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Roadmap of e-bus implementation in Indonesian Cities

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Outline

1. Why roadmap is important for e-bus adoption in Indonesia?
2. Policy gap analysis for e-bus implementation in Indonesia
3. Methodology on e-bus implementation
4. Case study of implementation phases in Jakarta, Greater Bandung and Greater Medan

Why roadmap is important for e-bus adoption?

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- A roadmap of e-bus implementation provides a clear implementation strategy to ensure the success of battery electric buses (BEB) deployment within the city/country.
- The roadmap of e-bus includes all aspects that are related for the implementation, such as:
  - Policy analysis;
  - E-bus deployments: E-bus technology and charging strategy required;
  - Charging infrastructure provision;
  - Implication of BEB deployment on the current grid;
  - Estimated amount of investment needed;
  - Proposed business models for BEB deployment;
  - Environmental and economic benefits of BEB adoption

ITDP Indonesia E-mobility Project (2021)

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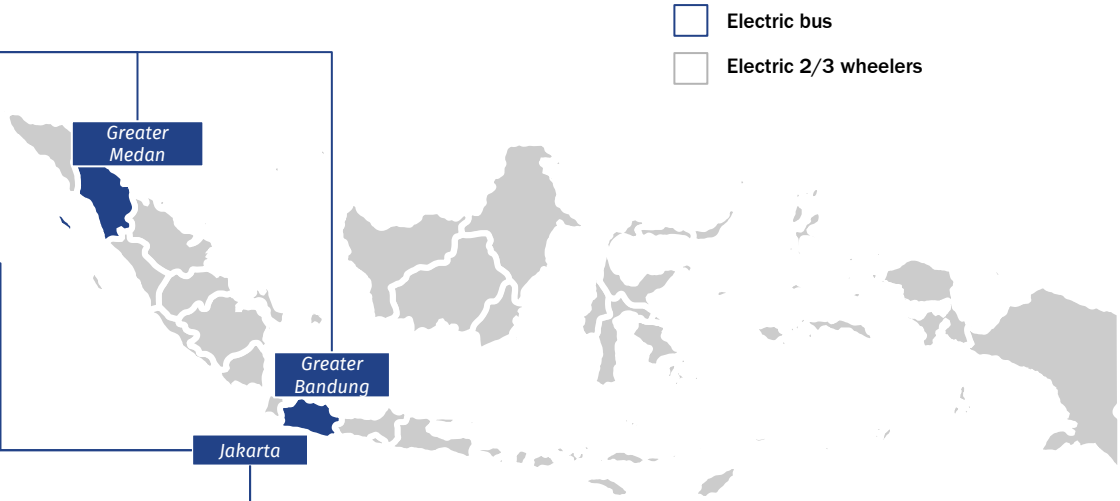
E-mobility Adoption Roadmap for Indonesian Mass Transit System
- *Funding: The World Bank*
- *January - November 2021*

TUMI E-bus Mission in Jakarta
- *Funding: Transformative Urban Mobility Initiative (TUMI)*
- *June 2021 - November 2022*

Supporting Jakarta's Transition to E-mobility
- *Funding: UNEP-CTCN*
- *March 2020 - May 2021*



Electric bus

Electric 2/3 wheelers

Action Plan to Scale-up Transjakarta E-buses
- *Funding: UK PACT*
- *February 2021 - February 2022*

Timetable for Two-Wheeler Ride Hailing Fleet Electrification
- *Funding: UK PACT*
- *February 2021 - February 2022*

National context:

Mainstreaming Electric 2&3 Wheelers in Indonesia
- *Funding: UNEP*
- *July 2021 - August 2022*

