Fuel Economy Measurement: Malaysia and Beyond

Possibilities, Challenges

GIZ

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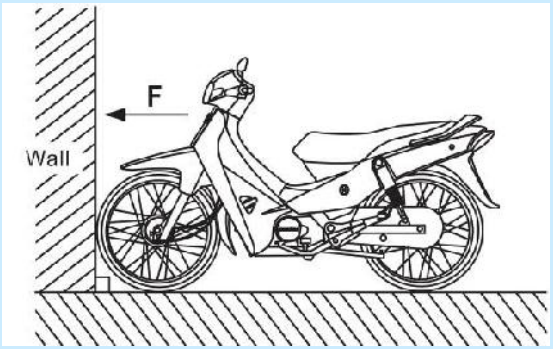

Outline

- Fundamentals of Sustainability in Transportation
- Transportation Data required
- Top Down data collection
- Bottom Up data Collection
- Highlights from Malaysian Study
- Ramifications for ASEAN

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Pillars of Sustainable Transport

Urban Planning 1: City Layout

- **Prevent necessity of moving people/goods large distances**
- **Design cities with efficient transport in mind**

Urban Planning 2: Mass Transit Systems

- **Mass Transport Systems are much less expensive to build ahead, more difficult to "retrofit" in later**
- **Mass Transit requires first/last mile options**

Vehicles: USE ONLY WHAT YOU NEED

Getting one person to work doesn't require an MPV

Make sure consumers pay the "full price" of their transport choice:

- **Don't subsidies fuels**
- **Tax inefficient transportation options**
- **Insure lower impact options are viable**

GET THE DATA:

Decisions need to be based on real data

What data do we need?

Trip purpose
Where people live, where they work, school, shop, etc.
What goods are produced where, Where they are processed, distributed, sold

Passenger (or freight) centric data:
Passenger km per year per vehicle (Car, motor, bus, taxi, train)
Modal Split: Car vs. motorcycle vs. bus

Vehicle centric data:
Fuel Consumption per km (or per passenger km)
Emissions
Fuel Consumed per ton-km of freight

Traffic Data:
Traffic concentration, flow rates, speeds

We can make changes to:
City layout, transportation infrastructure, vehicle types, fuel tariffs

Top Down Measurements

Oil Consumption

Good stats as few companies, and tracked
Mode split to various modes, vehicles difficult
“Leakage”

Leakage (Petrol):
Grass Trimmers
Small Gen Sets, Pumps
Unregistered Vehicles
Outboard Engine Boats
Cross-Border Smuggling
Molotov Cocktails

Leakage (Diesel):
Gensets, Pumps
Marine Applications
Agricultural equipment

Top Down Measurements

Vehicle Fleet Data from Registrations, Road Tax and etc.:
Number, type, fuel type
- Misses “unregistered” vehicles

Vehicle Mileage: Inspections (Annual, at time of re-sell)

Passenger load: May have upper legal limit per body type
- Not realistic estimate

Vehicle Usage: Some vehicles restricted to some activities
-Not generally realistic

Bottom Up Measurements

Individual Vehicle Statistics

Total km traveled per year / Total Fuel Consumed (per year) Good but averaged over 1 year of trips (Work/School Commute? Going to store? Weekend outings?)

Individual tank measurements

Good average data, but significant single tank variation at pump
Multi-trips means different purposes

