E-Bus Deployment Planning in Jakarta: Lessons Learned

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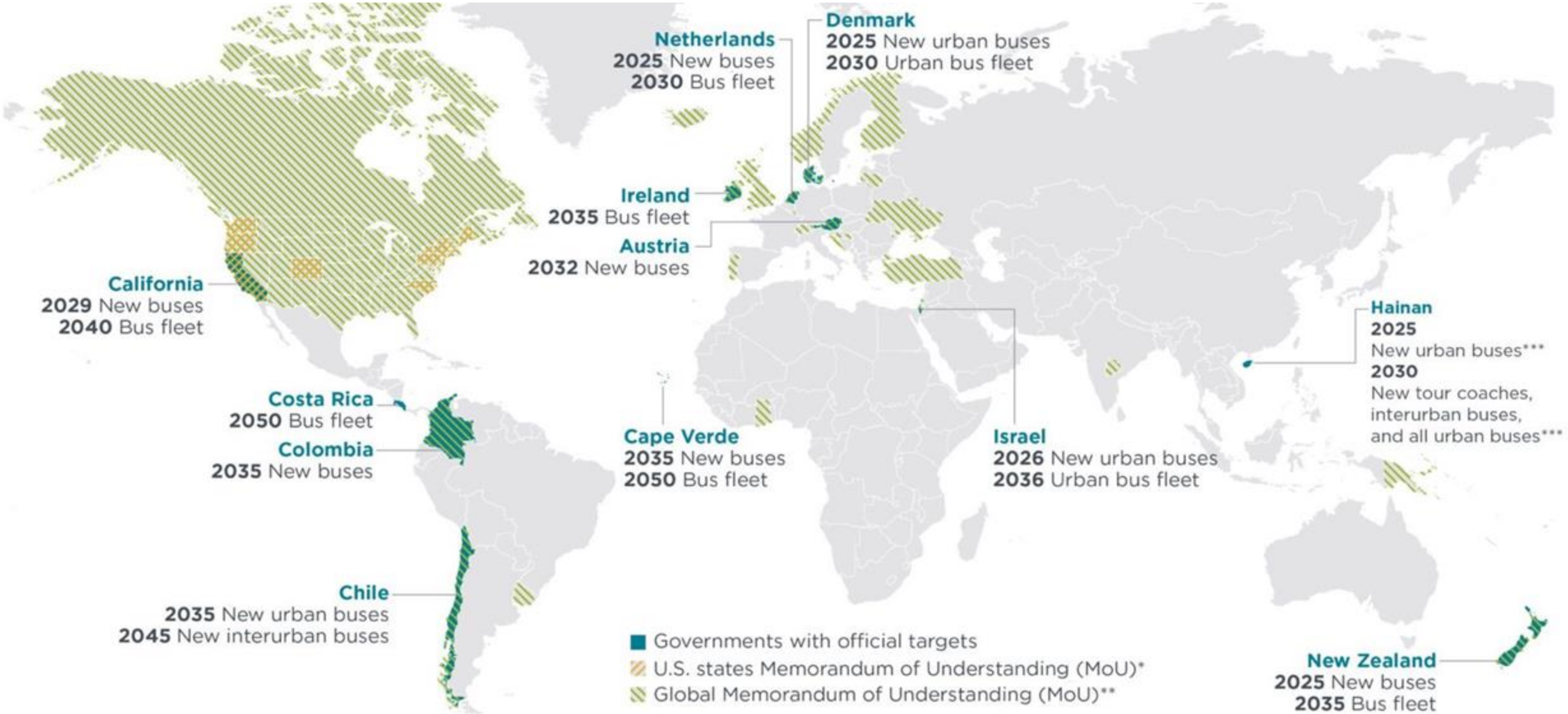
Governments that adopted targets for phasing out combustion engines from public transit buses 🚌



Source 🔗 : https://theicct.org/decarbonizing-bus-fleets-global-overview-of-targets-for-phasing-out-combustion-engine-

Common Barriers for E-Bus Deployment

- Battery electric bus technology presents complex technical and financial questions to operators
- E-buses present **higher capital costs** than traditional buses, but offer **lower operating costs**
- Operational questions must be addressed before scaling up: range, AC use, passenger loading
- **Total Cost of Ownership (TCO)** is a better tool to compare costs across very different technologies.
- Institutional and policy (e.g., procurement) barriers must be identified and addressed

