standards, communication protocol etc.
- Review of best practices adopted by top three global leaders in EV deployment.
- Assess readiness of SAARC countries in terms of policy, regulations, institutional capacity and technology deployment for EV.
- Recommendation for SAARC countries with respect to policy support, institutional development, incentive mechanism etc.

Electric Vehicle Maturity Model (EVMM) framework has been used for preparing the Electric Vehicle roadmap for the SAARC countries. Details about EVMM process is explained in slides #40-#41.
Global Electric Vehicle Scenario
Global EV Stock and Future Growth

- **Annual Electric Car sales** registered a milestone of 5.1 million + in 2018
- **Global Electric Car Stock** stands at over 5 million in December 2018
- **Largest Stock is in China** - 57% of global total

- **Global E-2W Sales** were 300 million for 2018
- **Global E-2W Stock** stands at 800 million
- **China has the highest share - over 99%**

- **Global Electric Bus Sales** was 8 million for 2018
- **Global Electric Bus Stock** stands at 460,000 in Dec 2018
- **China has the highest share - over 99%**

- **Almost 4.66 million private chargers** at residence & workplace, globally
  - Public Slow Charger Outlets: 0.4 million
  - Public Fast Charger Outlets: 0.14 million
  - **China has almost 1 million private chargers for fleets**

### Growth of EVs under different Policy Scenarios

#### New Policy Scenario

<table>
<thead>
<tr>
<th>Vehicle Type</th>
<th>2020</th>
<th>2030</th>
</tr>
</thead>
<tbody>
<tr>
<td>Two Wheelers and Three Wheelers</td>
<td>NA</td>
<td>455,000,000</td>
</tr>
<tr>
<td>Light Duty Vehicles</td>
<td>12,000,000</td>
<td>125,000,000</td>
</tr>
<tr>
<td>Buses</td>
<td>NA</td>
<td>1,500,000</td>
</tr>
<tr>
<td>Total</td>
<td>-</td>
<td>581,500,000</td>
</tr>
</tbody>
</table>

#### EV30@30 Scenario

<table>
<thead>
<tr>
<th>Vehicle Type</th>
<th>2020</th>
<th>2030</th>
</tr>
</thead>
<tbody>
<tr>
<td>Two Wheelers and Three Wheelers</td>
<td>NA</td>
<td>585,000,000</td>
</tr>
<tr>
<td>Light Duty Vehicles</td>
<td>NA</td>
<td>220,000,000</td>
</tr>
<tr>
<td>Buses</td>
<td>NA</td>
<td>4,500,000</td>
</tr>
<tr>
<td>Total</td>
<td>-</td>
<td>809,500,000</td>
</tr>
</tbody>
</table>
## Types of EV

<table>
<thead>
<tr>
<th>Technology/Protocol</th>
<th>BEV</th>
<th>HEV</th>
<th>PHEV</th>
<th>FCEV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Battery Charging</td>
<td>Plug-in</td>
<td>Regenerative Breaking</td>
<td>Plug-in</td>
<td>Fuel Cell Energy</td>
</tr>
<tr>
<td>Fuel</td>
<td>Electricity</td>
<td>Petrol/Diesel</td>
<td>Petrol/Diesel/Electric</td>
<td>Hydrogen</td>
</tr>
<tr>
<td>Infrastructure</td>
<td>Electric Charging Facilities</td>
<td>Refueling Stations</td>
<td>Refueling Stations &amp; Electric Charging Facilities</td>
<td>Hydrogen Production and Transportation facilities</td>
</tr>
<tr>
<td>Tailpipe Emissions</td>
<td>No</td>
<td>Low</td>
<td>Low</td>
<td>No</td>
</tr>
<tr>
<td>Features</td>
<td>• High efficiency</td>
<td>• Low emission</td>
<td>• Low emission</td>
<td>• High energy efficiency</td>
</tr>
<tr>
<td></td>
<td>• Oil independent</td>
<td>• Better fuel economy than ICE vehicles</td>
<td>• Better fuel economy compared to ICE vehicles depending on motor use and driving cycle</td>
<td>• Oil independent</td>
</tr>
<tr>
<td></td>
<td>• Commercially available</td>
<td>• Commercially available</td>
<td>• Commercially available</td>
<td>• Under Development</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Long range</td>
<td>• Long range</td>
<td></td>
</tr>
<tr>
<td>Challenges</td>
<td>• High cost compared to ICE vehicles</td>
<td>• High cost compared to ICE vehicles</td>
<td>• High cost compared to ICE vehicles</td>
<td>• Fuel Cell cost, reliability, safety</td>
</tr>
<tr>
<td></td>
<td>• Lack of charging infrastructure</td>
<td>• Battery sizing and management</td>
<td>• Battery sizing and management</td>
<td>• Hydrogen infrastructure</td>
</tr>
<tr>
<td></td>
<td>• Relatively short range</td>
<td>• Longer Range</td>
<td>• Lack of charging infrastructure</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Battery and battery maintenance</td>
<td></td>
<td>• Longer range compared to conventional hybrids</td>
<td></td>
</tr>
</tbody>
</table>
## Existing Battery Technologies