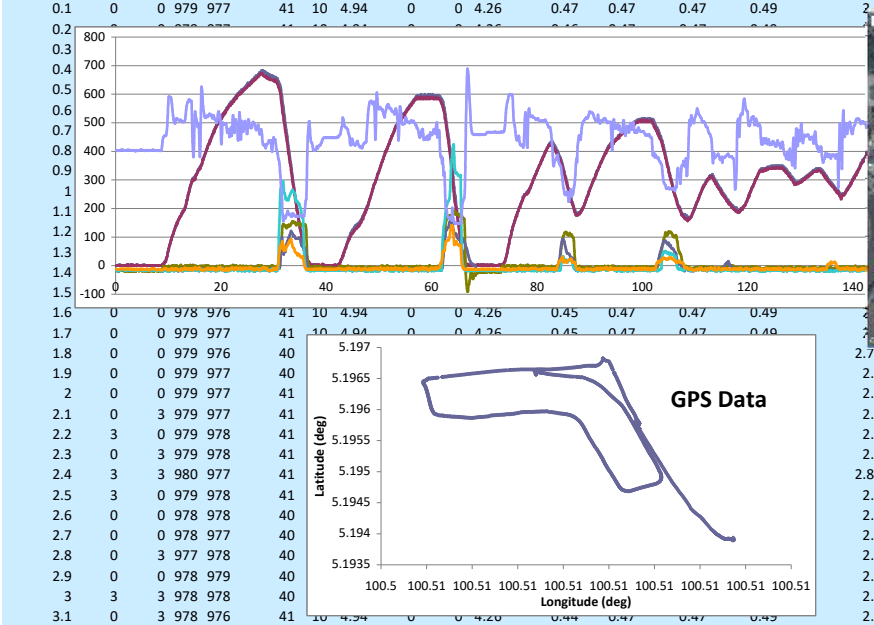
Bottom Up Measurements

Instrumented Vehicle

Eg. Portable Emissions Measurement System
Instantaneous measurements by location, time…
Determine Drive Cycle (speed, idle time…)
Trip Purpose: From Origin/Destination
What's the passenger load?
- One vehicle at a time, slow

FOCUS APPLIED TECHNOLOGIS 2016
DATA LOGGER VER2.0
Data From LT00017

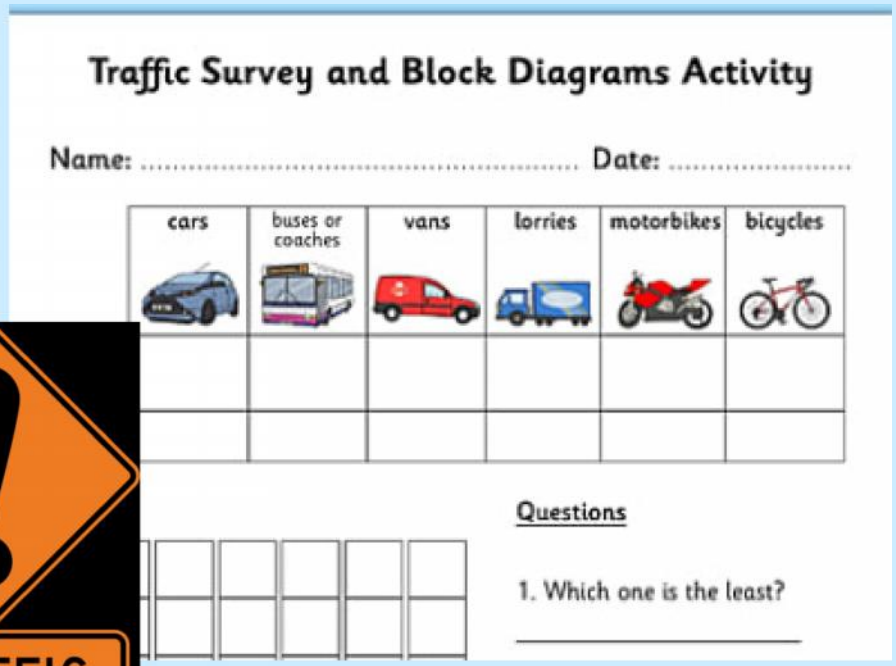
Time (sec)	RPM1 (rpm)	RPM2 (rpm)	TC1 (C)	TC2 (C)	IRtherm (C)	Th2 (C)	MAP (V)	Vdiv1 (V)	Vdiv2 (V)	LC (V)	FrontTorq (V)	Handle (V)	RearTorq (V)	LegPedal (V)	Displacement (V)	AccelX (mg)	Avg Acc	AccelY (mg)	AccelZ (mg)	Lat (deg N)	Lon (deg W)
0.1	0	0	979	977		41	10	4.94	0	0	4.26	0.47	0.47	0.47	0.49						
1.6	0	0	978	976		41	10	4.94	0	0	4.26	0.45	0.47	0.47	0.49						
1.7	0	0	979	977		41	10	4.94	0	0	4.26	0.45	0.47	0.47	0.49						
1.8	0	0	979	976		40															
1.9	0	0	979	977		40															
2	0	0	979	977		41															
2.1	0	3	979	977		41															
2.2	3	0	979	978		41															
2.3	0	3	979	978		41															
2.4	3	3	980	977		41															
2.5	3	0	979	978		41															
2.6	0	0	978	978		40															
2.7	0	0	978	977		40															
2.8	0	3	977	978		40															
2.9	0	0	978	979		40															
3	3	3	978	978		40															
3.1	0	3	978	976		41															
2.79																612	582.33	29	799	5.1938998	100.5083633
2.8																626	571.6	18	899	5.1938993	100.5083625
2.8																464	560.57	3	916	5.193897	100.5083616
2.8																555	566.17	6	921	5.1938954	100.5083608
2.8																483	565.63	38	895	5.1938948	100.5083595
2.8																652	567.43	29	803	5.1938964	100.5083562
2.81																615	565.53	32	743	5.1939015	100.5083517
2.8																531	563.3	6	822	5.1939055	100.5083468
2.8																596	563.07	18	857	5.1939093	100.5083418
2.8																501	565.43	158	924	5.1939119	100.5083377
2.8																545	571.93	109	903	5.1939151	100.5083333
2.8																600	577.1	65	851	5.193917	100.5083288
2.8																747	577.4	115	732	5.193919	100.508324
2.8																670	574.63	129	739	5.1939201	100.50832



