Bangladesh Environment Network (BEN)


BEN Bimonthly Webinar Series – 004 (Jan 28, 2023, Saturday)

10 AM – 12:00 PM EST New York Time (3 PM-5 PM London; 9 PM-11 PM Dhaka)

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Will be livestreamed at BEN Facebook Page

Welcome and Discussion

Dr. Md. Khalequzzaman

Professor of Geology, Lock Haven University & Global Coordinator, BEN

Sustainable Transportation: Potential for e-Mobility in Bangladesh

Keynote

Mr. Moshiuzzaman Mahmud,

Technical Director and International Strategy Lead, Integrated Transport Planning Ltd. (ITP), UK

Discussants

Dr. Shams Tanvir

Assistant Professor at California Polytechnic State University, San Luis Obispo, California, USA

Dr. Md. Ziaur Rahman Khan

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Dr. Zia Wadud

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Dr. Md. Shamsul Hoque

Professor and Transportation and Safety Expert, Dept. of Civil Eng., BUET, Dhaka, Bangladesh

Facilitation

Dr. Hossain Azam, Asst. Professor of Environmental Eng., Univ. of the District of Columbia & BEN Member, Washington, DC, USA

Chair

Dr. Saleh Tanveer

Professor, Ohio State University, Columbus, Ohio, USA and Former Global Coordinator of BEN

(Q&A and comments from the audience: 30 minutes)

Sustainable Transportation: Potential for e-Mobility in Bangladesh

Keynote: Mr. Moshiuzzaman Mahmud,
Technical Director and International Strategy Lead, Integrated Transport Planning Ltd. (ITP), UK

Abstract. Globally, e-mobility has gained tremendous traction over the last decade. Technological advancement has made it a more acceptable and reliable mode of transport. While Electric Vehicles (EVs) have been on the scene for a long time, the last five years were transformational in gaining popularity. There was a sharp increase in EV stocks globally over that period. In 2019 the global sale of electric cars was 2.1 million, making the global stock 7.2 million[1]. Compared to the conventional Internal Combustion Engine (ICE) car sales, the proportion of electric cars is still relatively low (2.6%). However, the year on growth of electric cars tops 40%, which is a significant increase. In addition to the growth of electric cars, other alternative forms of transport modes such as buses, freight vehicles, three-wheelers, and two-wheelers are also transitioning into the electric powertrain. According to the World EV Outlook 2020, the Global EV stock could potentially increase to more than 140 million if the current governments' policies and the Paris Climate Action pledges are met. It is nearly 19 times higher than the current stock, which is undoubtedly a giant leap just over the next ten years[2].

The most prominent benefits of EVs come from the reduction of fuel emissions. There is a severe air quality issue across Dhaka city and other major metropolitan cities in Bangladesh. The situation has improved to a certain extent due to the mass conversions to CNG fuel, which emits 5-10% less CO2 than petrol or diesel-driven vehicles. CNG is, however, not an infinite source, despite the fact that it is currently a cheaper fuel source in the country. Additionally, it is not a zero-emission solution either. Due to the lack of regulatory enforcement, there have been incidents of explosions caused by low-quality CNG tanks fitted in the vehicles. In order to meet the UN SDG (Sustainable Development Goals), which Bangladesh has signed up to, the country will need to go beyond CNG. E-mobility presents a huge opportunity to move towards that goal.

Despite the early ban on electric three-wheelers, due to their structural fault causing fatal accidents, the market has already been penetrated by imported vehicles. These vehicles caused around 10% of fatal accidents across the country[3]. In addition to the imported electric three-wheelers (Easy Bike), there has been a growing trend of converting traditional rickshaws into battery-driven mode. Those conversions took place on the regular body frame without the necessary modifications needed to cater for increased speed and weight. These conversions have also been banned by the High Court, as they presented higher safety hazards. There is a strict ban on electric three-wheelers in Dhaka city.
Due to the low vehicle standard, e-mobility failed to create the right consensus amongst road users and decision-makers.

All the above key issues need a holistic approach that creates an enabling environment for the future sustainable low-carbon transport system in Bangladesh. Given the presence of multiple vehicle modes, it is necessary to bring everything under an overall e-mobility umbrella and create a fit-for-purpose policy and regulatory framework.

This discussion will focus on the following topic areas to give a high-level view on the rational for transport electrifications and what needs to be considered for Bangladesh going forwards,

- Premise of Electric vehicles.
- Global trends.
- E-mobility in Bangladesh.

[1] Source: Global EV Outlook 2020
[2] Source: Global EV Outlook 2020
[3] Source: Report from Passenger Welfare Association of Bangladesh

- Policy and regulatory considerations for Bangladesh (Global best practice), i.e:
    - The right recognition of the need for EVs and the significance of the policy framework for adopting EV;
    - A platform that creates a robust institutional structure that can manage this multi-dimensional transport system.
    - A system that encourages private sector participation in deploying EVs.
    - The right and consistent vehicle standards are maintained.
- Infrastructure requirements.
- Energy sector.
- Finally, need for a sustainable transport solution.

Sustainable Transportation: Potentials for e-Mobility in Bangladesh

Moshiuzzaman Mahmud

Technical Director, Integrated Transport Planning Ltd.