Policy gap analysis for e-bus implementation in Indonesia

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Policy type	Current policies	Gap analysis
Direct incentives for consumers	Ministry of Home affairs reduced the vehicle tax and transfer fee for BEVs. Local governments also adopting reduced transfer fees.	Only Jakarta and Bali have adopted local transfer fee schemes that favor electric vehicles. The current tax reduction incentive for Completely Built Up (CBU) is not clear yet (e.g., the period and the amount of incentives). **Strong monetary incentives** for electrification of mass transit, such as a **national level policy** for **vehicle registration and transfer taxes** is required.
Indirect incentives for consumers	Presidential Regulation (PR) 55/2019 establishes several regulatory pathways for indirect (non-fiscal) incentives	Non-fiscal incentives are typically managed at the local level. Only Bali seems to be regulating preferential parking access and mobility flexibilities for BEVs. **A more robust set of non-fiscal measures** is required, for instance the **implementation of Low Emission Zones (LEZ).**
Infrastructure development policies	Ministry of Energy has issued technical regulations for charging stations and battery swap stations.	The BEV program has already been included on the Medium-Term National Development Plan (RPJMN) 2020-2024. This document is focused on charging infrastructure development in Indonesia, and the development of the battery industry in Indonesia More **detailed incentives regarding installation for new connections** to support charging infrastructure, the current regulation from MEMR 13/20 has not mentioned this issue.
Public fleet vehicle mandates	None in place.	Indonesia **could adopt e-bus and taxi mandates for key cities with serious air quality challenges**, and expand over time to all cities.
Adopting innovative business models	Innovative business models now open for electric chargers and battery swapping stations.	The Government of Indonesia (GoI) could consider **adopting split business models** where the asset owner and operator are independent entities. Also, expand contract periods to reflect the financial needs of e-bus costs, which should **extend to 15 years**.

Methodology on e-bus implementation

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Identify key specification for analysis

- Daily distance per bus per route;
- Bus type (medium or single bus);
- Commonly available battery size in the e-bus market based on the bus type.

Routes grouping allocation for each depot

- Buses per route are assigned to proposed depot locations, based on operational routes by considering distance to the depot and number of fleets;
- Each depot will be operated by different operators.

Identify appropriate charging strategy for each battery size options

- Overnight charging
- Midday charging during off-peak period
- Fast charging at terminus

- Analyze charging strategies per route, starting from the smallest battery size option;
- Three options to be analyzed and optimized: 1) overnight charging at depot; 2) combination of overnight+midday charging at depot/a charging facility; and 3) combination of overnight charging at depot+fast charging at terminus;
- Aspects to be considered: energy requirement to cover daily distance, battery size, depot proximity, space availability at terminus, operational schedule, and state-of-charge (SOC).

Calculate total cost per route for each battery size options

- CAPEX: E-bus procurement cost (including battery cost and taxes), charger procurement cost, charger installation cost, battery replacement cost; and salvage value of e-buses;
- OPEX: Operational and maintenance costs;

Select the most cost-effective option per route

- Based on total cost per route

Develop strategy of implementation phases

- With regard to estimated demand, financial analysis, technology readiness, and spatial analysis (the possibility of having shared charging facility at the depot and/or terminus).

Recommendation on Charging Strategy Selection

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Overnight charging at depot

A. No additional charging infrastructure needed
B. Lower Total Cost of Ownership (TCO)

Midday charging at the depot or a charging (staging) facility for charging during off peak hours

A. To cover energy requirements for the routes which can not be covered by overnight charging only at the depot
B. The e-buses will be charged during off peak hours (split period)
C. The charging facility should be less than 5 km from the end/start of each routes

Opportunity charging with installed fast charging facility at terminus

A. Will be installed to support the energy requirement for the routes which cannot be covered by overnight charging only.
B. Charging occasion at the end of routes
C. Charging duration will be in line operational schedule (headway)
D. Charging at terminus will use pantograph charger

