



Institute for Transportation
& Development Policy

Jak
Lingko

D21JULUS

Bus Listrik

transjakarta

MYS-23370



Heading Towards 100,000: Scaling Electric Bus Fleets Case Study: Jakarta

26th September 2023

Outline



- Glimpse of Jakarta's Transport Conditions
- Overview of Transjakarta Electrification Program
- Lesson Learned from Transjakarta E-bus Pilot



Jakarta's transport conditions (source: ITDP Indonesia)

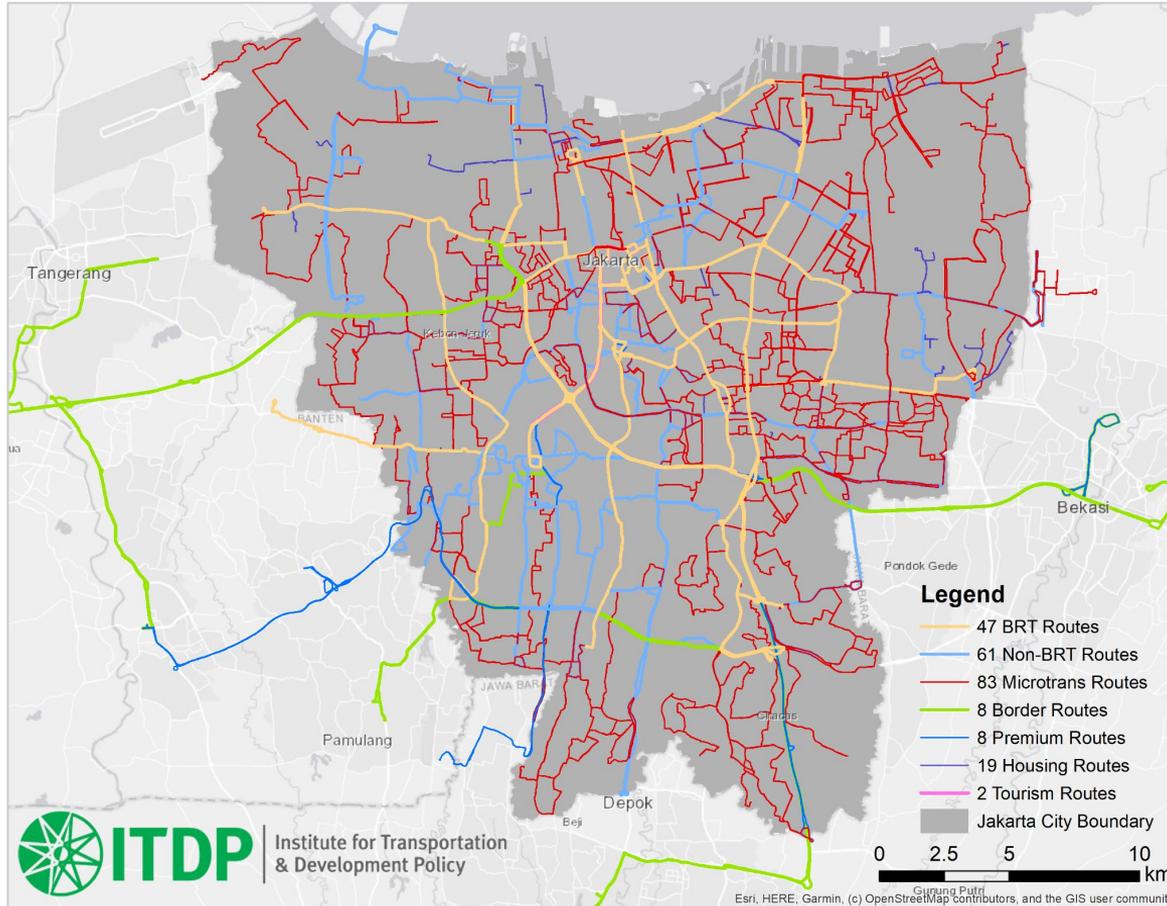
Jakarta is the largest city in Indonesia and ASEAN, with a total area of (661.5 km²) and population of 10.56 million (2020).