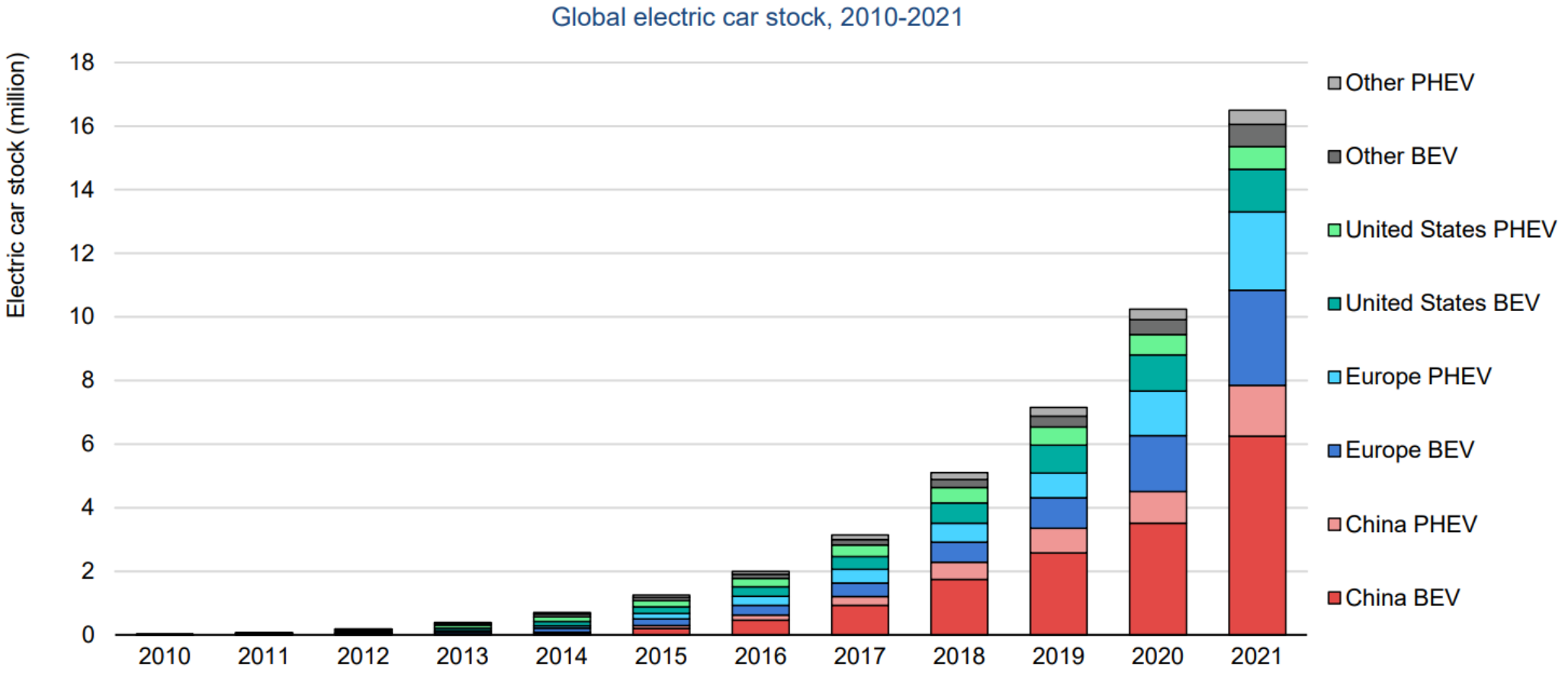
Content

- Background of electric vehicles
- Global trend
- E-mobility in Bangladesh
- E-mobility opportunities and constraints in Bangladesh
- Key considerations
  - Policy and regulatory
  - Charging infrastructure
  - Energy sector
- A pathway to a sustainable future

Background of electric vehicles

- Paris agreement
  - Substantially reduce global greenhouse gas emissions.
  - Review countries' commitment every five year.
  - Provide financing to developing countries to mitigate climate change, strengthen resilience and enhance abilities to adapt to climate impacts.
- Countries to develop their Nationally Determined Contribution (NDC) every five years.

Global trend



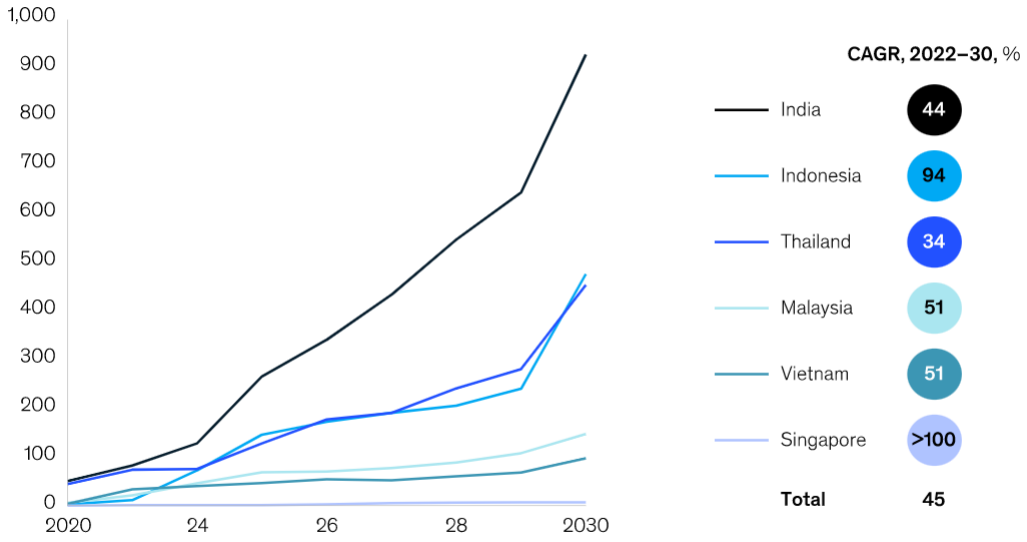
Global trend

- The global e-mobility market to reach US$802 billion by 2027 (Bloomberg).
- The European Electric Vehicle Market is expected to have a high annual growth rate of approximately 36% annually between 2019 and 2024 (Market Data Forecast).