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Addressing Technical and Cost Challenges

Fleet

Fleet Level Analysis

- Evaluates TCO ($/km) for the current and future electric fleet
- Explores the impact of contract duration, taxation policies, electricity, and fuel pricing
- Helps identify institutional and policy barriers that can be addressed by authorities and procurement

Route

Route Level Analysis

- Evaluates cost per km at the route level – focuses on energy consumption challenges
- Identifies the most cost-effective route to electrify and the most challenging ones
- Identifies detailed technical issues before investing in pilots or procurement
- Help bus operators make technical and economic decisions

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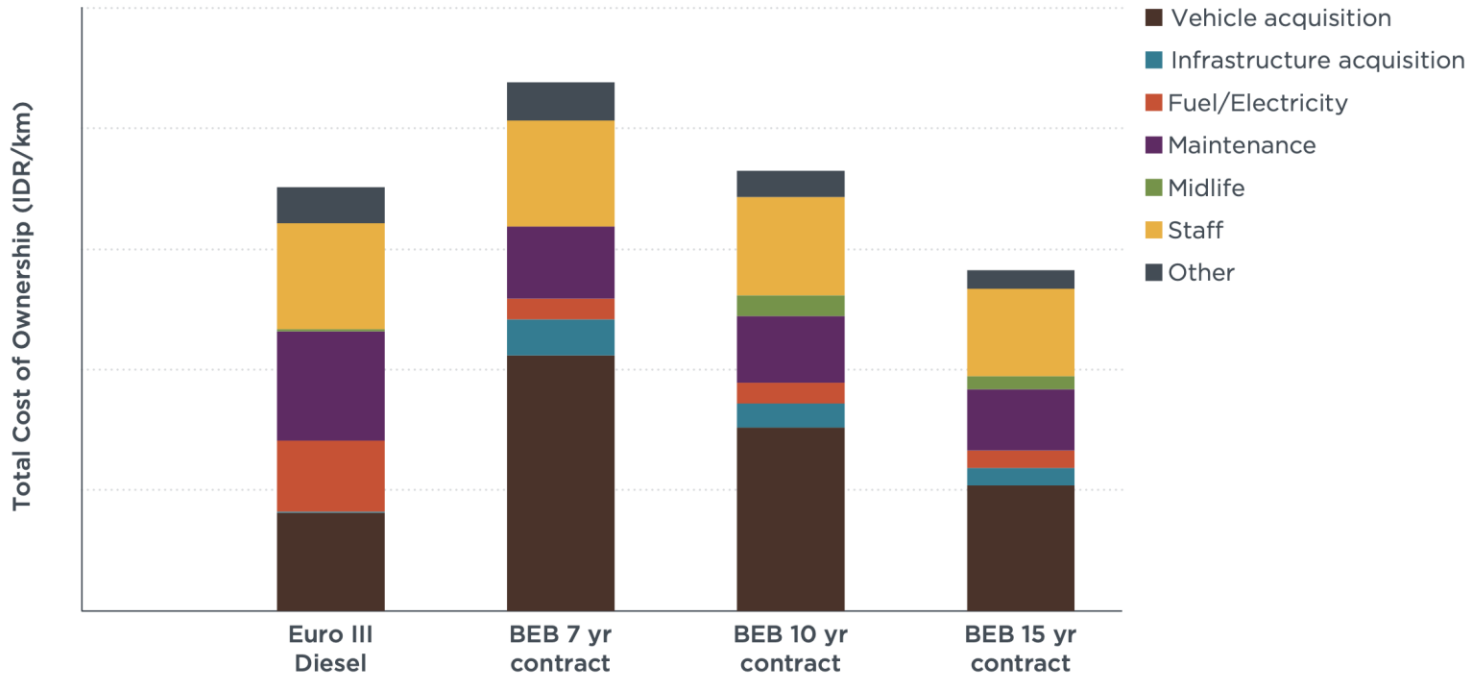
Fleet-level analysis offers key institutional and policy insights for fleet electrification

Transjakarta: Impact of contract duration on TCO (IDR/km)



