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Session 3

Transport and Emissions Model

Sebastian Mueller

Data Scientist

Asian Development Bank

12 March 2026, 15:00-17:30

Modelling the Impact of LEZs

Yohan Iddawela

Data Scientist, Asian Development Bank

12 March 2026



Case Study 1: Estimating the Effects of the Motorcycle Ban in Hanoi on Emissions & Traffic

Hanoi Motorbike Ban


VN EXPRESS INTERNATIONAL
Subsidiary of VnExpress | The most read Vietnamese newspaper | HCMC 32° | Vietnamese Edition

News Business Tech Travel Life Sports World Perspectives VnE-GO

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Hanoi to ban gasoline motorbikes during specific hours starting July 2026

By Vo Hai | November 27, 2025 | 12:32 am PT



Gasoline motorbikes on the streets of Hanoi. Photo by VnExpress/Ngoc Thanh

Hanoi will begin limiting gasoline motorbikes to specific hours from July 2026, rolling out the city's first low-emission zone as part of a phased plan to curb traffic pollution in its busiest districts.

Under a resolution unanimously approved by the Hanoi People's Council on Nov. 26, the Vietnamese capital will start banning gasoline motorbikes during specific hours or within designated areas inside Ring Road 1 in the downtown starting July 1, 2026.

The restrictions apply to both personal vehicles and app-based motorbike services. Cars that fail to meet Euro 4 emissions standards will also face time-based or route-based limits, with an eventual full ban planned.

The low-emission zone is one of Hanoi's most ambitious efforts yet to tackle its

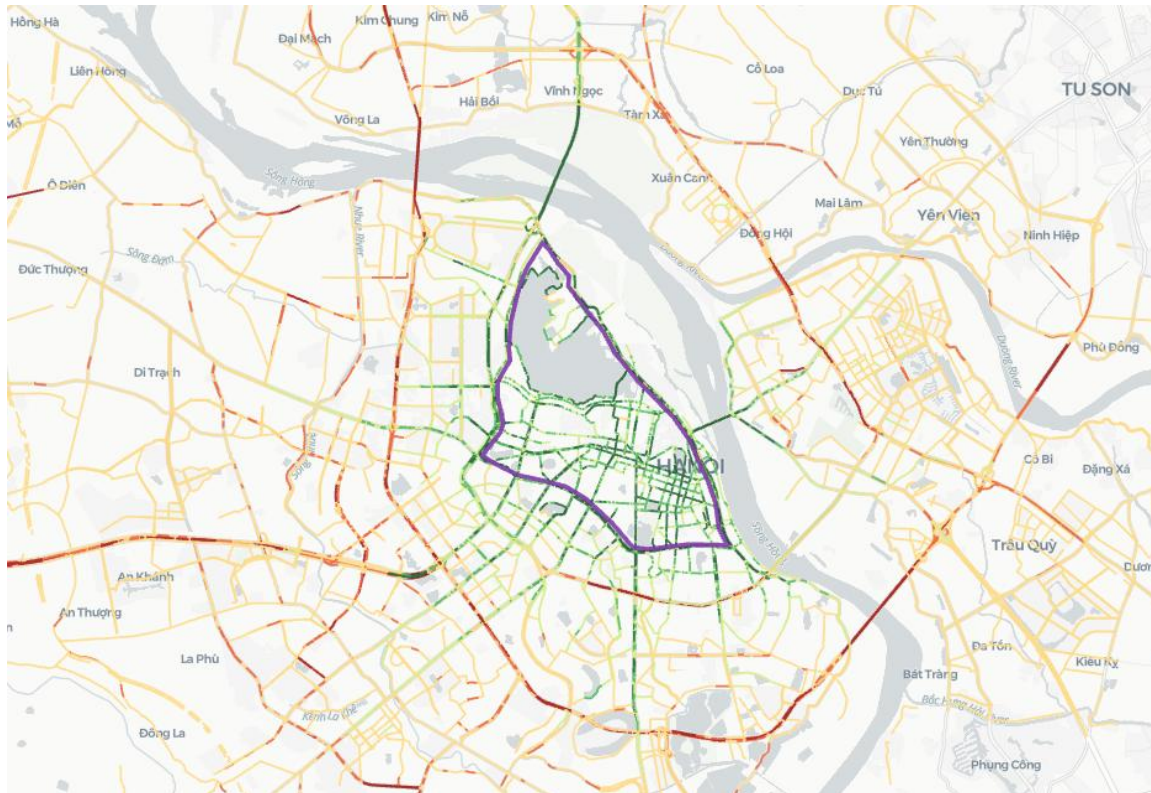
The proposed policy bans motorcycles from areas within Hanoi's Ring Road 1



