

## POLICY BRIEF

# Jakarta Transportation Transformation:

## Reassessing Transportation Sector Net Zero Emissions Target for 2050

### Summary

The greenhouse gas emissions are a dual threat in Indonesia because it endanger public health through air pollution and contribute to the climate crisis by increasing the risk of extreme weather events and flooding. One of the reasons for this increase in pollution is the rise in the number of vehicles, particularly private ones, to approximately 20 million units, particularly private ones, coupled with the continuous use of fossil fuels as the primary energy source. Therefore, this policy brief explains the estimated future conditions of if there is no change in the transportation sector and outlines the measures that should be carried out to achieve net zero emission (NZE) target by 2050. The results obtained through an analysis of transportation behavior and the formulation of various scenarios showed that the target to achieve NZE transportation by 2050 is impossible, even with the set of policies and programs. The main recommendation in this policy brief is a call for action to all parties to strive for changes in mobility behavior from private motorized vehicles to public transportation or non-motorized vehicles, such as bicycles and walking. Furthermore, it indicated the need to accelerate electrification with a transition to renewable energy sources.

## DKI Jakarta Emissions and Transportation

Emissions from vehicles are the main contributor to air pollution in DKI Jakarta, Indonesia. Transportation sector is responsible for significant emissions, with NO<sub>x</sub>, CO, PM<sub>10</sub>, and PM<sub>2.5</sub> accounting for 72.4%, 92.36%, 57.99%, and 67.03%, respectively. These emissions pose a substantial risk to public health, particularly for vulnerable groups such as children and pregnant women (Lestari et al., 2020). Aside from the immediate

health impacts, the transportation sector also increases the existing climate crisis in the region. For instance, over the past three decades, Jakarta has experienced an average temperature increase of 1°C, rising from 26.87°C to 27.89°C from 1991 to 2021 (World Bank, 2021). This warming trend is accompanied by changes in precipitation patterns, including a notable increase in rainfall intensity, which reached 377 mm per day in 2020. Consequently, this

extreme weather condition triggers the risk of flooding in the region (Fajar, 2020).

The high level of private vehicle ownership is one of the factors contributing to high emissions from the transportation sector. This issue is compounded by the fact that DKI Jakarta is the second largest urban agglomeration in the world (Martinez & Masron, 2020), with a population of approximately 10 million in 2020. Consequently, the city experiences an increasing demand for travel and the movement of people and goods (United Nations, 2019). This increased demand coincides with an increase in private vehicle ownership, which is presently twice of the population, approximately 20.2 million units<sup>[1]</sup> (BPS Provinsi DKI Jakarta, 2021). The strong inclination of the people of DKI Jakarta to own private vehicle is evident in the increased private vehicle growth rates of 4.9% for motorcycle and 7.01% for cars<sup>[2]</sup>, surpassing both the population growth rate of Jakarta (0.92%)<sup>[3]</sup> and the expansion of road sections (0.01% per year) (Wismadi et al., 2013).

Congestion is a persistent problem synonymous with transportation in DKI Jakarta. This issue not only leads to fuel wastage and increased air pollution but also has adverse effects on public health. Moreover, the 2019 World Bank report predicted that the congestion in Jakarta caused significant annual economic losses amounting to IDR 37 trillion (Roberts et al., 2019).

On the other hand, the availability of green open spaces (GOS) and infrastructure in Jakarta are still very limited. Currently, the city only has approximately 34 km<sup>2</sup> of green space<sup>[4]</sup>. That figure is smaller than the land dedicated to roads in 2018, totaling 46 km<sup>2</sup>, excluding parking areas (Dinas Komunikasi dan Informasi DKI Jakarta, 2020). In essence, there is competition with respect to the allocation of space for private vehicles and green infrastructure. This is in contrast to the concept of developing cycling and pedestrian infrastructure, which could serve as both green spaces and support the increased use of public transportation facilities (Rietveld et al., 2001; Loo, 2021).

