SAARC Energy Centre, Islamabad
Pakistan

THE REPORT

Webinar to Disseminate the Study on
“Infrastructure & Enabling Environment for Road Electric
Transport in SAARC Member States”

Tuesday, May 5, 2020, Islamabad
Organized by
SAARC Energy Centre, Islamabad

5th May 2020

SAARC Energy Centre
697, Street 43, Sector E-11/4 (NPF),
Islamabad, Pakistan
www.saarcenergy.org
Introduction

SAARC Energy Centre Islamabad, under its approved Program Activities for the year 2020, successfully conducted a Webinar to Disseminate the Study on “Infrastructure and Enabling Environment for Road Electric Transport in SAARC Member States” on Tuesday, 5th May 2020. Agenda of the webinar is available at Annexure-I.

1. Main focus of the webinar was towards dissemination of the findings and recommendations of the study to the delegates from SAARC Member States in order to get their feedback and comments for value addition and further improvement of the study report. Areas discussed were: Study Approach and Methodology, Global EV Scenario and Future Growth, EV Types and Battery Technologies, EV Business Models, Key Drivers for EV Adoption in SAARC, and Country-wise Recommendations. Furthermore, China’s rapid journey towards EV and Pakistan’s current EV landscape were also discussed.

Participation

2. The webinar was attended by a total of 116 professionals representing public sector organizations, academia, private sector and other stakeholders from within and outside SAARC region. The Study Authors from India Smart Grid Forum, and Resource Persons from China and Pakistan shared their knowledge pertaining to technologies, government policies, existing practices, and international experience in the field of Electric Vehicles. The participants list is available at Annexure-II.
Description
3. The webinar started with welcome remarks by Program Coordinator, Mr. Muhammad Umar Mukhtar, from SAARC Energy Centre. The technical session comprised of presentations by the Resource Persons. Each presentation was followed by a brief Q&A session. The program coordinator read out conclusions, which were gathered during the webinar. Before closing the webinar, the Program Coordinator from SAARC Energy Centre offered remarks of appreciation to all the participants and Resource Persons.

Technical Proceedings
4. All the presentations delivered during the webinar are available at SEC’s website www.saarcenergy.org. The list of Resource Persons / Experts is available at Annexure-III and presentations made by them at Annexure-IV. Brief information of each delivered presentation is as follows:

Presentation 1 – Introduction to the Study and ISGF
*Mr. Reji Kumar Pillai, President India Smart Grid Forum & Ms. Reena Suri, Executive Director ISGF*
5. Mr. Pillai is a well-known name in India with regards to smart grids and electric vehicles, and advises the Government of India on EV policies. Being the Team Lead of the study author team, he started the technical proceedings by providing a brief introduction to the study, including its aims, objectives and key areas of focus. He, along with fellow colleague Ms. Reena Suri also introduced the credentials of India Smart Grid Forum (ISGF) to the participants, especially their past work on electric vehicles,

Presentation 2 – Study Approach, Methodology, Outcomes, & Findings
*Mr. Suddhasatta Kundu, Technical Manager, India Smart Grid Forum*
6. Mr. Suddhasatta Kundu has vast experience in planning and developing EV projects and studies in India, and was a key part of the study team. He apprised the participants on the approach and methodology taken for the study report. Furthermore, Mr. Kundu explained the Global EV Scenario, and gave a detailed technical overview of the types of EVs and the battery technologies covered in the study report. He comprehensively covered the study outcomes, and presented a thorough roadmap for each SAARC Member State for adopting EVs. Finally, he concluded his presentation by explaining the Electric Vehicle Maturity Model to the participants, on the basis of which the country-wise roadmaps and recommendations were developed.

Presentation 3 – Manufacturing of BEV: Discussion on Global Trends and Pakistan
*Dr. Shakeel Sadiq Jajja, Assistant Professor, Lahore University of Management Sciences*
7. Dr. Shakeel discussed the technical aspects of Electric Vehicles in detail, and informed the participants of the perspectives and issues related to the manufacturing of
EVs. He presented the key components of EVs with regards to local manufacturing, and comprehensively described the EV manufacturing value chain in Pakistan.

8. According to Dr. Shakeel, Pakistan’s industry with regards to battery manufacturing mainly focuses on lead acid batteries, and there is not enough focus on lithium ion batteries. Furthermore, he informed the participants that various motor manufacturers exist in Pakistan, but they lack in motor quality and sophistication because mostly recycled and scrapped material is used for motor manufacturing. He further informed that controller manufacturing is non-existent in Pakistan, and stressed the need for universities and R&D institutes to shift their focus towards EV research.

Presentation 4 – The Road to Electrification in China

Mr. Alan Liu, CEO, GH Energy, China

9. Mr. Liu presented a comprehensive overview of China’s EV revolution and informed the participants how China rapidly became a world leader in EV manufacturing and adoption. He started his presentation by describing the current situation of EVs in China, and apprised the participants that around 1.2 million EVs were sold in China in 2019 alone. Mr. Liu stated that since 2014, over 200 startups in China have been developing and manufacturing EVs, and the focus is now on integrating artificial intelligence and 5G technology to develop intelligent EVs. He also described that due to China’s dependence on imported oil, the government has prioritized the electrification of transport sector through EVs.

Feedback Session and Conclusion

Mr. Muhammad Umar Mukhtar, Research Fellow (Energy, Transport & Environment), SAARC Energy Centre

10. Mr. Mukhtar moderated a feedback session for getting insights and comments of the participants with regards to the study report. The participants did not have any specific comments regarding the study; however, they were keen to ask more questions from the study authors regarding general EV topics and trending EV technologies. The participants were given the chance to openly interact with the Resource Persons and ask questions on wide ranging topics such as charging standards, EV life cycle impact, technology localization, Pakistan EV policy, EV maturity model, and longest distance covered by EVs in India. At the end of the session, Mr. Mukhtar thanked everyone for their active participation in the session. He informed the participants that the draft study report has been uploaded on the SEC website, and requested them to go through the study report in order to share study related feedback and comments in email.
Closing of Webinar

Mr. Muhammad Umar Mukhtar, Research Fellow (Energy, Transport & Environment), SAARC Energy Centre

11. Mr. Muhammad Umar Mukhtar informed all the participants that the presentations will be available on SAARC Energy Centre’s website (www.saarcenergy.org). He requested the participants to submit suggestions and comments to SEC for any further improvement to the study report. He informed the participants that they may also suggest and submit any topics of their interest to SEC for arranging future webinars. He closed the webinar with a thank you note to everyone attending the Webinar.

12. All the presentations delivered during the webinar are available at SEC’s website www.saarcenergy.org.
Annexures
Webinar Agenda

Webinar to Disseminate the Study on “Infrastructure and Enabling Environment for Road Electric Transport in SAARC Member States”
Tuesday, 5th February 2020

<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
</tr>
</thead>
<tbody>
<tr>
<td>11:00</td>
<td>Introduction</td>
</tr>
<tr>
<td>11:05</td>
<td>Introduction to the Study and ISGF&lt;br&gt;Presenter: Mr. Reji Kumar Pillai (President – India Smart Grid Forum)</td>
</tr>
<tr>
<td>11:25</td>
<td>Approach and Methodology of the Study&lt;br&gt;Presenter: Mr. Suddhasatta Kundu (Technical Manager – ISGF)</td>
</tr>
<tr>
<td>11:45</td>
<td>Q &amp; A session</td>
</tr>
<tr>
<td>12:00</td>
<td>Study Outcomes, Findings and Recommendations&lt;br&gt;Presenter: Mr. Suddhasatta Kundu (Technical Manager – ISGF)</td>
</tr>
<tr>
<td>12:20</td>
<td>Q &amp; A session</td>
</tr>
<tr>
<td>12:30</td>
<td>Study Report Feedback Session&lt;br&gt;Moderator: Mr. Muhammad Umar Mukhtar – RF(ETE) SAARC Energy Center</td>
</tr>
<tr>
<td>12:45</td>
<td>Manufacturing of BEVs: Discussion on Global Trends and Pakistan&lt;br&gt;Presenter: Dr. Shakeel Sadiq Jajja (Assistant Professor – LUMS)</td>
</tr>
<tr>
<td>13:05</td>
<td>Q &amp; A session</td>
</tr>
<tr>
<td>13:10</td>
<td>The Road to Electrification in China&lt;br&gt;Presenter: Mr. Alan Liu (CEO – GH Energy)</td>
</tr>
<tr>
<td>13:30</td>
<td>Q &amp; A session</td>
</tr>
<tr>
<td>13:35</td>
<td>Summarizing Conclusions and Recommendations of Webinar</td>
</tr>
<tr>
<td>13:45</td>
<td>Closing of Webinar</td>
</tr>
</tbody>
</table>

