Advancing E-Buses:

A Guide to Batteries and Charging

Executive Summary

ITDP

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COVER PHOTO: Jakarta Public Transportation Innovates by presenting environmentally friendly electric buses to realize the blue sky jakarta program with electric buses
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A Note from ITDP CEO Heather Thompson

We at ITDP know that investing in public transport systems centered on electric buses is essential to helping cities and governments achieve urgent climate, economic, and social equity goals. Existing efforts to electrify urban transport are already setting the stage for more livable cities with fewer carbon emissions, better air quality, cost savings for individuals, and improved accessibility. With more than 670,000 e-bus units already deployed around the world, there is no doubt that e-buses hold the key to tackling the transport-related challenges many cities face.

As the market share for e-buses continues to grow, the success of these fleets requires planners and decisionmakers to make more intentional decisions regarding battery and charging infrastructure as part of broader transport policies. Currently, many governments are focused primarily on the procurement and deployment of vehicles and fleets themselves. However, for the long-term success of these systems and their operations, an electric transition requires a much more comprehensive approach than just swapping out traditional bus fleets.

Governments must also place equal emphasis on assessing opportunities and challenges related to battery technologies, charging infrastructure, grid capacity, and operational planning to ensure e-bus fleets are made resilient and reliable in the long run. Otherwise, the lack of planning for a city's charging and grid capabilities can result in costly inefficiencies that hinder, rather than help, electric mobility.

This is why our team is excited to share the following Guide, which places a much-needed spotlight on the integration of vehicle electrification with well-planned charging strategies through five actionable steps. ITDP's leadership and expertise in public transport, and bus systems in particular, positions us well to build upon the emerging best practices and innovation in this sector. We hope that transport stakeholders will take advantage of this framework to make more informed decisions about the evolving landscape of e-bus systems, which will help ensure that the future of public transport benefits both people and the planet.

Best,
Heather Thompson
CEO of ITDP

ADVANCING E-BUSES: A GUIDE TO CHARGING AND IMPLEMENTATION

Public transportation systems are essential for creating more compact, accessible, efficient, and equitable cities, enabling mobility for all while minimizing environmental impacts. Public transport also needs to be electrified to meet our climate goals. Many cities worldwide are committed to decarbonizing their public transport systems by acquiring battery electric buses. However, successful electrification requires more than just replacing vehicles; it means understanding a new system for powering the vehicles.

This new system is built on the interrelationship between batteries and charging infrastructure. Selecting the right mix of battery and charging technologies is critical for efficient electrification of public bus fleets. This selection includes charging types and locations as well as battery sizes and weights. The battery and charging selection process will influence the service planning for the system and determine its operational and financial performance. Given the wide variety of battery and charging options available, this decision-making process should be informed by local context, market availability, and evidence-based studies.

Battery and charging infrastructure selection is at the heart of creating a successful e-bus public transport system, and it is the critical aspect to understand in the transition from diesel to electric. This necessitates a holistic approach that considers the broader implications of sizes of batteries on the range, passenger capacity, and weight of the vehicles and also the impact of the charging infrastructure on the urban environment and electrical grid.

The Interconnected Elements of E-Bus Planning: Batteries, Charging, and Their Impacts

Battery and charging infrastructure decisions are interconnected and have cascading impacts on cost, range, and operational capabilities.