Research Question

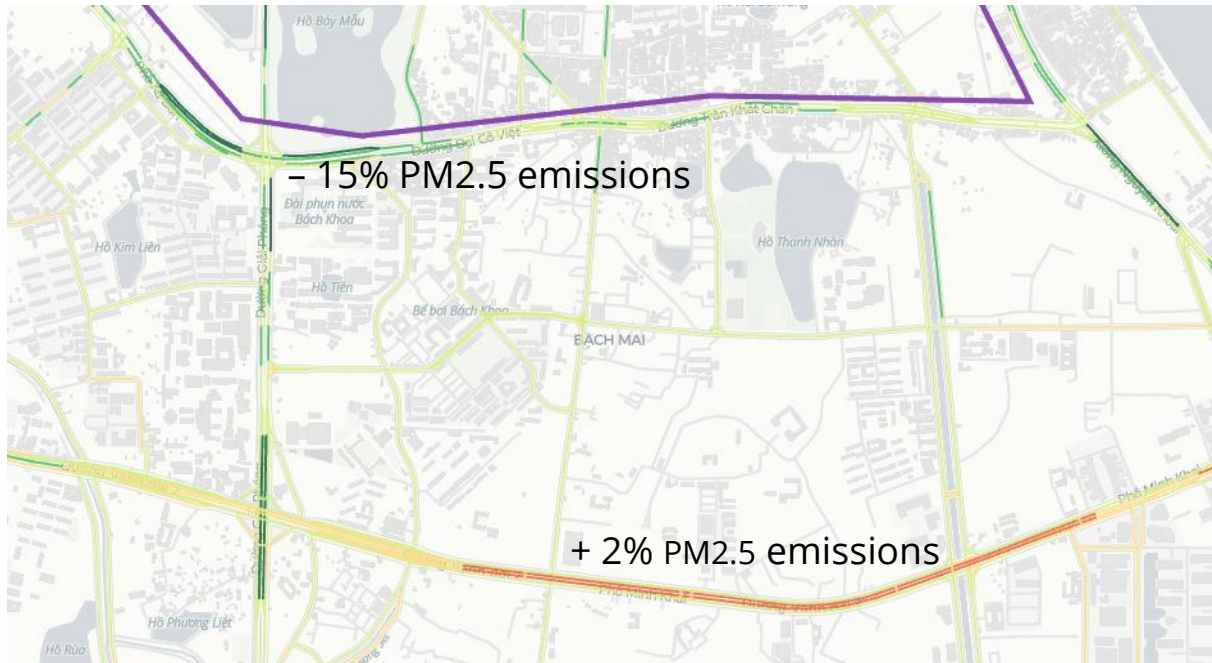
What is the effect of the motorcycle ban on emissions inside and outside the LEZ?

PM2.5 emissions are reduced by 32% inside the LEZ while there is almost no effect outside the LEZ



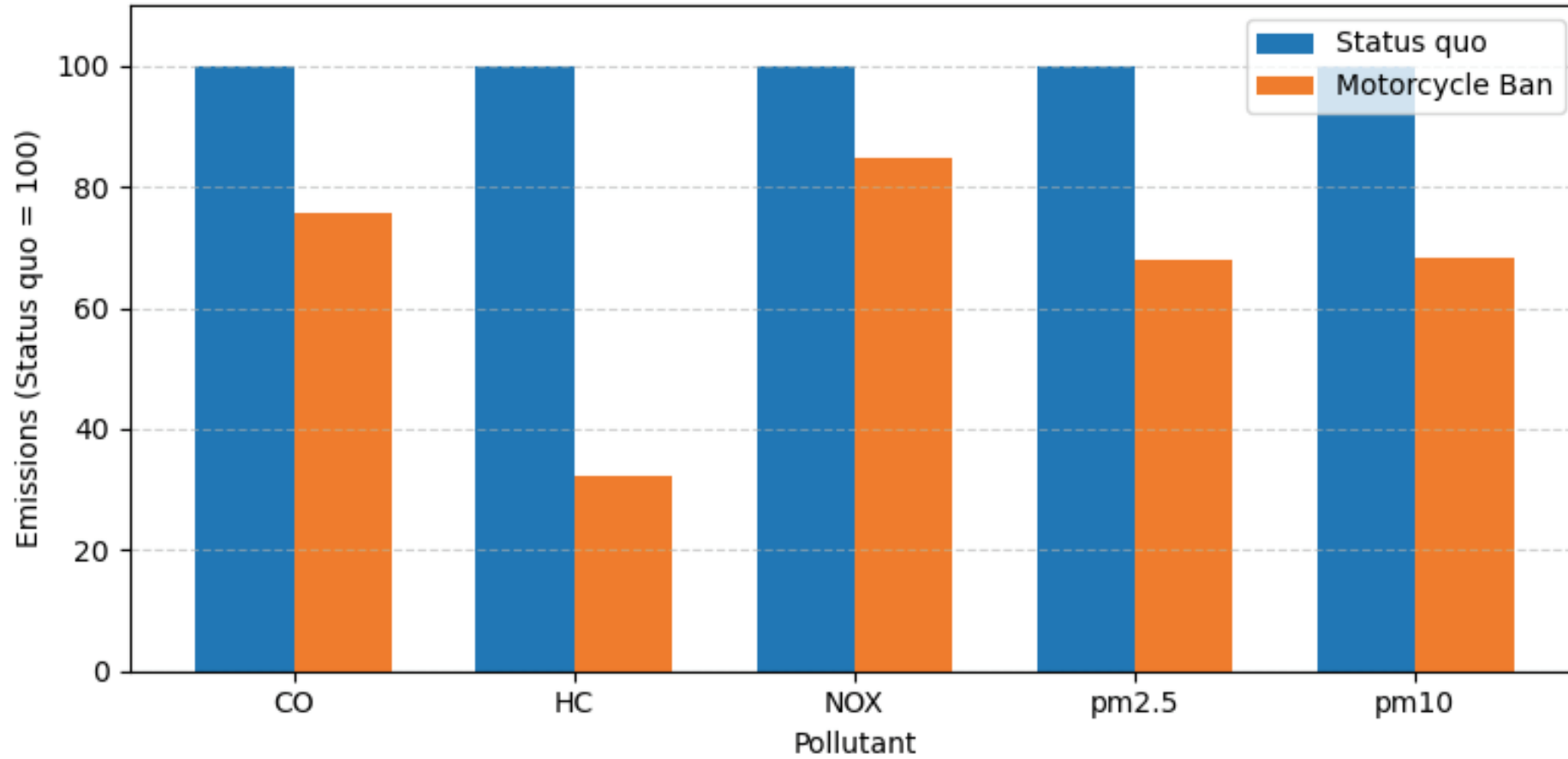
Darker green means higher reduction in PM2.5 while red means increase in PM2.5 emissions