	Euro III Diesel	BEB 7 yr contract	BEB 10 yr contract	BEB 15 yr contract
Ratio to baseline diesel	1	1.20	1.04	0.80

Preliminary recommendations from this study:

- Increasing contract duration from 7 to 15 years offers the lowest TCO per km for BEBs. This follows practices for BEB contracts in Latin-American countries.
- Ensure high daily utilization for BEB, the higher the value the lower the TCO
- Eliminating diesel subsidies improve the BEB's TCO differential with respect to diesel bus TCO
- Reducing taxes and fees for BEB improve their TCO with respect to diesel

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Source https://theicct.org/wp-content/uploads/2023/04/E-bus-TCO-in-Indonesia-REVISED-Working-Paper-12-A4-v4-FINAL-FOR-PUBLICATION94.pdf

Why Route-level Analysis?

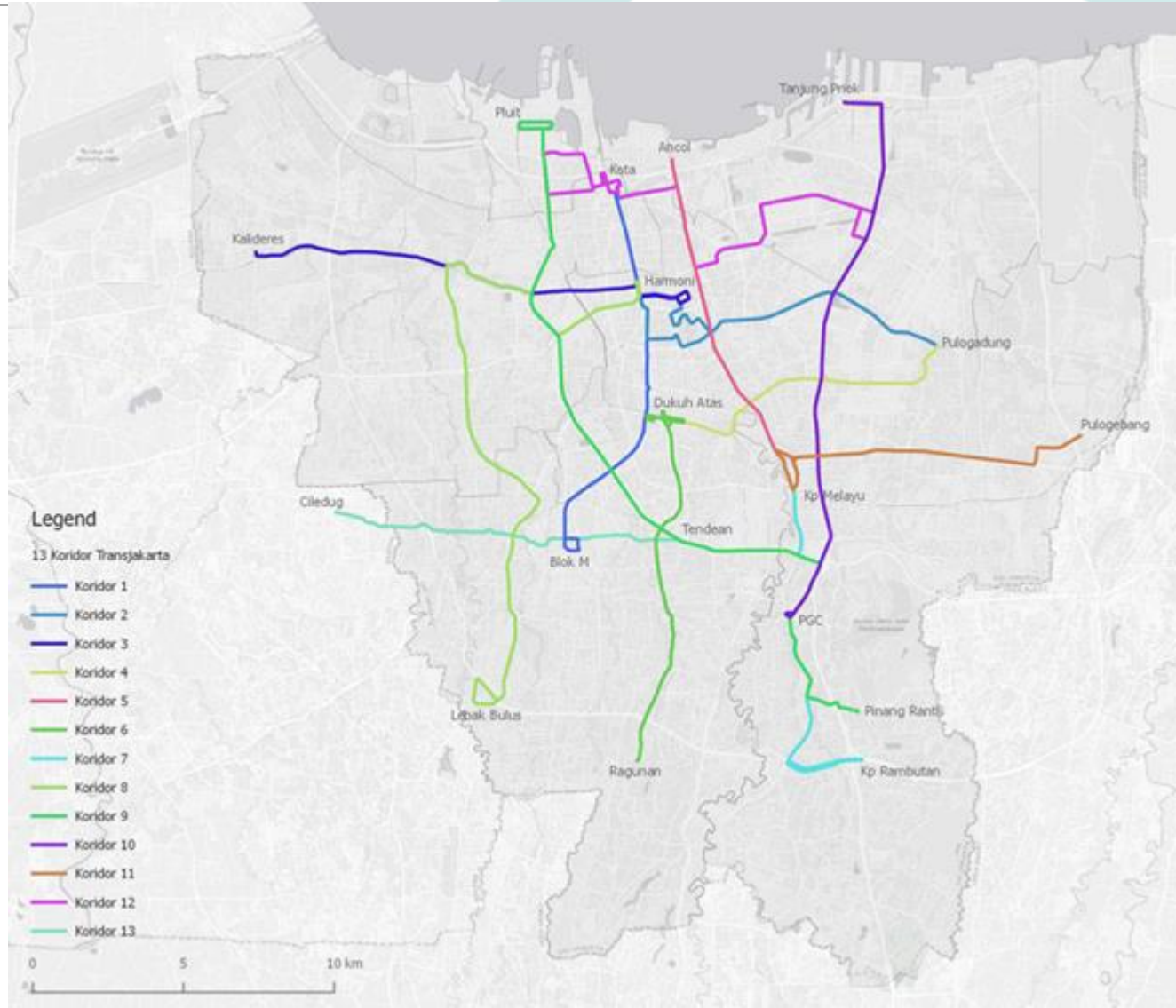
It provides a more detailed level of analysis by focusing on these important e-bus deployment questions:

1. How does the range of commercially available battery-electric buses compare to the daily utilization of buses currently in service?

