SMEP | Sustainable Manufacturing and Environmental Pollution

Rapid E-Mobility Transition, Lead Poisoning, and Market and Policy Innovation Opportunities

Factsheet for

The Industry Stakeholders and Policymakers

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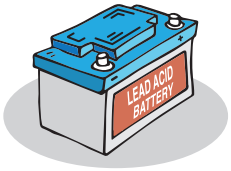
Georgetown University McDonough School of Business

Stanford Graduate School of Business

Rapid E-Mobility Transition, Lead Poisoning, and Market and Policy Innovation Opportunities

Purpose



To provide key information on the electric three wheeler battery industry in Bangladesh, including factors that have resulted in prevalence of inferior quality batteries in the market, which are associated with energy inefficiencies and lead pollution. Factors include:

- Cash constraints from the customers
- Involvement of the informal sector in battery manufacturing and lead recycling
- Varying levels of governance, regulation, and standards enforcement
- Tax and regulatory burden on the formal sector

Who We Are

Lead Researchers:
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Donor and Partners

This research is supported by the Sustainable Manufacturing and Environmental Pollution (SMEP) Programme. The SMEP Programme is implemented by the UK Foreign, Commonwealth, and Development Office (FCDO) and is implemented in partnership with the United Nations Conference on Trade and Development (UNCTAD). The SMEP grant is administered by Pure Earth Bangladesh and has been awarded from February 2023 to February 2025.

Research Insights

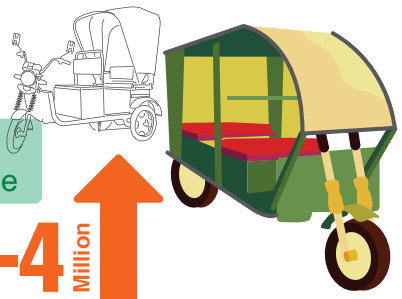
- Research indicates potential for business model solutions in the electric three wheeler battery sector, not just lead acid, but also advanced lead-free batteries like Lithium
- Requires market and regulatory support

CONTEXT

Bangladesh has a rapidly growing number of electric three-wheelers such as EZ Bikes, Mishuks, and e-rickshaws.

Opportunity

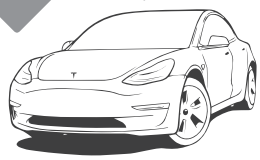
- Urban mobility
- Switching from fossil fuel transport to fight climate change
- Spurring innovation



3-4 Million
Electric Three-Wheelers in Bangladesh

112 Million
passengers per day[1]

Total number of Teslas Worldwide (around 3.3M)



Major Challenges

- Powered from poor Lead-Acid batteries
- Inefficient energy use
- Large quantity of lead required

[1]Refer to the assumptions for this calculation in Annex 1, Item 1

Short life and Recycled once a year

Generating Lead Waste

estimated at over

167,000 MT annually.[2]

Lead is informally and illegally recycled in informal or semi-formal bhattis, causing lead contamination and poisoning[3]

Every time a battery is recycled in the informal sector, 15-20% of lead is released into the environment (air, water, soil).

Within 5 km of an Informal Smelting Site

Lives at least

20%

of the population of Bangladesh[5]

6 percentage point

increase in terminated pregnancies

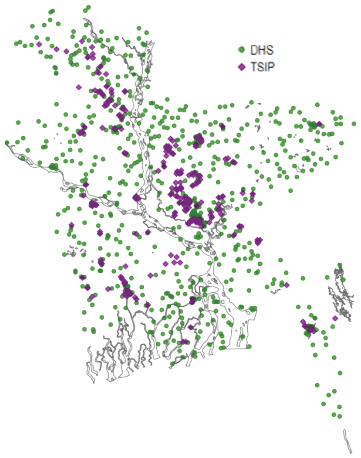
In Bangladesh, two in three children have high levels of lead in their blood.

Lead Causes

- IQ loss
- Impairing Education
- Loss of Income
- Cardiovascular Diseases
- Renal Diseases
- Miscarriages in Pregnant Women[4]

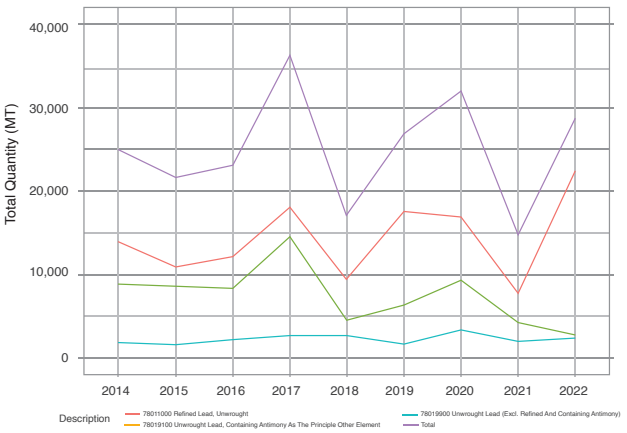
Geolocation of DHS* Clusters

*Demographic and Health Surveys (DHS)



The graph shows toxic sites identified through Pure Earth's TSIP program (purple squares) and the geolocation of the household clusters for maternal health data (2014 & 2018 surveys- green circles). After a 2015 LAB tax hike, women near toxic sites had more terminated pregnancies, boosting local battery production and recycling.

