



2- and 3-wheelers in Southeast Asia

Opportunities for affordable, clean, and efficient mobility

Jacob Teter, IEA

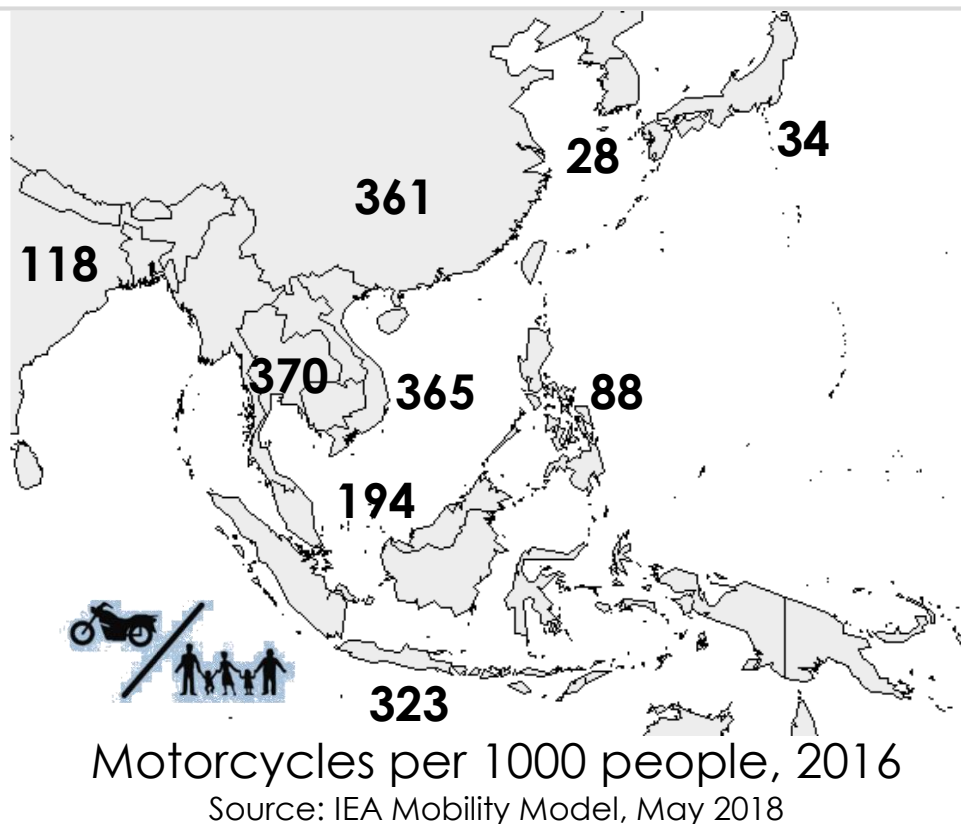
Jakarta, 16 July 2018



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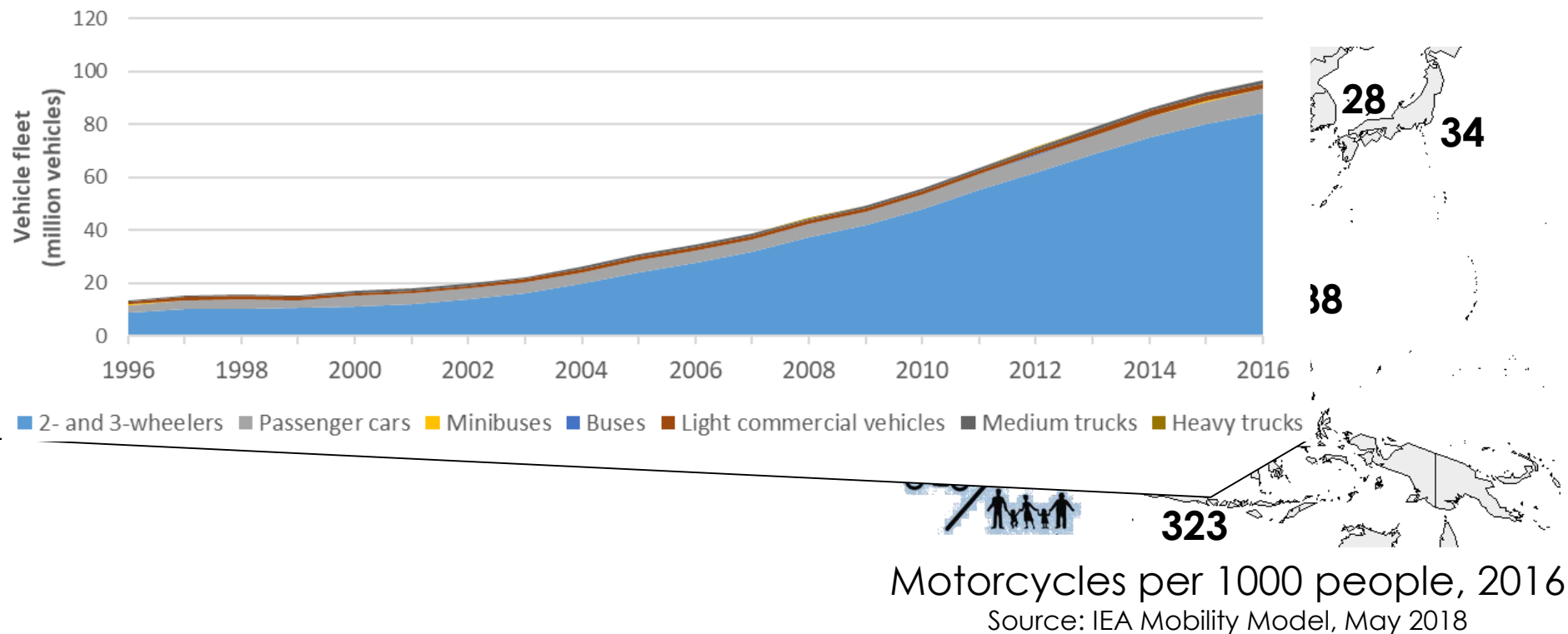
- The utility, ubiquity, and economic benefits of 2&3-wheelers
- Energy consumption and emissions
- Improvements in fuels and vehicles in recent decades
- Potential benefits from fuel economy or electrification
- Efficient transport in current and future megacities