Bottom Up Measurements

Parking lot survey: Some idea of destination (but not purpose),
Fleet/age info
Vehicle Mix, age, ridership?

Road Side surveys: Vehicle Mix, Speed
Purpose? Distance?
+ Multiple Vehicles **- One location at a time**



Bottom Up Measurements

Road Side Measurements: Speed, Vehicle Size, emissions (if chosen well)

+ Fast, precise data

- Single point

- No info on purpose, destination, …

Bottom Up Measurements

Vehicle Sequestration Measurements:

+ Excellent Weight, Emissions, FC

- Slow

- Invasive

Bottom Up Measurements

Commuter Surveys:

Trip Purpose
Origin, Destination
Approximate Distance
Approximate FC
Approximate Passenger Loads
Approximate Mode Breakdown
Costing info
+ Lots of (otherwise) hard to get data
- Subjective and systematically underestimates some information

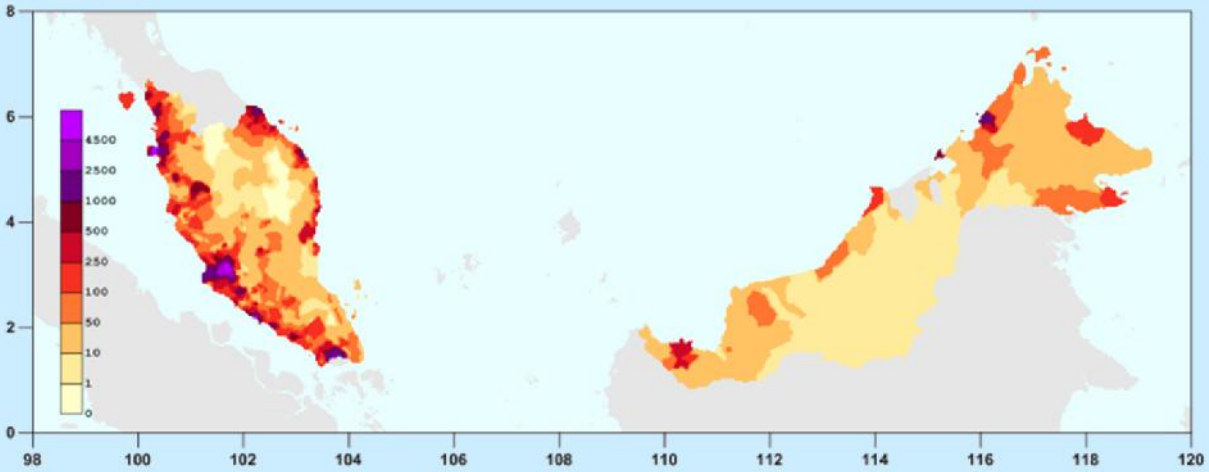
While individual consumer surveys are very useful, the tend to systematically underestimate number of trips (eg. they only give the mandatory trips, forgetting discretionary trips)

QUESTION:
How can we get this data voluntarily submitted from commuters?