## Decarbonization Program of DKI Jakarta Government

The DKI Jakarta Provincial Government is driven by the urgency of the situation to achieve net zero emission (NZE) by 2050, with a particular focus on the transportation sector. The programs launched in 2012<sup>[5]</sup> comprise the use of low-emission energy sources such as the installation of solar panels on the roofs of government buildings, public facilities (schools, health services, hospitals, and sports complexes), and private buildings. Furthermore, the government has set ambitious targets for the improvement of public transportation services. The government is working towards reaching

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<sup>1</sup> This number is dominated by private vehicles (3.3 million cars and 16.1 million motorcycles). The rest are buses (35,266 units) and trucks (679,708 units). This number does not include freight transportation.

<sup>2</sup> Delivered by Ir. Driejana, M.SCE, Ph.D. from the Faculty of Civil Engineering, Bandung Institute of Technology (2021) in Public Consultation: Grand Design of Air Pollution Control, DKI Jakarta Province.

<sup>3</sup> According to the BPS report of DKI Jakarta Province published in 2020.

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<sup>4</sup> This number is only 5.177% of the total area of DKI Jakarta (Data from Jakarta Satu).

<sup>5</sup> Jakarta Environment Agency and Vital Strategies. (2020). Towards Jakarta's Clean Air.

90% coverage by 2022 while also integrating these services with various transportation modes. They assume a significant revitalization effort, which includes upgrading 346 kilometres of sidewalks and 103.5 kilometres of dedicated cycling lanes (Ramadhan, 2022). In line with the sustainability objectives, there is a plan to have TransJakarta buses operate with 50% electric energy by 2025<sup>[6]</sup>. As of today, approximately 30 units of TransJakarta buses<sup>[7]</sup> use electric energy, showcasing the government's commitment to reducing emissions in the public transportation sector.

The government has also initiated several programs aimed at improving the environmental sustainability of the city. One of these programs is the ambitious expansion of green open spaces by 30% in 2030. However, in 2019, green open spaces accounted for only about 9.2% of the total area of Jakarta, a figure that later decreased to 5.117% based on data from the DKI Jakarta Provincial Government in 2022 (Prakoso & Herdiansyah, 2019; Jakarta Satu, 2022). A Low Emission Zone (LEZ) was also implemented in the Kota Tua area, with the primary goal of restricting private vehicle access to improve air quality. This move had a significant environmental impact, resulting in the reduction of approximately 1.5 million tons of carbon dioxide equivalent (CO<sub>2</sub>e) emissions in 2018, which accounted for relatively 11% of the total emissions in the transportation sector (Dinas Lingkungan Hidup DKI Jakarta, 2019).