Information for the participants:

1. All times mentioned in agenda are according to Pakistan Standard Time (PKT). The participants from other Member States may attend Webinar by following their own national time. The time conversion for all Member States is given below for reference:

<table>
<thead>
<tr>
<th>Country</th>
<th>Afghanistan</th>
<th>Bangladesh</th>
<th>Bhutan</th>
<th>India</th>
<th>Maldives</th>
<th>Nepal</th>
<th>Sri Lanka</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local time</td>
<td>(PKT-00:30)</td>
<td>(PKT+01:00)</td>
<td>(PKT+01:00)</td>
<td>(PKT+00:30)</td>
<td>PKT</td>
<td>(PKT+00:45)</td>
<td>(PKT+00:30)</td>
</tr>
</tbody>
</table>

2. The participants can ask questions to presenters by typing questions or clicking to the raised hand option into the Attendees pane of the main window of GotoWebinar software. You may send in your questions at any time during the presentations; we will collect these and address them during the Q&A session at the end of each presentation.

3. All participants can also submit comments/views and/or observations on webinar to SAARC Energy Centre through email to Mr. Muhammad Umar Mukhtar, Research Fellow (ETE) (rfete@saarcenergy.org) by 12th May, 2020.
## List of Participants

<table>
<thead>
<tr>
<th>S. No.</th>
<th>First Name</th>
<th>Last Name</th>
<th>Email address</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Rabnawaz</td>
<td>Anjum</td>
<td><a href="mailto:rabnawaz.anjum@kapco.com.pk">rabnawaz.anjum@kapco.com.pk</a></td>
</tr>
<tr>
<td>2</td>
<td>Muhammad Asad</td>
<td>Malik</td>
<td><a href="mailto:asad.malik@gil.com.pk">asad.malik@gil.com.pk</a></td>
</tr>
<tr>
<td>3</td>
<td>Hafsa</td>
<td>Chohan</td>
<td><a href="mailto:hafsa.qayyum96@gmail.com">hafsa.qayyum96@gmail.com</a></td>
</tr>
<tr>
<td>4</td>
<td>Ugyen</td>
<td>Yoezr</td>
<td><a href="mailto:ugyen.dhps@gmail.com">ugyen.dhps@gmail.com</a></td>
</tr>
<tr>
<td>5</td>
<td>Mujtaba</td>
<td>Yaqoob</td>
<td><a href="mailto:mujtabayaqoob@yahoo.com">mujtabayaqoob@yahoo.com</a></td>
</tr>
<tr>
<td>6</td>
<td>Muhammad Ali</td>
<td>Qureshi</td>
<td><a href="mailto:m.qureshi2@unido.org">m.qureshi2@unido.org</a></td>
</tr>
<tr>
<td>7</td>
<td>Stuart</td>
<td>Zhang</td>
<td><a href="mailto:sanping.zhang@siemens.com">sanping.zhang@siemens.com</a></td>
</tr>
<tr>
<td>8</td>
<td>Arshad</td>
<td>Bajwa</td>
<td><a href="mailto:afbajwa@gmail.com">afbajwa@gmail.com</a></td>
</tr>
<tr>
<td>9</td>
<td>Jamil</td>
<td>Masud</td>
<td><a href="mailto:jamil.masud@sepproject.com">jamil.masud@sepproject.com</a></td>
</tr>
<tr>
<td>10</td>
<td>Ashraf Hossain</td>
<td>Bhuiyan</td>
<td><a href="mailto:ahossain@idcol.org">ahossain@idcol.org</a></td>
</tr>
<tr>
<td>11</td>
<td>Balasubramanyam</td>
<td>Karnam</td>
<td><a href="mailto:bala.k@indiasmartgrid.org">bala.k@indiasmartgrid.org</a></td>
</tr>
<tr>
<td>12</td>
<td>Hussni Mubrak</td>
<td>Azizi</td>
<td><a href="mailto:Hussni.azizi@gmail.com">Hussni.azizi@gmail.com</a></td>
</tr>
<tr>
<td>13</td>
<td>Amar</td>
<td>uddin</td>
<td><a href="mailto:amaruddin4@gmail.com">amaruddin4@gmail.com</a></td>
</tr>
<tr>
<td>14</td>
<td>Dibya</td>
<td>Adhikari</td>
<td><a href="mailto:dibyaadhikari33@gmail.com">dibyaadhikari33@gmail.com</a></td>
</tr>
<tr>
<td>15</td>
<td>Dr Fatima</td>
<td>Alvi</td>
<td><a href="mailto:fatimaalvi2007@gmail.com">fatimaalvi2007@gmail.com</a></td>
</tr>
<tr>
<td>16</td>
<td>Umer</td>
<td>Younis</td>
<td><a href="mailto:umer.younis@hotmail.com">umer.younis@hotmail.com</a></td>
</tr>
<tr>
<td>17</td>
<td>Aminath Maiha</td>
<td>Hameed</td>
<td><a href="mailto:aminath.maiha@environment.gov.mv">aminath.maiha@environment.gov.mv</a></td>
</tr>
<tr>
<td>18</td>
<td>Fakhar</td>
<td>Alam</td>
<td><a href="mailto:fakhar2879@gmail.com">fakhar2879@gmail.com</a></td>
</tr>
<tr>
<td>19</td>
<td>Junaid</td>
<td>Khan</td>
<td><a href="mailto:tojunaid@gmail.com">tojunaid@gmail.com</a></td>
</tr>
<tr>
<td>20</td>
<td>Hassan</td>
<td>Zaidi</td>
<td><a href="mailto:hassan.zaidi@totalparco.com.pk">hassan.zaidi@totalparco.com.pk</a></td>
</tr>
<tr>
<td>21</td>
<td>Abid</td>
<td>Latif</td>
<td><a href="mailto:abid.latif@totalparco.com.pk">abid.latif@totalparco.com.pk</a></td>
</tr>
<tr>
<td>22</td>
<td>Nirmal</td>
<td>Paudel</td>
<td><a href="mailto:nirmal323@gmail.com">nirmal323@gmail.com</a></td>
</tr>
<tr>
<td>23</td>
<td>Tula</td>
<td>poudel</td>
<td><a href="mailto:rfet@saarcenergy.org">rfet@saarcenergy.org</a></td>
</tr>
<tr>
<td>24</td>
<td>Abdullah</td>
<td>Salaam</td>
<td><a href="mailto:abdullah.salaam@live.com">abdullah.salaam@live.com</a></td>
</tr>
<tr>
<td>25</td>
<td>Humairah</td>
<td>Jabeen</td>
<td><a href="mailto:humairah_jabeen@hotmail.com">humairah_jabeen@hotmail.com</a></td>
</tr>
<tr>
<td>26</td>
<td>Munalah</td>
<td>Akhtar</td>
<td><a href="mailto:munalakhtar@yahoo.com">munalakhtar@yahoo.com</a></td>
</tr>
<tr>
<td>27</td>
<td>Pratik</td>
<td>Karki</td>
<td><a href="mailto:pratikkarki77@gmail.com">pratikkarki77@gmail.com</a></td>
</tr>
<tr>
<td>28</td>
<td>Tahir</td>
<td>Iqbal</td>
<td><a href="mailto:tahirse6393@gmail.com">tahirse6393@gmail.com</a></td>
</tr>
<tr>
<td>29</td>
<td>Farrukh</td>
<td>Iqbal</td>
<td><a href="mailto:dgun@mofa.gov.pk">dgun@mofa.gov.pk</a></td>
</tr>
<tr>
<td>S. No.</td>
<td>First Name</td>
<td>Last Name</td>
<td>Email address</td>
</tr>
<tr>
<td>-------</td>
<td>----------------</td>
<td>---------------</td>
<td>--------------------------------------</td>
</tr>
<tr>
<td>30</td>
<td>Ali Waqas</td>
<td>Malik</td>
<td><a href="mailto:dr.dr.aliwaqas@gmail.com">dr.dr.aliwaqas@gmail.com</a></td>
</tr>
<tr>
<td>31</td>
<td>Hasibullah</td>
<td>Qazizada</td>
<td><a href="mailto:hasibullahqazizada7.5@gmail.com">hasibullahqazizada7.5@gmail.com</a></td>
</tr>
<tr>
<td>32</td>
<td>SAYAK</td>
<td>MULLICK</td>
<td><a href="mailto:sayak5648@gmail.com">sayak5648@gmail.com</a></td>
</tr>
<tr>
<td>33</td>
<td>Ritwik</td>
<td>Ray Chaudhuri</td>
<td><a href="mailto:ritwik.raychaudhuri96@gmail.com">ritwik.raychaudhuri96@gmail.com</a></td>
</tr>
<tr>
<td>34</td>
<td>Muhammad Khayyam</td>
<td>Ilyas</td>
<td><a href="mailto:khayyam.ilyas@gmail.com">khayyam.ilyas@gmail.com</a></td>
</tr>
<tr>
<td>35</td>
<td>Imran Ali</td>
<td>Shah</td>
<td><a href="mailto:coaltechnology@gmail.com">coaltechnology@gmail.com</a></td>
</tr>
<tr>
<td>36</td>
<td>Aayush</td>
<td>Anand</td>
<td><a href="mailto:aayushanandpathak@gmail.com">aayushanandpathak@gmail.com</a></td>
</tr>
<tr>
<td>37</td>
<td>Alan</td>
<td>Llu</td>
<td><a href="mailto:lchskqhbdl@hotmail.com">lchskqhbdl@hotmail.com</a></td>
</tr>
<tr>
<td>38</td>
<td>Mir</td>
<td>Muhammad</td>
<td><a href="mailto:mir.mangie@gmail.com">mir.mangie@gmail.com</a></td>
</tr>
<tr>
<td>39</td>
<td>Jahanzeb</td>
<td>Hassan</td>
<td><a href="mailto:jahanzeb.rsl@gmail.com">jahanzeb.rsl@gmail.com</a></td>
</tr>
<tr>
<td>40</td>
<td>Sujan</td>
<td>Adhikari</td>
<td><a href="mailto:adhikariisujan@gmail.com">adhikariisujan@gmail.com</a></td>
</tr>
<tr>
<td>41</td>
<td>Mehnaz</td>
<td>Gardezi</td>
<td><a href="mailto:cs@saarcenergy.org">cs@saarcenergy.org</a></td>
</tr>
<tr>
<td>42</td>
<td>Muhammad Adnan</td>
<td>Arshad</td>
<td><a href="mailto:madnan.arshad@hotmail.com">madnan.arshad@hotmail.com</a></td>
</tr>
<tr>
<td>43</td>
<td>shoalb</td>
<td>ahmad</td>
<td><a href="mailto:ddcord@saarcenergy.org">ddcord@saarcenergy.org</a></td>
</tr>
<tr>
<td>44</td>
<td>Kush</td>
<td>Lohana</td>
<td><a href="mailto:kushlohan1998@gmail.com">kushlohan1998@gmail.com</a></td>
</tr>
<tr>
<td>45</td>
<td>Ihsan</td>
<td>Marwat</td>
<td><a href="mailto:rfee@saarcenergy.org">rfee@saarcenergy.org</a></td>
</tr>
<tr>
<td>46</td>
<td>Subash</td>
<td>Panta</td>
<td><a href="mailto:subpan.kha@gmail.com">subpan.kha@gmail.com</a></td>
</tr>
<tr>
<td>47</td>
<td>Junaid</td>
<td>Ahmed</td>
<td><a href="mailto:junaid0235@gmail.com">junaid0235@gmail.com</a></td>
</tr>
<tr>
<td>48</td>
<td>Mohammed Khalil</td>
<td>Anjum</td>
<td><a href="mailto:khalilianjum350@gmail.com">khalilianjum350@gmail.com</a></td>
</tr>
<tr>
<td>49</td>
<td>Farman</td>
<td>Marwat</td>
<td><a href="mailto:acctt.asstt@saarcenergy.org">acctt.asstt@saarcenergy.org</a></td>
</tr>
<tr>
<td>50</td>
<td>Muhammad</td>
<td>Awais</td>
<td><a href="mailto:admin.asstt@saarcenergy.org">admin.asstt@saarcenergy.org</a></td>
</tr>
<tr>
<td>51</td>
<td>Owais</td>
<td>Khan</td>
<td><a href="mailto:19060025@lums.edu.pk">19060025@lums.edu.pk</a></td>
</tr>
<tr>
<td>52</td>
<td>Wania</td>
<td>Rafi</td>
<td><a href="mailto:wania.rafi@ke.com">wania.rafi@ke.com</a></td>
</tr>
<tr>
<td>53</td>
<td>Anam</td>
<td>Iqbal</td>
<td><a href="mailto:anam.iqbal@lums.edu.pk">anam.iqbal@lums.edu.pk</a></td>
</tr>
<tr>
<td>54</td>
<td>Buland</td>
<td>Siddiqui</td>
<td><a href="mailto:buland.siddiqui@sepproject.com">buland.siddiqui@sepproject.com</a></td>
