SMEP | Sustainable Manufacturing and Environmental Pollution

The Circular Economy of Lead Acid Batteries in Bangladesh with Formal and Informal Processes

UK International Development
Partnership | Progress | Prosperity

UNITED NATIONS UNCTAD

PURE EARTH BANGLADESH

GEORGETOWN UNIVERSITY McDonough School of Business

STANFORD GRADUATE SCHOOL OF BUSINESS

The Circular Economy of Lead Acid Batteries in Bangladesh with Formal and Informal Processes

Bangladesh suffers from massive lead emissions from its circular Lead-Acid Battery (LAB) industry. E3Ws are the dominant source of scrap lead, though LABs have various other uses. We recommend a smelting fee scheme with a fee imposed on every LAB and a subsidy per ULAB processed by a qualified formal smelter. An alternative approach is to increase the import tariff on lead and support ULAB collection for a qualified formal smelter. The smelting fee scheme and the alternative approach reduce lead emissions by favoring formal processes.

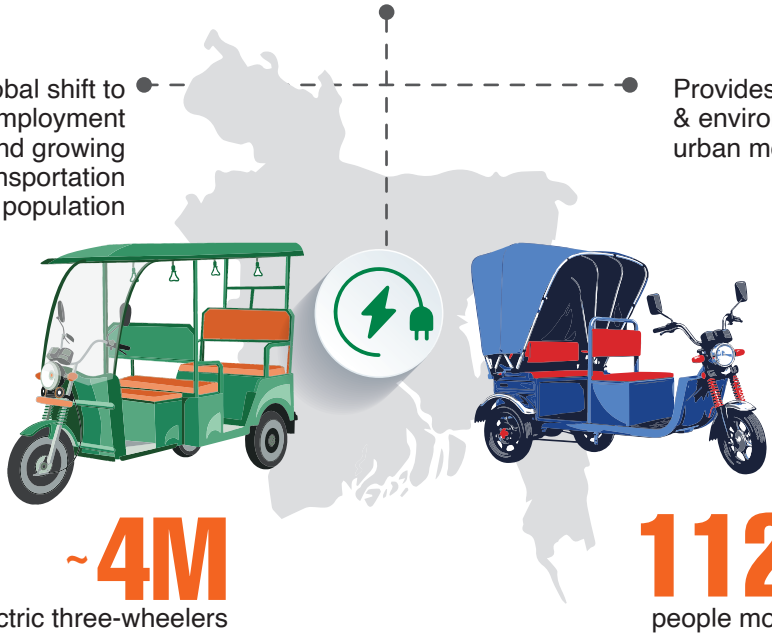
This factsheet summarizes the findings of the field research '*How to Reduce Lead Emissions from a Lead-Acid Battery Circular Economy with Formal and Informal Processes*' led by Pure Earth with support of a research team from Georgetown and Stanford Universities, and in collaboration with government ministries in Bangladesh.

E-Mobility in Bangladesh

Bangladesh has witnessed a surge of E3Ws on streets in recent years, such as EZ bikes, Mishuks, and e-rickshaws.

Driven by the global shift to e-mobility, employment opportunities, and growing demand for transportation relative to the population

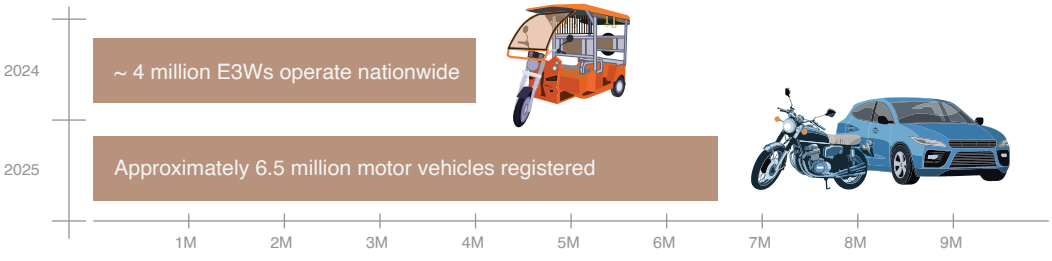
Provides fast, affordable & environment-friendly urban mobility



~4M
electric three-wheelers (E3Ws) in Bangladesh

112M
people move every day

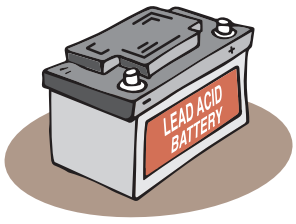
Bangladesh has approximately 6.5 million motor vehicles registered with the Bangladesh Road Transport Authority (BRTA), yet an estimated 4 million E3Ws operate nationwide, the vast majority of which are illegal and unregistered.



Circular Management Challenges of LABs

E3Ws are powered by poor-quality Lead-acid batteries that are:

- Short-lived, requiring frequent replacement and early recycling
- Inefficient in energy usage
- Emission-intensive and requires large amount of lead



80%
of used lead-acid batteries are recycled in illegal, informal sites

125kg
of lead is contained in each E3W battery, which is 15 times that of a car battery.