2. How do route and operational characteristics affect bus energy consumption and the range of electric buses?

3. From a cost and operational perspective, which routes make the most sense to electrify first?

4. Where and when should electric buses charge?

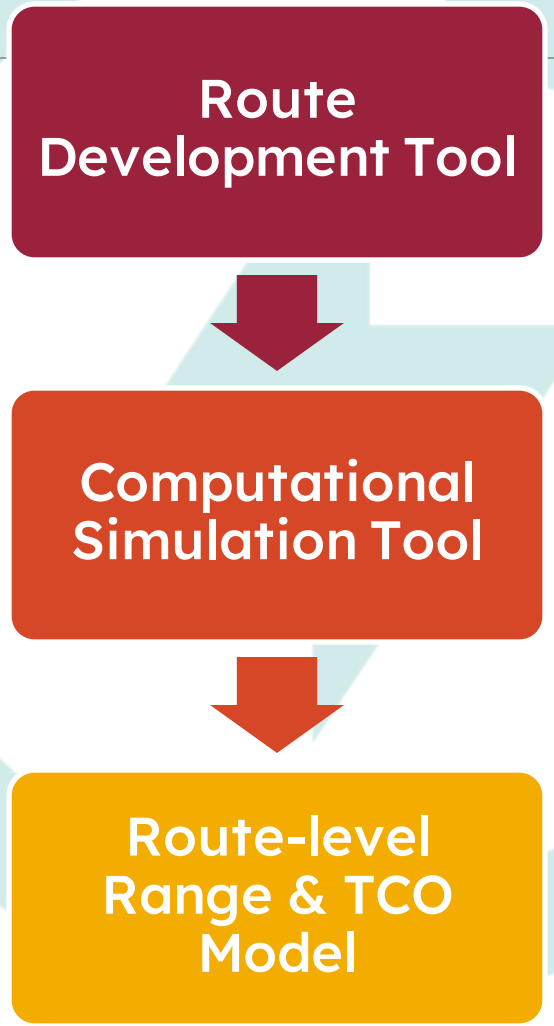


ICCT's Route-level TCO Modeling Components

GPS data for buses servicing individual routes used to develop **representative drive cycles**

Vehicle simulation modeling applied to estimate **energy consumption** of different technology options

Energy consumption outputs from simulations used in estimation of driving range and **total cost of ownership**



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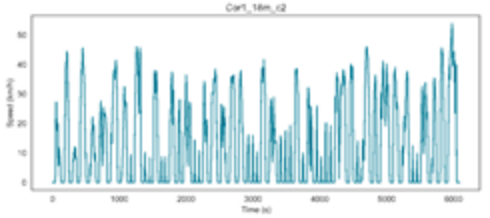
E-Bus Drive Cycle Development uses real-world bus operational data to construct a Representative Duty Cycle for a given route