</tr>
<tr>
<td>55</td>
<td>nauman</td>
<td>hussain</td>
<td><a href="mailto:sfo@saarcenergy.org">sfo@saarcenergy.org</a></td>
</tr>
<tr>
<td>56</td>
<td>Mohammad Abubakr</td>
<td>Javed</td>
<td><a href="mailto:abubakr.javed@lums.edu.pk">abubakr.javed@lums.edu.pk</a></td>
</tr>
<tr>
<td>57</td>
<td>Saad</td>
<td>Latif</td>
<td><a href="mailto:saad.latif@ke.com.pk">saad.latif@ke.com.pk</a></td>
</tr>
<tr>
<td>58</td>
<td>Malik</td>
<td>Faizan</td>
<td><a href="mailto:malik.faizan@lums.edu.pk">malik.faizan@lums.edu.pk</a></td>
</tr>
<tr>
<td>59</td>
<td>Aijaz</td>
<td>Ahmed</td>
<td><a href="mailto:aijisiddiqi@yahoo.com">aijisiddiqi@yahoo.com</a></td>
</tr>
<tr>
<td>60</td>
<td>Arif</td>
<td>Goheer</td>
<td><a href="mailto:arifgoheer@gmail.com">arifgoheer@gmail.com</a></td>
</tr>
<tr>
<td>S. No.</td>
<td>First Name</td>
<td>Last Name</td>
<td>Email address</td>
</tr>
<tr>
<td>-------</td>
<td>------------------</td>
<td>----------------</td>
<td>---------------------------------------------------</td>
</tr>
<tr>
<td>61</td>
<td>Sidra</td>
<td>Farooqi</td>
<td><a href="mailto:sidra_farooqii@hotmail.com">sidra_farooqii@hotmail.com</a></td>
</tr>
<tr>
<td>62</td>
<td>Ali Hussain Umar</td>
<td>Bhatti</td>
<td><a href="mailto:alihussain_95@outlook.com">alihussain_95@outlook.com</a></td>
</tr>
<tr>
<td>63</td>
<td>Kifayatullah</td>
<td>Kalhoro</td>
<td><a href="mailto:electronics_engineer91@yahoo.com">electronics_engineer91@yahoo.com</a></td>
</tr>
<tr>
<td>64</td>
<td>Engr Gulzar Ahmed</td>
<td>Memon</td>
<td><a href="mailto:engrgulzarmemon@hotmail.com">engrgulzarmemon@hotmail.com</a></td>
</tr>
<tr>
<td>65</td>
<td>Akbar</td>
<td>Yusuf</td>
<td><a href="mailto:Akbar.Yusuf@sepproject.com">Akbar.Yusuf@sepproject.com</a></td>
</tr>
<tr>
<td>66</td>
<td>Iram</td>
<td>Shahzadi</td>
<td><a href="mailto:iramrvcc@gmail.com">iramrvcc@gmail.com</a></td>
</tr>
<tr>
<td>67</td>
<td>Malik</td>
<td>Arslan</td>
<td><a href="mailto:malik.arslan@lums.edu.pk">malik.arslan@lums.edu.pk</a></td>
</tr>
<tr>
<td>68</td>
<td>Mehak</td>
<td>Masood</td>
<td><a href="mailto:mehakmasood@gmail.com">mehakmasood@gmail.com</a></td>
</tr>
<tr>
<td>69</td>
<td>Muhammad</td>
<td>Muzzamil</td>
<td><a href="mailto:mohammadmuzzamil@hotmail.com">mohammadmuzzamil@hotmail.com</a></td>
</tr>
<tr>
<td>70</td>
<td>Sarfaraz</td>
<td>khan</td>
<td><a href="mailto:sarfaraz.npo@gmail.com">sarfaraz.npo@gmail.com</a></td>
</tr>
<tr>
<td>71</td>
<td>Ali</td>
<td>Khan</td>
<td><a href="mailto:ali.khan@akla.com.pk">ali.khan@akla.com.pk</a></td>
</tr>
<tr>
<td>72</td>
<td>Ahsan</td>
<td>Zaheer</td>
<td><a href="mailto:18020324@lums.edu.pk">18020324@lums.edu.pk</a></td>
</tr>
<tr>
<td>73</td>
<td>Ali</td>
<td>Husnain</td>
<td><a href="mailto:ali.husnain@wwindea-pk.org">ali.husnain@wwindea-pk.org</a></td>
</tr>
<tr>
<td>74</td>
<td>Donald</td>
<td>McCubbin</td>
<td><a href="mailto:dmccubbin@usaid.gov">dmccubbin@usaid.gov</a></td>
</tr>
<tr>
<td>75</td>
<td>Imran</td>
<td>Ahmed</td>
<td><a href="mailto:engr_imran.ahmed@yahoo.com">engr_imran.ahmed@yahoo.com</a></td>
</tr>
<tr>
<td>76</td>
<td>Tasneem</td>
<td>Chowdhrey</td>
<td><a href="mailto:tchowdhrey@hotmail.com">tchowdhrey@hotmail.com</a></td>
</tr>
<tr>
<td>77</td>
<td>Mohammad Arham</td>
<td>Sohail</td>
<td><a href="mailto:mohammad.sohail@lums.edu.pk">mohammad.sohail@lums.edu.pk</a></td>
</tr>
<tr>
<td>78</td>
<td>Naveed</td>
<td>Arshad</td>
<td><a href="mailto:naveedarshad@lums.edu.pk">naveedarshad@lums.edu.pk</a></td>
</tr>
<tr>
<td>79</td>
<td>Muhammad Huzaifa</td>
<td>Qasmi</td>
<td><a href="mailto:huzaifaqasmi2011@gmail.com">huzaifaqasmi2011@gmail.com</a></td>
</tr>
<tr>
<td>80</td>
<td>Muhammad Usman</td>
<td>Tahir</td>
<td><a href="mailto:musmantahir16@gmail.com">musmantahir16@gmail.com</a></td>
</tr>
<tr>
<td>81</td>
<td>Sultan</td>
<td>Khan</td>
<td><a href="mailto:sfakhan@meconsultonline.com">sfakhan@meconsultonline.com</a></td>
</tr>
<tr>
<td>82</td>
<td>Ahmad</td>
<td>Talha</td>
<td><a href="mailto:rftt@saarcenergy.org">rftt@saarcenergy.org</a></td>
</tr>
<tr>
<td>83</td>
<td>Naveed</td>
<td>Qureshi</td>
<td><a href="mailto:gnaveed777@gmail.com">gnaveed777@gmail.com</a></td>
</tr>
<tr>
<td>84</td>
<td>Sana</td>
<td>Qayum</td>
<td><a href="mailto:sanaaqayum@gmail.com">sanaaqayum@gmail.com</a></td>
</tr>
<tr>
<td>85</td>
<td>Farhana</td>
<td>Chowdhury</td>
<td><a href="mailto:solartieltd@gmail.com">solartieltd@gmail.com</a></td>
</tr>
<tr>
<td>86</td>
<td>Bhaskar</td>
<td>Pradhan</td>
<td><a href="mailto:plet@saarcenergy.org">plet@saarcenergy.org</a></td>
</tr>
<tr>
<td>87</td>
<td>Prashanthi</td>
<td>Narangoda</td>
<td><a href="mailto:director@saarcculture.org">director@saarcculture.org</a></td>
</tr>
<tr>
<td>88</td>
<td>Nimal</td>
<td>Perera</td>
<td><a href="mailto:nimal_pr@sltnet.lk">nimal_pr@sltnet.lk</a></td>
</tr>
<tr>
<td>89</td>
<td>Laveet</td>
<td>Kumar</td>
<td><a href="mailto:laveet.kumar@gmail.com">laveet.kumar@gmail.com</a></td>
</tr>
<tr>
<td>90</td>
<td>Gonzalo</td>
<td>Duran</td>
<td><a href="mailto:ceo@aerometro.org">ceo@aerometro.org</a></td>
</tr>
<tr>
<td>91</td>
<td>Faisal</td>
<td>Abbas</td>
<td><a href="mailto:faisalabbas4513@gmail.com">faisalabbas4513@gmail.com</a></td>
</tr>
<tr>
<td>S. No.</td>
<td>First Name</td>
<td>Last Name</td>
<td>Email address</td>
</tr>
<tr>
<td>--------</td>
<td>---------------</td>
<td>-----------------</td>
<td>--------------------------------</td>
</tr>
<tr>
<td>92</td>
<td>Rajesh</td>
<td>P</td>
<td><a href="mailto:prajesh@asci.org.in">prajesh@asci.org.in</a></td>
</tr>
<tr>
<td>93</td>
<td>Abdul</td>
<td>Wahab</td>
<td><a href="mailto:wahab.saarc@gmail.com">wahab.saarc@gmail.com</a></td>
</tr>
<tr>
<td>94</td>
<td>Abdul</td>
<td>Wahab</td>
<td><a href="mailto:deo@saarcenergy.org">deo@saarcenergy.org</a></td>
</tr>
<tr>
<td>95</td>
<td>Shuvam</td>
<td>Sarkar Roy</td>
<td><a href="mailto:shuvam@indiasmartgrid.org">shuvam@indiasmartgrid.org</a></td>
</tr>
<tr>
<td>96</td>
<td>zain ul abedin</td>
<td>khewa</td>
<td><a href="mailto:engineerzain17@gmail.com">engineerzain17@gmail.com</a></td>
</tr>
<tr>
<td>97</td>
<td>Asad</td>
<td>Mahmood</td>
<td><a href="mailto:asadm_46@yahoo.com">asadm_46@yahoo.com</a></td>
</tr>
<tr>
<td>98</td>
<td>Ki Joon Kim</td>
<td>Kim</td>
<td><a href="mailto:kjkim@adb.org">kjkim@adb.org</a></td>
</tr>
<tr>
<td>99</td>
<td>Reji Kumar</td>
<td>Pillai</td>
<td><a href="mailto:reji@rejikumar.com">reji@rejikumar.com</a></td>
</tr>
<tr>
<td>100</td>
<td>SUDDHASATTA</td>
<td>KUNDU</td>
<td><a href="mailto:s.kundu@indiasmartgrid.org">s.kundu@indiasmartgrid.org</a></td>
</tr>
<tr>
<td>101</td>
<td>Nazrul</td>
<td>Islam</td>
<td><a href="mailto:epnz2009@gmail.com">epnz2009@gmail.com</a></td>
</tr>
<tr>
<td>102</td>
<td>S M Mohibur</td>
<td>Rahman</td>
<td><a href="mailto:mohib9@gmail.com">mohib9@gmail.com</a></td>
</tr>
<tr>
<td>103</td>
<td>Ahsan</td>
<td>Javed</td>
<td><a href="mailto:ahsan@saarcenergy.org">ahsan@saarcenergy.org</a></td>
</tr>
<tr>
<td>104</td>
<td>Reena</td>
<td>Suri</td>
<td><a href="mailto:reena.suri@indiasmartgrid.org">reena.suri@indiasmartgrid.org</a></td>
</tr>
<tr>
<td>105</td>
<td>Tanvir</td>
<td>Ahmad</td>
<td><a href="mailto:pltt@saarcenergy.org">pltt@saarcenergy.org</a></td>
</tr>
<tr>
<td>106</td>
<td>pradeep</td>
<td>kumar</td>
<td><a href="mailto:ravichandran.pradeep.kumar@pwc.com">ravichandran.pradeep.kumar@pwc.com</a></td>
</tr>
<tr>
<td>107</td>
<td>Huma</td>
<td>Kamran</td>
<td><a href="mailto:pstodirector@saarcenergy.org">pstodirector@saarcenergy.org</a></td>
</tr>
<tr>
<td>108</td>
<td>Gopal</td>
<td>Basnet</td>
<td><a href="mailto:yiur_gopalbasnet@yahoo.com">yiur_gopalbasnet@yahoo.com</a></td>
</tr>
<tr>
<td>109</td>
<td>Abdallah</td>
<td>Baba</td>
<td><a href="mailto:abdallah.baba@gmail.com">abdallah.baba@gmail.com</a></td>
</tr>
<tr>
<td>110</td>
<td>Saad</td>
<td>Zaheer</td>
<td><a href="mailto:saadzaheer@gmail.com">saadzaheer@gmail.com</a></td>
</tr>
<tr>
<td>111</td>
<td>Jitaditya</td>
<td>Dey</td>
<td><a href="mailto:jitaditya.dey@pwc.com">jitaditya.dey@pwc.com</a></td>
</tr>
<tr>
<td>112</td>
<td>Tanvir</td>
<td>Ahmad</td>
<td><a href="mailto:tanvir.ahmad@yahoo.com">tanvir.ahmad@yahoo.com</a></td>
</tr>
<tr>
<td>113</td>
<td>Bhim</td>
<td>gautam</td>
<td><a href="mailto:journalistbhim@gmail.com">journalistbhim@gmail.com</a></td>
</tr>
<tr>
<td>114</td>
<td>Tehseen</td>
<td>Ilahi</td>
<td><a href="mailto:engineer_tehseen@yahoo.com">engineer_tehseen@yahoo.com</a></td>
</tr>
<tr>
<td>115</td>
<td>Khurram</td>
<td>Shabbir</td>
<td><a href="mailto:khurram.shabbir@live.com">khurram.shabbir@live.com</a></td>
</tr>
<tr>
<td>116</td>
<td>Mirza Itaf</td>
<td>Hussain</td>
<td><a href="mailto:altafmirza878@gmail.com">altafmirza878@gmail.com</a></td>
</tr>
</tbody>
</table>
# List of Presenters/Resource Persons