To accommodate the mobility needs, Jakarta is currently served by different types of public transport (PT) modes:

- Road-based public transport: Transjakarta;
- Rail-based public transport: KRL commuter line, Mass Rapid Transit (MRT Jakarta), and Light Rail Transit (LRT) Jakarta and Jabodebek.

However, the PT mode share in Jakarta is still low (below 10%).

Overview of Transjakarta Services



Transjakarta is the bus rapid transit (BRT) system in Jakarta and currently the longest BRT system in the world.

- The 13 main corridors span 250 kilometers across the city.
- It has seven different types of services, with a total of 228 routes.
- 87% Jakarta residents are served by Transjakarta services within 500-meter or less walking radius (2023).
- Peak daily ridership: 1 million (in February 2020 and June 2023).

**C40
CITIES**

In 2019, the Jakarta Government signed a collaboration with C40 to develop a **Climate Action Plan (CAP)** aligned with the Paris Agreement. Fossil-Fuel-Free Streets Declaration: **(1) Procuring only zero-emission buses**, starting from 2025; and **(2) Ensuring that most areas of Jakarta City Center are emission-free by 2030**.



Jakarta Government Instruction 91/2021

Instruction to Transportation Agency to:
Expedite the procurement of 100 electric bus as a pilot project

Jakarta Government Regulation 90/2021

Establish net zero emissions by 2050
Shift to electric buses for public transportation

Governor of Jakarta Decree 1053/2022

50% electric bus under Transjakarta service by 2027
100% electric bus under Transjakarta service by 2030

The Government of Jakarta aims to achieve **50% and 100% Transjakarta electrification** respectively in 2027 and 2030 (more than 10,000 e-buses).

Current Progress of Transjakarta Electrification



Jul - Oct 2020
Pre-Trial 2 E-buses
in 1 route
Two type of BYD
E-buses were used
(BYD C6 and K9).

Aug 2021
30 E-buses procured in
Jakarta
The entire e-buses were
stored at the selected
e-bus operator.

Jan - Jun 2022
Construction of 10
port Charging pile
The operator built a
charging station with a
total of 10 double-gun
chargers (2x100 kW).

Jun 2022
All 30 E-buses rolled
out in 2 routes.
On-depot charging
station (overnight
charging).

2020

2021

2022

2023



March 2021
Open bidding
procedure
Transjakarta post the
E-bus pilot needs on the
E-Procurement website
and it is open for all
operators to bid.

Oct 2021 - Dec 2021
Choosing the operator and
contract settlement
Transjakarta and E-bus
operator were intensively
discussing the gross-contract
component and determine
each role and responsibilities.

Mar 2022
4 E-buses rolled out in 1
route
As the expected charging
station was still under
construction, charging activity
was done using the OEM's
charging station.

Aug 2023
22 additional
e-buses rolled out in
4 routes.
A total of 15 of
double gun chargers
at depot (2x100 kW).

Currently, there are 52 e-buses (12-m) that operate in Transjakarta by one operator on non-BRT routes, and 48 additional e-buses are planned to operate by December 2023 by two different operators.

Monitoring and Evaluation of Transjakarta E-bus

Vehicle Performance

Operating Performance

Environmental Impacts

Social and Gender Impacts



Total Days of Operation: **423 days**



Total Operation Distance: **2.1 million km**



Average Charging Time: **75 minutes**



Average Energy Consumption: **1 kWh/km**



Average Travel Distance: **233 km/day**

Emissions saved from March to December 2022 from Transjakarta e-bus pilot:

1,445,235.8 kg of CO₂eq

859.0 kg of PM_{2.5}

545.4 kg of SO₂

19,088.0 kg of NO_x

Note: Based on the operational data of 30 Transjakarta e-buses from March 4th, 2022 to April 30, 2023.