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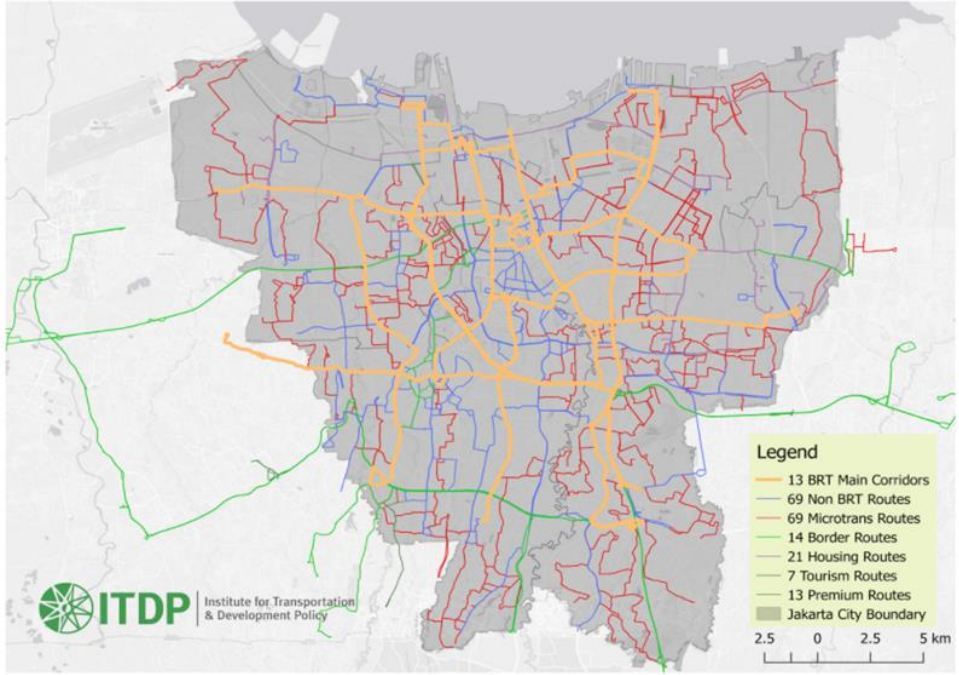
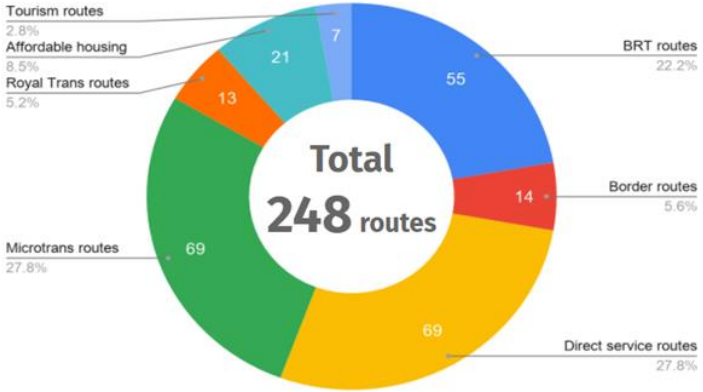
Case Study: E-mobility adoption for Transjakarta

Overview of Transjakarta



248 BRT stations **5,932** bus stops



Source: Transjakarta (2020)