2- & 3-wheelers: fast, convenient, affordable motorized mobility



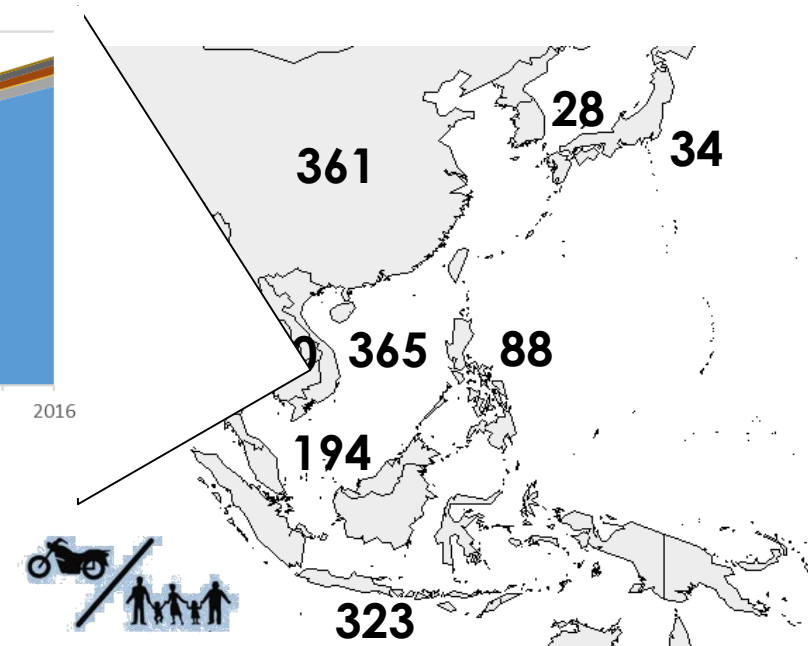
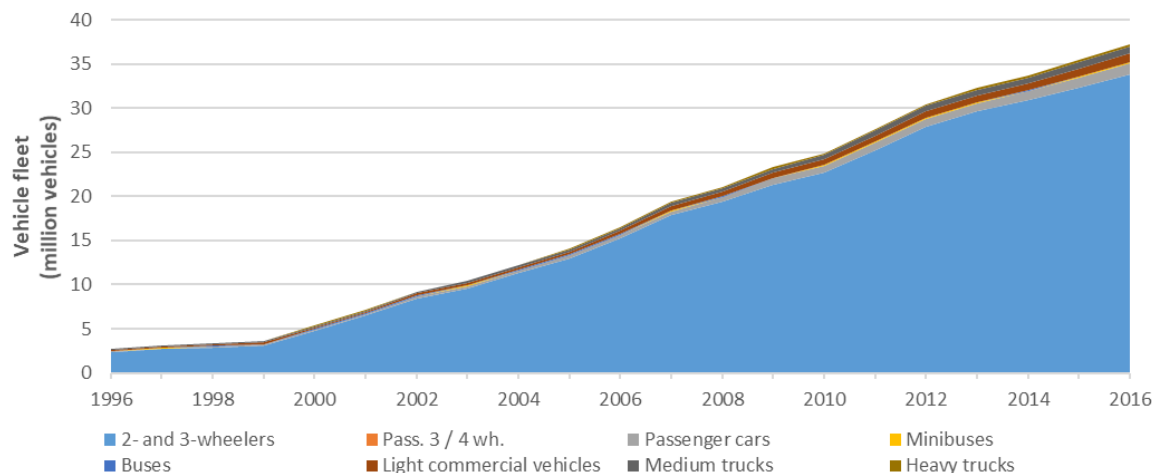
2- & 3-wheelers provide affordable mobility throughout Asia