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Name</th>
<th>Designation</th>
<th>Organization</th>
<th>Email address</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Mr. Reji Kumar Pillai</td>
<td>President</td>
<td>India Smart Grid Forum</td>
<td><a href="mailto:reji@rejikumar.com">reji@rejikumar.com</a></td>
</tr>
<tr>
<td>2.</td>
<td>Mr. Suddhasatta Kundu</td>
<td>Technical Manager</td>
<td>India Smart Grid Forum</td>
<td><a href="mailto:s.kundu@indiasmartgrid.org">s.kundu@indiasmartgrid.org</a></td>
</tr>
<tr>
<td>3.</td>
<td>Ms. Reena Suri</td>
<td>Executive Director</td>
<td>India Smart Grid Forum</td>
<td><a href="mailto:Reena.suri@indiasmartgrid.org">Reena.suri@indiasmartgrid.org</a></td>
</tr>
<tr>
<td>4.</td>
<td>Dr. Shakeel Sadiq Jajja</td>
<td>Assistant Professor</td>
<td>Lahore University of Management Sciences</td>
<td><a href="mailto:ssj@lums.edu.pk">ssj@lums.edu.pk</a></td>
</tr>
<tr>
<td>5.</td>
<td>Mr. Alan Liu</td>
<td>CEO</td>
<td>GH Energy</td>
<td><a href="mailto:alanliu@ghed.com.cn">alanliu@ghed.com.cn</a></td>
</tr>
</tbody>
</table>
Presentations Delivered During the Webinar