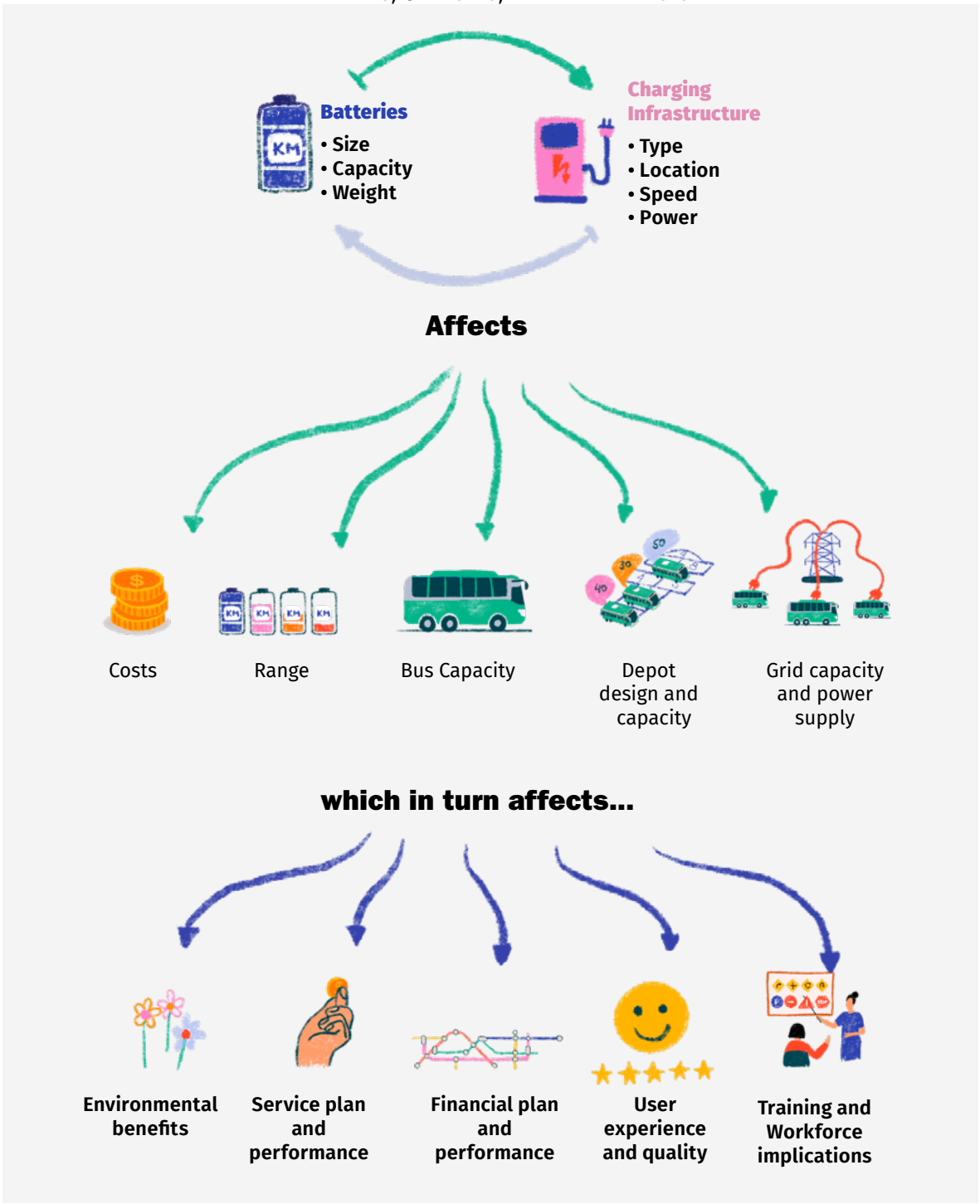
Proper planning is crucial not only for a smooth transition but also to avoiding costly and time-consuming mistakes common to e-bus adoption, such as buying too many buses and having buses sit for a year as cities figure out the charging plan. ***The Batteries and Charging Guide*** supports decision-makers and transport planners with information on the effective and efficient implementation of e-buses, emphasizing the importance of foregrounding the selection of appropriate battery and charging technologies tailored to specific urban contexts. This ensures that money invested is well-spent and delivers the best outcomes for reaching climate, equity, and health goals.