<table>
<thead>
<tr>
<th>Battery Chemistry</th>
<th>Maximum C Rate</th>
<th>Max Temperature (Degree Celsius)</th>
<th>Life (Maximum Cycles)</th>
<th>Power Density (Wh/kg for cell)</th>
<th>Average Module Price (US$/kWh in 2018)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lithium Ion Iron-Phosphate (LFP)</td>
<td>Up to 2C</td>
<td>40</td>
<td>1500-3000</td>
<td>100-130 Wh/kg</td>
<td>270</td>
</tr>
<tr>
<td>Lithium Ion- Nickel Manganese Cobalt (NMC)</td>
<td>C/2</td>
<td>40</td>
<td>1000-2000</td>
<td>230-250 Wh/kg (for NMC 811)</td>
<td>250</td>
</tr>
<tr>
<td>Lithium Ion- Nickel Manganese Cobalt (NMC)</td>
<td>3C</td>
<td>40</td>
<td>3000-4000</td>
<td>200 Wh/kg (for NMC 622)</td>
<td>400</td>
</tr>
<tr>
<td>Lithium Nickel Cobalt Aluminium (NCA)</td>
<td>2C</td>
<td>40</td>
<td>1000-1500</td>
<td>250-270 Wh/kg</td>
<td>230</td>
</tr>
<tr>
<td>Lithium ion Titanate Oxide (LTO)</td>
<td>6C</td>
<td>60</td>
<td>7500-10000</td>
<td>50-80 Wh/kg</td>
<td>700</td>
</tr>
</tbody>
</table>

**Source:** (ISGF White Paper Electric Vehicle Charging Stations Business Models for India, 2018)
EV Business Models

I. AGGREGATOR MODEL
• Coordinator between system operator, EV owner and distribution utility
• Collates EVs and create a potential source of energy that can be used by the utilities and system operator during the periods of high demand-supply gap.

II. OWNER MODEL
• Integrate large EV fleet through individual vehicle owners who then directly participate in the energy market
• EV owner will receive signals and directly manage the requests from utilities and system operators with the help of the two-way communication and control systems. This can be achieved by optimizing charging price so that the EV owner can minimize the charging cost at all times while reducing the stresses on the power grid.

III. DISCOMS
• DISCOMs shall be the owners and operator of charging facilities under a separate deregulated model

IV. BUS DEPOTS
• STUs themselves shall be the owners and operators of charging facilities for their own buses as well as their franchisee private bus operators

V. BATTERY SWAPPING
• The battery charging could be at public facilities or at their own captive industrial establishments from where charged batteries can be delivered at strategic locations within the city

VI. FRANCHISEES AT PARKING LOTS AND MUNICIPAL FACILITIES
• Franchisees of DISCOMs will own and operate charging facilities at premised allotted by City Governments/Municipalities or leased from the landlords.
Electric Vehicle Key Drivers in SAARC Countries

Limited Availability and Depleting Fuel

GHG Emissions from the Transport Sector

Deteriorating Air Quality

Volatility in Oil Prices

INDC Commitments
### SAARC Countries: Existing Scenario

<table>
<thead>
<tr>
<th>Country</th>
<th>Installed Power Generation Capacity (MW)</th>
<th>Crude Oil Imports (USD Million)</th>
<th>Petrol Imports (USD Million)</th>
<th>Diesel Imports (USD Million)</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Afghanistan</td>
<td>585</td>
<td>NA</td>
<td>327 (2017-18)</td>
<td>16.5 (2017-18)</td>
<td>Electricity imports of 5761 GWh from neighboring nations</td>
</tr>
<tr>
<td>Bangladesh</td>
<td>15,821</td>
<td>483 (2016-17)</td>
<td>3,814 (2016-17)</td>
<td>-</td>
<td>Petrol Imports include all Petroleum products</td>
</tr>
<tr>
<td>Bhutan</td>
<td>1,623</td>
<td>-</td>
<td>25 (2016)</td>
<td>82 (2016)</td>
<td>Electricity exports of 5372.5 MU</td>
</tr>
<tr>
<td>India</td>
<td>3,44,689</td>
<td>49,055 (April-November,2017)</td>
<td>7,624 (April-November,2017)</td>
<td>-</td>
<td>Petrol Imports include all Petroleum products</td>
</tr>
<tr>
<td>Nepal</td>
<td>1,070</td>
<td>-</td>
<td>1087.5 (2016-17)</td>
<td>-</td>
<td>Petrol Imports include all Petroleum products</td>
</tr>
<tr>
<td>Pakistan</td>
<td>26,186</td>
<td>1,840.7 (2016-17)</td>
<td>4,846 (2016-17)</td>
<td>-</td>
<td>Petrol Imports include all Petroleum products</td>
</tr>
<tr>
<td>Sri Lanka</td>
<td>4,043</td>
<td>587.6 (2017)</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>4,01,424</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
</tbody>
</table>

SAARC Countries: Transport Sector Scenario

Share of transport sector in consumption of oil and petroleum products

- India: 47%
- Nepal: 65%
- Pakistan: 48%
- Sri Lanka: 69%
- Bangladesh: 36%
- Bhutan: 59%
- Maldives: 31%

Source - SARI, TERI & GIZ

GDP
- The transport sector for each SAARC country has a contribution of at least 7% in the respective GDPs

Registered Motor Vehicles
- SAARC region has over 238 million registered motor vehicles
- Steep increase in motor vehicles is forecasted in the near future

Primary Energy Consumption
- By the year 2015, the share of transport sector in primary energy consumption stood at 7%

GHG Emissions
- The transport sector contributes 6% to 27% of total GHG emissions for different SAARC countries

Share of transport sector in GHG emission

- Pakistan: 11%
- Bangladesh: 6%
- Sri Lanka: 16%

Source - USAID
Key Recommendations of the Study
Afghanistan: EV Roadmap 2018-20

**Vision, Policy & Regulatory, Institutional Capacity (VPRIC)**
- Establishment of an EV Apex Body for Transport Planning and Policy Development

**Roadmap for Incentive (RI)**
- Subsidize import duty on EVs and registration on e-2W and e-3W
- Reduce property tax for charging station installation

**Automotive Sector (AS)**
- E-2W to be imported from India, China and Japan
- Battery and charging equipment to be imported from India and China for pilot projects

**Electrical Infrastructure (EI)**
- Exploitation of 300GW RE potential and power capacity augmentation by DABS for EV charging