Roads leading into the LEZ have lower PM2.5 emissions while roads around it can see increased PM2.5 emissions

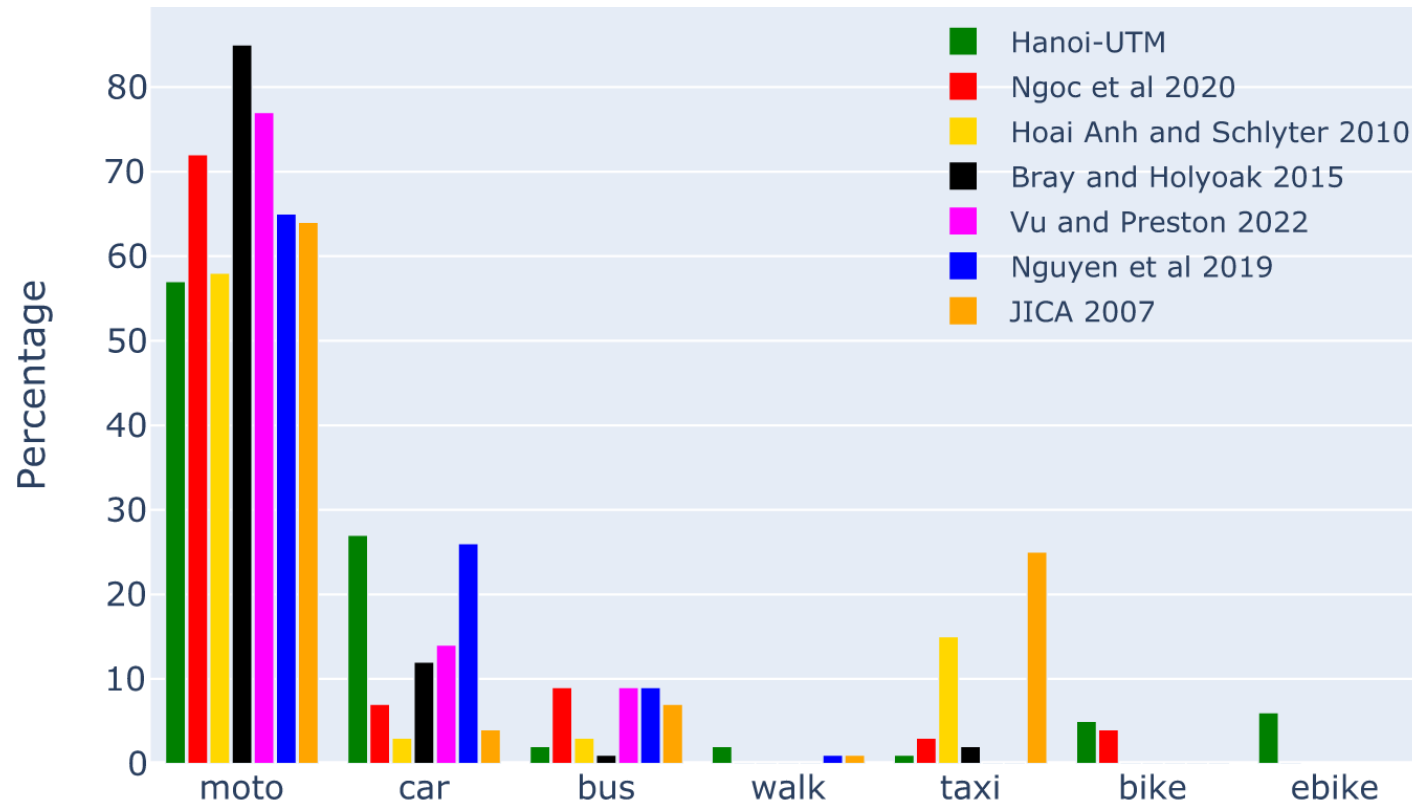


Darker green means higher reduction in PM2.5 compared to the status quo, while red means increase in PM2.5 emissions