The Guide outlines a comprehensive approach, from understanding political frameworks and prioritizing e-bus routes to assessing market options and developing charging strategies. By providing a detailed overview of battery types, charging methods, and decision-making frameworks, the Guide aims

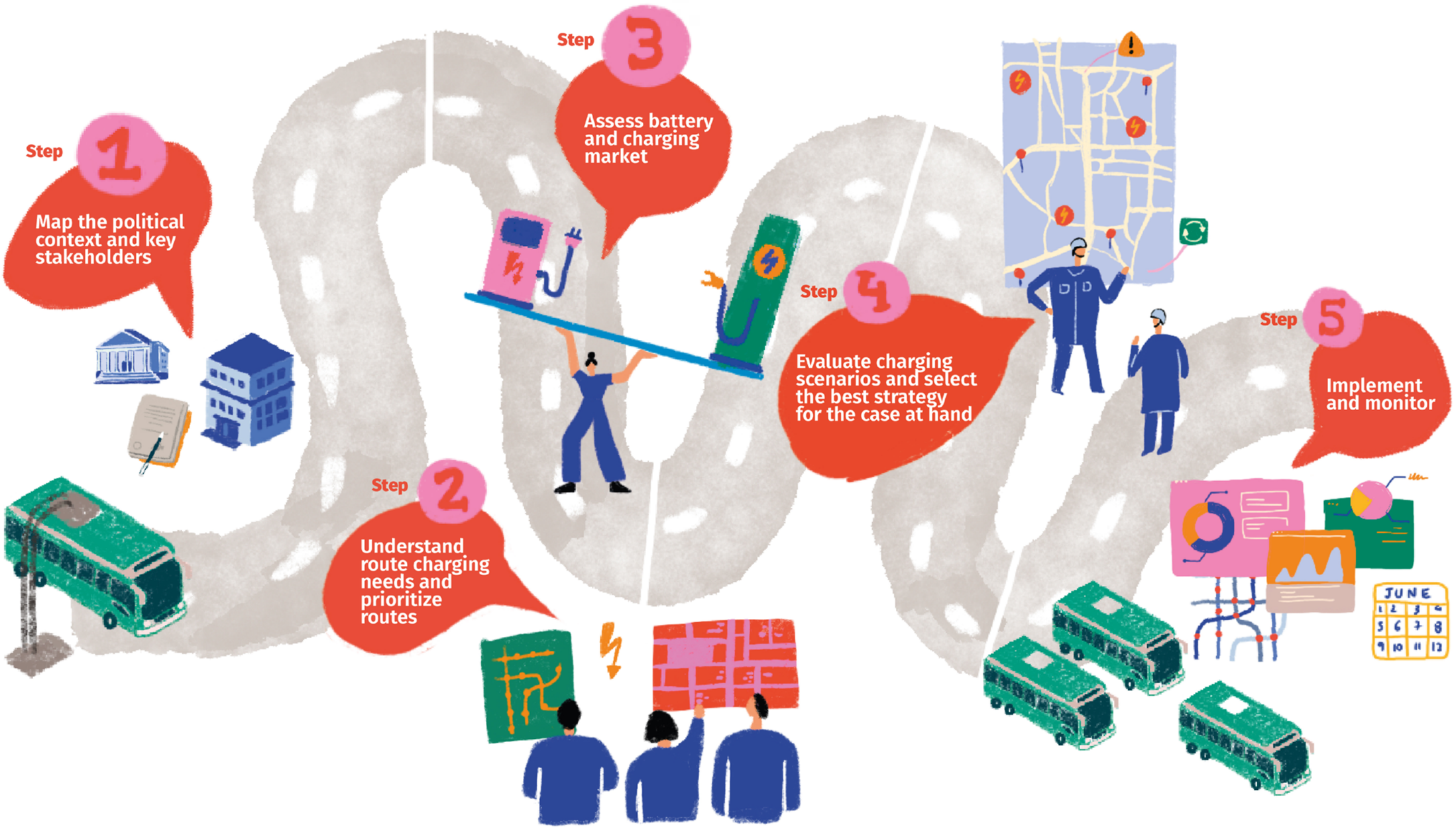
to equip stakeholders with the tools needed for making informed decisions in fleet electrification, drawing on international best practices and the latest technological advancements.