**EV Technology (EVT)**
- Due to import of e-buses and e-3W from China and India, GB/T, CHAdeMO or CCS2 should be adopted

**Value Chain Integration (VCI)**
- Big business houses to use e-2W and e-4W for their own use and to set up EVSE in their areas
- Hotels, hospitals and companies to pool their CSR funds for financing of electric buses, four wheelers and charging stations on pilot basis

**Customer (CUST)**
- Create awareness regarding EV pilot programs and encourage the population to use e-Buses and e-3W

**Social & Environmental**
- Organizing EV awareness programs, conduct workshops and seminars
Afghanistan: EV Roadmap 2020-25

**Vision, Policy & Regulatory, Institutional Capacity (VPRIC)**
- National EV Policy
- Pilot project on e-Bus and e-3W in major cities by central and local governments and development banks

**Roadmap for Incentive (RI)**
- Govt support for e-3W, e-Bus and taxis pilot projects
- Low interest loans on e-2W and e-4W
- Govt support for 3rd party charging station installation

**Automotive Sector (AS)**
- E-Bus and e-3W for pilots to be imported from India, China and Japan. Services to be provided by OEMs for initial years.

**Electrical Infrastructure (EI)**
- Upgradation of electrical infrastructure in bus depots and terminus, three wheeler parking spaces, etc. in major cities by DABS for installation of charging stations.

**EV Technology (EVT)**
- Retrofitting of existing three wheelers which are operating for a long time into e-3W

**Value Chain Integration (VCI)**
- Battery swapping model for e-3W with the help of a Battery Leasing Agency (BLA)
- DABS and Ministry of Transport to set up charging station for e-buses in bus depots

**Customer (CUST)**
- Govt vision on EVs communicated to customers
- Incentives and benefits for adopting or using an EV to be communicated properly to customers

**Social & Environmental**
- E-buses and commercial taxi fleets can also provide opportunity to the existing workforce by providing them adequate training on O&M skills
Afghanistan: EV Roadmap 2025-30

Vision, Policy & Regulatory, Institutional Capacity (VPRIC)
- Mandated EV zones in certain city centres, government offices, embassies, major market areas
- EV adoption city targets focused on public transportation by 2035

Roadmap for Incentive (RI)
- Subsidized registration charges for one year for passenger cars as well as subsidies on CAPEX
- Duty free import of plant and machinery for setting up of assembly unit on one time basis

Automotive Sector (AS)
- Setting up small assembling units for e-2W and e-3W with foreign companies
- Servicing facility for charging stations can be provided by OEMs and local capacity development

Electrical Infrastructure (EI)
- Improvement in power quality through deployment of technologies like harmonic filters, static compensators

EV Technology (EVT)
- Govt and international research labs, technology institutes, private companies to work on optimization of lithium extraction process

Value Chain Integration (VCI)
- Pilot project charging stations should be established at prominent bus routes and areas having high 3W concentration

Customer (CUST)
- ToU pricing and its benefits to the customers must be displayed to make them aware of their benefits

Social & Environmental
- Deployment goals by the government to help bring electricity in the remote areas
**Vision, Policy & Regulatory, Institutional Capacity (VPRIC)**
- Launch nation-wide EV mission along with a set of policies and guidelines for e-3W
- Nodal agency to oversee the EV implementation

**Roadmap for Incentive (RI)**
- Subsidize import duty on EVs and registration on e-3W and e-4W for 1 year
- Reduce property tax for e-3W manufactures and assemblers
- Free parking and reduced tolls for electric vehicles

**Automotive Sector (AS)**
- E-rickshaws and 2 wheelers to be locally produced or assembled from parts imported from India, China and Japan; PPP or JV route can be used for this purpose

**Electrical Infrastructure (EI)**
- Power Quality, Peak Demand and DT assessment by DISCOMs in urban areas for EV charging

**EV Technology (EVT)**
- Batteries used in e-3W to be upgraded to lithium ion batteries
- E-2W technology to be upgraded in terms of design, battery capacity etc.

**Value Chain Integration (VCI)**
- Government building and offices to install charging stations in their premises for EV usage
- Major utilities like BPDB, REB etc. to invest in public charging and EV fleet infrastructure

**Customer (CUST)**
- Incentives and benefits of EVs passed on to customers
- R&D on the vehicle usage pattern to figure out the load curve for a particular day by EV cell

**Social & Environmental**
- Organizing EV awareness programs, conduct workshops and seminars

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*Bangladesh: EV Roadmap 2018-20*
Value Chain Integration (VCI)
- PPP model with private parking owners or service providers or OEMs and discoms to distribute risk
- Bundle EVSE as mandatory in new buildings through Building Codes

Customer (CUST)
- TOU pricing for EV to be communicated to customers
- Subsidized EVs and 2 wheelers for first few 1000 customers

Social & Environmental
- E-Bus and Commercial Taxi fleets to provide opportunity to existing workforce

Vision, Policy & Regulatory, Institutional Capacity (VPRIC)
- BIWTA and BRTA to define guidelines for licensing, driving norms, operation routes to streamline the EV adoption process
- Public bus, taxi fleet, 3 wheeler fleet electrification and charging station targets in Dhaka and Chittagong

Roadmap for Incentive (RI)
- Tax free/reduced tax for profit repatriation to foreign companies
- Reduced tariff for passenger using electric water transport

Automotive Sector (AS)
- Servicing for electric ferries and charging stations to be provided by OEMs for initial years.
- Local manufacturing through foreign collaborations or 100% FDI and EV parts

Electrical Infrastructure (EI)
- Electrical infrastructure upgradation and power quality improvement in bus depots and terminus, 3 wheeler parking spaces, etc. in cities by discoms for charging station installation.