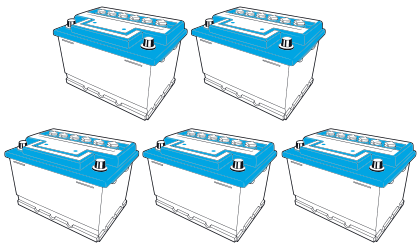
Quantity of Lead Imports and Exports in MT: Bangladesh, 2014-2022



In the import and export of lead products plot, there is a sharp increase in the circulation of lead in the domestic market from 2016 onwards. This is likely in response to the increase in import tax on LABs in 2016 and the increase in export taxes on lead and lead parts in 2018 (after which lead export almost completely stopped).

[2]Refer to Annex 1, Item 2, for assumptions on which this estimate is based.
[3]The World Bank, 'Enhancing Opportunities for Clean and Resilient Growth in Urban Bangladesh, Country Environmental Analysis', 2018.
[4]UNICEF and Pure Earth, 'The Toxic Truth Report', 2020. https://www.pureearth.org/wp-content/uploads/2021/04/The-Toxic-Truth-Childrens-Exposure-To-Lead-Poll
[5]Mazhab, Kundu, and Plambeck, 2024

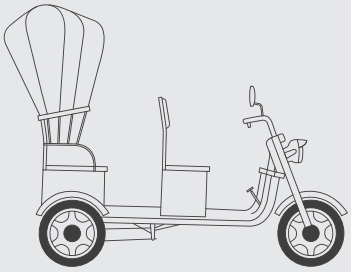
The Battery Market and Current Challenges



One EZ bike alone contains **125** kg lead in batteries

15 car starter batteries

The market for Electric three-wheelers' Batteries in BDT **8710** Crores (US$871 million).[6]



Both the vehicles and this battery segment are often informal and unregulated, resulting in large tax losses for the government.

Tax revenue loss for the government in the range of **915 CRORES** BDT (US$91 million)

Reason for The Poor Quality of Batteries:

- Lack of regulation on battery standards
- High import taxes on batteries

A set of EZ Bike Batteries

- Cost over 72,000 Tk (or US$650)
- It lasts only 8-11 months

Short battery life causes

- A high recycling rate and increased lead pollution
- Increases the operating cost of EZ Bikes
- Affecting the livelihood of millions of drivers and vehicle owners

Loss of Tax

- Assuming that only 30% of the ULABs recycling market is formal and pays 15% taxes, a 70% informality level results in tax revenue loss[7]

Used battery scrap price is over 200 Tk/kg in the domestic market. Price of unrefined lead is over 300 Tk/kg. In contrast, the price of refined lead in the international market is less than 200 Tk/kg.

Over **80%** lead is currently being informally recycled in Bangladesh.

The battery industry requires a large amount of lead, the primary ingredient in lead-acid batteries. Lead can be safely and economically recycled from used lead acid batteries (ULAB), but over 80% of the lead is currently being informally recycled in Bangladesh.

Most of the formal smelting facilities are little utilized due to high operating costs. They are at a disadvantage relative to informal smelters that do not pay taxes, have lower energy costs and weak pollution controls, and can be found everywhere due to the small scale of operations. Their costs are also lower in the collection, transport, and storage of used batteries.

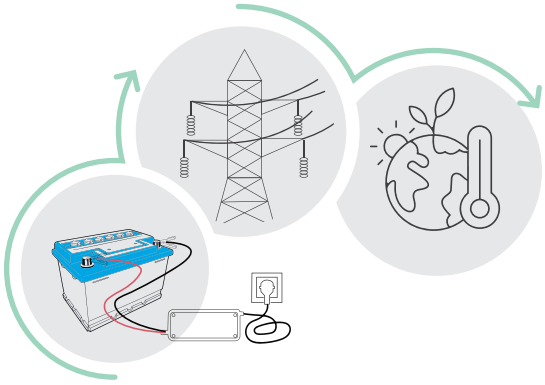
Informal, tax-evading battery manufacturing units, often set up by foreign manufacturers (and jointly owned by Bangladeshi individuals) flood the market with low-quality electric three-wheeler batteries. Unable to compete on price, large reputable Bangladeshi manufacturers also produce low-quality batteries. Unfortunately, counterfeiting and misleading labeling practices have been noted in this market, which in turn, creates mistrust in the market.