Global trend

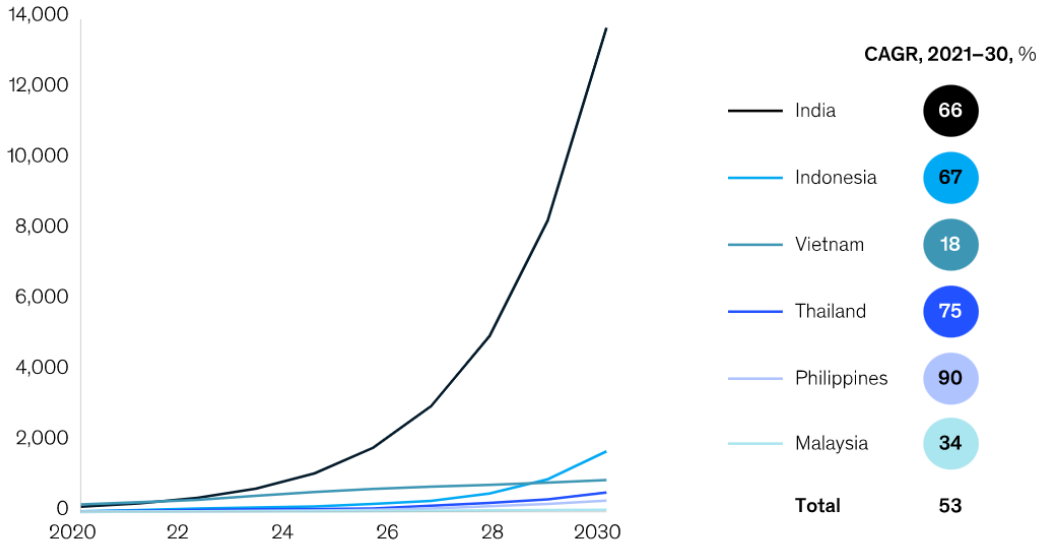
A rapid increase of EVs in Asia is expected

E4W production in selected countries, thousands of vehicles



Source: IHS Markit Light Vehicle Powertrain and Alternative Propulsion Forecast Model; McKinsey analysis

E2W[1] sales in select countries, thousands of vehicles



[1]Includes e-scooter and e-motorcycles
Source: McKinsey EVOLVE tool; ASEAN Automotive Federation; expert interviews; International Clean Council on Transportation motorcycles data; Statista; WRI India

E-Mobility in Bangladesh

- Bangladesh updated its NDC in 2021 in advance of COP26.
- The key contributors to Bangladesh's energy sector emissions are power, transport, households and brick kilns.
- Investment required (by 2030):
  - Unconditional US$32billion – 6.73% CO2 reduction; and
  - Conditional US$143billion – 15.12% CO2 reduction.

E-Mobility in Bangladesh

- The most penetration came from three-wheelers (Easy Bikes).
- EV policy-wise, Bangladesh is at a very early stage of EV adoption.
- Due to structural faults, these electric three-wheelers caused significant accidents (10% fatal accidents – a report from Passenger Welfare Association Bangladesh).
- The traditional rickshaws are fitted with electric motors, which are also structurally unsafe for ride.

E-Mobility in Bangladesh

- What are the rationales for considering electric vehicles in Bangladesh
  - Poor air quality (high concentration of PM2.5).
  - High CO2 emissions (14% from transport and 42% from the power sector)(Bangladesh CO2 Emissions - Worldometer (worldometers.info).
  - Energy security (reliance on imported fossil fuel).
- Roads are extremely congested and need for more sustainable mass transit solution.

Opportunities and constraints

Strength

Large labour market

Rationale for a green an sustainable transport system

Private entrepreneurship

Acute need for reducing environmental emissions

Weakness

Lack of appropriate policy & strategy framework

Lack of appropriate regulatory framework

Lack of electric vehicle standards

Opportunities

High-three wheeler mode share

Private entrepreneurship

State-owned public transport operator

Greening of the grid

Potential for domestic industries

Threat

Lack of appropriate finance

Energy sector is still fossil-fuel based

Cannibalise non-motorised rickshaw market

National level electricity supply

Multi-party coordination

Key considerations – Policy & regulatory

- An EV policy framework should consider
  - Transport system (demand side), i.e., market segments, key market entry points.
  - Energy transition (demand side), i.e., green energy sector, trade-offs of EVs.
  - Technology (supply side), i.e., access to technologies, supply chain, domestic industry.
  - Investment potentials (supply side), i.e., private sector participations.
  - Intended benefits, i.e., stakeholder buy-ins.
  - Institutional readiness, i.e., multi-sectoral coordination, operation, management and monitoring.

E-Mobility in Bangladesh

- NDC includes several initiatives for Bangladesh
  - Improve fuel efficiencies of transport.
  - Ease road traffic congestion through road widening, better public transport, NMT, **encouraging hybrid and electric vehicles,** introducing Intelligent Transport System (ITS).
  - 10% modal shift to mass transit (rail, metro, BRT).
  - Electrification of the railway system.
  - Enhance Inland Water Transport (IWT), including electric vessels.