EV Technology (EVT)
- EV standards of India and Japan adopted for interoperability.
Bangladesh: EV Roadmap 2025-30

**Vision, Policy & Regulatory, Institutional Capacity (VPRIC)**
- Mandatory electrification of private taxi fleets and water transport fleets
- Grid Code and Distribution Code guidelines must be updated for Vehicle to Grid (V2G) integration

**Roadmap for Incentive (RI)**
- Reduced property tax for residential complexes in few initial years for EV charging installation
- Promotion of battery recycling industry through tax-free income

**Automotive Sector (AS)**
- Local manufacturing units to joint venture with foreign companies for EV manufacturing including ferries
- 100% FDI in Lithium ion battery manufacturing
- Green bonds to finance EVs

**Electrical Infrastructure (EI)**
- Upgradation expense can be shared by OEMs or 3rd party service providers of charging stations
- Grid asset modernization for implementing V2G solution

**EV Technology (EVT)**
- EV testing and certification centre establishment
- R&D on EV design and battery technology to be initiated

**Value Chain Integration (VCI)**
- Dedicated fleet operators like for e-Buses and e-4Ws can invest by themselves or bring third party to invest in charging stations

**Customer (CUST)**
- Customers are engaged in prosumer programs through V2G integration on pilot basis
- Advance booking of parking slots through e-booking based on time and amount of charge in major cities

**Social & Environmental**
- EV manufacturing will help in job creation
- Usage of electric boats and launches will negate the chances of oil spills from boats
Bhutan: EV Roadmap 2018-20

**Vision, Policy & Regulatory, Institutional Capacity (VPRIC)**
- City target for electrification of public transportation including buses and taxi fleets. BPC as implementing agency for public buses electrification
- Mandate charging infrastructure and EVs at government offices and embassies

**Roadmap for Incentive (RI)**
- Exempt import and custom duty on EVs and EV components
- Subsidized registration charges for one year for electric 2 and 4 wheelers
- Reduce property tax for EV assemblers

**Automotive Sector (AS)**
- Encourage EV assembly units for mainly two and four wheelers
- E-buses, EVs, battery and charging equipment to be imported from India and China for pilot projects

**Electrical Infrastructure (EI)**
- BPC to assess the availability of power and spare capacity in DTs in areas having potential for charging station implementation

**Value Chain Integration (VCI)**
- BPC is to setup public charging and dedicated fleet infrastructure
- Tourism Council of Bhutan can plan for developing charging stations in various tourist places

**Customer (CUST)**
- Government vision and target for EVs communicated to customers
- Research on the vehicle usage pattern to figure out the load curve for a particular day by EV cell

**Social & Environmental**
- Organizing EV awareness programs, conduct workshops and seminars

**EV Technology (EVT)**
- Upgradation should be done in the battery segment with latest Li-ion batteries.
Bhutan: EV Roadmap 2020-25

**Vision, Policy & Regulatory, Institutional Capacity (VPRIC)**
- Subsidies on CAPEX for e-2W and e-4W
- Separate EV tariff to be considered as also TOU tariff
- In Thimphu, fleet operators of private taxis to be encouraged to shift to EVs through incentives

**Roadmap for Incentive (RI)**
- Reduced electricity tariff for charging for EV charging
- Reduced road tax for electric four wheeler commercial fleet
- Reduced property tax for residential charging infrastructure

**Automotive Sector (AS)**
- Servicing facilities of EVs and charging stations to be provided by OEMs

**Electrical Infrastructure (EI)**
- Electrical infrastructure upgradation and power quality improvement in cities by BPC for charging station installation
- Grid asset modernization for V2G

**EV Technology (EVT)**
- Consider adopting EV standards of India to ensure interoperability

**Value Chain Integration (VCI)**
- Major cities and tourist places can prioritize the installation of charging stations in parking lots, urban centres, markets, tourist spots etc.
- Mandatory for the JV hydropower project companies to develop public charging stations

**Customer (CUST)**
- TOU pricing for EV to be communicated to customers
- Incentives and benefits passed onto EV users

**Social & Environmental**
- EV deployment mainly buses and commercial taxi fleets can also provide opportunity to the existing workforce by providing them adequate training on O&M skills
Bhutan: EV Roadmap 2025-30

**Vision, Policy & Regulatory, Institutional Capacity (VPRIC)**
- Guidelines for 3rd party charging stations and providing charging as a service without any kind of licensing at least for one year.
- Grid Code and Distribution Code guidelines must be updated for Vehicle to Grid (V2G) integration.

**Roadmap for Incentive (RI)**
- Attractive FDI policy with single window clearance, registration, tax breaks, repatriation facility etc.
- Bulk insurance at concessional rate for commercial fleets.

**Automotive Sector (AS)**
- Testing and certifying facility to be established in conjunction assembling units for EVs.
- Promote local manufacturing of e-2W through PPP or with foreign companies.

**Electrical Infrastructure (EI)**
- Upgradation of electrical infrastructure.
- Grid asset modernization for implementing V2G solution.

**EV Technology (EVT)**
- R&D on EV design to be initiated in collaboration with technology institutes, research labs, industries etc.

**Value Chain Integration (VCI)**
- Bundle EVSE as mandatory in new buildings through Building Codes.
- Dedicated fleet operators like for e-Buses and e-4Ws can invest by themselves or bring third party to invest in charging stations.

**Customer (CUST)**
- Customers are engaged in prosumer programs through V2G integration on pilot basis.
- Advanced services for customers like door to door service for car charging.