2- & 3-wheelers: the dominant vehicle type in Southeast Asia



Indonesia's 2- & 3-wheeler fleet has grown 10-fold over the past two decades

2- & 3-wheelers: the dominant vehicle type in Southeast Asia

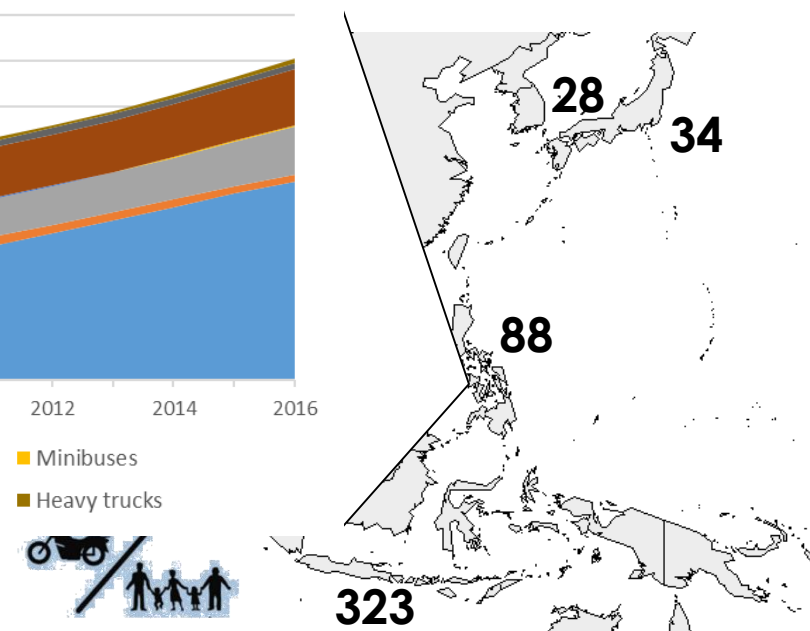
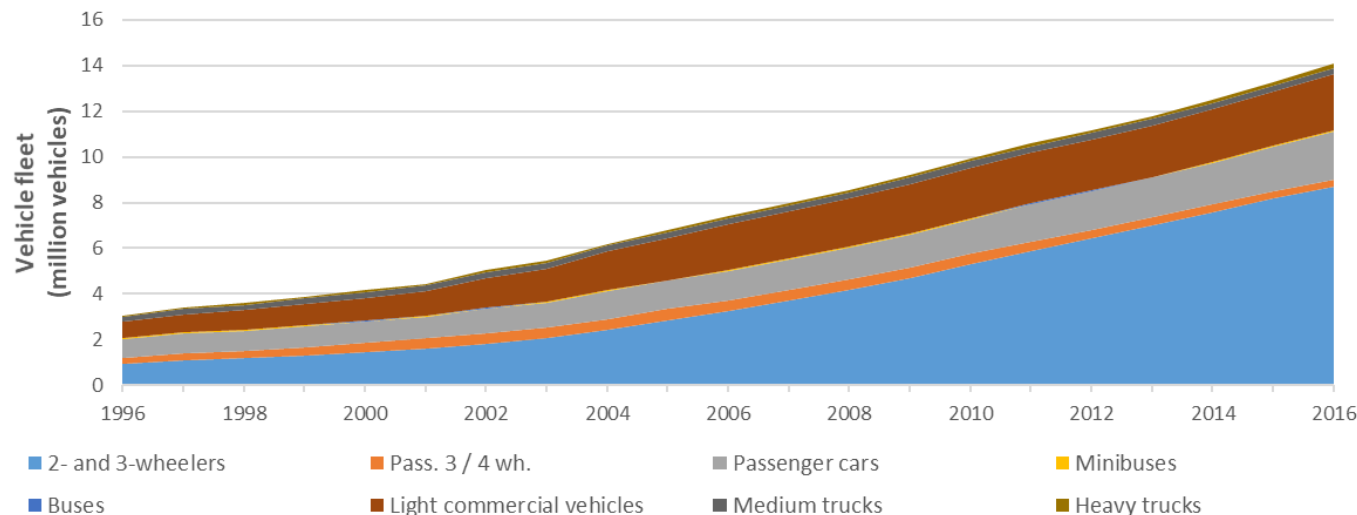


Motorcycles per 1000 people, 2016

Source: IEA Mobility Model, May 2018

This pattern of a growing 2- & 3-wheeler fleet with rising incomes is mirrored in Vietnam

2- & 3-wheelers: the dominant vehicle type in Southeast Asia

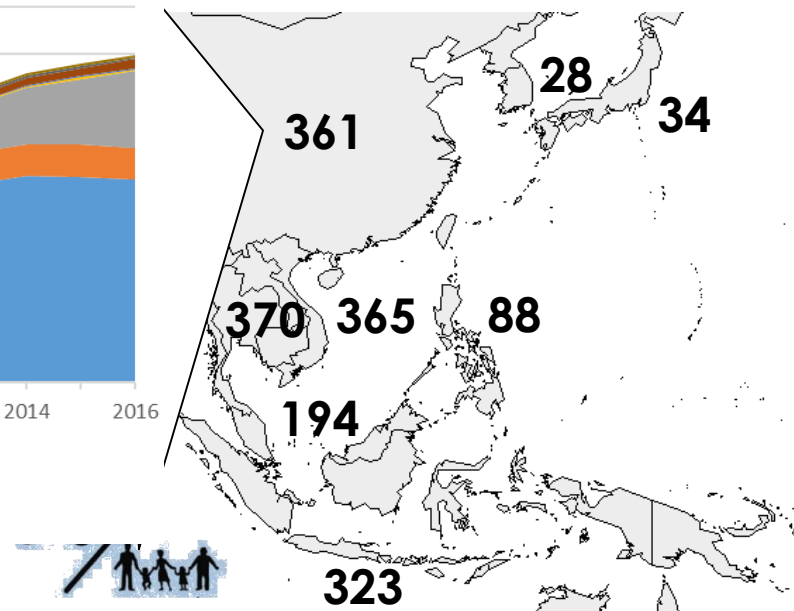
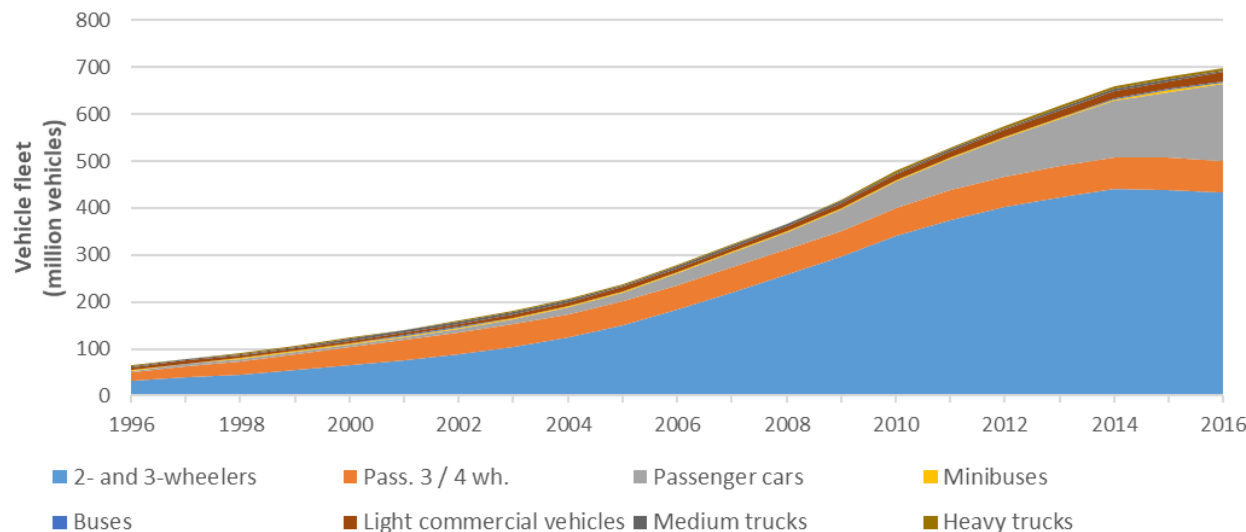