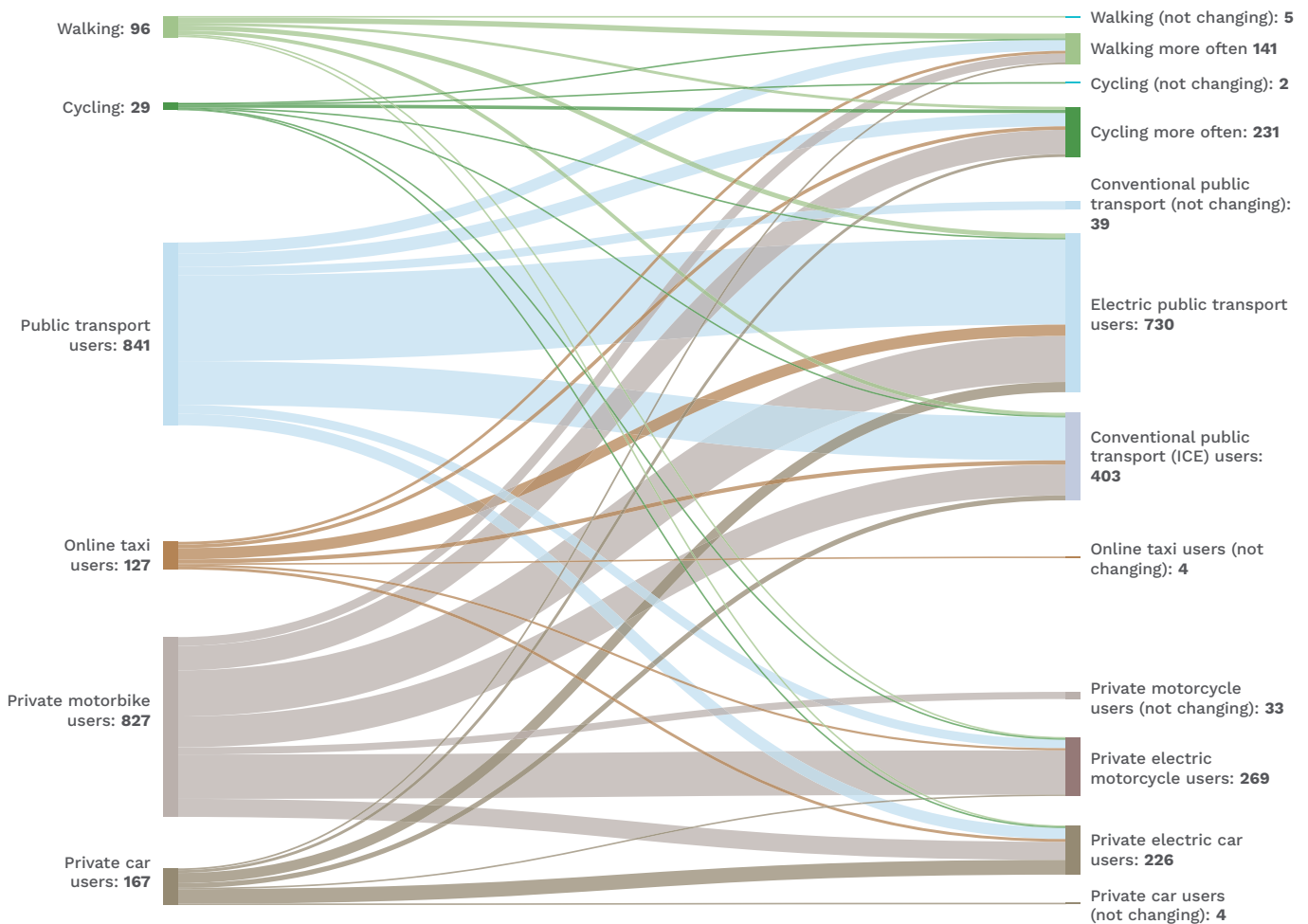
## People behavior and future transport preferences

A survey conducted in DKI Jakarta with 2,097 respondents has explained the predominant modes of transportation in the region. The survey results reported that public transportation (40.18%) and private motorcycles (39.51%) are the two most commonly used means of travel. The choice of transportation mode is greatly influenced by the income earned by respondents and the duration of the daily commutes. Public transportation is the preferred option for many due to its cost-effectiveness. For commuters travelling from the urban agglomeration area, Bodetabek (Bogor, Depok, Tangerang, and Bekasi) area to the city centre of Jakarta, the cost for using public transportation typically falls in the range of IDR 4,000 to IDR 6,000 per trip. Therefore, using a private vehicle can be considerably more expensive, with costs potentially reaching up to IDR 200,000 to IDR 500,000 per month or the equivalent of IDR 8,000 to IDR 20,000 per day.

In terms of travel duration, public transportation is the preferred mode for long-distance travel, with an average travel time of 62 minutes. This is followed by private cars and motorcycles, with a duration of 44 minutes and 34 minutes, respectively. For shorter travel distances, respondents prefer to walk or cycle for an average time of 15 or 22 minutes when commuting to work or school.

<sup>6</sup> Based on the results of interviews conducted with relevant policymakers.