Transjakarta's Electrification Plan

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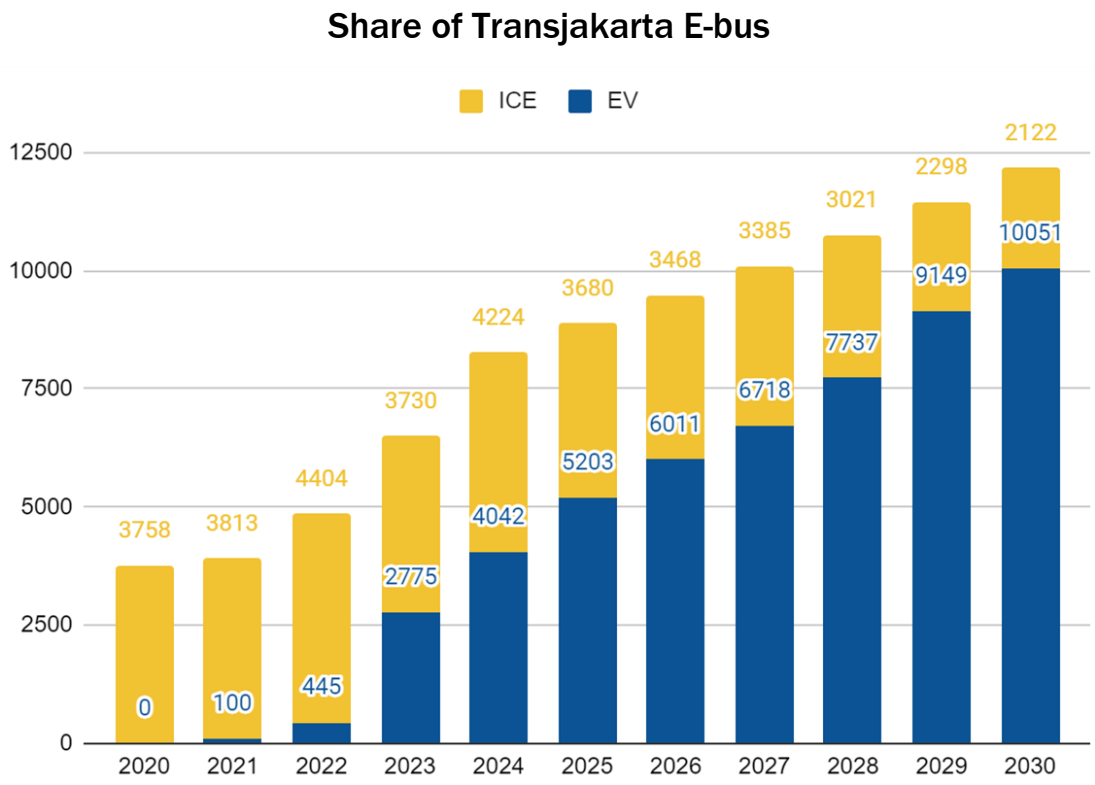

Around **10,000 electric bus fleets** are planned to be operated by 2030.

The procurement targets varies for every fleets type of Transjakarta.

Source: Transjakarta

Summary on Transjakarta E-Bus Charging Strategy for Transjakarta BRT and non-BRT (Direct Service) routes

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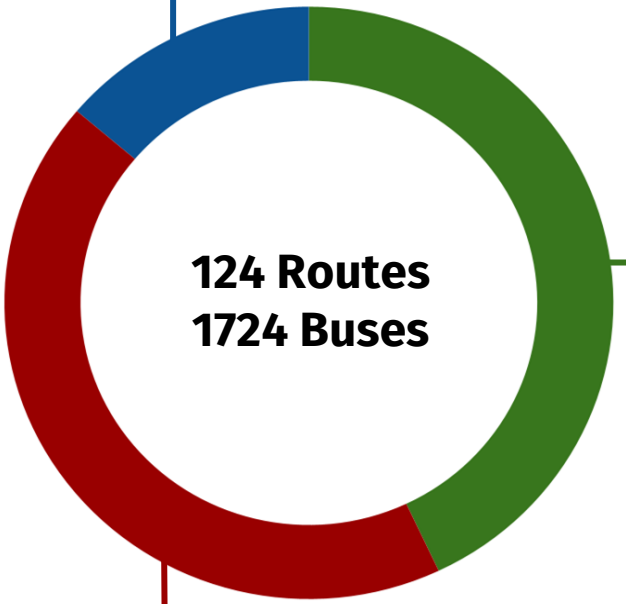

Overnight charging at the depot (14%)

Overnight + opportunity + additional off-peak charging strategy (43%)

Overnight + opportunity charging at terminal (43%)

Opportunity charging analysis parameters:

1. Space availability at terminus (dedicated land or mixed traffic)
2. Available dwelling time vs charging time (based on the power output of the chargers)

Recommendation on E-bus Implementation Phase

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ITDP recommended **5 Phases of Implementation** of Transjakarta E-Bus Deployment **for BRT and non-BRT routes**, starting from 2021 to 2030.