**Social & Environmental**
- 3rd party service providing of charging stations will lead to job creation and people.
India: EV Roadmap 2018-20

**Vision, Policy & Regulatory, Institutional Capacity (VPRIC)**
- Mandate charging infrastructure and EVs at government offices and embassies
- National E-Mobility Programme that uses the demand aggregation model, should be expanded

**Roadmap for Incentive (RI)**
- GST rate should be rationalized on EVs and EV components
- Reduced fare for e-bus users; Reduced EV charging tariff

**Automotive Sector (AS)**
- Local manufacturing of EVSE, EVs and batteries through JVs with companies in Europe, China, Japan
- In house development of motors and power electronic equipment used for EVSE and EV

**Electrical Infrastructure (EI)**
- Discoms to assess the availability of spare capacity in DTs
- Upgradation of electrical infrastructure for charging station installation

**EV Technology (EVT)**
- Retrofitting of the older EV models with new technology
- Develop custom charging connector and communication protocol

**Value Chain Integration (VCI)**
- Government building and offices to electrify their vehicles and install charging stations in their premises.
- Discoms and MORTH to setup e-bus charging at depots and terminuses

**Customer (CUST)**
- Government vision and target for EVs as well as TOU pricing benefit communicated to customers
- Research on the vehicle usage pattern to figure out the load curve for a particular day by EV cell

**Social & Environmental**
- Organizing EV awareness programs, conduct workshops and seminars focussed on EV benefits
India: EV Roadmap 2020-25

Vision, Policy & Regulatory, Institutional Capacity (VPRIC)
- Public transport electrification - Smart City Mission
- Grid Code and Distribution Code guidelines to add V2G
- Building code revision: Charging infra mandated

Roadmap for Incentive (RI)
- Reduced tax on profit repatriation
- Subsidized registration charges for 1-2 years for 3 wheelers. Road and toll tax exemption for electric buses. Subsidized parking charges for electric cars.

Automotive Sector (AS)
- Servicing facilities of electric vehicles and charging stations to be provided by OEMs

Electrical Infrastructure (EI)
- Upgradation expense shared by OEMs or 3rd party service providers of charging stations
- Implementation of charging stations by supermarkets, big retailers with electrical network upgradation at own cost.

Value Chain Integration (VCI)
- State Transport Authorities to install charging stations on ferry ghats for boats
- PPP model with private parking owners or service providers or OEMs and discoms to distribute risk
- Pilot projects for water transport fleet electrification

Customer (CUST)
- Advance booking of parking slots through e-booking based on time and amount of charge required by the individual
- Incentives and benefits of EVs passed on to customers

Social & Environmental
- E-2W and E-3W manufacturing and assembling plants will help in job creation

EV Technology (EVT)
- Enhancement of the charging standards and communication protocols being used
India: EV Roadmap 2025-30

Vision, Policy & Regulatory, Institutional Capacity (VPRIC)
• Government to make mandatory full electrification of public bus fleets in metro cities and tier-1 and tier-2 cities and that of private taxi fleets throughout the country.
• Government to provide guidelines of battery recycling

Roadmap for Incentive (RI)
• Road and toll tax exemption for commercial electric taxi fleets.
• Promote battery recycling industry through tax free income or reduced interest on loans for JVs

Automotive Sector (AS)
• Battery manufacturing through 100% FDI and JV with local companies
• Battery recycling industry to be established with foreign collaborations

Electrical Infrastructure (EI)
• Facilitate EV owners to participate in demand response programs
• Grid asset modernization for implementing V2G solution

EV Technology (EVT)
• R&D on battery and battery recycling

Value Chain Integration (VCI)
• Bundle EVSE as mandatory in new buildings through Building Codes
• Dedicated fleet operators like for e-Buses and e-4Ws can invest by themselves or bring third party to invest in charging stations

Customer (CUST)
• Customers are engaged in prosumer programs through V2G integration on pilot basis
• Advanced services for customers like door to door service for car charging

Social & Environmental
• Usage of electric boats and launches will negate the chances of oil spills from boats and facilitate in reducing water pollution
Maldives: EV Roadmap 2018-20

Vision, Policy & Regulatory, Institutional Capacity (VPRIC)
• MEE, MED and MTA to launch nation-wide EV mission with a set of policies
• Govt to discuss with banks for low cost loans for E-2Ws in the initial years or can provide subsidy on CAPEX

Roadmap for Incentive (RI)
• Exempt import and custom duty on EVs and EV components
• Reduced property tax for hotels & resorts using electric vehicle or electric boats
• Reduced electricity tariff for charging

Automotive Sector (AS)
• EV Testing and Certification Centre to be established
• Battery and charging stations to be imported from countries like China for the pilot projects

Electrical Infrastructure (EI)
• Discom to assess the availability of power and spare capacity in DTs
• DISCOMs should assess the possibility of incorporating charging stations in the existing mini and micro grids

Value Chain Integration (VCI)
• Government building and offices to electrify their vehicles and install charging stations in their premises
• Resorts and hotels can use EV and electric boats for tourist transportation and can install charging station in their premises

Customer (CUST)
• All incentives and benefits for adopting or using an EV to be communicated properly to customers

Social & Environmental
• Organizing EV awareness programs, conduct workshops and seminars

EV Technology (EVT)
• Technology for E-2Ws to be upgraded in terms of design, battery capacity etc.
• Maldives can adopt CCS, CHAdeMo and Indian charging standards
Maldives: EV Roadmap 2020-25

Vision, Policy & Regulatory, Institutional Capacity (VPRIC)
- Mandate the use of electric two and four wheelers for vehicle rental companies, resorts and hotels
- Building code revision: Charging infra mandated in Male

Roadmap for Incentive (RI)
- Reduced anchorage fee and taxes for electric yacht
- Subsidy or low interest loan from banks for small fishermen for purchasing electric boats

Automotive Sector (AS)
- Assembling units for EVs and e-boats mainly to be set up on JV model with foreign companies
- Local manufacturing of EV like by ILAA Maldives Pvt. Ltd promoted by providing land, water and import logistic facility for manufacturing at a reasonable cost

Electrical Infrastructure (EI)
- Power quality improvement
- Upgradation of electrical infrastructure for charging stations

EV Technology (EVT)
- EV two & four wheeler testing and certification center to be developed.
- R&D on EV design to be initiated in collaboration with international research labs, technology institutes, etc.