Other pollutants also decrease significantly within the LEZ



Our model factors in mode choice shift



Alternative transport if motorbikes are banned (%)

Car	23.5
Taxi	13.4
Ebike	11.1
Bus	16.8
Bike	13.0
Light train	11.4
Walking	10.8

*Data from [Urban Transport Modelling for Sustainable Well-Being in Hanoi survey](#)

Motorbike users will not substitute towards public transport, when motorbikes are banned

6%

A 1km increase in distance travelled increases the likelihood of choosing public transport over a car drops by 6%.

76.5%

If motorcycles are banned, over three-quarters of users are predicted to shift to cars (23.5%), taxis (13.4%), or e-motorbikes (11.1%). This shift is heavily dictated by how distance and time change the "attractiveness" of each mode

0%

If motorbikes are banned, there is **no statistically significant increase** in the likelihood of people choosing to walk or bike for their daily needs

Rather than shifting to low-cost active travel, users are more likely to incur the higher costs of taxis or car ownership to maintain their current levels of mobility and speed.

Case Study 2: Estimating the Effect of the BMA Green List on Emissions

Older trucks and buses are banned on high pollution days in Bangkok unless green-listed

58,000

Buses and trucks have been green-listed by documenting proper maintenance¹

2.3%

Of inspected vehicles have not passed emissions testing for green-listing^{2,3}

50%

Emissions reduction can be achieved if vehicles are repaired prior to green-listing⁴

¹ [Thaiger](#) ² [Nation Thailand](#) ³ [BMA \(a\)](#) ⁴ [BMA \(b\)](#)

The number of days with active restriction in 2025 has been limited

On these days, the reduction in PM_{2.5} was in part caused by less trucks on the roads

2

Days of active restrictions in 2025 so far (23-24 January 2025)

12%

The reported reduction in truck traffic in the LEZ¹

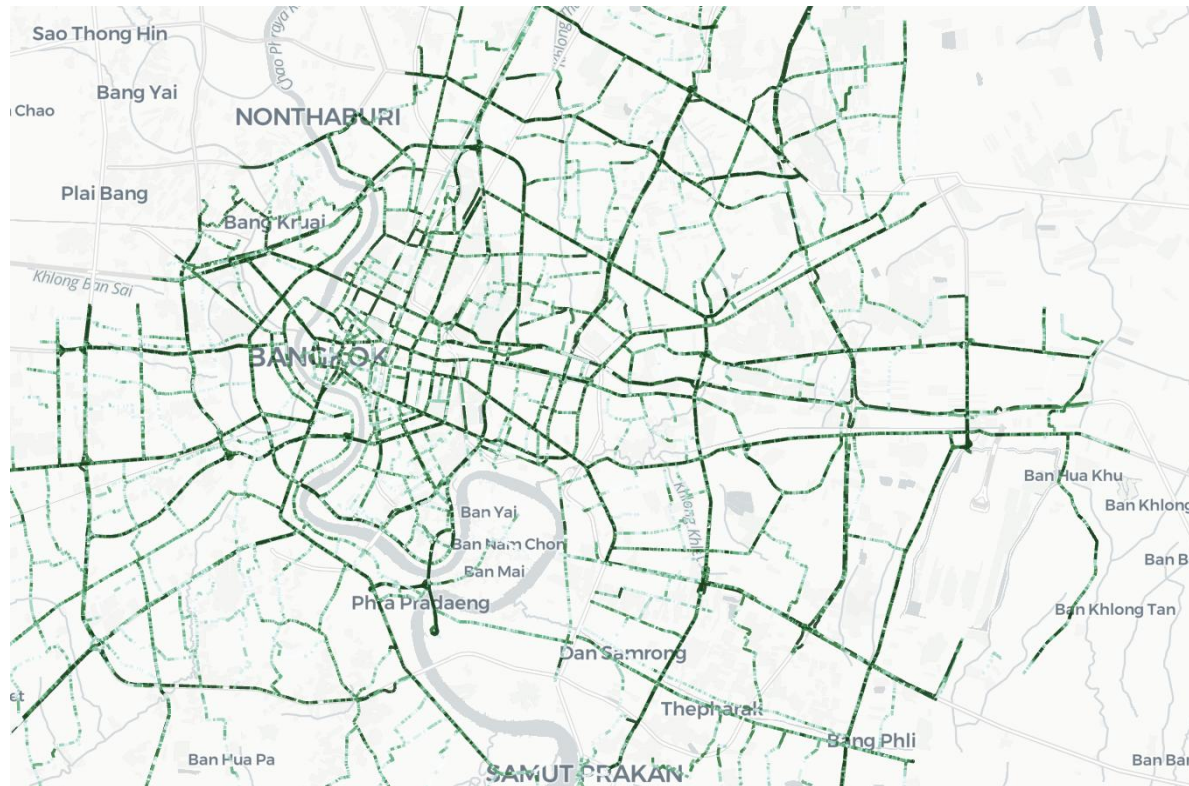
8%

The reported reduction in PM_{2.5} in the LEZ compared to surrounding areas¹

¹ BMA

We estimate the BMA green-list currently reduces exhaust PM_x emissions by 1.4%

This is based on the current share of vehicles registered on the green list



- Reduction in exhaust PM_x emissions on non-restriction days compared to pre-green list
- The darker green the road segment, the higher the reduction