Motorcycles per 1000 people, 2016

Source: IEA Mobility Model, May 2018

The 2&3-wheeler fleet in the Philippines grew 7.5 fold, while the economy grew by a factor of 2.5

2- & 3-wheelers: the dominant vehicle type, also in China

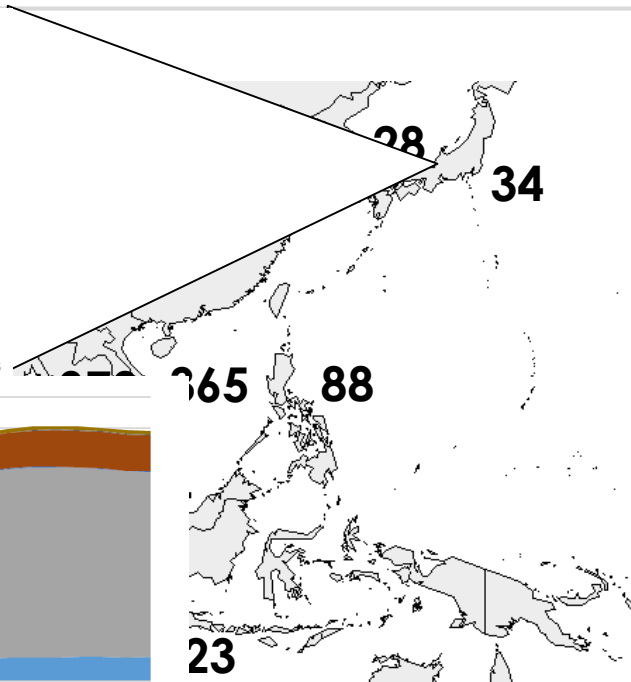
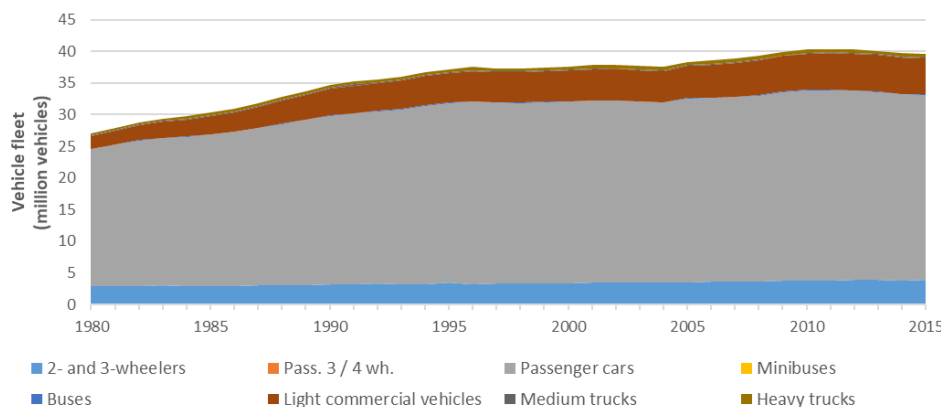
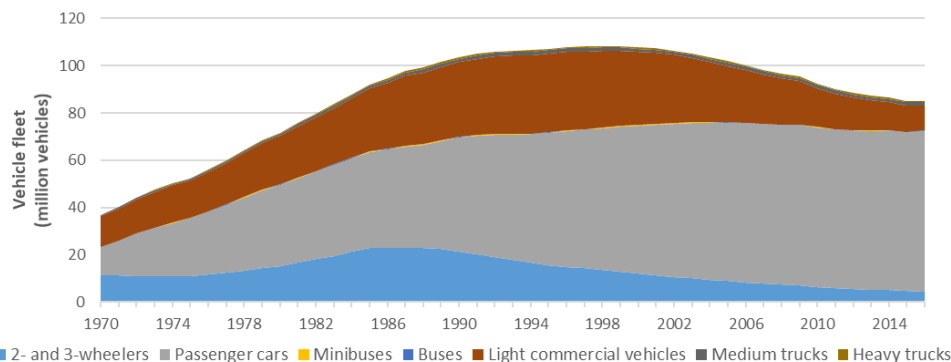