2021 - 2024		2024 - 2027		2027 - 2030
Phase 1	**Phase 2**	**Phase 3**	**Phase 4**	**Phase 5**
Single bus	**Single bus** **Medium bus**	**Single bus** **Medium bus**	**Single bus** **Medium bus** **Articulated bus**	**Single bus** **Medium bus** **Articulated bus**
Overnight + Staging Facilities + Terminal Charging	Overnight + Terminal Charging	Overnight + Staging Facilities + Terminal Charging	Overnight + Staging Facilities + Terminal Charging	Overnight + Staging Facilities + Terminal Charging

Detailed report can be downloaded from ITDP Indonesia website: *https://itdp-indonesia.org/publication/support-for-e-mobility-transition-in-jakarta/*

Opportunities and Barrier of Transjakarta Electrification

Opportunities	Barriers
• Compared to other urban bus providers in other cities in Indonesia, Transjakarta has **more financial and resource capability** for the electrification. • Transjakarta has strong commitment for the electrification. It already **has a roll-out plan and target** for e-bus deployment. • BRT and non-BRT Transjakarta already **has** several **supporting facilities** needed for the electrification, such as depots.	• **Lack of supporting local policies** for large scale deployment of Transjakarta e-bus. • 32% of electric fleets of Transjakarta in 2030* will come from microbuses. But as of now, all of microbus fleets still uses ICE engines. **Microbus electrification** possess **higher complexity** and social issues. • **Current** Transjakarta **business models and financing schemes can not cope** with the electrification target. Innovative financing schemes and business models are needed to accelerate the electrification.

**Based on the Transjakarta electric bus procurement target by 2030*

Case Study: E-mobility adoption for new BRT systems in Greater Bandung and Greater Medan

Project Background

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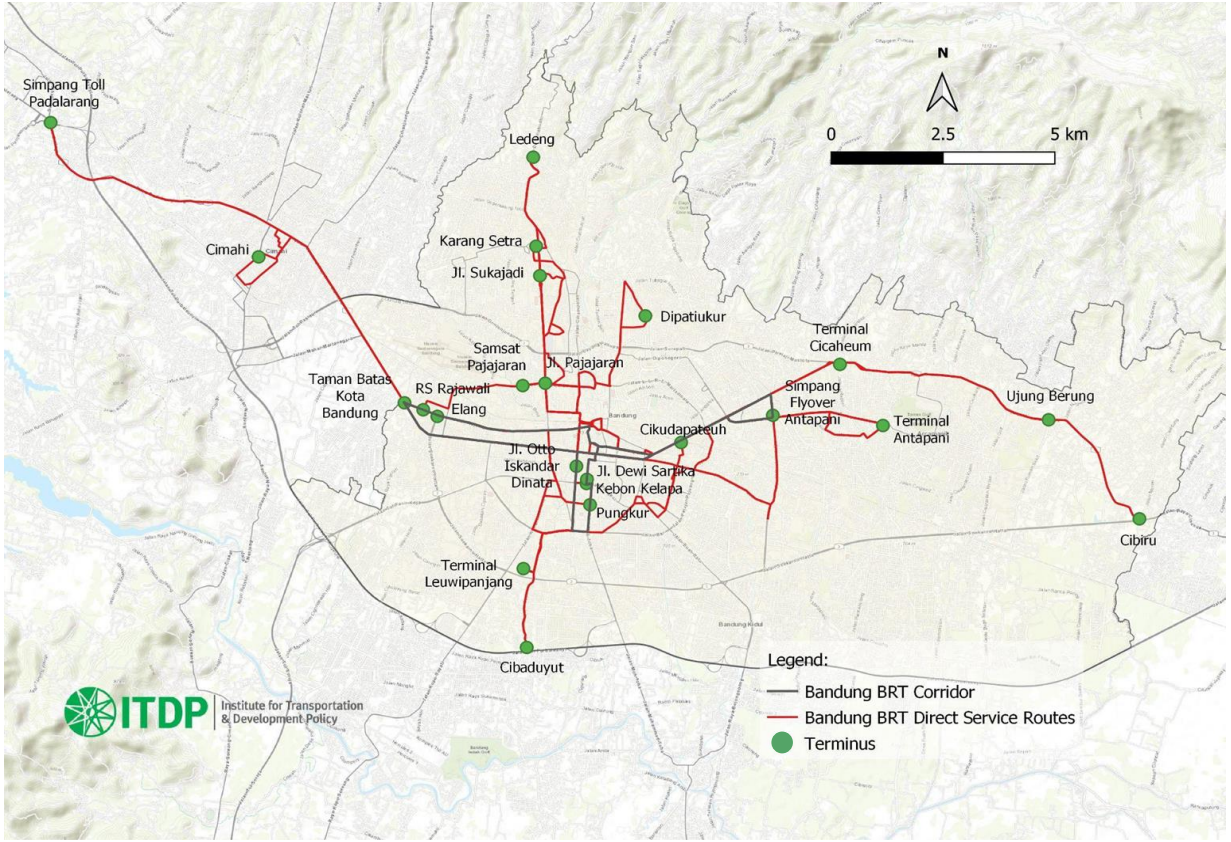
The World Bank is currently preparing **the Indonesian Mass Transit Program Support Project (IMTPSP)** to enhance urban mobility and accessibility on high priority corridors in Greater Medan and Greater Bandung.