1. “Study on Infrastructure and Enabling Environment for Road Electric Transport in SAARC Member States” by Mr. Reji Kumar Pillai, Ms. Reena Suri and Mr. Suddhasatta Kundu (ISGF)
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 (on going)
- Designing of Time of Use Electricity Tariff in the State of Gujarat (on going)
- 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
**Project Brief and Objectives**

- 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 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

  **Key Interventions**
  - Policy & regulatory
  - Business model & tariff design
  - Electric grid upgradation
  - Institutional development

  **Outcome**
  - 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
- Recommend action 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

Annual Electric Car sales registered a milestone of 5.1 million s 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-ZW Sales were 300 million for 2018
Global E-ZW Stock stands at 800 million
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

Global EV Stock and Future Growth

<table>
<thead>
<tr>
<th>Growth of EVs under different Policy Scenarios</th>
<th>New Policy Scenario</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vehicle Type</td>
<td></td>
</tr>
<tr>
<td>2020</td>
<td>2030</td>
</tr>
<tr>
<td>Two Wheelers and Three Wheelers</td>
<td>NA</td>
</tr>
<tr>
<td>Light Duty Vehicles</td>
<td>12,000,000</td>
</tr>
<tr>
<td>Buses</td>
<td>NA</td>
</tr>
<tr>
<td>Total</td>
<td>581,500,000</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>EV30@30 Scenario</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Vehicle Type</td>
<td></td>
</tr>
<tr>
<td>2020</td>
<td>2030</td>
</tr>
<tr>
<td>Two Wheelers and Three Wheelers</td>
<td>NA</td>
</tr>
<tr>
<td>Light Duty Vehicles</td>
<td>NA</td>
</tr>
<tr>
<td>Buses</td>
<td>NA</td>
</tr>
<tr>
<td>Total</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>FCV</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 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</td>
<td>• Better fuel economy compared to ICE vehicles depending on motor use and driving cycle</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Commercially available</td>
<td>• Commercially available</td>
<td>• Long range</td>
<td>• Oil independent</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Commercially available</td>
<td></td>
<td>• Under Development</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>• Longer range compared to conventional hybrids</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Battery and battery maintenance</td>
<td></td>
<td></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 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>