Motorcycles per 1000 people, 2016

Source: IEA Mobility Model, May 2018

China's fleet is still mostly composed of 2- & 3-wheelers

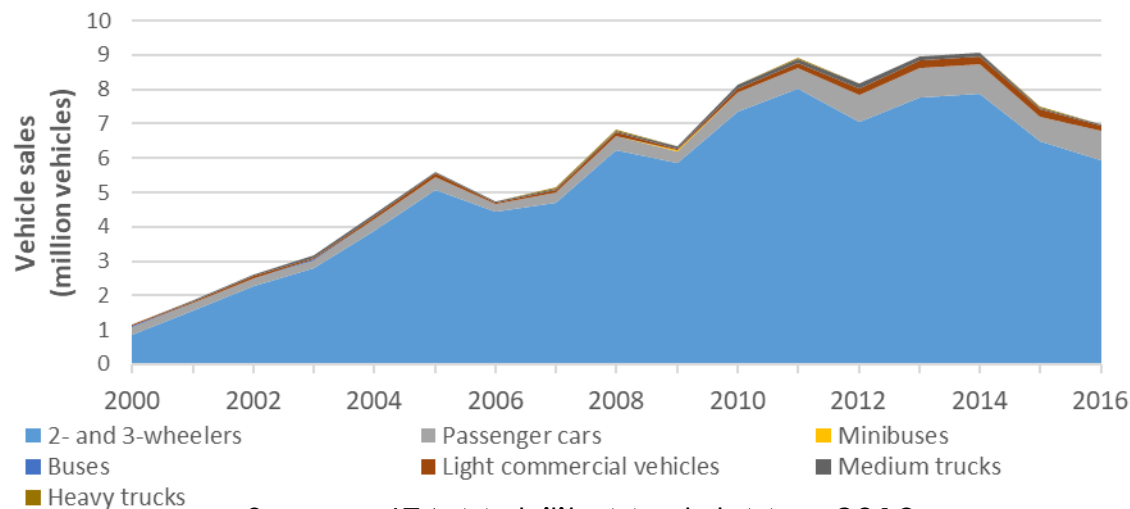
2- & 3-wheelers: enduring utility, even in developed economies



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ility Model, May 2018

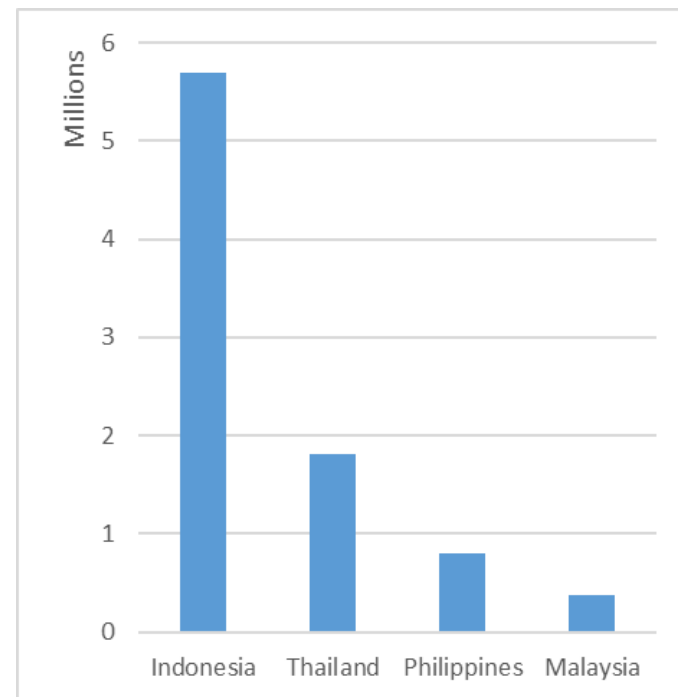
- Japan's fleet composition trends suggest that 2&3-wheelers might be 'just a phase' of development
 - But France's trends suggest the enduring utility of this vehicle type in certain contexts