Key considerations – Charging infrastructure

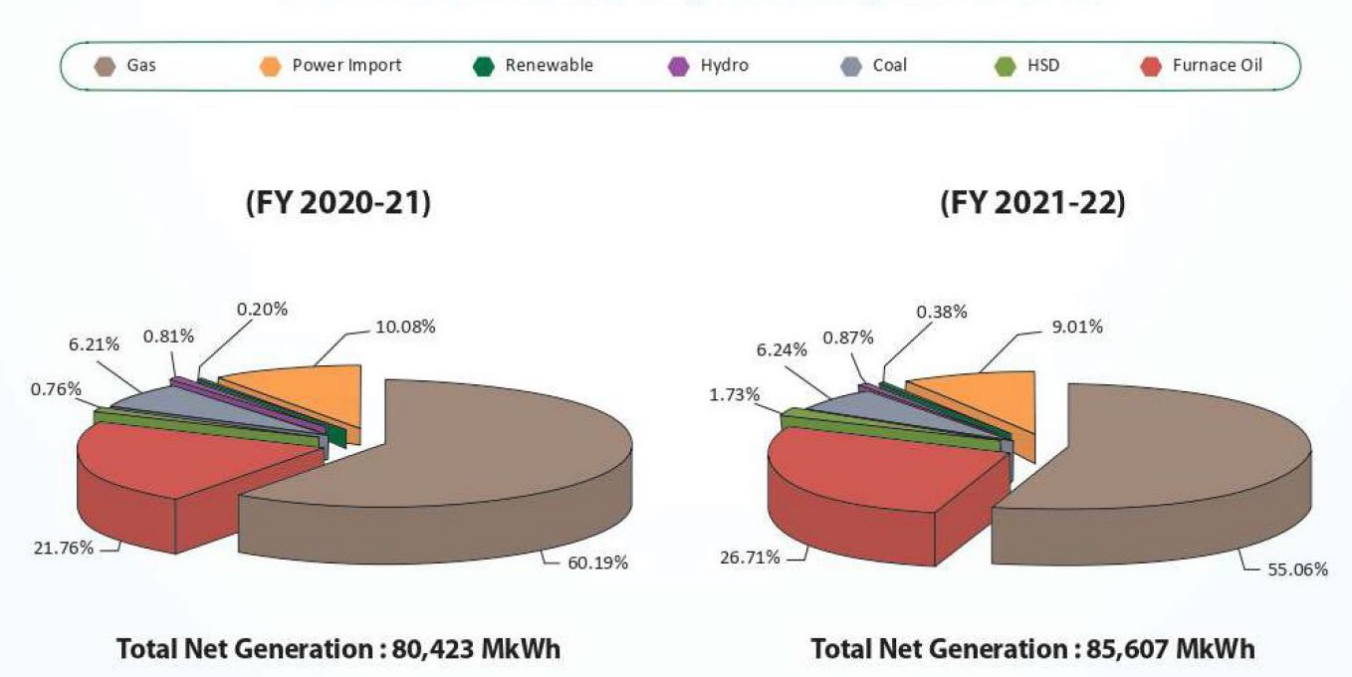
- There is no public EV charging infrastructure in Bangladesh.
- Adequate charging infrastructure is needed to support EV adoption.
- Considerations for charging infrastructure supply
  - Area-wide planning for destination-based charging.
  - Consideration for Grid capacity.
  - Potentials for battery swapping for three-wheelers.
  - Attractive business model for the private sector participations.

Key considerations – Energy sector

- Energy sector is an integral part of the EV ecosystem.
- The greening of the grid is critical to maximising the benefits of EVs.
- EVs will only offset tailpipe emissions to the power sector if the grid is not green enough.

Key considerations – Energy sector

- Power generation mix in Bangladesh



A pathway to a sustainable future

- Few questions for further discussions
  - Are Electric Vehicles our only solution to tackle climate change?
  - What are the prospects of the energy sector in Bangladesh to support EVs?
  - What business models and technologies can be considered for EV charging infrastructure in Bangladesh?
  - What other alternative sustainable technological solutions are there for Bangladesh?
  - What policy and regulatory reforms are needed to promote EVs in Bangladesh?

Thank you

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Electric Vehicles in Bangladesh: Opportunities and Challenges

Department of Electrical and Electronic Engineering, BUET, Dhaka

EV in Bangladesh

3 Wheelers

About 1.5 million
Demand ≈ 200000 year
Local Production capacity ≈ 50000 year

EV in Bangladesh

4 Wheelers

Made in Bangladesh Car is coming soon

MG ZS EV

Others

Government is planning to introduce Electric Traction in the Bangladesh Railway

66-feet boat, named 'Iron'

Country Specific: Bangladesh

Sl. No	Type of Vehicles	Upto-2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Upto-June 2020	Grand Total
1	Ambulance	2793	219	181	243	338	480	378	495	564	667	311	**6669**
2	Auto Rickshaw	126763	20423	23545	15697	19897	20000	11173	9168	21638	30967	10217	**309488**
3	Auto Tempo	14266	175	626	395	500	1095	1322	1592	609	228	42	**20850**
4	Bus	27778	1761	1439	1107	1488	2391	3833	3760	2755	3606	1501	**51419**
5	Cargo Van	3522	489	282	687	608	399	1017	1413	1280	4	1	**9702**
6	Covered Van	5658	2354	1421	2271	2869	2354	3340	5176	5729	3042	792	**35006**
7	Delivery Van	17063	1004	774	894	1176	1719	2181	2410	2100	1531	515	**31367**
8	Human Hauler	6520	1152	715	385	225	1142	3487	3393	1423	510	91	**19043**
9	Jeep(Hard/Soft)	32286	2134	1569	1314	1870	3601	4892	5425	5555	5630	1943	**66219**
10	Microbus	66379	4051	3044	2537	4313	5224	5804	5575	4137	3683	1149	**105896**
11	Minibus	25644	276	249	148	256	323	472	492	436	837	285	**29418**
12	Motor Cycle	759257	114616	101588	85808	90685	240358	332057	326550	395603	406897	138193	**2991612**
13	Pick Up (Double/Single Cabin)	32240	10460	7625	6553	9554	10257	11371	13512	13097	11952	4372	**130993**
14	Private Passenger Car	219830	12950	9224	10472	14699	21062	20304	21959	18227	16783	5009	**370519**
15	Special Purpose Vehicle	6371	396	226	227	172	296	620	993	1339	1182	330	**12152**
16	Tanker	2706	317	195	226	362	324	394	319	529	419	166	**5957**
17	Taxicab	44380	75	172	51	374	88	44	15	161	11	6	**45377**
18	Tractor	20600	5200	3494	1885	1522	1699	2576	2777	3553	2561	856	**46723**
19	Truck	82871	7327	4335	5129	8136	6330	7275	10353	12663	8326	2229	**154974**
20	Others	1317	7	1	1080	1595	2073	3870	5021	5976	5294	2007	**28241**
TOTAL		**1498244**	**185386**	**160705**	**137109**	**160639**	**321215**	**416410**	**420398**	**497374**	**504130**	**170015**	**4471625**