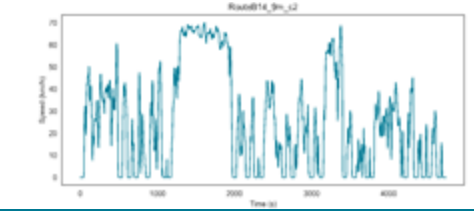
GPS installation in diesel buses

GPS data collection in target routes. QA/QC

Convert weeks of data into representative drive cycles

Run a model E-bus into individual representative drive cycles





E-bus Range and Energy consumption

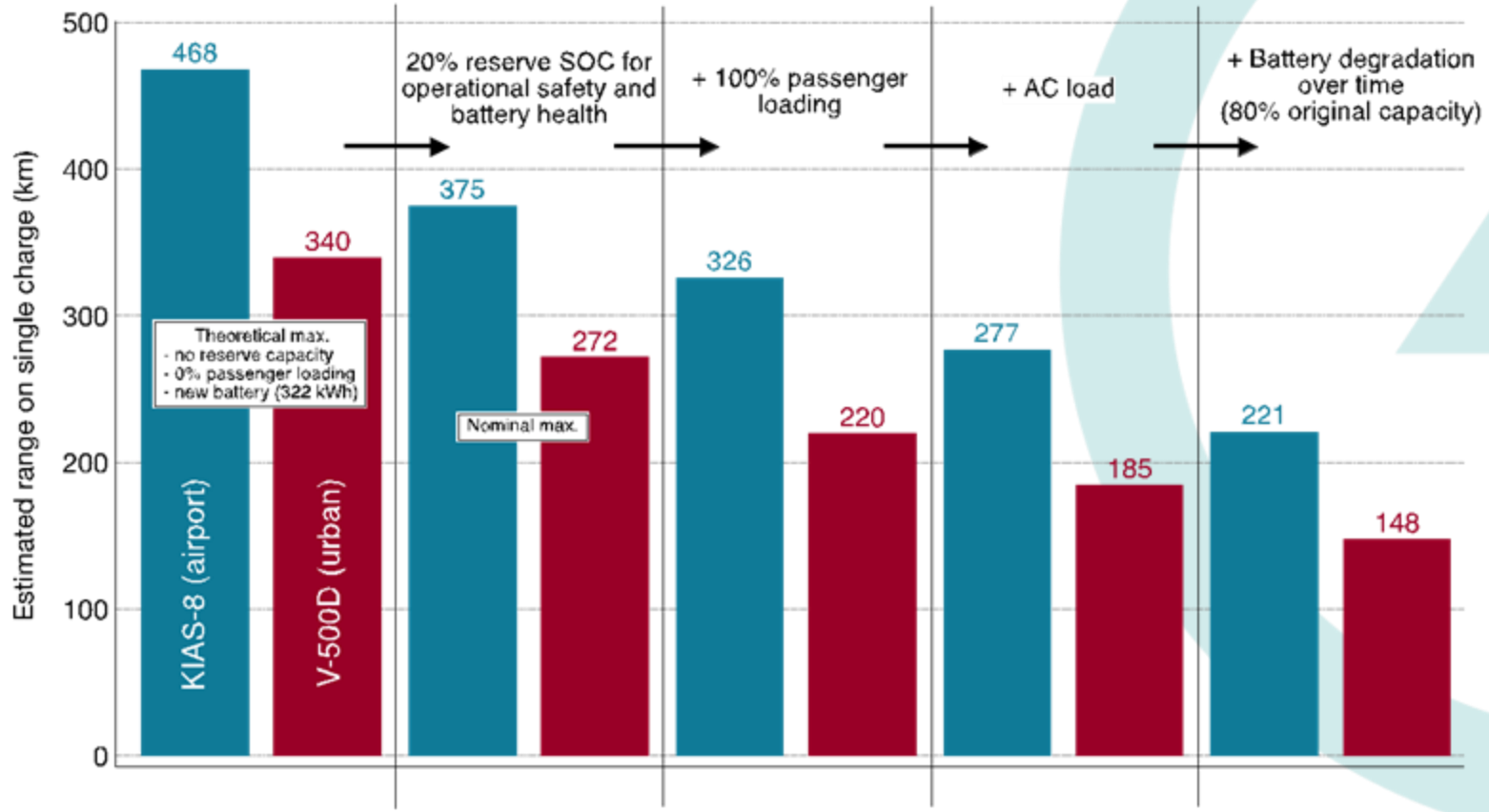
Route level TCO

Resources :

- https://theicct.org/wp-content/uploads/2023/04/E-bus-TCO-in-Indonesia-REVISED-Working-Paper-12-A4-v4-FINAL-FOR-PUBLICATION94.pdf
- https://theicct.org/publication/heavy-vehicles-indonesia-electrification-june23/

The same E-Bus offers different operating ranges depending on route conditions and other factors