Vehicle sales in Indonesia



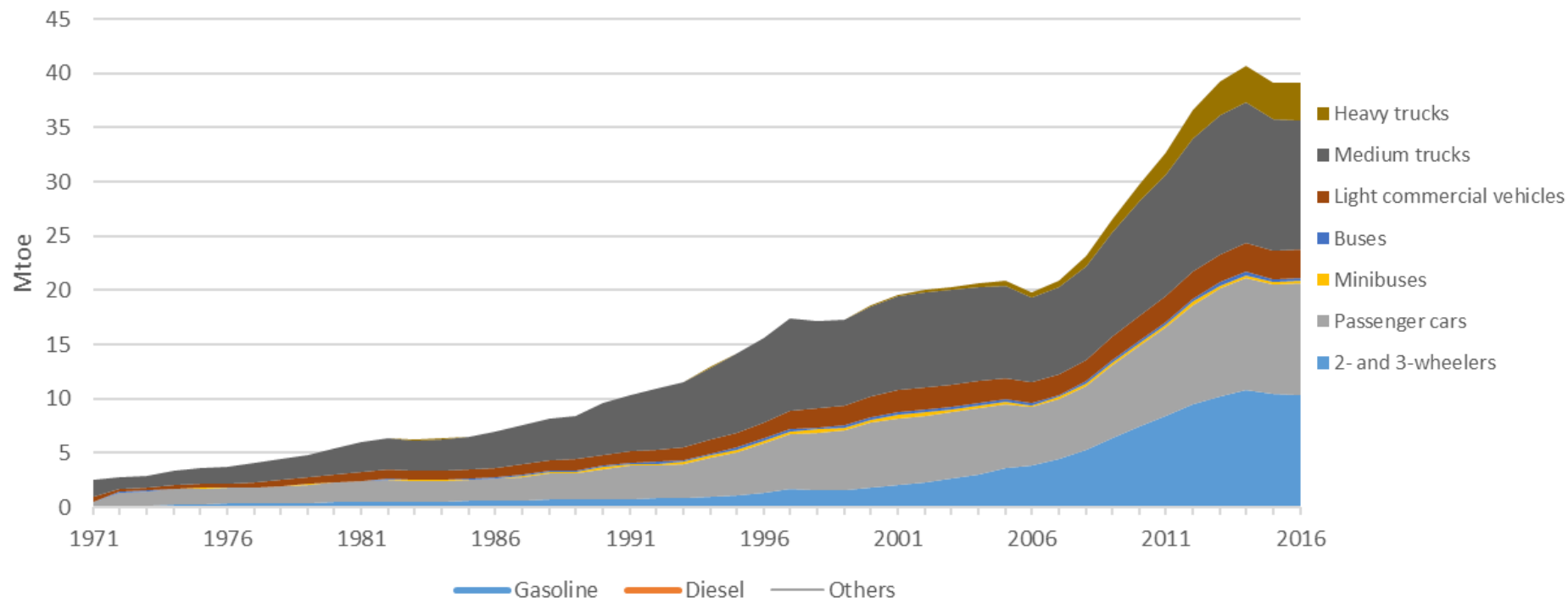
Source: IEA Mobility Model, May 2018

Motorcycle production, 2015



Domestic assembly and manufacturing of 2- & 3-wheelers are major industries across ASEAN countries

Road Energy Consumption in Indonesia



- **2&3-wheelers consume 27% of road transport fuels in Indonesia**
- **Shares are similar across ASEAN: 21% in Vietnam, 10% in Thailand, 8% in the Philippines**

Fuel economy standards for 2-&3-wheelers in China

| Engine Size (cc) | China two-wheelers l/100km | China three-wheelers l/100 km |
|------------------|----------------------------------|-------------------------------------|
| ≤50(mopeds) | 2 | 2.3 |
| >50-100 | 2.3 | 3.3 |
| ≥100-125 | 2.5 | 3.8 |
| ≥125-150 | 2.5 | 3.8 |
| ≥150-250 | 2.9 | 4.3 |
| ≥250-400 | 3.4 | 5.1 |
| ≥400-650 | 5.2 | 7.8 |
| ≥650-1000 | 6.3 | 9 |
| ≥1000-1250 | 7.2 | 9 |
| ≥1250 | 8 | 9 |

- Fuel economy standards for 2&3-wheelers pay for themselves in reduced fuel cost very quickly
 - As with fuel economy standards on cars and trucks, they reduce reliance on oil imports

Controlling vehicle emissions

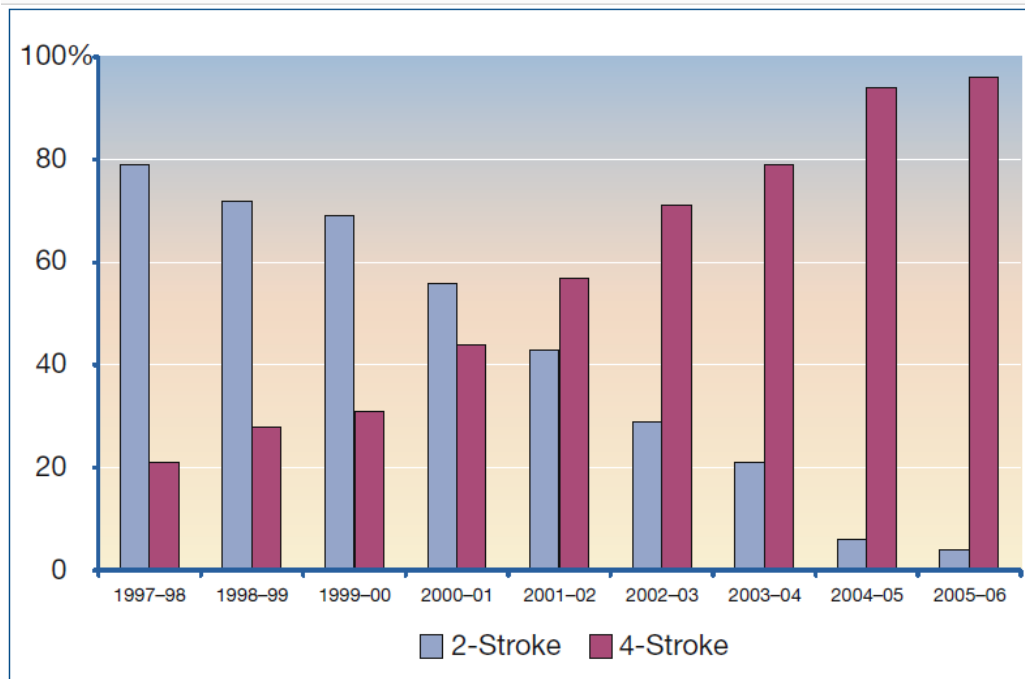
- Separate emissions standards:
 - 2&3-wheelers,
 - Light-duty vehicles (cars & vans),
 - Heavy-duty vehicles (trucks & buses)
- Policy coverage varies across Asia
- Also possible to regulate specific emissions (e.g. PM and NO_x in Japan)
- Health impacts are substantial, but the science and statistics linking emissions to health effects is complex
- Studies attempt to quantify health and economic impacts



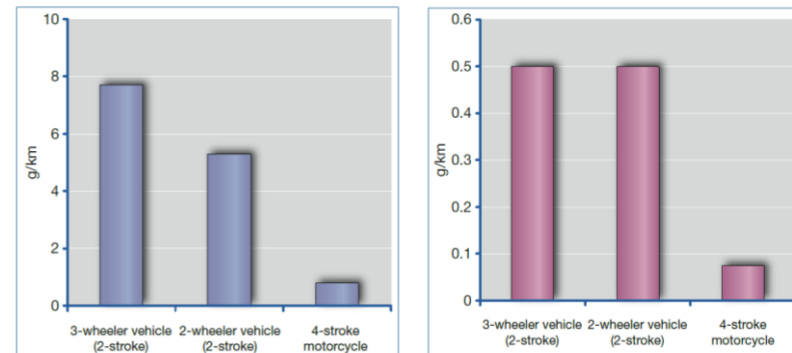
- **Economic costs of health impacts of air pollution in Jakarta in 2010 estimated at 535 million USD**
 - **Road traffic is among the major sources of air pollution in Greater Jakarta**

2- & 3-Wheelers: switching powertrain technologies

From 2-stroke to 4-stroke – sales volumes in India



HC and PM2.5 emissions : 2S versus 4S



Source: Shah, 2001

Source: M.N. Muralikrishna, "Indian Two-Wheelers", International Seminar on Fuel Efficiency, Petroleum Conservation Research Association, Chennai, 6-7 Dec, 2007.