To implement e-buses effectively, the development of a comprehensive plan for selecting batteries and charging technology that align with the unique needs of bus routes is key. The five steps below will equip decision-makers with the knowledge and tools necessary to make informed, strategic decisions that support the successful decarbonization of their bus fleets.

FIGURE 1. THE INTERCONNECTED ELEMENTS OF E-BUS PLANNING: BATTERIES, CHARGING, AND THEIR IMPACTS



Five Essential Steps
for E-Bus Deployment Planning



Step 1: Map the political context and key stakeholders

1. **Map policy goals**
2. **Map key stakeholders**
    - Identify relevant policies and institutions
    - Assess institutional responsibility

Step 2: Understand route charging needs and prioritize routes

1. **Establish goals for decarbonization**
2. **Conduct preliminary analysis to identify the most interesting routes to prioritize**
    - Well-connected routes
    - Routes that cross congested areas
    - Routes with bus lane priority
    - Routes within battery range
    - Routes that operators would like most
    - Flatter routes
    - Routes with consistent ridership
    - Routes along high-density areas
    - Number of vehicles per route
3. **Conduct data analysis and pilot testing to prioritize routes**
4. **Estimate energy consumption for the prioritized routes**
5. **Identify the charging needs for each route**

Step 3: Assess battery and charging market

1. **Identify options that meet charging needs**
    - Evaluate battery and charger pros and cons
    - Select the battery and charger specifications
    - Assess grid capacity and compatibility
    - Ensure scalability
    - Check for potential environmental impact
2. **Evaluate local availability and costs for the selected options**
    - Consider regional production capabilities
    - Document the process of information collection
    - Assess potential life cycle costs

Step 4: Evaluate charging scenarios and select the best strategy for the case at hand

1. **Identify most appropriate charging locations**
    - Terrain availability, space, and ownership
    - Zoning and regulatory constraints
    - Grid power and proximity to the electrical infrastructure
    - Proximity to the prioritized routes
    - Available area for infrastructure placement
    - Possibility of closing off the areas

2. **Conduct grid assessments at selected sites**
    - Analyze the existing distribution capacity
    - Check the need for potential upgrades or expansion
    - Ensure energy supply stability
    - Identify renewable energy integration opportunities
    - Engage with the local power company
    - Evaluate costs of grid connection and upgrades

3. **Analyze and compare charging strategies**
    - Assess pros and cons using comparison indicators
    - Evaluate the best use case
    - Check the potential scalability of the charging strategy
    - Define the best charging strategy

Step 5: Implement and monitor

1. **Elaborate service planning and time schedule**
2. **Develop design for infrastructure development**
3. **Identify and monitor data indicators**
4. **Implement technical training**
5. **Develop external communication strategy**
6. **Plan for battery reuse or recycling**

By following these steps, planners can effectively implement charging strategies that contribute to the success and long-term sustainability of e-buses.

While e-buses require higher initial investments, they generate substantial long-term savings by lowering emissions, fuel costs, and maintenance needs. Achieving e-bus deployment success requires new thinking, commitment, and a common vision among stakeholders. This holistic approach ensures that cities not only meet transportation needs but also enhance the overall quality of life, supporting a future where public transport is a key driver of sustainable and equitable cities.
Electrification of our public transport fleets is a critical step in creating compact, inclusive, climate-friendly cities of the future. This Guide gives cities committed to that goal the information they need to be successful.

The full paper is available at itdp.org and provides a more detailed overview of battery and charging technology options and the key considerations for each, serving as a practical guide for governments and planners.

The new electric buses used in the Brazilian capital.
SOURCE: Marcos Casiano via Shutterstock

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