Source: BRTA

EV Opportunities

- Demand of Low Cost Public transportation
- Increase in fuel cost
- NDC commitments of the Country
- Range of a private car is less than 50 km
- Electric Vehicle Sales Boom in Japan
- Tax benefit
- Comparatively better gird infrastructures in the city

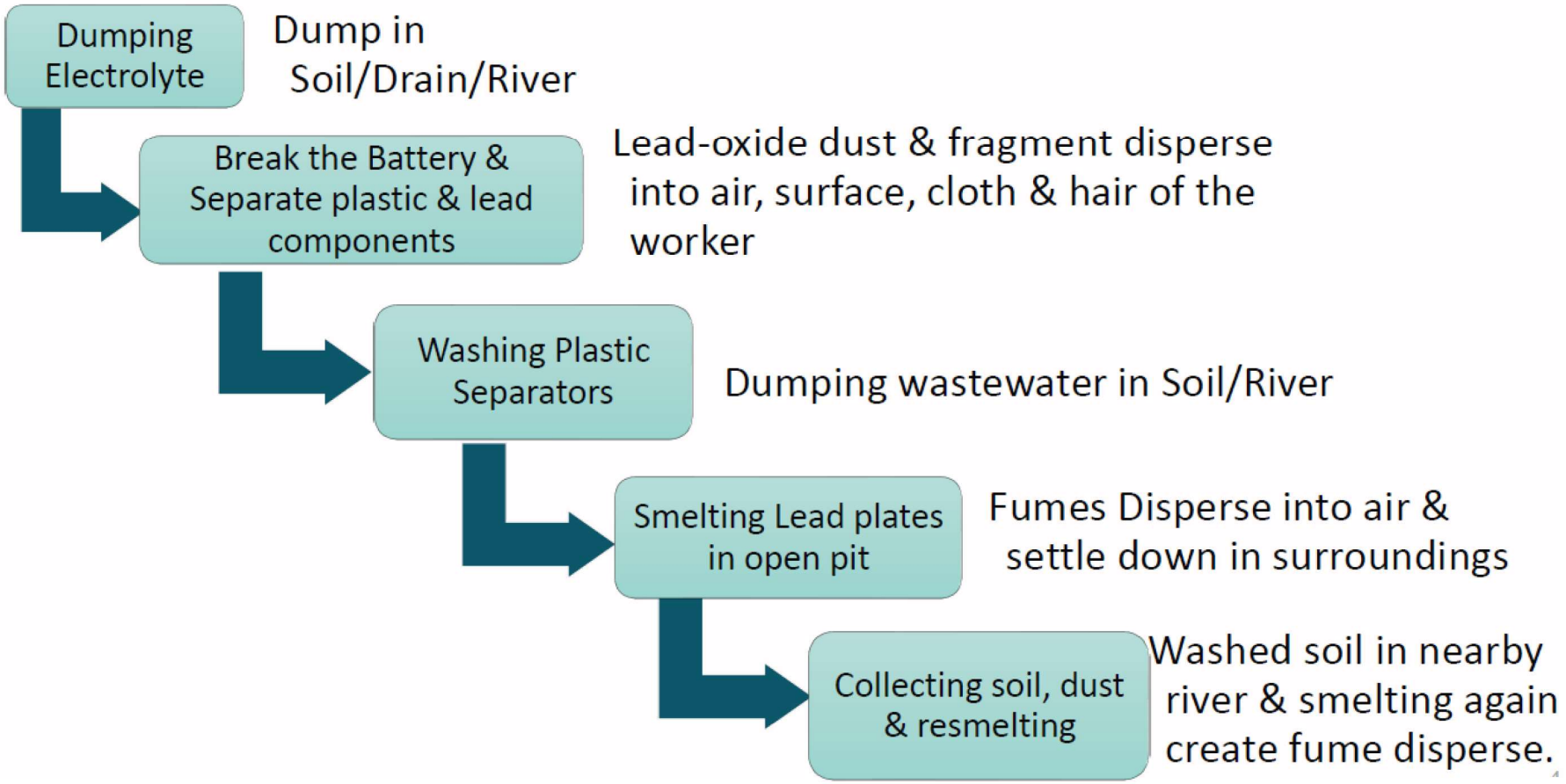
EV Challenges

- High pricing
- Lack of financial incentives
- Absence of charging infrastructures
- Lack of Technical manpower
- Large scale grid failure will lead to transportation chaos
- Battery waste management
  - Li-ion battery
  - Nickel-Metal Hydride (NiMH) batteries
  - Lead Acid battery

  A study by DOE's National Renewable Energy Laboratory suggest EV batteries may last 12 to 15 years in moderate climates and 8 to 12 years in severe climates.