- Progress has been made over the past decade across many Asian countries in moving to cleaner fuels and vehicle technologies
- One example is the replacement of 2-stroke engines with 4-stroke ones

2- & 3-Wheelers: switching fuels

CNG and LPG retrofits to 3-wheelers:

- Tuk-tuks in Bangkok have operated on **LPG** for decades
- Many major cities India in successfully converted from gasoline to **CNG** 3-wheelers (Delhi, Mumbai, also in Dhaka, Bangladesh)
- The immediate result has been **reduced PM and HC emissions**

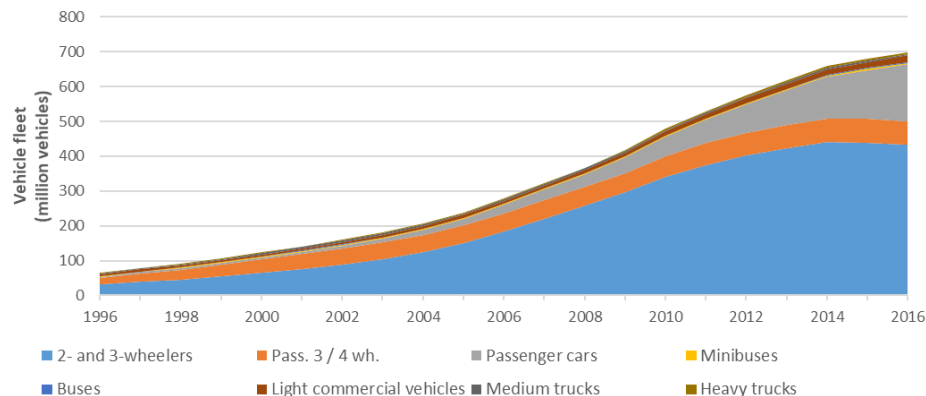
Challenges are numerous:

- Ensuring adequate fuel supply (and fueling infrastructure) is a concern: long queues for CNG refueling in Delhi
- Policies for alternative fuels should be based on **sound life cycle assessment** of their comparative performance in terms of energy efficiency & emissions
- Pricing policies can encourage adoption

- **Alternative fuels, like CNG and LPG, have fewer emissions, but there are challenges and tradeoffs**
- **Policies to promote alternative fuels should be undertaken with caution, and only with good data**

2- & 3-Wheelers: fuels and powertrain technologies

From ICE to electric 2&3-wheelers in China



- **Electric 2-3 wheelers, with no tailpipe emissions and efficiency in the range of 3-6x higher than ICEs, offer far lower energy and maintenance expenditures, superior acceleration, and emit far less GHGs, even on a grid mix that is mostly coal.**
- **Current e-bike and e-scooters models are cheaper than conventional scooters and motorbikes**
 - **In congested cities, they are at least as fast as cars**