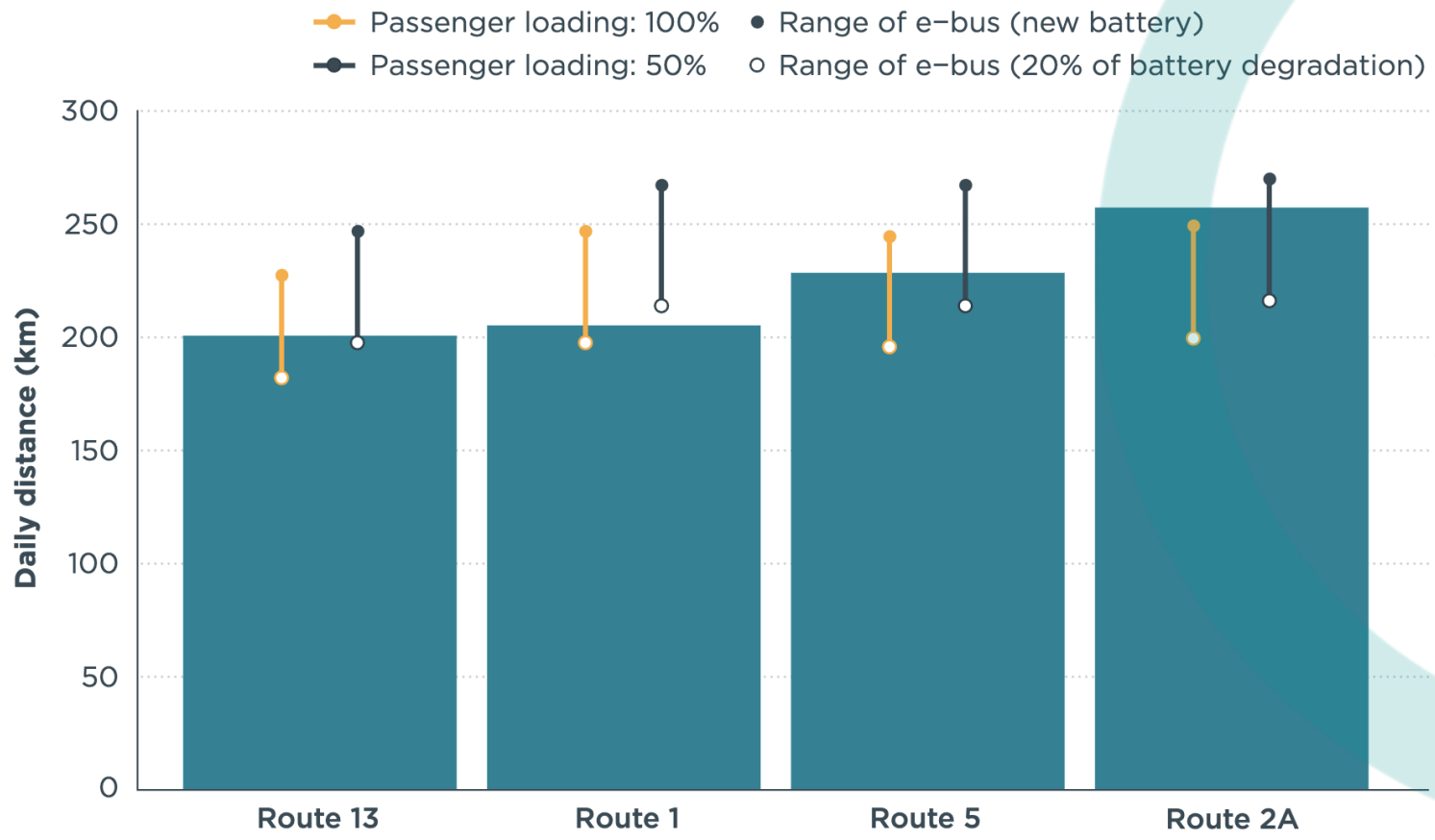
Daily range per full charge on a *12 m* bus with a *320 kWh* nominal battery capacity on 2 different routes



Example from ICCT's Bangalore E-Bus Adoption Study

Results for Transjakarta 12m Bus Routes

Electric range of buses operating on selected routes with varying passenger loads.



https://theicct.org/publication/analysis-of-zero-emission-bus-in-transjakarta-fleet-feb24/

Conclusions from Energy Consumption Evaluations and Operational Strategies for Problematic Routes