[6]Refer to Annex 1, Item 3, for assumptions on which this estimate is based.
[7]Refer to Annex 1 Item 5 for assumptions on which this estimate is based.

Loss of Electricity and Impact on Climate Change

Low-quality batteries waste electricity, which heat up during charging. A high amount of electricity is consumed to charge electric three-wheelers, estimated to be over 5% of Bangladesh's total electricity consumption.[8]

Such large electricity use can place strain on the electricity grid and contribute to climate change.



POTENTIAL OPPORTUNITIES

Lead acid batteries can be manufactured to have double the useful life and higher energy efficiency. This would reduce the rate of lead recycling and lead emissions by half.

Policy Adjustments and Business Model Innovation

Less polluting batteries are more attractive to rickshaw operators. Policy inputs and market incentives could also result in:

- An increase in formal lead recycling
- Standardization of the battery market
- Improved tax collection
- Lower electricity consumption

The project team researchers are working with formal lead and lithium manufacturers and microfinance organizations to identify and implement novel business models to increase the adoption of high-quality batteries.

Characteristic	Lithium-ion Batteries	Lead-acid Batteries
Energy Efficiency	30% reduction in electricity consumption	Consumes over 5% of country's total electricity
Value for Money	One lithium-ion (Li) battery (needs one battery to run an EZ bike) costs 1.2 lacs	One set of lead-acid batteries cost 72,000 Tk
Salvage Value	Currently is not more than 10,000 Tk	Salvage value is 44,00 Tk
Battery Life Cycle	4-5 years	8-11 months
	5 times the useful life, no lead poisoning	Short lifetime, recycling causes lead poisoning
	Other advanced battery technologies such as sodium ion, are also starting to become commercially viable.[9]	

[8]Refer to Annex 1 Item 4 for assumptions on which this estimate is based.

[9]INC42.com, Pooja Yadav, KPIT Introduces India's First Sodium-Ion Battery Technology As An Alternate To Li-Ion Batteries, https://inc42.com/buzz/kpit-introduces-indias-first-sodium-ion-battery-technology-as-an-alternate-to-li-ion-batteries/

ABOUT SMEP

The Sustainable Manufacturing and Environmental Pollution (SMEP) Programme has been established by the UK Foreign, Commonwealth and Development Office (FCDO) and is implemented in partnership with the United Nations Conference on Trade and Development (UNCTAD). The SMEP Programme is designed to facilitate the uptake of pollution mitigation solutions in sub-Saharan Africa and South Asia through research and piloting pollution mitigation technologies. This work extends to sharing evidence and identifying and engaging in areas where policy and regulatory adjustments may enable wider uptake of pollution mitigation solutions.

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NOTE

This document is an output of research funded by the Sustainable Manufacturing and Environmental Pollution (SMEP) Programme. UK International Development from the UK Government and the United Nations Conference on Trade and Development (UNCTAD) provide financial and technical support for SMEP.

Annex 1: Assumptions for the numbers in the factsheet

1. Number of people transported: The average number of trips made by an EZ Bike is 9 during peak hours and 5 during off-peak hours (from our survey data of 140 drivers). Assuming an average of 4 passengers per trip and assuming 2 million EZ Bikes, the total number of passengers in a day = 14*4*2,000,000 = 112 million

2. Annual lead waste generated Assume 2 million EZ Bikes, each with 5 batteries containing 25 kg lead, recycled once in 1.5 years => 6.7 million EV batteries recycled annually => 25* 6,700,000 kg or 167,000 MT of lead scrap generated in a year

3. Size of the EZ Bike battery market From above, 6.7 million EZ Bike batteries are replaced every year and each battery costs around $130, so the total annual market size = $130*6,700,000 or $ 871 million

4. Electricity consumption For a typical EZ Bike with a 60V battery system with 140 Amp-Hr energy capacity, the amount of electricity required for use with a full charge is 8.4 kWh. Energy efficiency is 70% in the highest quality lead-acid batteries in the country. The total amount of electricity consumed annually by one vehicle is (8.4/0.7)*365 kWh = 4.38 MWh. Very conservatively assuming 1 million vehicles in Bangladesh, the amount of electricity required to charge these vehicles is 4.38 TWh/year. The total electricity consumed in Bangladesh in 2020 was 82.5 TWh (https://www.iea.org/countries/bangladesh)

5. Assuming that only 30% of the ULABs recycling market is formal and pays 15% taxes, a 70% informality level results in tax revenue loss* for the government in the range of = 0.7*0.15*871 million = USD 91 million or 915 crores BDT.

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