Diesel is the default fuel for the proposed bus rapid transit (BRT) systems. ITDP is supporting the project on the design of these mass transit systems by exploring the **potential to leapfrog to e-mobility technologies**.

Different from Transjakarta system that has already established, the e-mobility adoption in Greater Bandung and Greater Medan is the new BRT system.

Greater Bandung BRT Network



Source: On-going study on E-Mobility Adoption Roadmap for the Indonesian Mass Transit Program

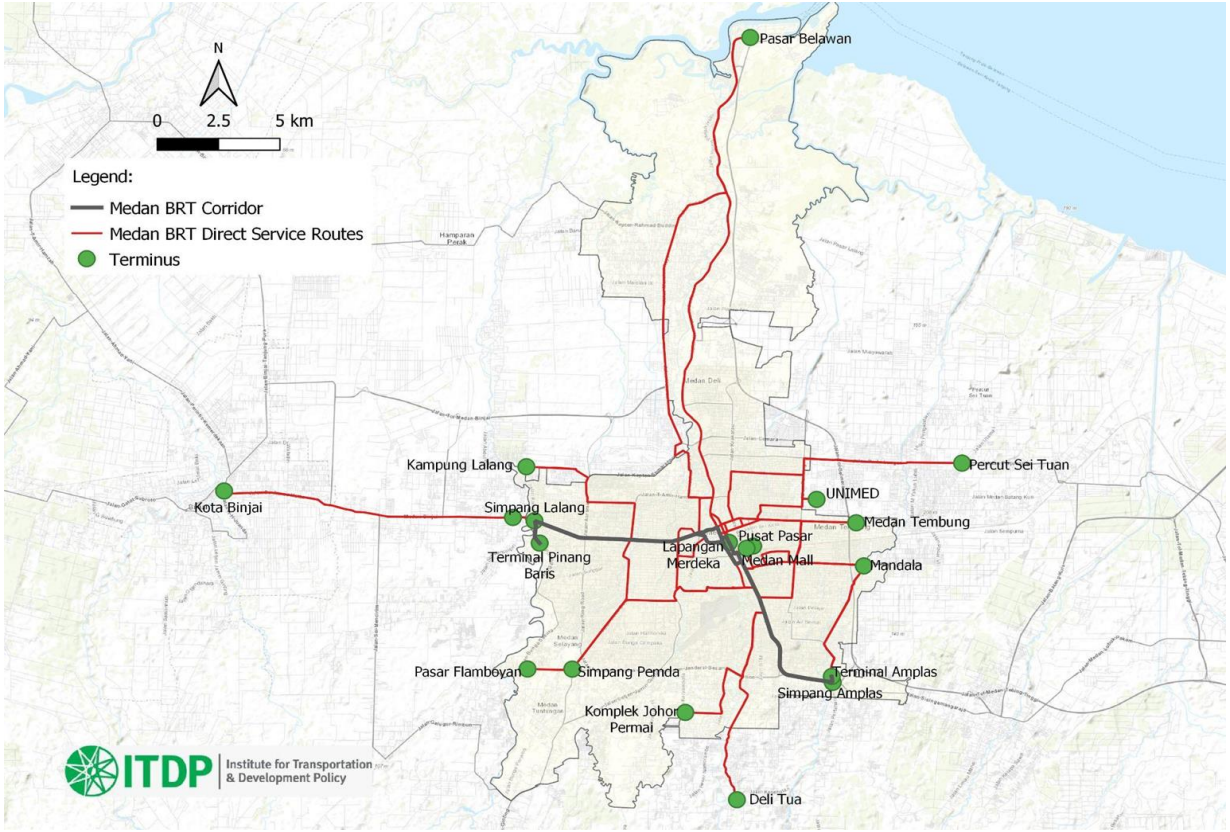
Bandung BRT corridor goes through East to West, with the total length of 19 km.