Monitoring and Evaluation of Transjakarta E-bus



Transjakarta's woman driver
(Source: ITDP Indonesia)



Technical audit of E-bus fleet design
(Source: ITDP Indonesia)

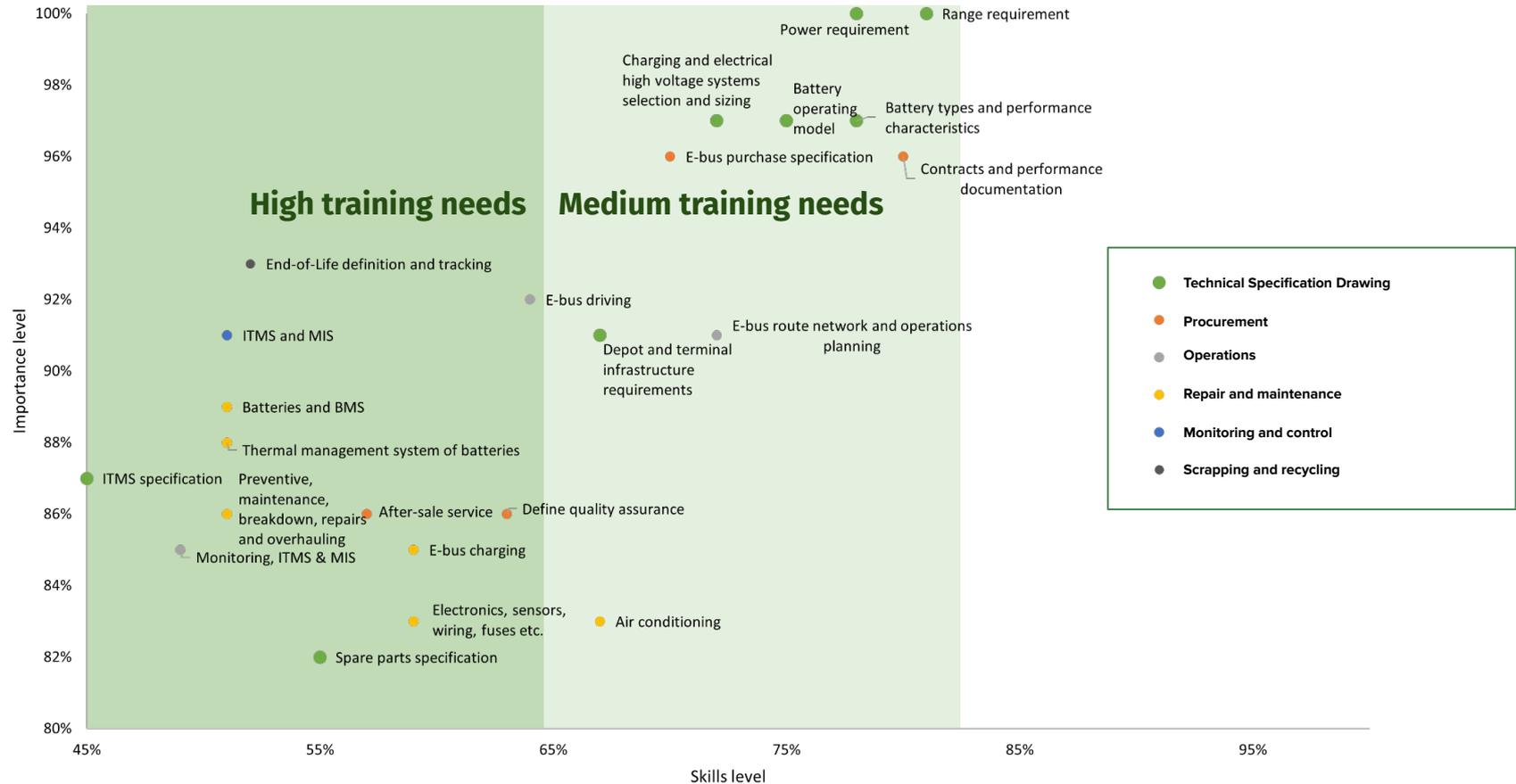


Interior of Transjakarta E-Bus
(Source: ITDP Indonesia)

ITDP Indonesia has conducted number of collaborative works vulnerable groups, including surveys, forum group discussions (FGD) and audits to understand more their needs.