167,000 MT
of lead waste are generated annually through recycling.

15-20%
of lead is released into the environment every time a battery is recycled, causing widespread contamination.

30kg
of lead is emitted annually per E3W in Greater Dhaka.

Why Informal Recycling Dominates

- Lower operating costs as it avoids taxes and regulations
- The current market structure rewards low-cost, high-emission recycling
- Formal recyclers face higher costs due to logistics, storage, and compliance requirements
- Faster and cheaper access to used batteries at the point of collection

Health and Economic Impacts of Informal ULAB Recycling

3rd most lead-impacted country globally is Bangladesh, according to global estimations

20% of the population lives within 5 km of informal smelting sites

~ 4 *percentage point* increase in terminated pregnancies

Lead-associated health risks:

- *IQ loss*
- *Learning Disability*
- *Loss of Income*
- *Cardiovascular Diseases*
- *Renal Diseases*
- *Pregnancy Miscarriages*

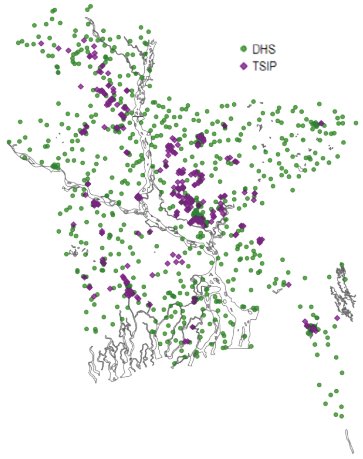
National survey shows ~38% children under 5 years have elevated blood lead levels

$29B annually lost due to lead exposure (approximately 8% of GDP).

$91M tax revenue is lost annually by the government due to informal recycling.
(Ref: Annex 1, Point no.5)

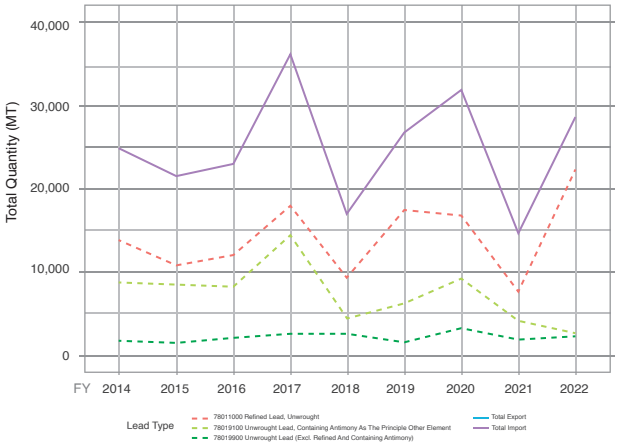
Geolocation of DHS* Clusters

*Demographic and Health Surveys (DHS)



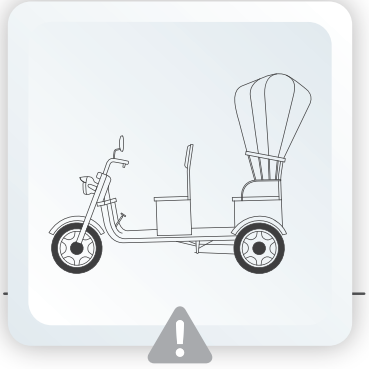
The graph shows toxic sites identified through Pure Earth's TSIP program (purple squares) and the geolocation of the household clusters for maternal health data (2014 & 2018 surveys- green circles). After a 2015 LAB tax hike, women near toxic sites had more terminated pregnancies, boosting local battery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

BDT
8710 Cr
(US$871 million) is the market size for electric three-wheeler batteries.



BDT
915 Cr
(US$91 million) is the estimated tax revenue loss for the government.