<sup>7</sup> This number is only about 3% of the total TransJakarta buses, 872 buses (Data from PPID TransJakarta in 2018).

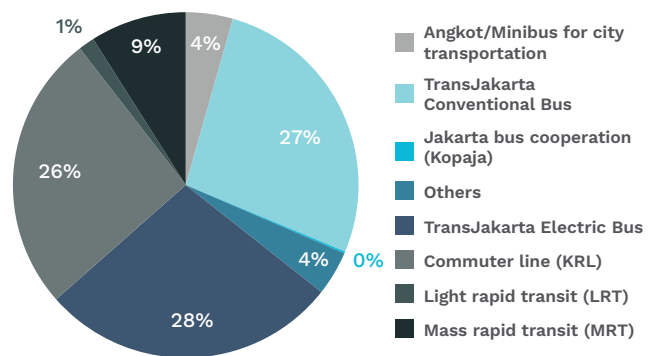


**Figure 1.** Preference for change in transportation modes according to respondents

Respondents are showing a positive stance regarding the future transportation choices. The most substantial shift in preferences was observed among users of private motorcycles, who are increasingly choosing to use bicycles or use public transportation as the preferred mode. Public transportation users are expressing a keen interest in transitioning to low-emission alternatives. A significant segment of respondents (6.7%) are considering including walking in the daily commute. Figure 1, shows that 11% of the respondents are enthusiastic about adopting cycling as a part of transportation routine.

Electric public transportation is the top choice of respondents for the future, as shown in Figure 2. The main modes targeted for the respondents' future transport preference change are the

TransJakarta buses (55%). This comprises 27% in favor of fossil fuel TransJakarta buses and 28% preferring the electric ones, with the Commuter Line following at 26%.



**Figure 2.** Type of preference for mode shift to public transportation

The majority of respondents (58%) selected to shift towards public transportation, mainly motivated by the desire to reduce emissions. This preference is further

driven by the affordability (18%) and the convenience of the vehicle (13%) of public transportation. Respondents also showed a high level of environmental awareness when selecting vehicle fuel sources. Although a significant portion still relies on fuel oil (81%), an overwhelming 93% of respondents agree that vehicles should ideally be powered by electricity generated from renewable sources, as shown in Figure 3. Furthermore, 97% of the respondents expressed commitment to adopting environmentally friendly and healthy-conscious modes of transportation<sup>[8]</sup>.

Respondents have articulated the expectations for the improvement of

pedestrian and cycling lanes, with a particular emphasis on ensuring its availability and safety. However, pedestrian facilities received the lowest evaluation score compared to other transportation infrastructure facilities. By 2019, Jakarta had only 63 km of bicycle lanes, mainly concentrated along a few main roads. There are plans to significantly expand this network, with the aim of erecting 196 km of bicycle lanes towards the end of 2021 and a total of 690 km by 2030 (Dinas Perhubungan DKI Jakarta, 2021). The people also anticipate improvements in public transportation services, with a focus on reducing travel times, improving accessibility, and shortening distances.