We modelled green list adoption scenarios as well as the phase-out of pre-Euro-IV vehicles

Pre-Green List: Results before implementing the Green List

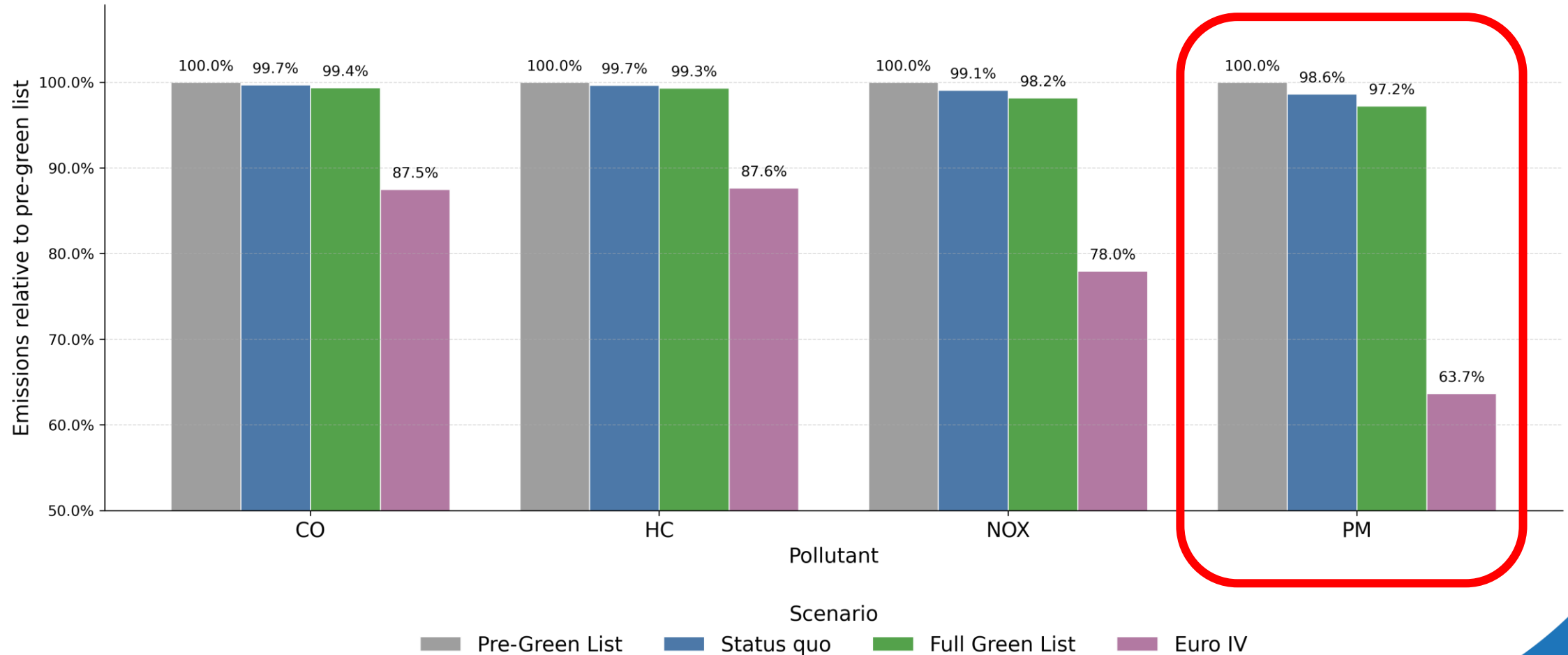
Status quo: Current status with 58,000 vehicles registered on the Green List assuming 2.3% of registered vehicles need upgrades to pass

Full Green List: All trucks are registered on the Green List assuming 2.3% of registered vehicles need upgrades to pass

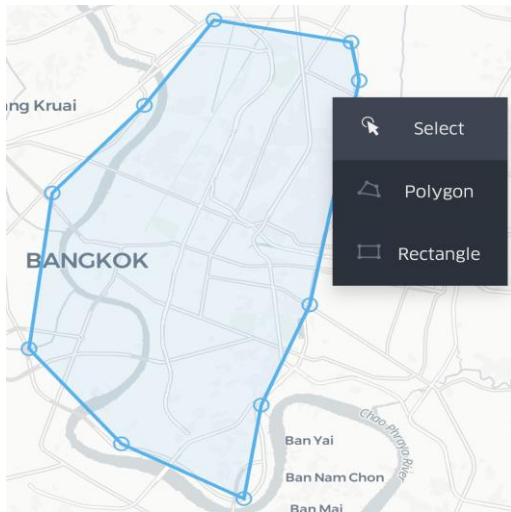
Euro-IV: Trucks with Euro-III and lower emission standards are phased out