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

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

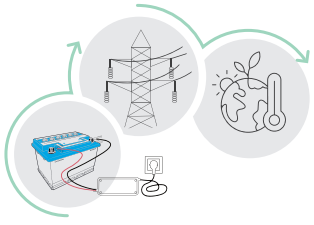
Short battery life causes

- 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

Loss of Electricity and Impact on Climate Change

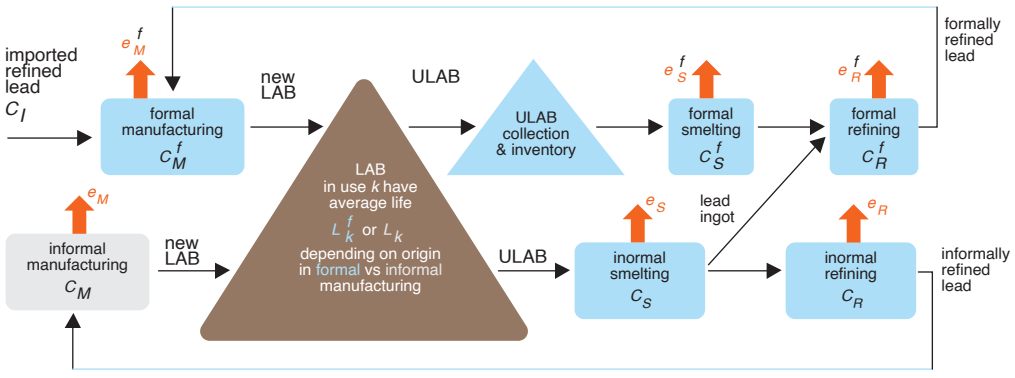


Low-quality batteries waste electricity, which heat up during charging. A high amount of electricity is consumed to charge electric three-wheelers, estimated to be over 5% of Bangladesh's total electricity consumption.

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

Key Processes and Parameters of a LAB Circular Economy

The partial equilibrium model shows how used lead-acid batteries flow through formal and informal collection, smelting, refining, and manufacturing systems.



In the figure,
c = process cost
e = emission-intensity
e^f = A formal process
e_M, e_s or e_R = Type of process

The equations of the model show: Increment of battery prices = Increment in process costs & lead losses, because each stage higher emissions = More lead input.

Figure: Partial Equilibrium Model for LAB

The model compares the formal sector's three possible lead sources: imports, informal recycling, and formal recycling, to explain how costs, emissions, and battery lifespan shape market outcomes and how policy can redirect the system toward lower-emission formal recycling.

Recommendations

Smelting Fee Scheme

Subsidize qualified formal smelters with low emissions and verified traceability

Manufacturers pay a smelting fee for each new LAB

A balanced smelting fee subsidy design → increases government revenue, giving market advantage to environmentally compliant manufacturers and recyclers

Impact: Raises ULAB market value, phases out informal, high-emission recycling, and shifts demand to formally manufactured LABs

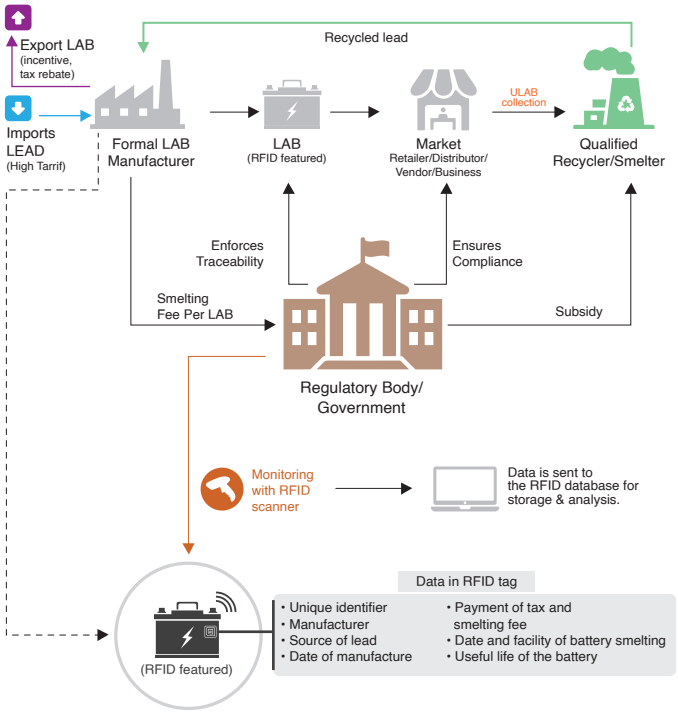
Traceability and Enforcement

Implement RFID tags on all batteries to track the manufacturer and smelter, confirming smelting fee payment

Regular checks by authorities in shops and on streets; fines for unregistered batteries

Monitor & publicise battery lifespan → encourage longer-lasting batteries and reduce informal ULAB recycling

Potential Solution: Proposed Circular Economy Model



Without proper policy intervention, falling demand for LABs can lower ULAB value, encourage dumping, and temporarily worsen emissions.

About SMEP

The “Development of Business Models and Policy Interventions to Reduce Informal ULAB Recycling in Bangladesh” project under the Sustainable Manufacturing and Environmental Pollution (SMEP) programme is led by Pure Earth Bangladesh, who have anchored the policy and stakeholder dialogues, supported by a research team led by Georgetown and Stanford Universities, along with local partners. The program is funded by the UK’s FCDO and implemented with UNCTAD, supporting developing countries in reducing industrial pollution while promoting sustainable production. The lead acid battery sector was prioritized in Bangladesh due to its importance to the country’s transportation, energy storage, and manufacturing systems.

Scan to know
more about 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.

Disclaimer

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.

SMEP | Sustainable Manufacturing and Environmental Pollution

Scan to read the full paper

UK International Development
Partnership | Progress | Prosperity

UNITED NATIONS UNCTAD

PURE EARTH BANGLADESH

GEORGETOWN UNIVERSITY McDonough School of Business

STANFORD GRADUATE SCHOOL OF BUSINESS