EV Battery Waste Management

Stages of Informally Recycling ULAB & Hazards

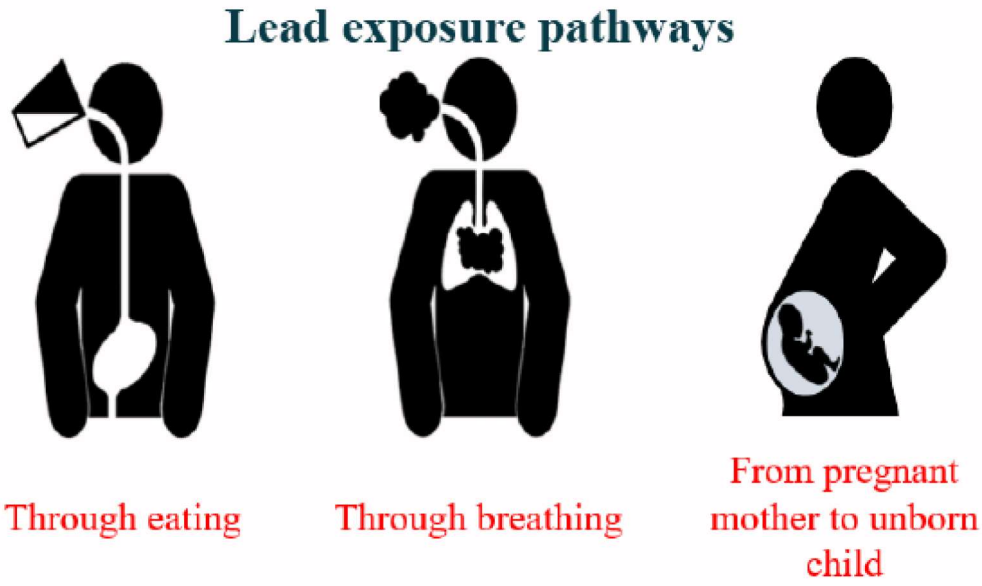


Source: icddr,b

EV Battery Waste Management

Bangladesh fact for lead

- One of the most lead impacted countries in the world
- 36 million children <19 years with BLL (blood lead level) above 5 µg/dl (60%)
- **70% of intellectual disability** in Bangladesh
- $16 billion (13.3 million crore Taka) in lost productivity annually, 6% of GDP
- **4th highest rate** of death from lead exposure (4% of all deaths)

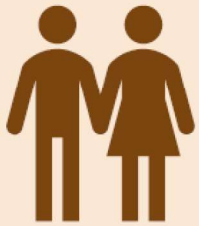


Source: icddr,b

EV Battery Waste Management

Cost of Lead Exposure in Bangladesh

- Every year **18.9–20.4 million** under-5 children losses on an average 7 IQ points due to lead poisoning
- World Bank estimated that the cost of this IQ loss is 796 - 860 billion taka which is **3.1–3.4%** of Bangladesh's GDP in 2019



- In 2019, about **59-64 thousand** adults died prematurely from cardiovascular disease due to lead exposure
- Annual cost of health effects is about **706 billion** Taka which is **2.7–2.9%** of GDP

Total estimated cost is **1538 billion** Taka annually which is **5.8–6.2%** of GDP

Source: icddr,b

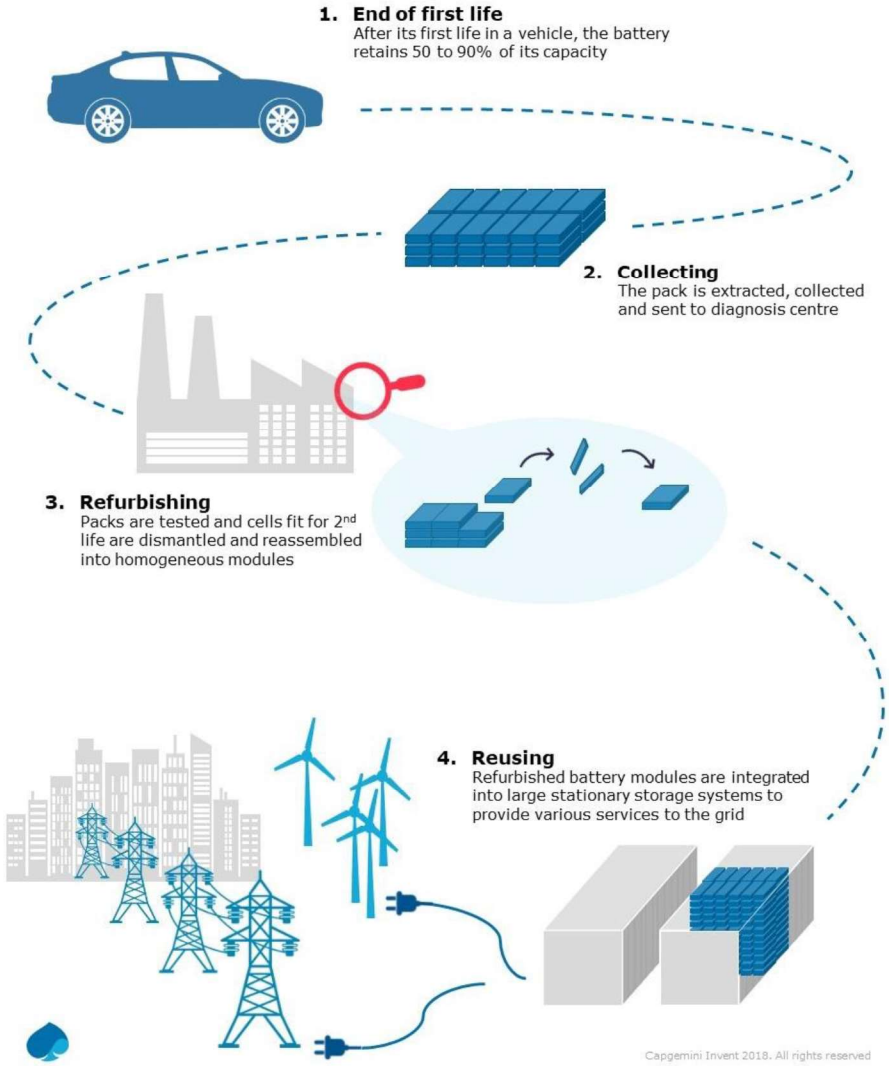
EV Battery Waste Management

Source: https://doi.org/10.1016/j.joule.2019.09.014

Second-Life Lithium Battery

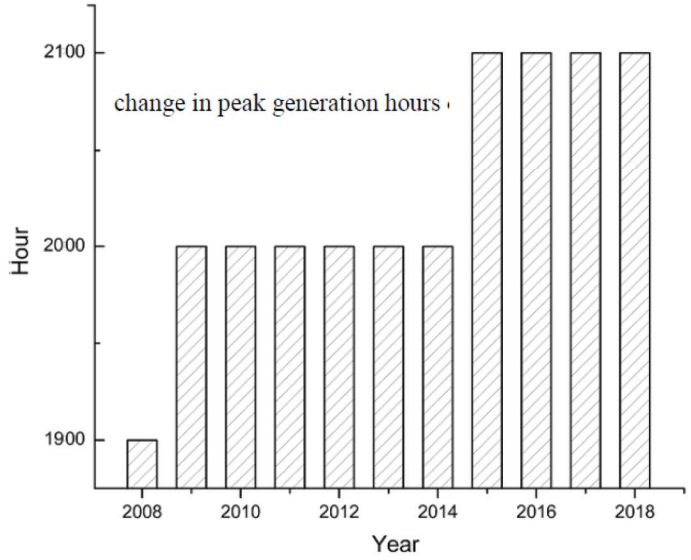
Why second-life lithium batteries?