Green-listing all trucks reduces exhaust PMx emissions by 2.8% while phasing-out older trucks achieves up to 36%

Road traffic emissions by scenario (relative to pre-green list)



Additionally, our model can simulate different LEZ restrictions and quantify traffic and emissions



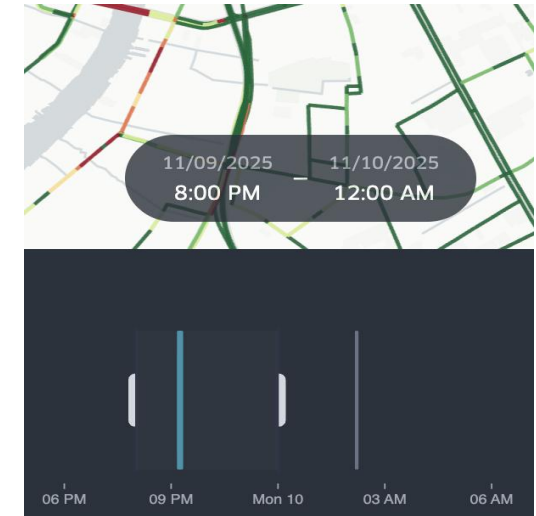
Examine geofenced LEZ areas with various types of restrictions (such as vehicle types, hours of the day, and emission standards)



Estimate traffic effects in and around LEZ zones



Estimate changes in emissions for CO, NO_x, HC, PM_x



Results can be provided for rush hour, daytime, evening rush hour, and nighttime.

These are provided at the **road-segment level** for major roads.

Methodology

Our methodology involves two parts



Part 1: Transport model

This provides information on vehicle speeds and traffic volumes per road segment.