Training Needs Assessment (TNA) Survey



Policy challenges

The **absence of clear and strong regulations** to achieve commitment and target on electric vehicle (e.g., EV's taxes, and proactive policies and regulations for e-buses).

Financial challenges and unscalable business model

- **High upfront cost for e-buses**, including additional cost for charging infrastructure;
- **Lack of incentives and subsidies**;
- Highly dependent on conventional business model that relies on operators;
- **Lack of certainty on financial attractiveness** for private sectors.

Operational challenges

- Insufficient knowledge for the new technology (e.g., maintaining e-buses in hazardous conditions);
- Lack of operational standardization;
- Lack of operator assistance and training;
- Other implementation challenges (e.g., insufficient charging infrastructure availability).

Monitoring and evaluation challenges

- **Lack of data collection and sharing** mechanism;
- **Lack of data verification and analysis**;
- Data integration challenges.

Policy aspects

A strong regulatory framework is needed to provide a legal basis for Transjakarta to implement e-buses at a large scale, beyond the pilot implementation.

Financing aspects

- **New financing solutions** and partnerships;
- **Reevaluate the cost for operators and adjust the payment structure** to reflect the higher capital cost of e-buses;
- **Engaging stakeholders** with lower financial capacity is crucial;
- **Exploration of funding schemes** are needed to identify the optimum cost of funds.

Operational planning and preparation

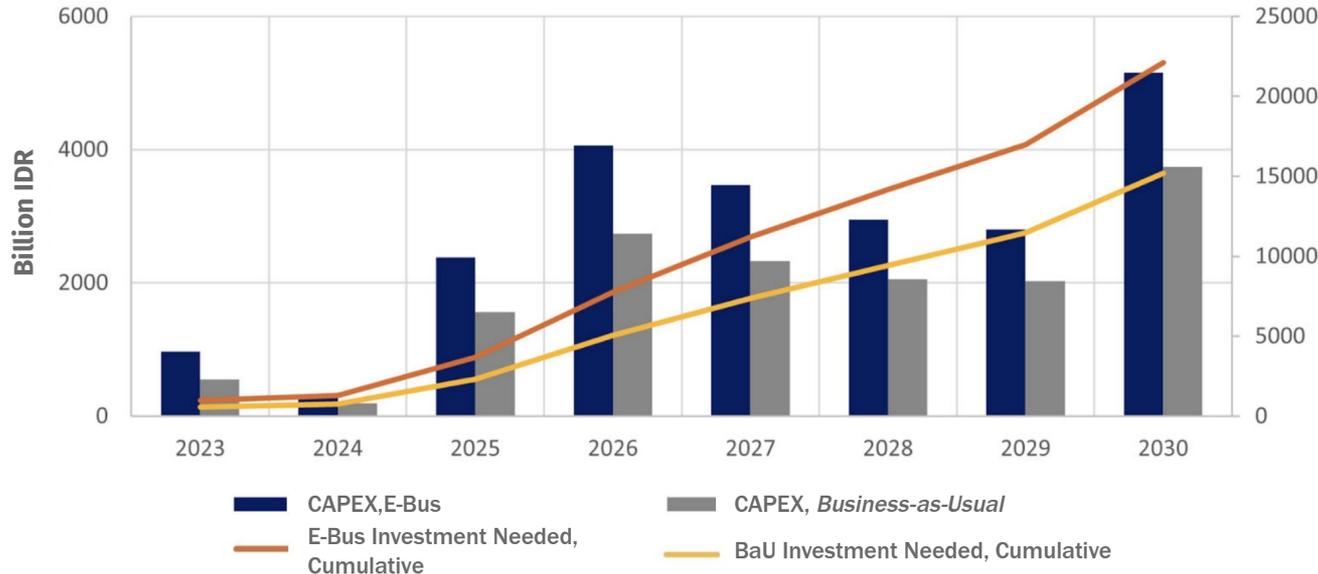
- **Charging infrastructure optimization** is essential for competitive total cost of ownership (TCO).
- Provide more **support to e-bus operators** (e.g., training to transfer sufficient skills and/or knowledge for improving operational efficiency).