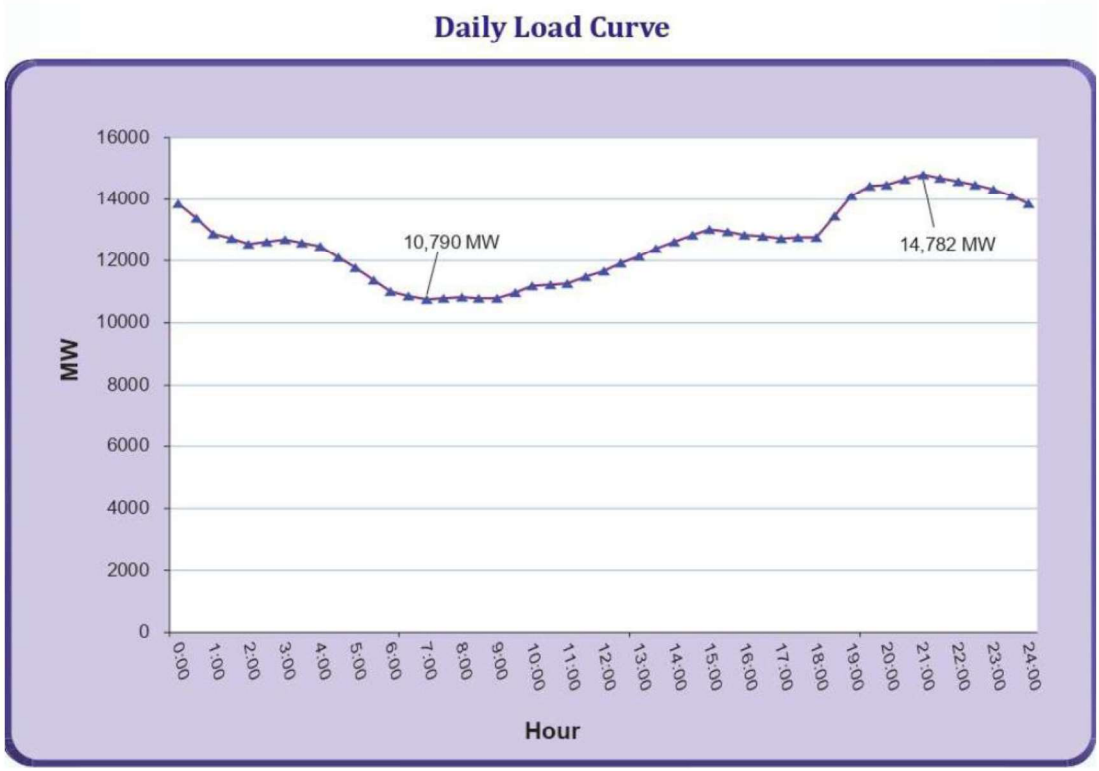
- Second life LiB, retired after reaching 70-80% of its initial capacity
- Have more than 5-10 years of service life (1500 cycle life) before reaching end-of-life
- Better energy efficiency, 90-95% for LiB compared to 70-80% for LAB
- Second life LiB cost around $50 /kWh, in contrast, average LAB cost $120 /kWh



EV Issues with Power Distribution Utilities

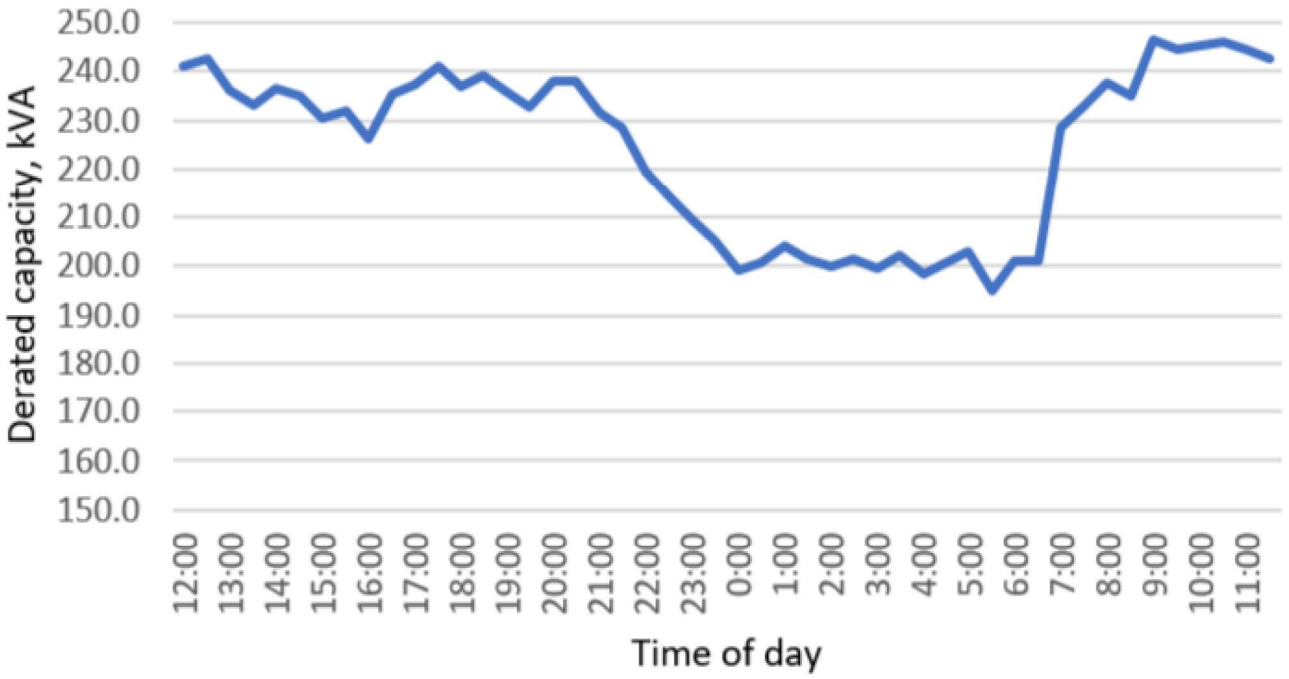
- Increased demand will stress network in areas with a high concentration of EVs
- Considering 750 W load for a single EV, 1 milion EVs charging is creating an additional demand of 750 MW load