Example: Malaysia Macro Data

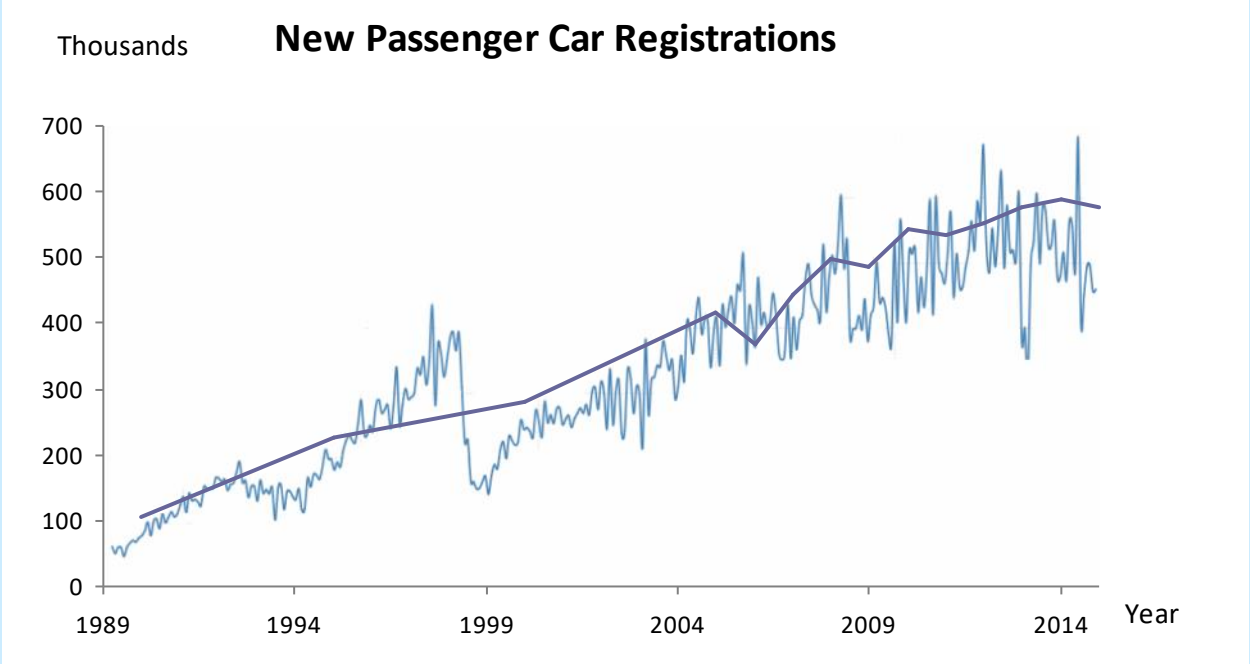
Population Concentration

30M
~2M undocumented



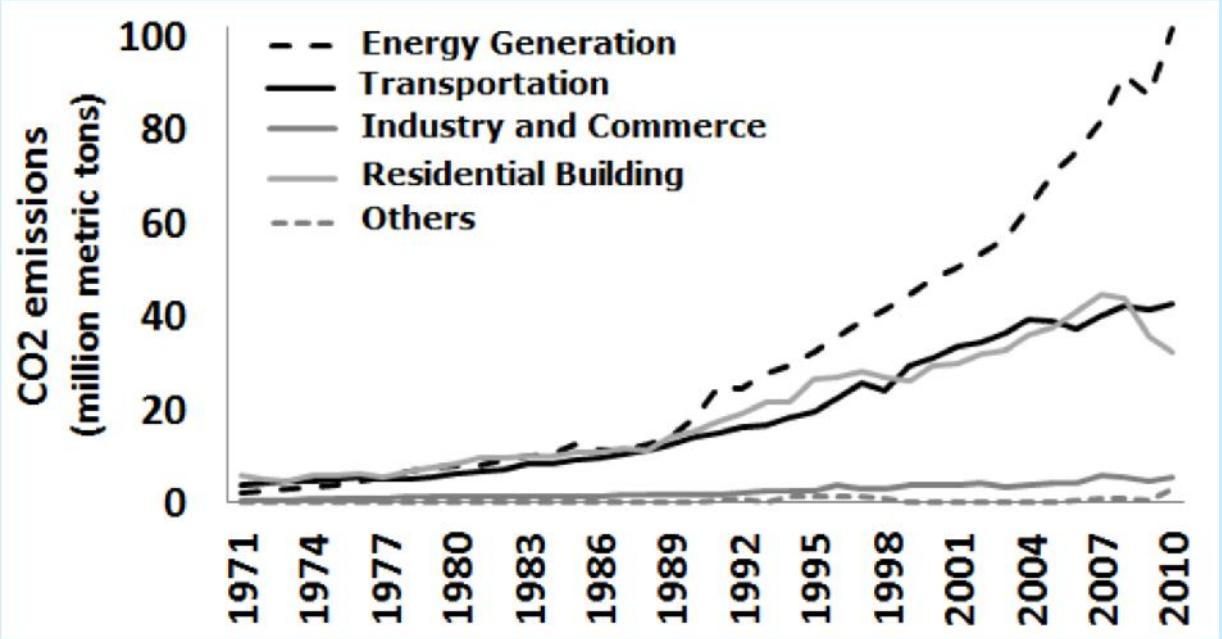
New car registrations 500,000/year

Fleet ~ 15M



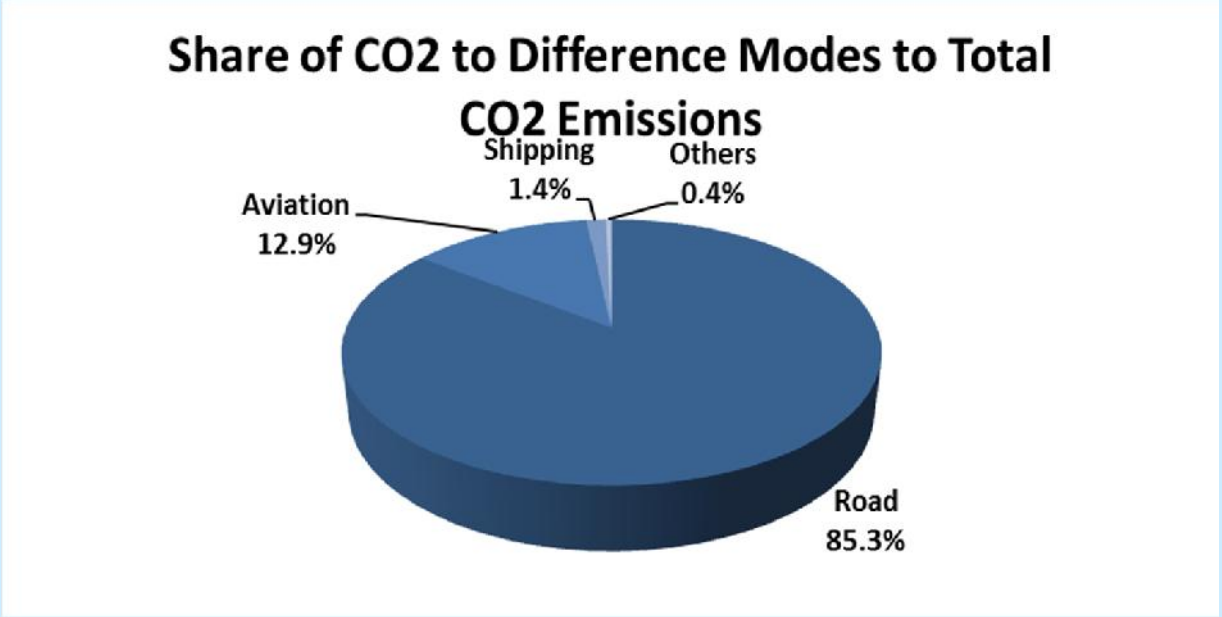
Example: Malaysia Emissions

Emissions by Sector
Transport is ~25%



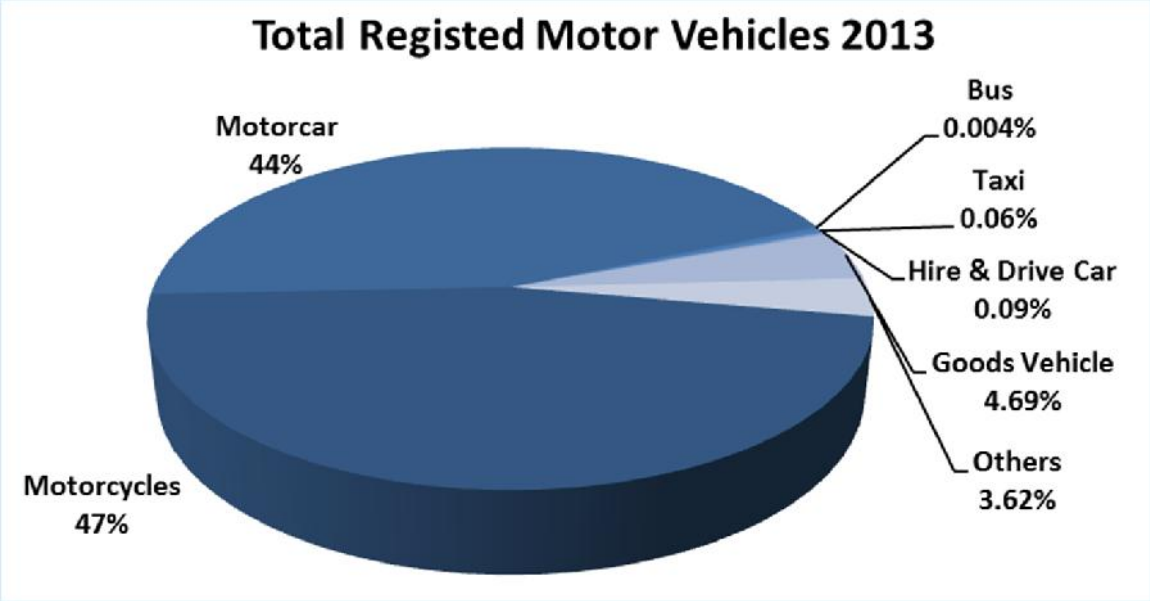
Transport Emission by Mode

Most comes from Road

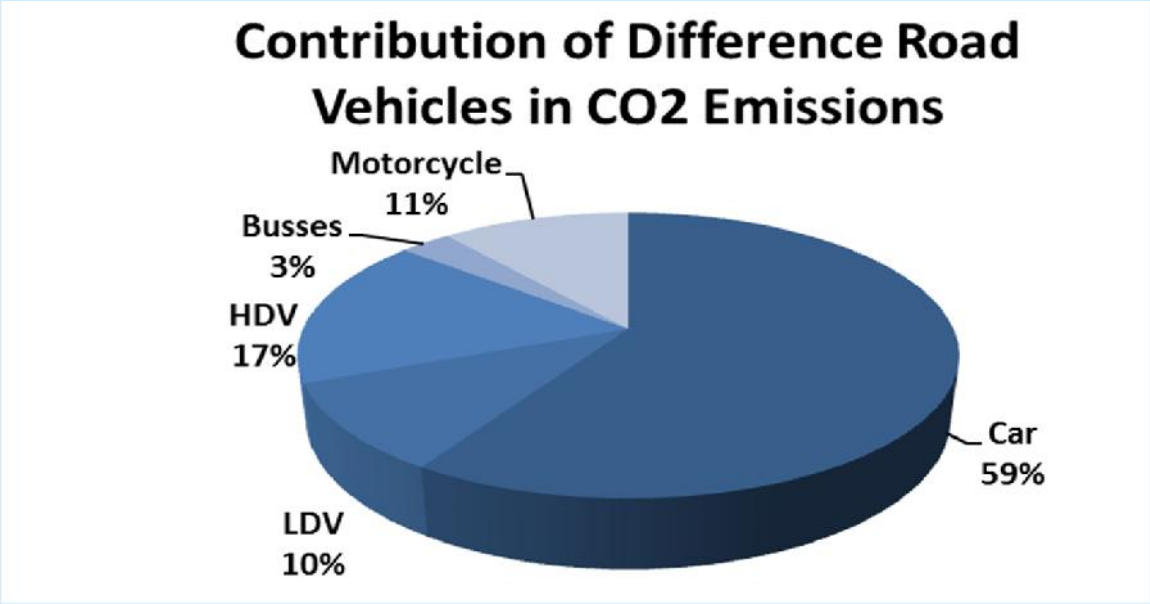


Example: Malaysia Road Emissions