Monitoring and evaluation

- Incorporate detailed **data collecting and sharing** mechanism.
- **Upgrade the e-bus control center and build capacity** on Intelligent Transportation System (ITS).
- **Summarize experiences and lessons learned** from the pilot project.

Estimated Investment Needed for Transjakarta Electrification

E-Bus CAPEX Comparison vs *Business-as-Usual**



Estimated total investment costs for electrification of 100% of the Transjakarta fleet (10,047 units), cumulative until 2030:

**~IDR 22 T or
USD 1.43 B**

including e-bus fleets procurement and charging infrastructure needed to achieve the 100% electrification target.

*The Business-as-Usual scenario assumes that Transjakarta will still have a fleet of 10,047 units in 2030, but all of them will be fueled by diesel or CNG.

Analysis of Possible Commercial Arrangements

		Option 1	Option 2	Option 3	Option 4
		Buy the service (BaU model)	Concessional model	Fleet leasing ¹	Combination of scenarios
	<i>Fleet ownership</i>	Bus operator	Transjakarta	Bus lessor	Single bus, low entry bus, medium bus: Buy-the-service model Articulated bus: Concessional model Microbus: Fleet and depot leasing
	<i>Fleet operations</i>	Bus operator	Bus operator	Bus operator	
	<i>Fleet maintenance</i>	Bus operator	OEM/APM	Bus lessor	
	<i>Overnight charging Infrastructure</i>	Bus operator	Bus operator	Bus operator (bus lessor for depot leasing)	
	<i>Terminal charging infrastructure ²</i>	Charging service providers	Charging service providers	Charging service providers	
	Source of financing	Equity from investors and debt from local commercial banks	Equity from The Government of Jakarta and debt from PT. SMI*, commercial banks, financial instruments	Equity from investors and debt from financial instruments	
ΔNPV with BaU scenario ³		9.2%	17.9%	12.5%	16.9%
Remarks		Regulatory and institutional mechanisms already exist	Most financially attractive from NPV standpoint	Most implementable (least capital cost from operators and Transjakarta)	Optimises financial and implementation feasibility

[1] = Also includes depot leasing
 [2] = Terminal charging infrastructure is arranged through Public Private Partnership (PPP) with charging service provider where they would get paid by Transjakarta for the initial investment and by operators for the energy used
 [3] = BaU = All ICE fleet scenario. as % of BaU (ICE fleet) NPV
 * = a Special Mission Vehicle (SMV) under the Ministry of Finance which is engaged in development financing.

Alternative Funding Schemes: Public and Private Financing

Source of fund / financing	Scheme	Description	Government Guarantee Letter	Special Purpose Vehicle	Other investment/ financing instruments	WACC Simulation Result
Public sector	A-1	PT SMI provides regional loans to The Government of Jakarta	✗	✓	✗	7.21%
	A-2	The combination of regional loans and financing products (PT. SMI)	✗	✓	✓	7.39%
	A-3	Development Financial Institutions (DFIs) or Export Credit Agencies (ECAs) loan to Government (2-step loan)	✓	✓	✗	6.86%
Private sector	B-1	Loans from local and foreign commercial banks, including Exporting Credit Agencies (ECAs)/Development Financing Institutions (DFIs)	✗	✗	✗	10.08%
	B-1A	Loan from commercial foreign banks to private sectors (BaU)	✗	✗	✗	10.18%
	B-2	Bond as investment instrument to raise capital	✗	✓	✓	11.32%
	B-2, Alt 1	Utilises Limited Participation Mutual Funds (<i>Reksa Dana Penyertaan Terbatas</i> , "RDPT") as the investment instrument, SPV as the asset owner	✗	✓	✓	9.89%
	B-2, Alt 2	Utilises RDPT, finance lease to operators	✗	✓	✓	10.03%
	B-2, Alt 3	Utilises RDPT, leverage lease agreement between SPV and leasing company	✗	✓	✓	10.54%

Highlights

The cost of funds for all alternative funding schemes is still more attractive since it is lower than interest in the market.