Source: BPDB

EV Issues with Power Distribution Utilities



Capacity Derating of Distribution Transformer
(calculation based on ANSI/IEEE C57.110-1986 and actual harmonics injected by battery chargers)

20% Derating of the Distribution Transformer

EV Safety Issues

Mechanical braking system

No Door

Headlight Position and absence of rearview Mirror

Sharp Corners in the body

EV Safety Issues

- Hydraulic Brake System
- Half Door
- Proper windshield
- Windshield wiper
- Identification Number
- Rear view mirror
- No sharp corner
- Two headlights in front of body
- 3-segment tail lamp
- Power cut during brake


Thank
you

What business models and technologies can be considered for EV charging infrastructure in Bangladesh?

Shams Tanvir, Ph.D., P.E.
Department of Civil and Environmental Engineering
California Polytechnic State University

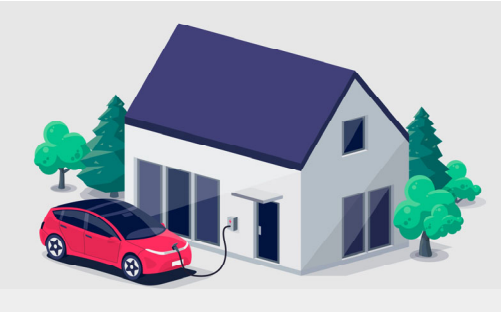
Presented at BEN Webinar on Sustainable Transportation: Potentials for e-Mobility in Bangladesh

Bangladesh, which EV infrastructure you'd invest in?

#Charges per day = #KMs traveled per day/Range (পাল্লা)

Types of Charging

More Commercial →



Home/Base Charging

Level 1 or Level 2
Suitable for overnight charging

Destination Charging

Level 2
Suitable for range-extension

On-route Fast Charging

Level 3
Suitable for long-distance travel and high-value trips

Affordable, Accessible, Equitable e-mobility

- We need an Eco-System
- Affordability (সামর্থ্য)
  - Cost↓ Usage↑
  - Total Cost = Vehicle Cost + Charging Cost + Maintenance
- Accessibility (প্রবেশযোগ্যতা)
  - Location!
- Equitability (সমতা)
  - গরিবের বাহনের অধিকার

Policy Implications

- Need a detailed Transportation Electrification Roadmap
- Need Public-Private Partnerships to accelerate usage in sectors affected by most environmental emissions
- Emerging business models
  - Battery swapping
  - Subscription-based public charging
  - Turnkey operation of fleet vehicles

THE MUSTANG WAY

PRIDE RESPONSIBILITY CHARACTER

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Sustainable Mobility: Role of EVs for Bangladesh

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Associate Professor in Transport & Energy Interactions
Centre for Integrated Energy Research & Institute for Transport Studies
UNIVERSITY OF LEEDS

7 Goals for Sustainable Mobility: Role of EVs for Bangladesh

(World Business Council on Sustainable Development 2004)

Way forward

- Electrification some inherent advantages for BD: less range anxiety, fleet charging, equity
- But …… EVs not a panacea - do not consider one goal (GHG) in isolation!

- Good public transport
- Beware of unintended effects (e-waste, noise, safety)
- Safety, safety, safety: opportunities for research & development
- Policies & Regulations: safety, noise, battery recycling etc.
- Electrify three-wheelers (safety!), buses, small vans and trucks first

Thank you

Z.Wadud@leeds.ac.uk

https://archive.dhakatribune.com/bangladesh/dhaka/2021/09/24/study-unfit-vehicles-responsible-for-15-of-air-pollution-in-dhaka
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https://archive.dhakatribune.com/bangladesh/dhaka/2018/07/05/dhaka-loses-3-2m-working-hours-to-traffic-congestion-daily

Impacts of Electric Vehicles on Air Pollution and Green House Gases (GHGs)

Electric vehicles (EVs) run on electricity only. They have no tailpipe emissions of air pollutants and green-house gases (GHG).

EV's impact on air quality and GHG's are from manufacturing and distributing electricity and battery manufacturing/recycling.

EV's impact can be minimized if powered by electricity generated from renewable sources such as, hydro, solar, wind, or nuclear power plants.

An average gasoline car in the US emits 3-4 times more air pollutants and GHG's than an EV.

The tailpipe emissions directly impact millions of passengers and people along the roadway or nearby houses.

Power production and battery manufacturing or recycling can be controlled significantly using pollution control technologies.

EVs are energy efficient: converts 77% of the electrical energy from the grid to power at the wheels. Gasoline vehicles only convert about 12-30% of the energy stored in gasoline to power at the wheels.