Value Chain Integration (VCI)
- Bundle EVSE as mandatory in new buildings through Building Codes
- RE projects or micro or mini grid projects to install charging infrastructure in premises

Customer (CUST)
- Time of use pricing and its benefits to the customers must be displayed to make them aware of their benefits

Social & Environmental
- EV deployment will provide opportunity to the existing workforce
- Tourism will flourish by projecting areas as carbon neutral with EV being the only transport mechanism
Maldives: EV Roadmap 2025-30

**Vision, Policy & Regulatory, Institutional Capacity (VPRIC)**
- Mandate electrification of yacht, boats, fishing boats, four wheelers and launches used for public transportation
- Streamline 3rd party charging process through guidelines

**Roadmap for Incentive (RI)**
- Duty free import of plant and machinery for setting up of manufacturing or assembly unit on one time basis
- Reduced property tax for EV manufacturers and assembly units

**Automotive Sector (AS)**
- Promote local manufacturing of e-2W or yacht and boats through PPP or joint ventures with foreign companies
- Servicing facility for charging stations can be provided by OEMs

**Electrical Infrastructure (EI)**
- Implementation of charging stations by supermarkets, big retailers with electrical network upgradation at own cost
- Grid asset modernization for implementing V2G solution

**Value Chain Integration (VCI)**
- Private parking owners or service providers can implement public charging stations along with distribution utilities
- Fishing companies to use electric trawlers and boats and can install charging stations for a specified fee

**Customer (CUST)**
- Customers are engaged in prosumer programs through V2G integration on pilot basis
- Advance booking of parking slots through e-booking in Male based on time and amount of charge required

**Social & Environmental**
- E-2Ws, cars and boats manufacturing and assembling plants will create jobs

**EV Technology (EVT)**
- MEA, technocrats and EV associations etc. to decide on the interoperability of charging and enhance the charging standards and communication protocols
Nepal: EV Roadmap 2018-20

Vision, Policy & Regulatory, Institutional Capacity (VPRIC)
- Govt to launch nation-wide EV mission with a set of policies and covert all 3 wheelers
- MPIT to identify and dictate EV adoption target to cities with respect to public transportation including buses and three wheelers.

Roadmap for Incentive (RI)
- Exempt import and custom duty on EVs and EV components
- Reduced electricity tariff for charging
- Subsidized registration charges for one year for e-2W and e-3W

Automotive Sector (AS)
- E-3Ws to be assembled with imported parts from India or China
- Promote local manufacturing through PPP or with joint ventures with foreign companies like in India, Japan, etc.

Electrical Infrastructure (EI)
- Discom to assess the availability of power and spare capacity in DTs in areas having potential for charging station implementation

EV Technology (EVT)
- Batteries used in E-3Ws to be upgraded to lithium ion batteries
- Indian charging standards (IS:17017) may be adopted

Value Chain Integration (VCI)
- Government building and offices to electrify their vehicles and install charging stations in their premises
- NEA along with DoTM to invest in charging stations for electric buses in bus depots and terminus

Customer (CUST)
- Government vision and target for EVs communicated to customers. All incentives and benefits for adopting or using an EV to be communicated properly to customers

Social & Environmental
- Tourism will flourish by projecting areas as carbon neutral with EVs
Nepal: EV Roadmap 2020-25

Vision, Policy & Regulatory, Institutional Capacity (VPRIC)
- Separate EV tariff or TOU pricing for EVs
- Building codes to mandate charging facility in dedicated spaces in urban areas

Roadmap for Incentive (RI)
- Reduced road tax for EVs commercial fleet
- Reduced property tax for residential complexes, resorts and hotels for installing charging stations

Automotive Sector (AS)
- Servicing facility for charging stations to be provided by OEMs. 100% local manufacturing units to be promoted for e-2W and e-3W
- Feasibility study for monorail in the capital

Electrical Infrastructure (EI)
- Upgradation of electrical infrastructure in bus depots and terminus, parking lots, malls etc. by NEA for installation of charging stations.
- Improvement in power quality

EV Technology (EVT)
- Nepal Engineering Company to enhance charging standards and communication protocols being used e.g. CCS, CHAdeMO, OCPP etc.

Value Chain Integration (VCI)
- Private parking owners or service providers can implement public charging stations along with NEA
- Travel & Tourism companies, resort owners to install public charging station

Customer (CUST)
- Time of use pricing and its benefits to the customers must be displayed to make them aware of their benefits

Social & Environmental
- EV deployment will provide opportunity to the existing workforce by providing adequate training on O&M skills
Nepal: EV Roadmap 2025-30

Vision, Policy & Regulatory, Institutional Capacity (VPRIC)
- Mandate private electric fleet electrification
- Grid Code and Distribution Code guidelines to add V2G

Roadmap for Incentive (RI)
- Promote battery recycling industry through tax free income in initial years or reduced interest on loans for JVs with minimum 25% stake of local companies

Automotive Sector (AS)
- Local capacity development on O&M of charging stations through training and skill development
- Charger manufacturing units to be set up with 100% FDI or through JVs with local companies

Electrical Infrastructure (EI)
- Grid asset modernization for facilitating two way communication for implementing vehicle to grid solution
- Electrical infrastructure upgradation for monorail implementation in Kathmandu

EV Technology (EVT)
- R&D on battery recycling to be initiated in collaboration with Nepal engineering Company, technology institutes, etc.