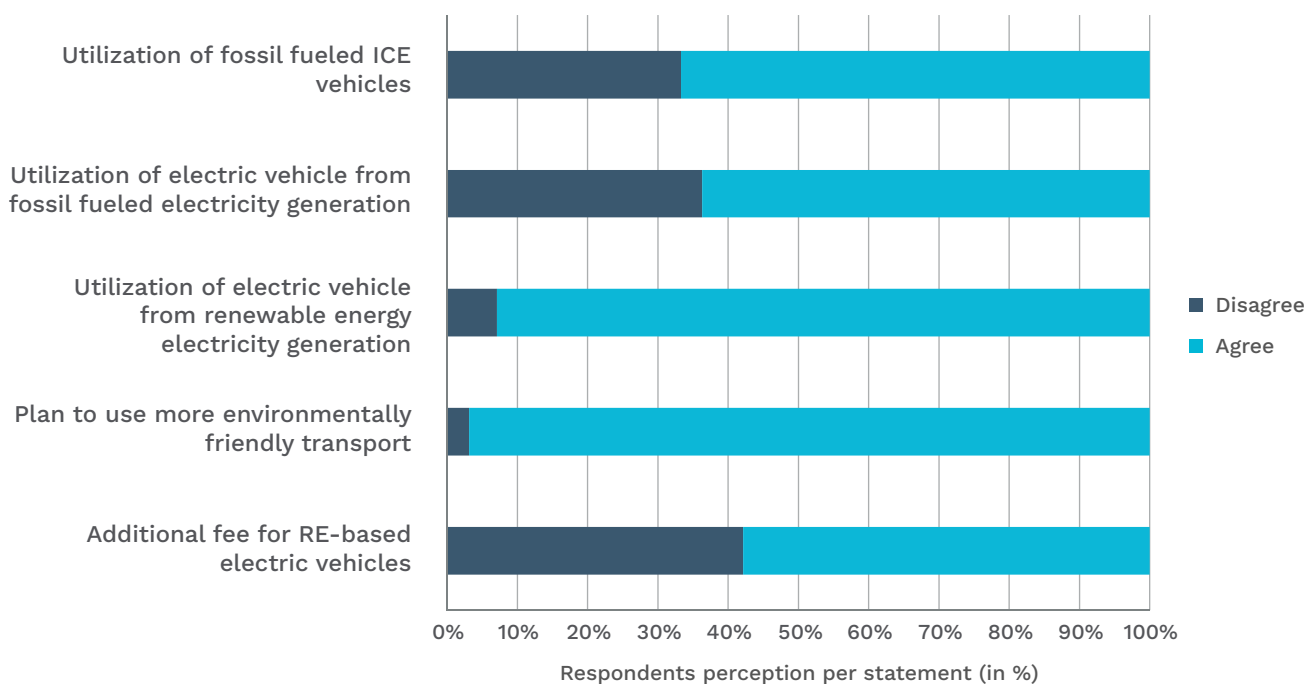


Figure 3. Perception of respondents regarding vehicle fuel use

## Scenarios Toward Net Zero Emission (NZE) Transportation

The changing transportation preferences among most respondents create an opening for the government to promote the adoption of non-motorized transportation

(NMT). This opportunity was supported by the substantial number of people already using public transportation. To progress toward achieving NZE conditions, the government needs to focus on a strategy that integrates both public and non-motorized transportation modes.

<sup>8</sup> This result is independent of respondents' knowledge about the characteristics, price, and renewable energy.

Therefore, the research question is, will DKI Jakarta be able to achieve NZE by 2050, given the enthusiasm of its people and government programs? This prediction was approached through four scenarios. These include (1) a business as usual scenario, (2) government program and policy intervention, (3) electrification and renewable energy use, and (4) towards 2050 NZE scenarios. **The business as usual scenario** maintains the status quo, reflecting no changes and in line with current trends. **The government**

**program and policy intervention scenario** are driven by policies and targets established by both the provincial and national governments. **The electrification and renewable energy use scenarios** embrace assumptions in line with targets set by international institutions that are relatively more ambitious than the previous scenarios (IEA, 2021). **The towards-NZE scenario** proposes more ambitious and progressive assumptions to reduce emissions to minimum or near-zero levels.