Inputs: GPS data, road network, fleet composition

Method: Traffic data-enhanced 4-step transport model



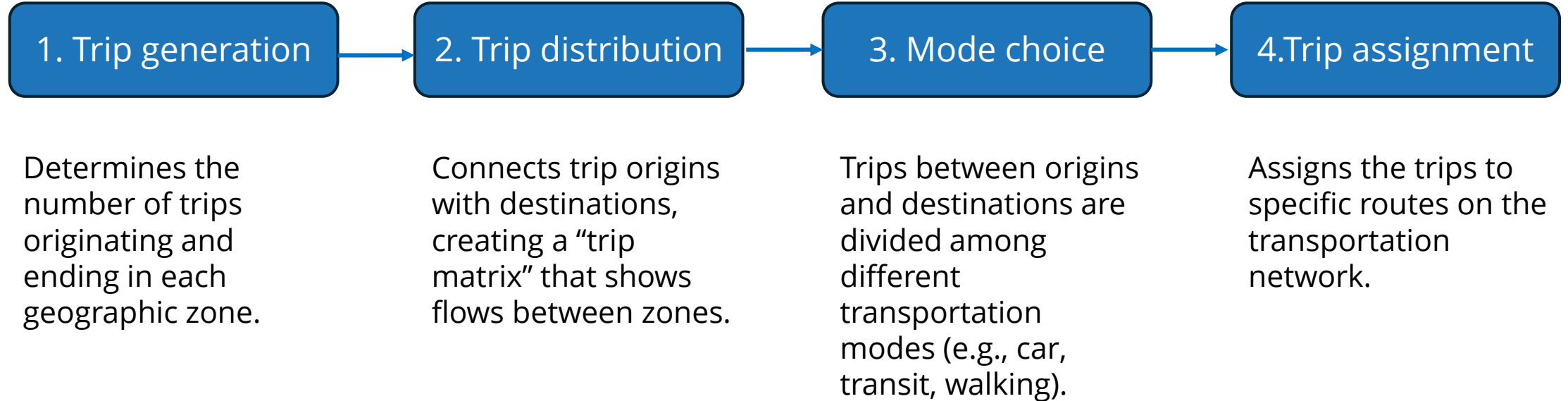
Part 2: Vehicle Emission model

This provides emissions by vehicle type and road segment

Inputs: Vehicle speeds and volumes, fleet composition

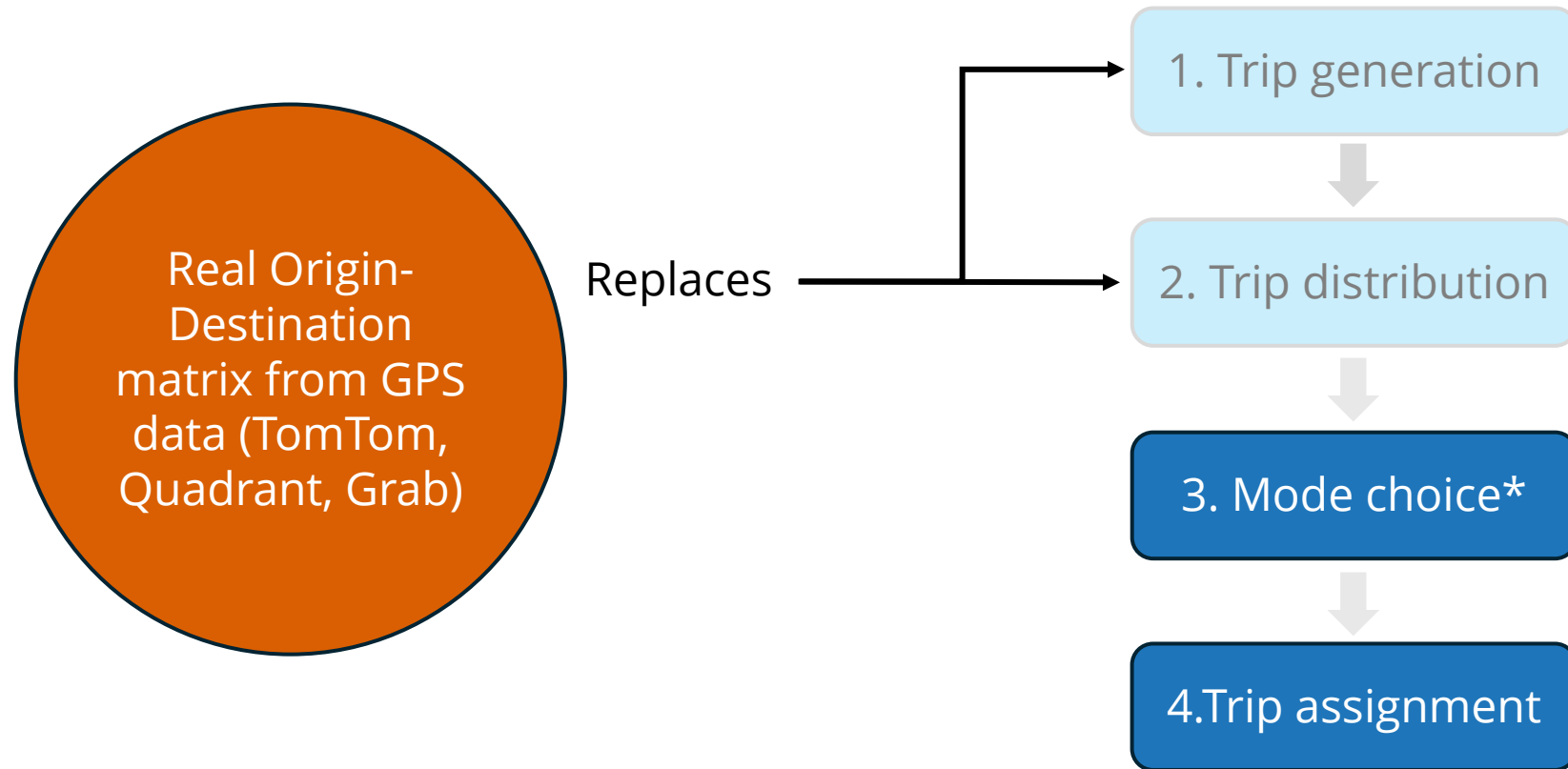
Method: Local speed-dependent emission factors

Traditional transport models involve 4 stages



We use GPS data to address the first two stages

We use GPS data from TomTom, Grab, Waze and Quadrant to measure trip generations and trip distribution.



* Currently under development

Using GPS data is accurate and more scalable



Greater accuracy

GPS-based OD matrixes capture real travel patterns



Reduced costs

No need for expensive household surveys



Location agnostic

GPS data is available globally



Dynamic

Can be updated continuously as real-world conditions change

Our speed-based emissions model quantifies pollutants for each vehicle type in Hanoi

The model applies speed-dependent emission factors calibrated to local conditions

Inputs:

- Road segment length
- Vehicle composition
- Traffic speed
- Traffic volume

Output: Emissions by vehicle type including passenger cars, motorcycles, light-good vehicles, trucks and busses

We combine local emission factors and COPERT to estimate emissions of vehicles in Hanoi

For Hanoi, there are only non-speed dependent emission factors available at 35 km/h of speed ([Ngo et al., 2023](#))

We take speed-dependent exhaust emission equations developed for Bangkok by Thailand's Pollution Control Department as a basis