Value Chain Integration (VCI)
- Transition of private cars into electric fleets will provide opportunity for the retailer or third party service providers to provide door to door servicing on charging of EVs in Kathmandu

Customer (CUST)
- Customers are engaged in prosumer programs through V2G integration on pilot basis
- Advanced services for customers like door to door service for car charging in Kathmandu

Social & Environmental
- Deployment goals by government will also help to bring electricity in the remote areas which can help in improving the living standard
Pakistan: EV Roadmap 2018-20

**Vision, Policy & Regulatory, Institutional Capacity (VPRIC)**
- MoC, MIP to launch nation-wide EV mission with a set of policies
- Pilot e-bus fleet project in Karachi, Lahore, Islamabad, etc.
- EV cell creation within concerned ministries.

**Roadmap for Incentive (RI)**
- Exempt import and custom duty on EVs and EV components
- Subsidized registration charges for one year for electric 2 and 3 wheelers
- Reduced tariff for passengers using electric buses

**Automotive Sector (AS)**
- Automotive Testing and Training Center to approve the 2 wheelers and 3 wheelers being manufactured and assembled
- Battery and charging stations to be imported from countries like China for the pilot projects

**Electrical Infrastructure (EI)**
- Discoms to assess the spare capacity in DTs, power availability and peak demand in both summer and winter season to figure out the EV demand the load network

**EV Technology (EVT)**
- Currently Pakistan has BMW Chargenow charging stations which follows CCS standards and as most of the vehicles are Japanese and Chinese, Pakistan can use CHAdeMO and GB/T charging standards.

**Value Chain Integration (VCI)**
- Distribution utilities and provincial transport authority to invest in charging station for e-buses in bus depots
- Big business houses to pool their CSR funds for financing of electric buses on pilot basis

**Customer (CUST)**
- Government vision and target for electric vehicle is communicated to customers
- Incentives and benefits to be passed onto EV customers

**Social & Environmental**
- Organizing EV awareness programs, conduct workshops and seminars to make people aware of the benefits of EV adoption
Pakistan: EV Roadmap 2020-25

**Vision, Policy & Regulatory, Institutional Capacity (VPRIC)**
- Public bus fleet electrification for intra city transfers and installation of charging stations in depots and terminus
- Separate EV tariff or TOU pricing for EVs. Building codes to mandate charging facility in dedicated spaces in urban areas

**Roadmap for Incentive (RI)**
- Reduced road tax and property tax for residential complexes, resorts and hotels for installing charging stations
- Duty free import of plant and machinery for manufacturing or assembly unit

**Automotive Sector (AS)**
- Local manufacturing units and service centers to be set up for electric 2 and 3 wheelers
- Manufacturing and assembling units for electric cars and buses mainly to be set up with JV with foreign companies

**Electrical Infrastructure (EI)**
- Upgradation of electrical infrastructure in bus depots, terminus, parking lots, malls etc. by discoms for charging infra installation

**EV Technology (EVT)**
- Automotive testing and training center to validate and certify the quality of electric vehicles manufactured
- In house development of EV technology

**Value Chain Integration (VCI)**
- Bundle EVSE as mandatory in new buildings through Building Codes
- Private bus companies to set up charging stations in their premises and can allow public charging for flat rate

**Customer (CUST)**
- ToU pricing and its benefits to the customers must be displayed to make them aware of their benefits
- Carry out research on the customer pattern of vehicle usage

**Social & Environmental**
- EV deployment mainly the buses, and commercial taxi fleets can also provide opportunity to the existing workforce by providing adequate training
Pakistan: EV Roadmap 2025-30

Vision, Policy & Regulatory, Institutional Capacity (VPRIC)
• Mandate public motor cars and jeeps electrification
• Grid Code and Distribution Code guidelines to add V2G
• In major cities like Karachi, Lahore, etc. private taxi fleet electrification to be incentivized

Roadmap for Incentive (RI)
• Reduced property tax for EV and battery manufacturers and promote battery recycling industry through tax free income

Automotive Sector (AS)
• Battery manufacturing units to be set up with JVs with foreign companies
• Servicing facility for charging stations can be provided by OEMs and local capacity development on O&M through T&D

Electrical Infrastructure (EI)
• Implementation of charging stations by supermarkets, big retailers with electrical network upgradation at own cost
• Grid asset modernization for facilitating two way communication for implementing vehicle to grid solution

EV Technology (EVT)
• Pakistan Automotive Institute, technocrats, EV associations etc. to decide on the interoperability, charging standards and communication protocols
• R&D on battery and battery recycling

Value Chain Integration (VCI)
• Dedicated fleet operators like for e-Buses and e-4Ws to invest or bring 3rd party to invest in charging infra
• Private parking owners or service providers can implement public charging stations with discoms or service providers

Customer (CUST)
• Advance booking of parking slots through e-booking based on time and amount of charge required by the individual in major cities like Karachi, Islamabad etc.

Social & Environmental
• Deployment goals to help bring electricity in remote areas to improve the living standard
• E-2W and e-3W manufacturing and assembling plants will help in job creation
Sri Lanka: EV Roadmap 2018-20

**Vision, Policy & Regulatory, Institutional Capacity (VPRIC)**
- MoT to launch nation-wide EV mission EV policy
- E-buses majorly intra city buses project in in major cities

**Roadmap for Incentive (RI)**
- Exempt import and custom duty on EVs and EV components
- Subsidized parking charges for EVs.
- Reduced property tax for E-3W manufacturers, EV assembly companies and hotels and resorts using EVs and charging equipment

**Automotive Sector (AS)**
- E-3Ws to be assembled with parts being imported from India or China
- Promote local manufacturing of electric 2 and 3 wheelers through PPP or JVs with foreign companies

**Electrical Infrastructure (EI)**
- Discoms to assess the supply and availability of spare capacity in DTs and power supply from RES