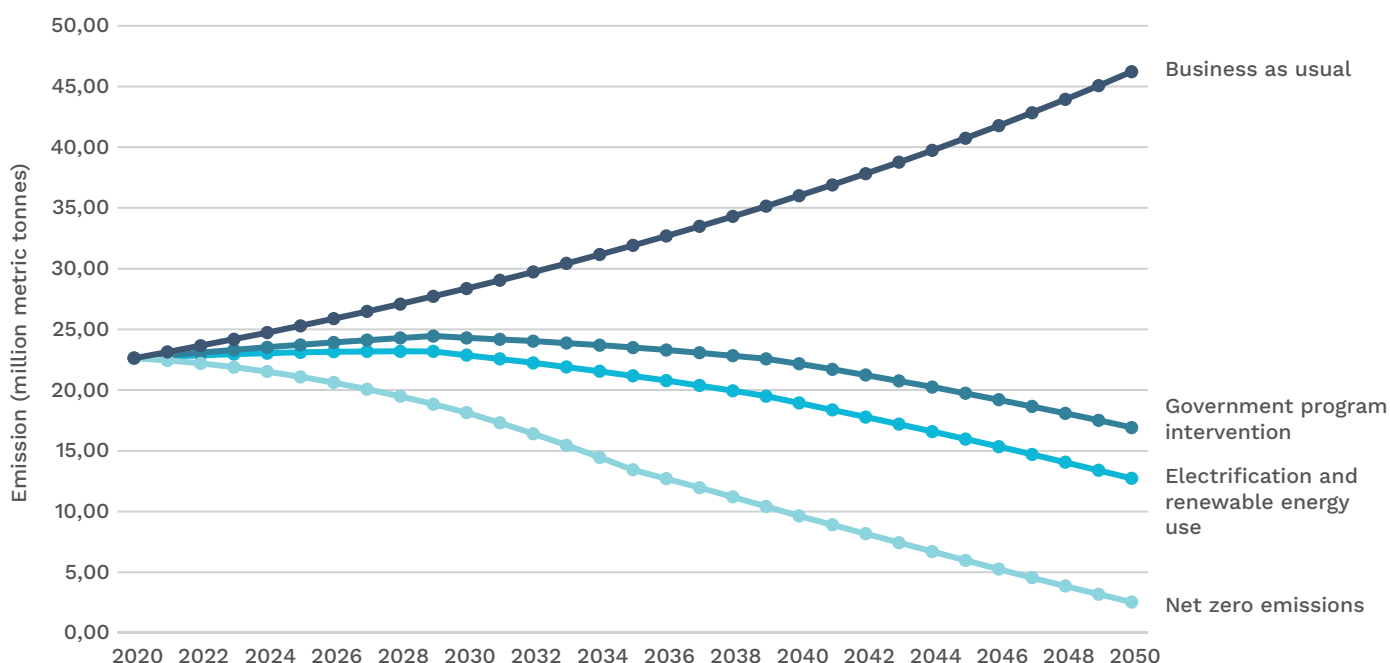


Figure 4. Comparison graph of four scenarios on DKI Jakarta estimated emissions in 2020-2050 (in million tons CO<sub>2</sub>e)

The findings from the emission scenario calculations are as follows:

**1. Emissions in 2020 are predicted to reach 22.8 million tons of CO<sub>2</sub>e, with fossil-fueled private vehicles as the largest contributors and public vehicles as smallest.**

- In 2020, the estimated emissions totaled 22,815,356 tons of CO<sub>2</sub>e.
- The largest portion of these emissions, approximately 15.84 million tons of CO<sub>2</sub>e, emanated from car and motorcycle users. Motorcycles, in particular, were

the leading source, contributing 9,833,690 tons of CO<sub>2</sub>e, which accounted for 16.12% of the total national transportation sector emissions in 2019.

- From the energy source, fossil fuels are the largest contributor to the transportation sector, amounting to 16,566,857 tons of CO<sub>2</sub>e.
- Public transportation made the smallest contribution, with 0.90% of the total emissions, equivalent to 200,360 tons of CO<sub>2</sub>e.

## 2. Achieving the NZE target is an exceedingly challenging goal when relying only on the current government programs. Thus, more ambitious and comprehensive targets and programs are imperative.