- ➔ Route 1 and Route 13 are the preferred routes to electrify as e-bus range exceeds the daily utilization range till the end of the battery useful life
- ➔ Additional midday charging events required for e-buses deployed in Route 5 and Route 2A
- ➔ Route 1 shows potential for resizing the battery.
  - ◆ The 324-kWh bus can serve Route 1 at 100% passenger capacity for the entire useful life of the battery.
  - ◆ Option to find a bus with a smaller battery complemented with mid-day charging at a lower capital cost

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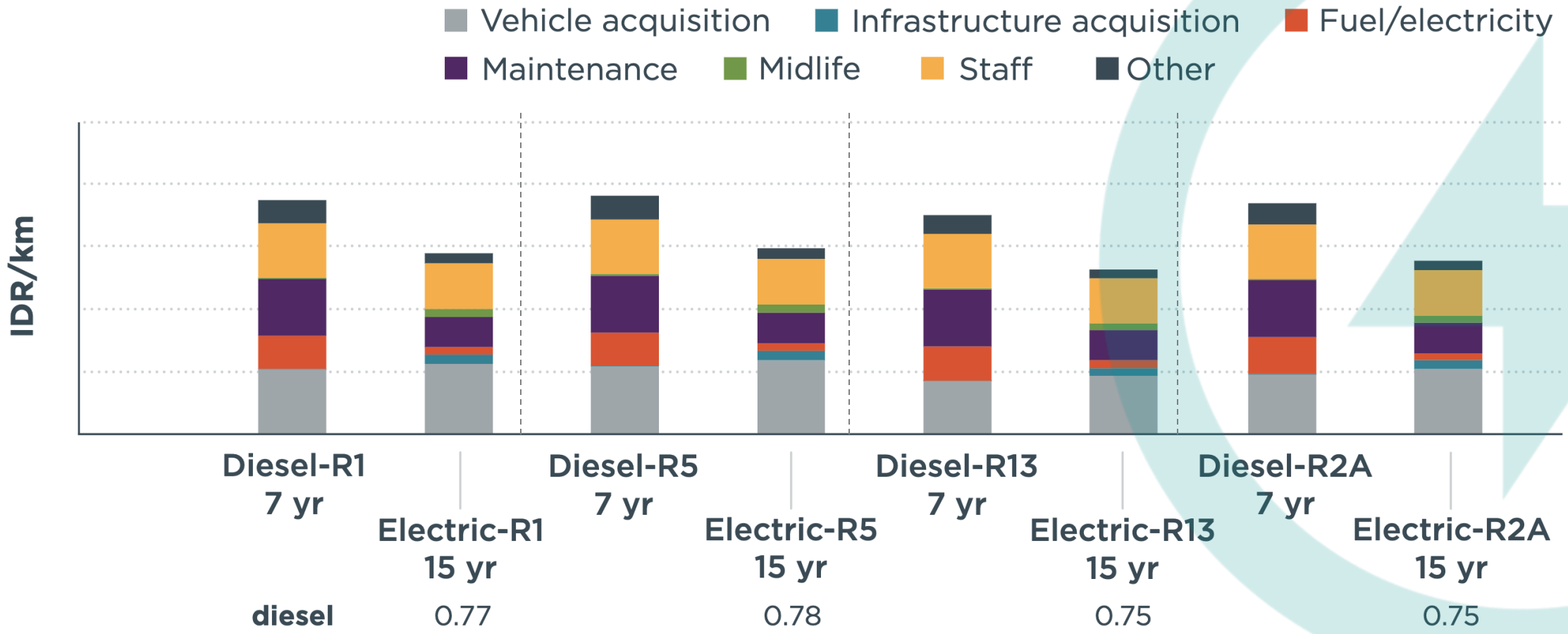
EC Values at the Route Level Result in accurate TCOs providing additional information for decision-making



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Key Messages

- TCO analysis is a powerful tool to identify and address policy and procurement barriers for e-bus deployments
- High-level TCO analysis helped **identify contractual practices that required tuning**, as well as broader **national policies** that could reduce the economic attractiveness of e-bus solutions
- Route level TCO offers other insights: the same e-bus with the same battery capacity shows different **energy consumption** (kWh/km) under different routes due to differences in driving patterns, passenger loading and road grade
- Route-level modeling and schedule analysis can inform electric bus transition strategies and technology selection before investments in pilot programs

Thank you

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