**EV Technology (EVT)**
- Technology for e-2W to be upgraded in terms of design, battery capacity etc.
- As Sri Lanka is currently using CHAdeMO & CCS, it may use Indian standard

**Value Chain Integration (VCI)**
- CEB with SLTMB to invest in charging infrastructure for e-buses in bus depots and termini
- Private parking owner, service providers, CEB, LECo, mall owners or hospitals can install public charging stations

**Customer (CUST)**
- Government vision, target, incentives and benefits for EV is communicated to customers
- TOU pricing and benefits communicated to customers

**Social & Environmental**
- Organizing EV awareness programs, conduct workshops and seminar
Sri Lanka: EV Roadmap 2020-25

Vision, Policy & Regulatory, Institutional Capacity (VPRIC)
- Public bus fleet electrification and installation of charging stations in depots and terminus by SLTB
- Electrification of public 3 wheeler fleet and inland water transport
- Reduced road tax for E-4W commercial fleet
- Tax free or reduced tax for profit repatriation for foreign companies
- Land on lease, water and logistic facility at reasonable cost for manufacturing or assembling units on EV and electric boats

Automotive Sector (AS)
- Servicing facility for charging stations to be provided by OEMs and local capacity development on O&M through T&D.
- 100% local manufacturing units to be set up for e-2W and e-3W service centres.

Electrical Infrastructure (EI)
- Upgradation and improvement in power quality of electrical infrastructure by CEB and LECO for charging infrastructure installation
- Reduced road tax for E-4W commercial fleet
- Tax free or reduced tax for profit repatriation for foreign companies
- Land on lease, water and logistic facility at reasonable cost for manufacturing or assembling units on EV and electric boats

Roadmap for Incentive (RI)
- Public bus fleet electrification and installation of charging stations in depots and terminus by SLTB
- Electrification of public 3 wheeler fleet and inland water transport
- Reduced road tax for E-4W commercial fleet
- Tax free or reduced tax for profit repatriation for foreign companies
- Land on lease, water and logistic facility at reasonable cost for manufacturing or assembling units on EV and electric boats

EV Technology (EVT)
- PUCSL, technocrats and EV associations to enhance charging standards and communication protocols
- EV 2 & 3 wheeler testing and certification center to be developed in Sri Lanka

Value Chain Integration (VCI)
- Transport Board along with distribution utility can set up charging stations for inland water transportation in Colombo
- Battery swapping model can be used for three wheelers with the help of a Battery Leasing Agency

Customer (CUST)
- Advance booking of parking slots through e-booking based on time and amount of charge required by the individual

Social & Environmental
- E-2W and E-3W manufacturing and assembling plants will create jobs and people of rural areas can opt for a sustainable living
Sri Lanka: EV Roadmap 2025-30

**Vision, Policy & Regulatory, Institutional Capacity (VPRIC)**
- Mandate electrification of private taxi fleets
- Target to convert entire water transport fleet including the fishing boats into electric fleet along with installation of charging stations
- Grid Code and Distribution Code guidelines to add V2G

**Roadmap for Incentive (RI)**
- Reduced property tax for EV and battery manufacturers and promote battery recycling industry through tax free income

**Automotive Sector (AS)**
- Charger manufacturing units to be set up with JVs with foreign companies
- Battery recycling industry to be developed with foreign collaborations

**Electrical Infrastructure (EI)**
- Grid asset modernization for facilitating two way communication for implementing vehicle to grid solution

**Value Chain Integration (VCI)**
- Bundle EVSE with highway development cost and install charging stations in the highways
- Dedicated fleet operators like for e-Buses and e-4Ws can invest by themselves or bring third party

**Customer (CUST)**
- Customers are engaged in prosumer programs through V2G integration on pilot basis
- Advanced services for customers like door to door service for car charging

**Social & Environmental**
- Provide electricity to remote areas
- Usage of electric boats for inland transport and fishing thereby reducing water pollution

**EV Technology (EVT)**
- R&D on EV design & battery recycling
Electric Vehicle Maturity Model (EVMM)

India Smart Grid forum has developed an Electric Vehicle Maturity Model (EVMM) to assess the readiness of a Country/City for EV adoption of EVs in terms of policy, infrastructure, technology, institutional structure, market dimensions, customer acceptance etc. which will help all stakeholders including concerned Government, Public Transport Utilities, Taxi/Fleet Operators, Electric Utilities, EV and Battery Manufacturers, EVSE Service Providers etc. to identify and implement the required steps that need to be taken in a phased manner to ensure sustainable EV adoption across the country/city.

The EVMM is structured across eight domains and 6 Levels of maturity to assess the preparedness/readiness for EV rollouts and measure the progress made in each domain by the country/city.
Overview of the Model

Eight Domains

Vision, Policy, Regulatory & Institutional Capacity
- Govt. Plans & Programs
- Policy & Regulations
- Org. Structure
- Capacity Building

Roadmap for Incentives
- Tax Breaks, Subsidy
- Profit Repatriation
- SMZ
- Loan Benefits
- Concessional Imports

Automotive Sector
- Local Manufacturing
- Auto Financing
- Import of Auto Components

Electrical Infrastructure
- EVSE Network
- Electric Network Capacity
- EV Tariff Structure
- VGI

EV Technology
- EV, EVSE & Battery Technology
- Power Electronics
- R&D

Value Chain Integration
- Business Model for EVSE
- Incentives for V2G

Customer
- Consumer Interest
- Capacity to Pay
- Advanced Services

Societal & Environmental
- Emission Reduction
- Shared Public Transportation
- New Job Creation

Six Levels
- "0" Default
- "1" Initiating
- "2" Enabling
- "3" Integrating
- "4" Optimizing
- "5" Pioneering
Thank You