Infrastructure is destiny

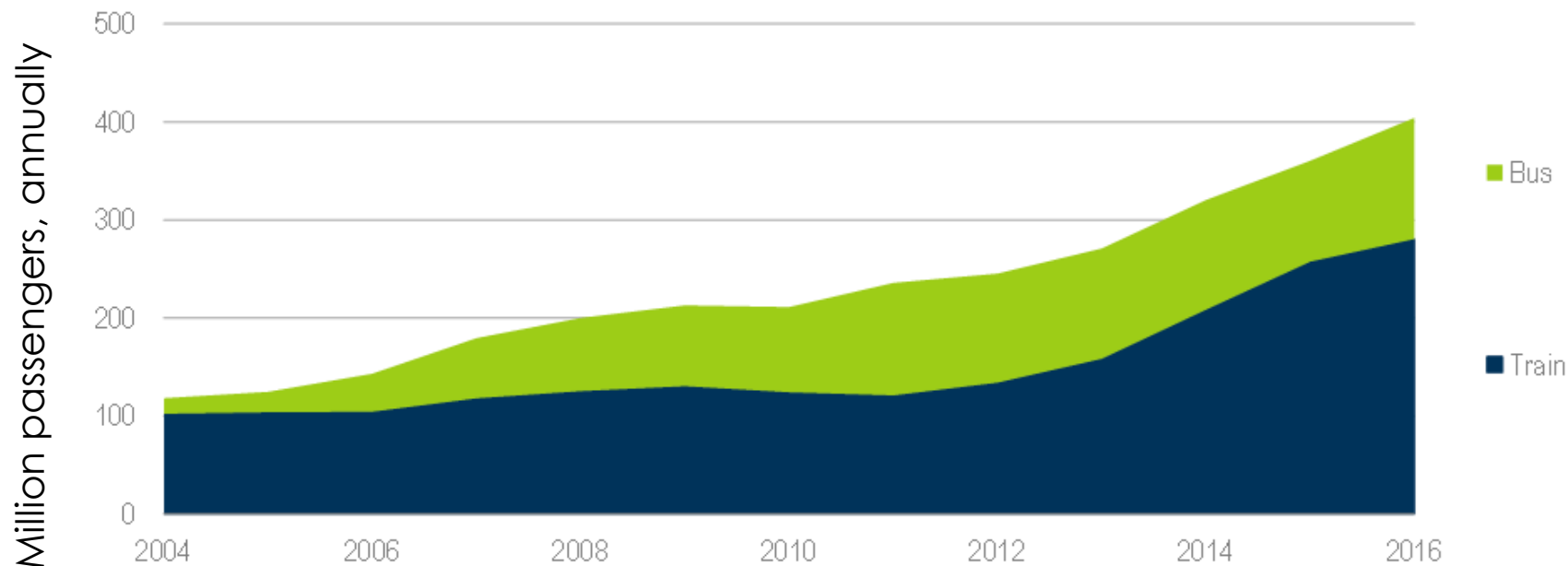


Québec 2012 / www.transportsviables.org/question-despace
Photo: Renaud Philippe



- Space utilization and passenger throughput are critical performance metrics in megacities
- Good urban design, including of transport infrastructure networks, can reduce emissions and improve safety

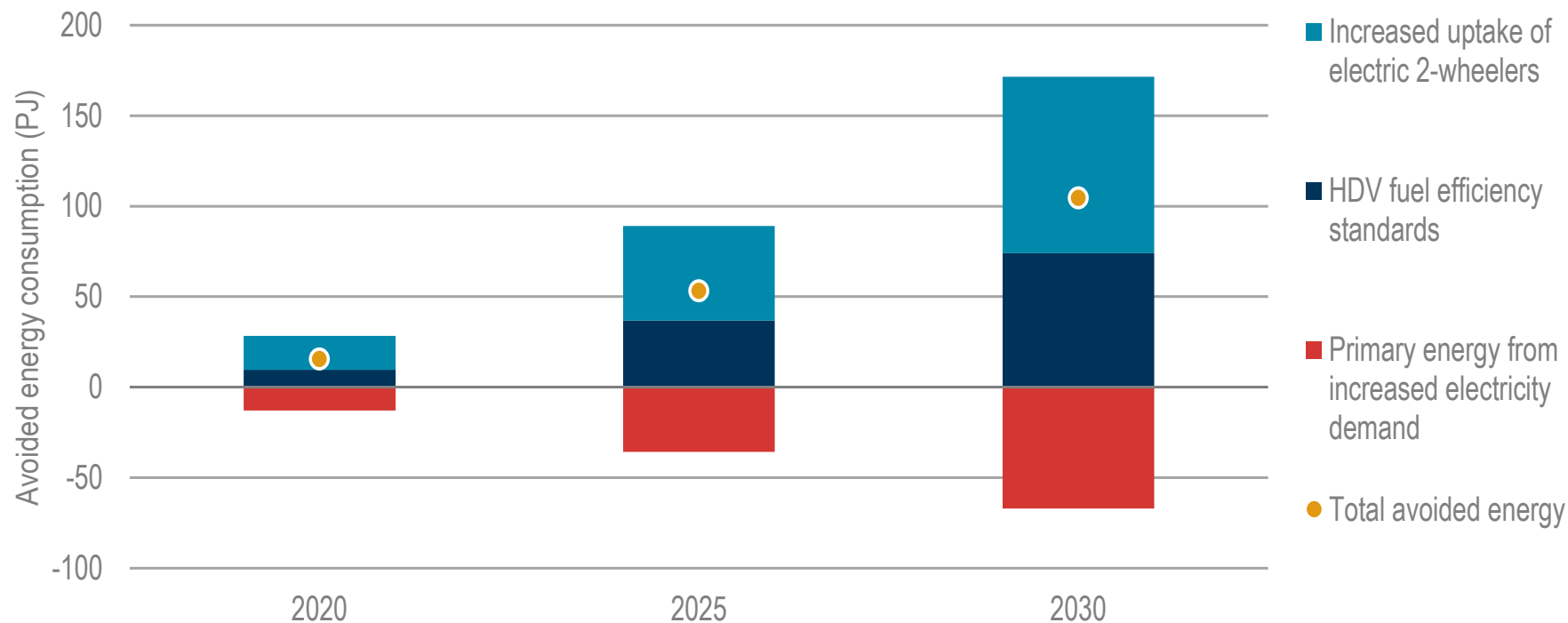
Number of train and bus passengers in the Greater Jakarta Area, 2004-16



Source: Sources: Adapted from Institute for Transportation and Development Policy (2017), personal communication, and Statistics Indonesia (2017).

- **To address huge challenges in congestion and air pollution, Greater Jakarta has been investing in Bus Rapid Transit and Mass Rapid Transit network extensions**

Where are we headed? : Energy Consumption



- Fuel savings from electrification would be partially offset by increases in electricity demand
- Consumption by Heavy-duty vehicles are also growing fast, and could be addressed through fuel economy standards

- Growing megacities must **strategically develop strategic mass transit corridors** as well as **staged rollout of travel demand management measures**.
 - Regions facing severe pollution should **tighten and harmonize emissions standards**. Consider **two-stage approach: regulations + incentives**.
 - **In-use compliance standards** and **effective inspection and maintenance programmes** are both needed to compliment emissions standards.
 - **Fuel economy standards for 2&3W-wheelers** can reduce states' reliance on foreign oil and to save their citizens money at the pump.
 - Look for **opportunities to make and sell electric 2-wheelers**, to foster electromobility and to eliminate tailpipe exhaust considerations.
 - Provide other incentives for electrification.
 - Target relevant stakeholders.
- **Smart policy uses good data, and recognises local context, opportunities, and tradeoffs**
 - **Everyone needs mobility, everyone breathes air**



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