- In the business as usual scenario, where current trends persist, emissions are estimated to double, reaching approximately 46 million tons of CO<sub>2e</sub>. The main contributors are private cars and motorcycles, accounting for 36% and 47% of the emissions, respectively.
- In the scenario where the government implemented policy programs and promoted changes in public behavior, there was an estimated reduction of 4.5 million tons of CO<sub>2e</sub> compared to emission levels in 2020. This reduction is driven by a combination of technological advancements and shifts in people's mobility behavior, including a greater reliance on public transportation and a preference for walking or cycling for shorter distances. Furthermore, emission reductions are also achieved through the transition to renewable energy using electric vehicles in line with the 2030 energy mix target.
- The third scenario, the electrification and renewable energy deployment, presents a more ambitious emission reduction strategy compared to the programs initiated by the central government and DKI Jakarta. This approach, driven by electrification and an increased usage of renewable energy sources, aims to reduce emissions by a substantial 10 million tons of CO<sub>2e</sub> when compared with the 2020 levels. To achieve this reduction, the scenario incorporated several elements, such as a reduction in private vehicle usage, a significant increase

in daily public transportation users, with an expected rise of 1.8 to 2 million per day, a renewable energy mix accounting for 31% of the total energy sources, and the commencement of vehicle electrification, with the objective of reaching approximately 100% electrification by 2050.

- The NZE scenario is expected to produce the smallest emissions of approximately only 2.6 million tons CO<sub>2e</sub> by 2050. However, this scenario still does not achieve absolute zero emission because it relies on specific assumptions sourced from several institutional references, particularly concerning energy efficiency and emission factors. It focuses on the use of an electricity grid that predominantly relies on renewable energy sources for power generation (IEA, 2021; Koffi et al., 2017). Emissions in this scenario mainly result from power generation for vehicle operation. Achieving a substantial reduction in emissions depends on a transformative shift in people's mobility behavior, characterized by a significant decrease in the number of cars (2.5 million units) and motorcycles (12.5 million units) by 2050. Therefore, renewable energy plays a critical role in reducing emissions arising from power generation.

## Recommendations

This research showed that the plan of **DKI Jakarta to achieve the NZE target in the transportation sector by 2050 is extremely challenging with the existing policies and programs.** In addition, this research exclusively assessed operational emissions from transportation activities in DKI Jakarta without considering emissions from the creation and development of various modes and infrastructure. The

maximum emission reduction achieved by 2050 is 88.5% or 20.2 million tons CO<sub>2</sub>e less than current emission levels.

The main recommendation is the need for **comprehensive actions** from various parties to achieve the NZE transportation by 2050, which includes the following:

**1. Establish and strengthen collaborative efforts among stakeholders across various sectors and levels - towards transportation sector decarbonization**

All stakeholders from various sectors and levels must collaborate to advance the decarbonization of the transportation sector. This collaborative effort should comprise the central DKI Jakarta and the local governments, the State Electricity Company, public transportation service providers, and vehicle manufacturers. It is equally important to promote mobility behavioral changes among the public, promoting reduced mobility and the adoption of environmentally friendly transportation modes.

**2. Integrate and optimize public transportation services to reduce people's dependency on private vehicles**

The use of public transportation to reduce the dependence on private vehicles is very important. This priority should be supported by an expansion of the public transportation network and the integration of its services. Expanding the coverage of

public transportation is particularly important to ensure that people do not have to rely on taxis or online motorcycles to access the nearest transit points for public transportation modes.

**3. Improve walking and cycling infrastructure to ensure equal rights and support as well as promotion for non-motorized transportation**

Improving both the quality and quantity of associated infrastructure is essential to promote the use of non-motorized transportation, such as cycling and walking, especially for short distances to pick-up points. It can be achieved by expanding green infrastructure to support cycling and walking, which not only helps absorb emissions but also enhances comfort with the cooling effect of tree shading. Furthermore, safety measures for non-motorized transportation should be a priority to protect cyclists and pedestrians.

**4. Decarbonize the electricity generation sector**

Transitioning existing power plants in the DKI Jakarta vicinity into renewable energy facilities is essential. To advance the decarbonization of the transportation sector, concurrent decarbonization of the power sector is crucial. This includes supporting the use of renewable energy sources, with a major focus on powering public transportation.

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