*Sources: (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 premises 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>327.607-09</td>
<td>16.5587-14</td>
<td>Electricity imports of 5/63 Gwh from neighboring nations</td>
</tr>
<tr>
<td>Bangladesh</td>
<td>15,422</td>
<td>485.050</td>
<td>3,810.845-07</td>
<td>-</td>
<td>Petrol Imports include all Petroleum products</td>
</tr>
<tr>
<td>Bhutan</td>
<td>1,623</td>
<td>-</td>
<td>250.069</td>
<td>820.168</td>
<td>Electricity exports of 537.23 MWh</td>
</tr>
<tr>
<td>India</td>
<td>3,44,089</td>
<td>49,055</td>
<td>7,624</td>
<td>-</td>
<td>Petrol Imports include all Petroleum products</td>
</tr>
<tr>
<td>Maldives</td>
<td>363</td>
<td>-</td>
<td>37.430</td>
<td>234.615</td>
<td></td>
</tr>
<tr>
<td>Nepal</td>
<td>1,070</td>
<td>-</td>
<td>1087.665-07</td>
<td>-</td>
<td>Petrol Imports include all Petroleum products</td>
</tr>
<tr>
<td>Pakistan</td>
<td>26,186</td>
<td>1,840.756</td>
<td>4,846.256-07</td>
<td>-</td>
<td>Petrol Imports include all Petroleum products</td>
</tr>
<tr>
<td>Sri Lanka</td>
<td>4,043</td>
<td>587.670</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**

<table>
<thead>
<tr>
<th>Country</th>
<th>share of transport sector</th>
<th>share of transport sector</th>
</tr>
</thead>
<tbody>
<tr>
<td>India</td>
<td>65%</td>
<td>47%</td>
</tr>
<tr>
<td>Nepal</td>
<td>69%</td>
<td>36%</td>
</tr>
<tr>
<td>Pakistan</td>
<td>48%</td>
<td>31%</td>
</tr>
<tr>
<td>Sri Lanka</td>
<td>6%</td>
<td>11%</td>
</tr>
</tbody>
</table>

**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 236 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.

Source: TERI, GIZ, IPA, 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-3W 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 Incentives (RI)
  - Govt support for e-3W, e-Bus and taxi 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 or 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
Annexure-IV

Bangladesh: EV Roadmap 2018-20

Vision, Policy & Regulatory, Institutional Capacity (VPRIC)
Launch national-wide EV mission along with a set of policies and guidelines for e-3W
Model agency to oversee the EV implementation

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

Automotive Sector (AS)
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

Technical 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 BPOB, REB etc. to invest in public charging and EV fleet infrastructure
- 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
- Social & Environmental
  - Organizing EV awareness programs, conduct workshops and seminars

Bangladesh: EV Roadmap 2020-25

Vision, Policy & Regulatory, Institutional Capacity (VPRIC)
BWITA and BRTA to define guidelines for licensing, driving norms, operation routes to streamline the EV adoption process
Public bus, taxicab 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

Technical Infrastructure (EI)
Electric vehicle infrastructure and power quality improvement in bus depots and terminals, 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.
- 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)
- TOD 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
Annexure-IV

Bangladesh: EV Roadmap 2025-30

- **Vision, Policy & Regulatory, Institutional Capacity (VPDIC)**
  - 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 new 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

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

- **Customer (CUST)**
  - Customers are engaged in consumer program through V2G integration on pilot basis
  - Advance booking of parking slots through 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 (VPDIC)**
  - City target for electrification of public transportation including buses and taxi fleets
  - BPC as implementing agency for public bus 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

- **Automotive Sector (AS)**
  - Reduce property tax for EV assemblers

- **Electrical Infrastructure (EI)**
  - Encourage EV assembly units for mainly two and four wheelers
  - 1-buses, EVs, battery and charging equipment to be imported from India and China for pilot projects

- **Value Chain Integration (VCI)**
  - BPC is to setup public charging at dedicated fleet infrastructure
  - Tourism Council of Bhutan can plan to 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

---

Page 23 of 49
Annexure-IV

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 all EV fleet operators to develop public charging stations

Customer (CUST)
TOU pricing for EV to be communicated to customers
Incentives and benefits passed on to 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-4W can invest by themselves or bring third party to invest in charging stations

Customer (CUST)
Customers are engaged in procurement program 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 station 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 EVs, 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
- Electrifi Industry Initiative (EII)
- Doms to assess the availability of spare capacity in NID
- Upgradation of electrical infrastructure for charging station installation

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

**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**
- Organising EV awareness programs, conducting seminars and workshops focussed on 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 VCI
- 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 (EII)
- 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 ghat for boats
- PPP model with private parking owners; service providers or OEMs and discoms to distribute risk
- Pilot projects for water transport fleet electrification

**Customer (CUST)**
- Advance booking of parking slots through 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 assembly plants will help in job creation
India: EV Roadmap 2025-30

- Vision, Policy & Regulatory Institutional Capacity (VPRIC)
- EV Technology (EVT)
  - R&D on battery and battery recycling

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

Customer (CUST)
- Customers are engaged in prosumer program 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

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 AIs

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

Maldives: EV Roadmap 2018-20

- Vision, Policy & Regulatory Institutional Capacity (VPRIC)
- EV Technology (EVT)
  - Technology for E-4Ws to be upgraded in terms of design, battery capacity etc.
  - Maldives can adopt CCS, CHADEMO and India charging standards

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 buses 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

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)
- Xicom to assess the availability of power and spare capacity in DTS
- VS/COMs should assess the possibility of incorporating charging stations in the existing mini and micro grids
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 VU.
- Roadmap for Incentive (RI)

**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.
- Power quality improvement
- Upgradation of electrical infrastructure for charging stations.

**Electrical Infrastructure (EI)**

**Value Chain Integration (VCI)**
- 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.
  - Bundle EVSE as mandatory in new building 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 customers must be displayed to make them aware of their benefits.
- Social & Environmental
  - EV deployment will provide opportunity to its 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 yachts, boats, fishing boats, four wheelers and launches used for public transportation.
- Streamline 3rd party charging process through guidelines.
- Roadmap for Incentive (RI)

**Automotive Sector (AS)**
- 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.
- Promote local manufacturing of e-2W or yacht and seats 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)**
- EV Technology (EVT)
  - MEA, technocrats and EV associations etc. to decide on the interoperability of charging and enhance the charging standards and communication protocols.
- 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 consumer program through V2G integration on pilot basis.
- Advance booking of parking slots through a booking in Male based on time and amount charge required.
- Social & Environmental
  - E-2Ws, cars and boats manufacturing an assembling plants will create jobs.
Nepal: EV Roadmap 2018-20

Vision, Policy & Regulatory, Institutional Capacity (VPRIIC)
- Revise to launch nation-wide EV mission with a set of policies and co-opt all 3 wheeler manufacturers
- VRIT to identify and dictate EV adoption target to utilities with respect to public transportation including buses and three-wheelers.

Roadmap for Incentive (RI)
- IVA to 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-3W to be assembled with imported parts from India or China
- Promote local manufacturing through PPP or joint ventures with foreign companies like in India, Japan, etc.

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

EV Technology (EVT)
- Batteries used in E-3W to be upgraded to lithium ion batteries
- Indian charging standards (IS:37017) may be adopted

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

Customer (CUST)
- NEA and DoTM to communicate properly to customers
- NEA and DoTM to communicate properly to customers
- Tourism will flourish by projecting areas as carbon neutral with EVs

Nepal: EV Roadmap 2020-25

Vision, Policy & Regulatory, Institutional Capacity (VPRIIC)
- 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. 300% 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 depot 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)
- NEA and DoTM to invest in public charging stations along with NEA
- NEA and DoTM to install public charging stations
- NEA and DoTM to install public charging stations

Customer (CUST)
- Time of use pricing and its benefits to 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 (VPRI)
- 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 EVs 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% DDI or through JV with local companies

Electrical Infrastructure (EI)
- 3rd asset modernization for facilitating two-way communication for implementing vehicle to grid solution
- Electrical infrastructure upgrade and monitoring implementation in Kathmandu

EV Technology (EVT)
- R&D on battery recycling to be initiated in collaboration with Nepal engineering companies, 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 to the remote areas which can help in improving the living standards

Pakistan: EV Roadmap 2018-20

- Vision, Policy & Regulatory, Institutional Capacity (VPRI)
- MoC, MIP to launch nation-wide EV mission with a set of policies
- Pilot electric 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 Centre to approve the 1 wheelers and 3 wheelers being manufactured and assembled
- Battery and charging stations to be imported from countries like China for the pilot project