The demand of 99,000 pax per day (the World Bank, 2021).

There are 16 direct service* routes in this BRT system, with the total of 200 fleets.

* = Direct Services: A service pattern where multiple bus routes run in mixed traffic on local streets and then continue onto the BRT corridor. (BRT Planning Guide, ITDP 2017).

Greater Medan BRT Network



Source: On-going study on E-Mobility Adoption Roadmap for the Indonesian Mass Transit Program

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Medan BRT corridor goes through Pinang Baris to Amplas.

Total corridor length = 21 km, with the estimated demand of 150,000 pax per day (the World Bank, 2021).

In total there are 19 direct service routes in this BRT system, with the total of 400 fleets.

Strategies on the implementation phase of e-bus adoption in Greater Bandung and Greater Medan

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Scenarios	Pros:	Cons:
100% electric	• All the infrastructure will be 100% prepared for electric buses. • Does not need to wait for another contract period to electrify all fleets in the system. • Higher impact on the greenhouse gas **(GHG) reduction**. • The necessary resources such as staff, maintenances, spare parts, and capacity building will be **focused for the electric bus.**	• E-bus technologies are not yet matured in Indonesia. Limited availability of charging infrastructure and e-buses in Indonesia. • **Limited experience** from bus operators to operate the e-buses. • If there are **issues with the electric buses**, this will have impact on the operational of the BRT. • **Higher capital cost** due to higher cost of e-buses compared with internal combustion engine (ICE) buses.
Partial implementation: Considering charging infrastructure technology	• **Reduce CAPEX**, due to higher capital cost for providing electric buses and charging infrastructure. • Analyze **performance comparison** between ICE vs electric bus. • If there are issues for the electric buses, there are **ICE buses available as a backup**.	• Need to **provide infrastructure for ICE and electric buses**. Higher cost to provide different types of infrastructure. • Needs to **wait for another contract period**, to be able to achieve 100% electric buses, • The **fleet management will be more complex**.

Key takeaways for other cities on e-bus adoption for public transport

- Institutional setup of the current transit system, including public transport authority, level of service (LOS) regulator, and bus operators.
- Several regulatory setups which need to be implemented, are as follows:
  - Local LOS regulation;
  - Update listings in the government's procurement system;
  - Regulatory permissions to install charging infrastructure.
- Operational aspects that should be introduced are:
  - Standardized headway and operational hours,
  - Route itinerary adjustment to improve the service.
- Infrastructure to support e-bus adoption for public transport:
  - Dedicated bus stops/stations and terminus;
  - Depot facility;
  - Charging infrastructure provision;
  - Grid capacity that can accommodate the impact of e-bus deployment;
  - Command center and Intelligent Transportation System (ITS) infrastructure.

Thank you

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