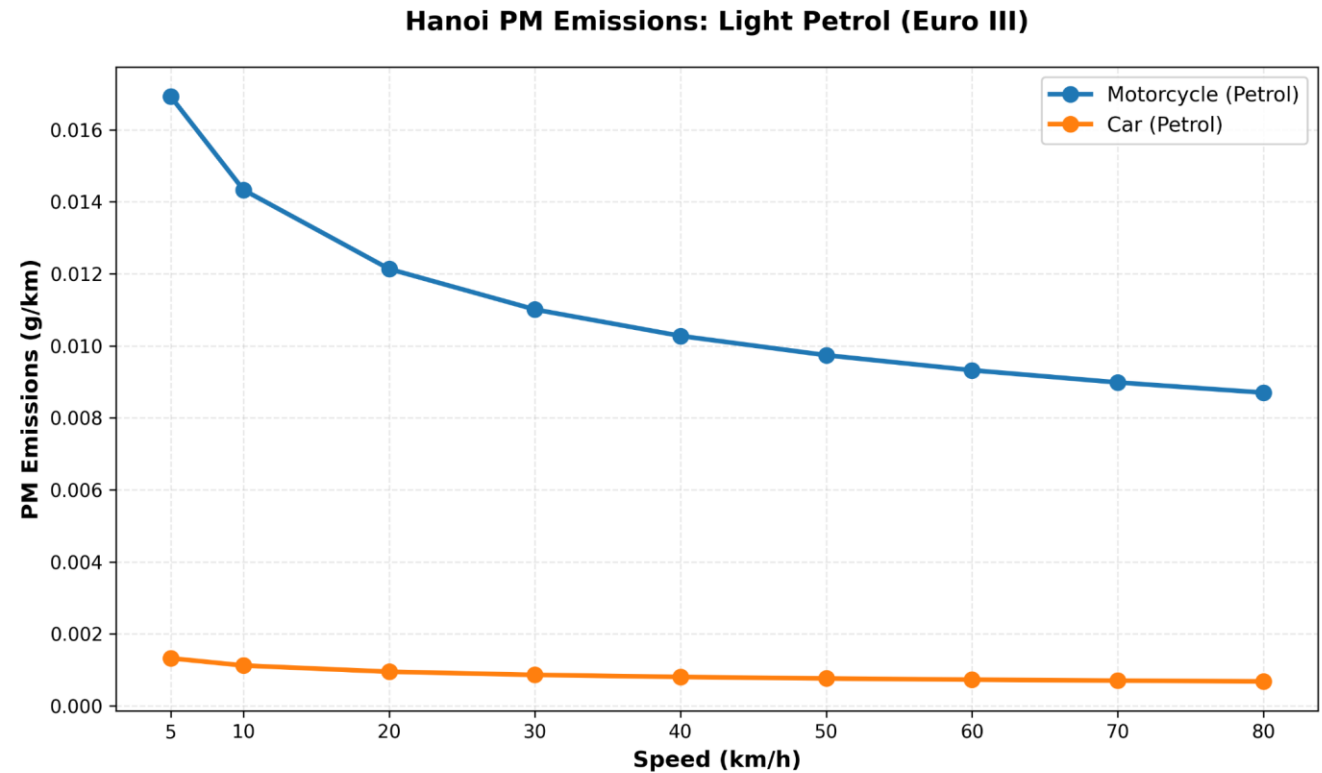
We maintain their functional form and scale them to match the Hanoi values at 35 km/h

We further add COPERT-based non-exhaust PM2.5 and PM10 emission factors for brake pad, tire and road abrasion emissions

We currently do not consider road dust (resuspension) emissions; these contribute mainly to coarse particulate matter and not PM2.5.

Example: Exhaust PM2.5 emission for personal cars and motorcycles

- Motorcycles emit significantly more PM2.5
- This is because motorcycle engines have poorer air-fuel control, higher oil consumption, lower exhaust temperatures, and less effective emission aftertreatment than cars
- Cars emit 2-3x non-exhaust PM due to their higher weight



Own figure

We use publicly available and proprietary data shared with ADB

Data type	Source	Cost	Scale
GPS / traffic data	Grab, Quadrant, TomTom	Free for ADB or already paid for under different projects	Regional or global
Road network	OSM	Free	Global
Fleet composition	Ngo et al., 2023	Free	Local
Emissions factors	Automotive Emission Laboratory (AEL) of the Thailand Pollution Control Department (PCD), Ngo et al., 2023 , COPERT	Free	Local or regional

Obtaining official government data will help us improve our model



Fleet composition

Vehicle registration by vehicle type and emission standard will help us improve emission estimates



Traffic counts

The number of vehicles along roads can be used to calibrate and validate our transport model



Public transport usage

Public transport trips data helps us estimate the split between private and public transport



Commuter preferences

Can be used to fit a behavioural model that estimates when people switch between modes

As a next step, we want to incorporate an Air Quality Model

This will help us better understand actual air pollution.



Part 1: Transport Model



Part 2: Emission model



Part 3: Air Quality Model

While our emission model estimates the **quantity of pollutants emitted**, an air quality model estimates the **concentration of pollutants in the air**

- Inputs: Vehicle emissions (from our emission model), ambient air pollution, weather data
- Method: Dispersion model (e.g. AERMOD)

Summary: we are developing a rapid evaluation tool for ADB

This tool is designed to be scalable across geographies, and easily used by ADB project teams.



Adaptable

Our model can be quickly adapted to other Southeast-Asian cities



Actionable

It gives ADB a way to evaluate different policy scenarios quickly and in a data-driven manner



Accurate

Combining high-volume GPS data with local context yields accurate results