Utilizing other funding instruments and the involvement of private financing companies provides a higher cost of funds, but can provide higher financing flexibility.

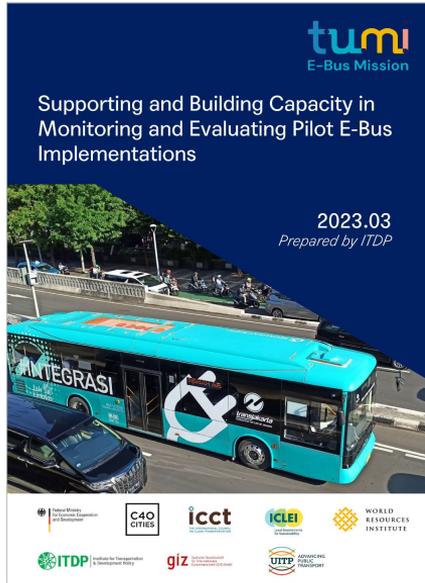
The national government has an important role in providing guarantees to reduce the cost of funds and smoothen the access to finance.

Summary

- A **strong regulatory framework** is needed to provide a legal basis for Transjakarta to implement e-buses at a large scale, beyond the pilot implementation.
- Develop a **long-term sustainable business model** for e-bus and charging infrastructure procurement and operations.
- Provide both **technical support** on e-bus operations and charging infrastructure.
- Incorporate detailed **monitoring and evaluation** scheme to ensure smooth transition to e-buses in the system.



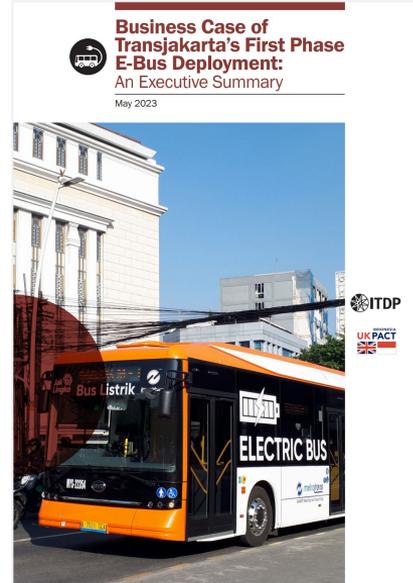
Available Resources



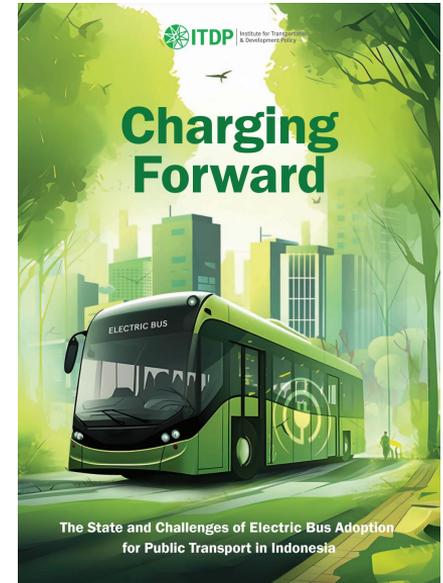
[Supporting and Building Capacity in Monitoring and Evaluating Pilot E-Bus Implementations](#)



[Building a Regulatory and Financial Basis for Transjakarta's First Phase E-bus Deployment](#)



[Business Case of Transjakarta's First Phase E-bus Deployment: An Executive Summary](#)



Will be launched soon on ITDP Website in October, 2023.

Thank you!

Vinensia Nanlohy - vinensia.nanlohy@itdp.org
Public Transport & Electrification Associate II - ITDP Indonesia

Alfisahr Ferdian - alfisahr.ferdian@itdp.org
Transport & Informal Public Transport Associate II - ITDP Indonesia