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 and load network

EV Technology (EVT)
- Currently Pakistan has BMW Chargeno charging stations which follows CCS standards and as most of the vehicles are Japanese or Chinese, Pakistan can use CHAdeMO and GB 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 & 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 customers

Social & Environmental
- Organizing EV awareness programs, conductions, workshops and seminars to make public 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, terminals, parking lots, malls etc. by discoms for charging infra installation

**Ev Technology (EVT)**
- Automotive testing and training center validate and certify the quality of electric vehicle manufactured
- In house development of EV technology
- Value Chain Integration (VCI)
  - Bundle EVSE as mandatory in new building 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 customer must be displayed to make them aware of the benefits
- Carry out research on the customer pattern vehicle usage

**Social & Environmental**
- EV deployment mainly the buses, an 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 car and jeep electrification
- Grid Code and Distribution Code guidelines to add VDC
- 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)**
- EV battery manufacturing units to be set up with JVs with foreign companies
- Service facility for charging stations can be provided by OEMs and local capacity development on O&M through R&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 an e-4WVs to invest or bring 3rd party to invest in charging infra
  - Private parking owners or service provider can implement public charging stations without discoms or service providers

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

**Social & Environmental**
- Deployment goals to help bring electricity to 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 nationwide EV mission EV policy
- E-buses majorly intra city buses project in in major cities

**Roadmap for Incentives (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-1Ws to be assembled with parts being imported from India or China
- Promote local manufacturing of electric 2 and 3 wheelers through PPPs or JV's with foreign companies

**Technical Infrastructure (EI)**
- Systems to assess the supply and availability of spare capacity in DTHs and power supply from RES

---

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

**Roadmap for Incentive (RI)**
- Reduced road tax for E-4W commercial fleet
- Tax free or reduced tax for profit repatriation for foreign companies

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

**Technical Infrastructure (EI)**
- Upgradation and improvement in power quality of electrical infrastructure by CEB and LECO for charging infrastructure installation

---

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

**Value Chain Integration (VCI)**
- CEB with SUT/MB to invest in charging infrastructure for e-buses in bus depots at termini
- Private parking owner, service providers, CIE, LECO, mall owners or hospitals can install public charging stations

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

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

---

**EV Technology (EVT)**
- USCIL, technotraits and EV associations to enhance charging standards and communication protocols
- 2W & 3W lessor 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 the 2W with the help of a Battery Leasing Agency

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

**Social & Environmental**
- E-2W and E-3W manufacturing and assembly 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 eDS

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 IIs with foreign companies
  - Battery recycling industry to be developed with foreign collaborations

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

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
  - Profits Repatriation
  - SME
  - 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

- "5" Pioneering
- "4" Optimizing
- "3" Integrating
- "2" Enabling
- "1" Initiating
- "0" Default

Thank You

India Smart Grid Forum
CBIP Building, Mulcha Marg,
Chanakyapuri,
Delhi-110021
Website: www.indiaSMARTgrid.org
2. “Manufacturing of BEVs: Discussion on Global Trends and Pakistan” by Dr. Shakeel Sadiq Jajja, Assistant Professor – LUMS

Manufacturing of Battery Electric Vehicles: Discussion on Global Trends and Pakistan

Dr. Shakeel Sadiq Jajja
Associate Professor of Operations and Supply Chain Management
Director, Executive MBA
Suleman Dawood School of Business
Lahore University of Management Sciences
Lahore, Pakistan
Email: ssi@lums.edu.pk

Overview

- Appreciating various types of electric vehicles
- Global trends in manufacturing and adoption of battery electric vehicles (BEVs)
- Manufacturing value chain of battery electric vehicles (BEVs) in Pakistan
- Future outlook in Pakistan
Electric Vehicle Types

1. Battery Electric Vehicles (BEVs) or All-Electric Vehicles
2. Plug-In Hybrid Electric Vehicles (PHEVs)
3. Hybrid Electric Vehicles (HEVs)

Why is it important to differentiate?

1. Consumer standpoint
2. Infrastructure standpoint
3. Distribution and after-sale service standpoint
4. Manufacturing standpoint
5. Technological transition standpoint
6. Regulatory standpoint

Key Components of BEVs

- Battery
  - Lithium-ion
  - Lead Acid
- Battery management system
- Motor
  - DC Series Motor
  - Brushless DC Motor
  - Permanent Magnet Synchronous Motor (PMSM)
  - Three Phase AC Induction Motors
  - Switched Reluctance Motors (SRM)
- Controller
- Cables
- Body
Global Trends

• Electric mobility is expanding at a rapid pace globally.
• In 2018, the global electric car fleet exceeded 5.1 million, up 2 million from the previous year and almost doubling the number of new electric car sales.
• Battery electric vehicles (BEVs) account for 64% of the world’s electric car fleet.
• The People’s Republic of China remains the world’s largest electric car market, followed by Europe and the United States.
• Norway is the global leader in terms of electric car market share.
• Vision 30 @ 30 – Aims to reach 30% EV market share by 2030. Signatories: China, Japan, Finland, France, Netherlands and Sweden.

Dr. Shakeel Sadiq Jajja, LUMS

Regional Share in Global Stock of Electric Cars - 2018

Dr. Shakeel Sadiq Jajja, LUMS
Global electric car sales and market share, 2013-18

Drivers of BEV Mass Adoption

- Energy efficiency: EVs are three-to-five times more energy efficient than conventional internal combustion engine (ICE) vehicles.
- Energy security: BEVs reduce reliance on oil-based fuels and can reduce dependence on oil imports for many countries.
- Air pollution: BEVs have zero tailpipe emissions and can address pollution issues, especially in urban areas and along road networks.
- Green House Gas emissions: BEVs can deliver significant reductions in GHG emissions especially from road transport relative to ICE vehicles.
- Noise reduction: EVs are quieter than ICE vehicles and hence contribute to less noise pollution, especially in the two/three-wheeler category.
Falling Battery Prices

- Battery price >$1000/kWh in 2010
- By 2025 batteries will increasingly use cathode chemistries that are less dependent on cobalt, such as NMC 811 (80% nickel, 10% manganese, and 10% cobalt) or advanced NCA batteries
- Graphene Technology
- Supercapacitor (SC)

Global Battery Market

- Lead acid batteries have a higher market share but LIBs have a higher growth rate
- Automotive applications accounted for over 70% of total lithium-ion battery shipments in 2018, compared to just 43% in 2015 and 6% in 2010

Dr. Shakeel Sadiq Jajja, LUMS
Government Policies

- Critical policy measures used by leading countries:
  - **Fuel economy standards** (e.g. Corporate Average Fuel Economy, ZEV mandate etc.): used in U.S.A, China, Japan, Canada and EU
  - **Fiscal Incentives** for zero- and low-emissions vehicles (e.g. tax credits, subsidies to manufacturers and consumers)
  - **Economic Instruments** - To boost the value proposition of EVs and help bridge the total cost of ownership gap between electric and conventional vehicles (e.g. free registration or license plates, lower toll or parking fees, access to bus lanes etc.)
  - Globally policy support is being used to address the strategic importance of the **battery technology value chain**.

Dr. Shakeel Sadiq Jajja, LUMS

---

Government Policies

- **Procurement Programs** – To stimulate demand for electric vehicles and to enable an initial roll-out of publicly accessible charging infrastructure.
  - In the city of Shenzhen, government mandated operators to go electric, 16 000 electric buses operate, the largest-scale electric bus transition observed in a city.
  - Largest electric bus fleet procurement in Europe: 100 electric buses on routes in the Schiphol Airport area in the Netherlands
- **Infrastructure Support Policies**: Minimum requirements to ensure EV readiness in new or refurbished buildings and parking lots, and the roll-out of publicly accessible chargers in cities and on highway networks.
- **Adoption of standards** to facilitate inter-operability of various types of charging infrastructure.