Roughly equal number of motorcycle and cars

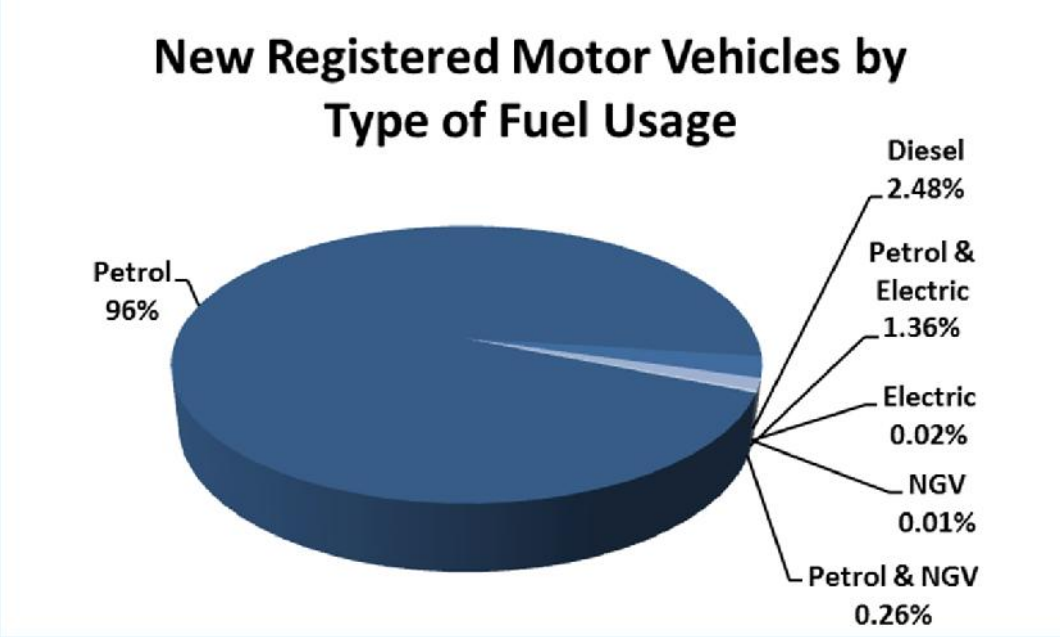


But cars consume the bulk of the fuel

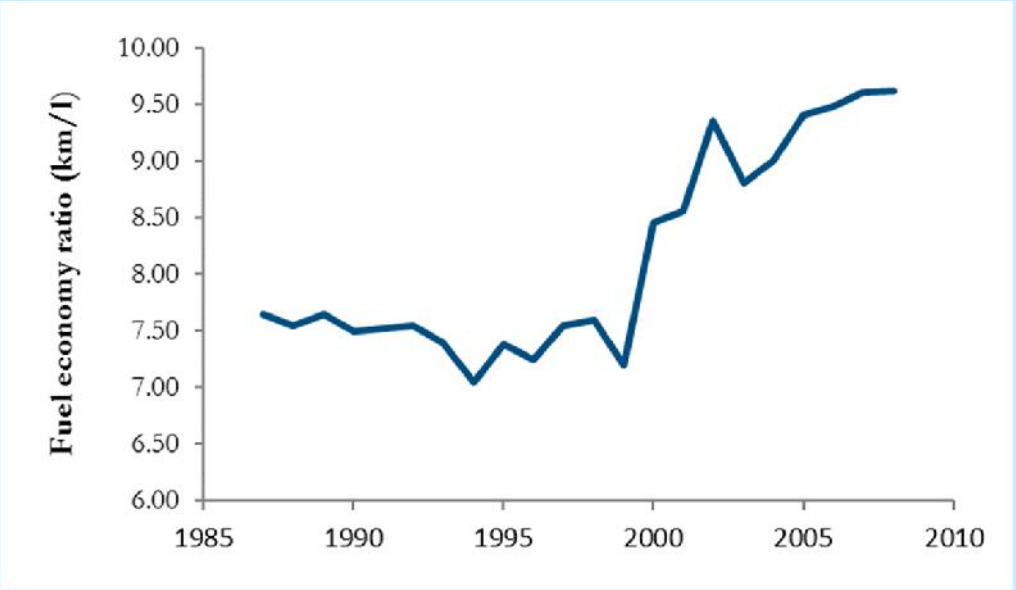


Example: Malaysia

Most cars are Petrol



Around 2000 there was a shift to Fuel Injection improving Fuel Economy



Example: Malaysia

Number of Passenger Cars (road tax): **10.5M in 2013**

Typical Fuel Consumption (University Study): **9.5 km/liter**

Number of Passenger km/year (govt inspection): **24k km/year**