Dr. Shakeel Sadiq Jajja, LUMS
CHINA – Adoption Trends

- Target of 5 million EVs by 2020 including 4.6 million passenger light-duty vehicles (PLDVs).
- New electric vehicle (NEV) mandate: 12% NEV credit sales in passenger cars. NEVs get between two and six credits depending upon their range. OEMs must earn enough credit to match 12% of their output.
- Roadmap for NEV sales share: 7-10% by 2020, 15-20% by 2025 and 40-50% by 2030.
- Proposal for tightened fuel economy standard for cars (4 L/100 km by 2025).
- Current fuel economy standard to be used till 2020

Dr. Shakeel Sadiq Jajja, LUMS

CHINA – Adoption Trends

- China is both the biggest manufacturer and the biggest market for cars globally.
- Buys more than half of the world’s new electric cars.
- China’s electric car market is 3 times larger than the US electric car market. In 2018, China had 1.26 million electric cars to 361,000 electric cars in the US.
- China has the largest volume of EV in absolute terms. But relatively, EVs still account only for a small fraction of the market.

Dr. Shakeel Sadiq Jajja, LUMS
CHINA – Manufacturing Trends

- Uses the term New Energy Vehicles which includes BEVs, hybrids and plug-in hybrids.
- Built a complete value chain with a high percentage of locally produced components being incorporated into foreign cars produced in China.
- Foreign automotive vehicle & components manufacturers must form joint ventures with local firms to enter the Chinese market.
- China leads the electric two-wheeler market: produced 26 million units and had an estimated stock of 250 million units (1/4th of the global stock) in 2018.
- Domestic OEMs have a 94% market sales share of the Chinese EV market.
- Incentives being phased out in recent years as industry matures and cost of production falls.
- China remains the global leader in the production of both mined rare earth products and refined rare earth compounds, with Chinese production accounting for 86% of global refined production in 2017. Rare earths are a key raw material in permanent magnets which are used in electric motor for EVs.
- Research focus on Graphene Technology - China International Graphene Industry Union (CIGIU) for industrial development of Graphene.

Dr. Shakeel Sadiq Jajja, LUMS

BEVs Value Chain in Pakistan

Dr. Shakeel Sadiq Jajja, LUMS
Entrepreneurial ventures
- Power Electronics Pakistan (PEP), Lahore
- Jolta, Lahore
- S. Zia ul Haq & Sons (SZS), Karachi
- InerZ, Islamabad

Existing automobile manufacturers (Perspectives)
- Nishat Hyundai
- Atlas Group
- Sazgar Engineering
- Omega Industries (Road Prince)

Component manufacturers (Current Situation)

- **Battery**
  - Treet Daewoo (Lead acid: deep cycle and maintenance free batteries)
  - Atlas (Lead acid)
  - Pakistan's battery industry seems to be lead acid based manufacturing
  - Some effort towards importing and assembling Li ion cells is happening
  - LUMS School of Science and Engineering (Assembly of Li ion using imported cells)
  - Challenge is optimization of energy density, charging time, price, temperature, efficiency (temperature sensitive), weight, life cycle, ...
  - Graphene based technology and ultra capacitors: globally battery constraints seem coming down sharply

- **Motor manufacturing**
  - Gujranwala (Golden pumps, Diamond Motors, Akhlas Motors, ...)
    - Various types of motors though mostly AC motors
    - Sophistication and export orientation is lacking
    - Mostly from recycled material (electric sheets: majority recovered from international scrap; copper wires: original requires scale so second hand used; bearing: several levels of quality ABS...)
    - Key facilities for research and development such as for testing for international standards lacking
    - Efficiency and temperature relationship
    - Can possibly reverse engineer over time (5-7 years) and designing might take longer
  - Possible role of fan manufacturing industry

Dr. Shakeel Sadiq Jaija, LUMS
Component manufacturers (Current situation)

- Cables
  - Fast Cables
  - Two items: conductor (almost constant) and insulator (varies)
  - Current automobile market size is too small for large companies
  - BEVs can bring opportunities in 4 wheelers
  - In BEVs, unlike ICE based vehicles, temperatures not very high
  - Though lab equipment is missing it can quickly catch up
- Controller
  - Could not find a specific company
  - Companies like Jolta and InerZ are working to develop their own

---

Universities and R&D Institutions

- LUMS School of Science and Engineering
  - Student projects on electric vehicles and international competitions
- NED Karachi
  - Student projects
  - Working with Mehran fans to develop motors
- UET Lahore
  - Test beds of electric motors
- UET Peshawar
- LUMS Energy Institute
  - Working with federal government to provide intellectual support in the development of BEVs encouraging policies

Dr. Shakeel Sadiq Jajja, LUMS
International players

- Interested in:
  - Pakistan’s market
  - Manufacturing for global markets
- Integrated electric kits providing combination of:
  - Battery packs
  - Battery management system
  - Motor
  - Controller
  - Battery swapping system

Economic sense of BEVs

- Upfront cost
  - Battery is the major cost in BEVs (approximately 30-50% in Li ion based BEVs)
  - Cost goes very high with Li ion battery
  - Affordable price with lead acid but issues of lead acid
  - Li ion is the way to go – for now
- Companies in Pakistan are targeting some design innovations to bring the upfront cost down e.g., SZS (4 wheeler) and InerZ (2 wheeler)
- Operating cost attractive
Regulatory framework

- Current Auto Development Policy 2016-21 does not have needed focus on BEVs
- Recently government has announced an electric vehicles policy
- Policy making in conflicting objectives: new players, existing players, climate change, localization
- Pakistan hoping to become a signatory of International Energy Agency’s 30%@2030 initiative
- Green banking regulations of State Bank of Pakistan (mainly focus on solar energy)
- Energy supply in Pakistan is surplus in next ten years (LUMS Energy Institute)
- Energy infrastructure and business models

Dr. Shakeel Sadiq Jajja, LUMS

Future Outlook - Pakistan

- Key components
  - EV kits: Seem a transition for aspirant 2/3 wheelers
  - Battery (Li ion and or lead acid) – Reducing cost: step wise localization beginning from assembly of cells
  - Battery management system: critical for Pakistani environment
  - Motor: leverage the existing knowledge to localize in 5-7 years
  - Controller: some companies are working on it
  - Body: requires innovation to bring the cost down
  - Cables: seem quite ready
- Financing (high upfront cost)
  - Loans for BEVs
  - Battery leasing models: Cars and batteries
- Starting target markets: Two/three wheelers, commercial vehicles, institutional customers
- Policy (Enhancing demand versus enhancing demand as well as localization)

Dr. Shakeel Sadiq Jajja, LUMS
3. “The Road to Electrification in China” by Mr. Alan Liu – CEO GH Energy

From 2014 to 2019, China's electric vehicle production and sales have maintained a high growth rate, with China's sales being more than the total of other countries.
In 2014, Elon Musk brought the first Tesla to China to complete the delivery.

China kicks off a wave of car electricization.

Since 2014, more than 200 start-ups in China have been developing and manufacturing intelligent electric vehicles.
Why Electric Vehicles Become China’s National Policy

China’s dependence on foreign oil in 2019 has exceeded 72%, crude oil has become the country's biggest security risk!

Foreign exchange reserves, the country’s core wealth, are handed over to other countries on the way of crude oil by state-owned enterprises that remain on China by electricity is a choice that the central government must make.

16-18 as Premier Li Keqiang of the State Council promotes industry development

19 General Secretary Xi Jinping "Traffic Power" rises as national strategy, with electrification in the first place

After 6 years of accumulation, electric vehicles have become quite competitive with fuel vehicles

Mainstream brands will launch mainstream all-electric vehicle in 2019
2019 is China’s electric vehicle year

China has entered the era of electric vehicles

China has become the world’s largest electric vehicle market in 2018, accounting for more than 50% of the global market
Tesla China plant to release maximum capacity
China’s major auto companies have also unveiled ambitious plans for electric vehicles

China’s government’s "new infrastructure construction" plan also includes electric vehicle charging infrastructure in key areas

China’s electric vehicle market will lead the global electric vehicle market for a long time

Thank you!