Total Fuel Consumed = 10.5M x (24k km / 9.5km/liter) x .720toe/1000liter
= 19 Mtoe

Total fuel consumption for passenger cars: **19 Mtoe**

Example: Malaysia

“Bottom up” petrol consumption for passenger cars: **19 Mtoe**

“Top Down” (petrol sales) consumption passenger cars: **12.3 Mtoe**
ERROR: 54%!

The governmental number for annual mileage comes from vehicle inspections. These inspections are not mandatory, and the only passenger cars that routinely get inspected are government fleet vehicles, which experience unusually high usage.

A quick survey (petrol station) determined the following:
Typical annual mileage (personal car): 15,500km/year

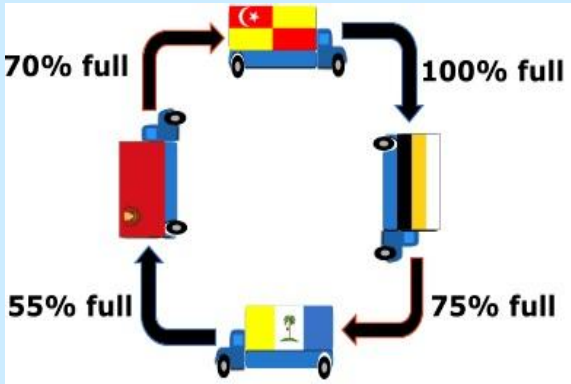
10.5M x (15.5k km / 9.5km/liter) x .720toe/1000liter = 12.3 Mtoe (Bottom up)

MORAL: Be careful how you use official numbers, and always reality check results with “bottom up” data.

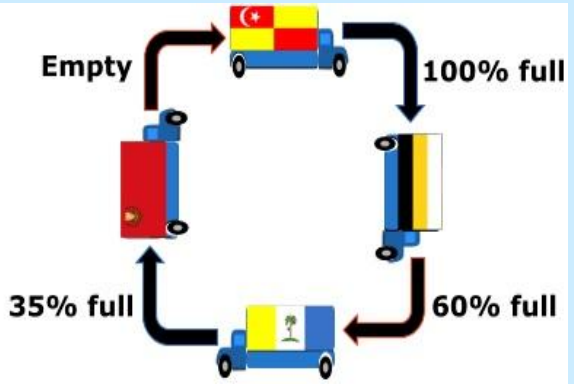
ASEAN level Results

The Malaysian work highlited several things that can be done at the ASEAN level to improve transportation sustainability:

1) Freight Exchange
We need to have an international level “load share” to improve Freight efficiency.



Above a more efficient (example) shipment journey with backloads (pick up freight from each destination drop off point)



Above inefficient (example) shipment journey with no backload (no pick up freight from destination drop off points)

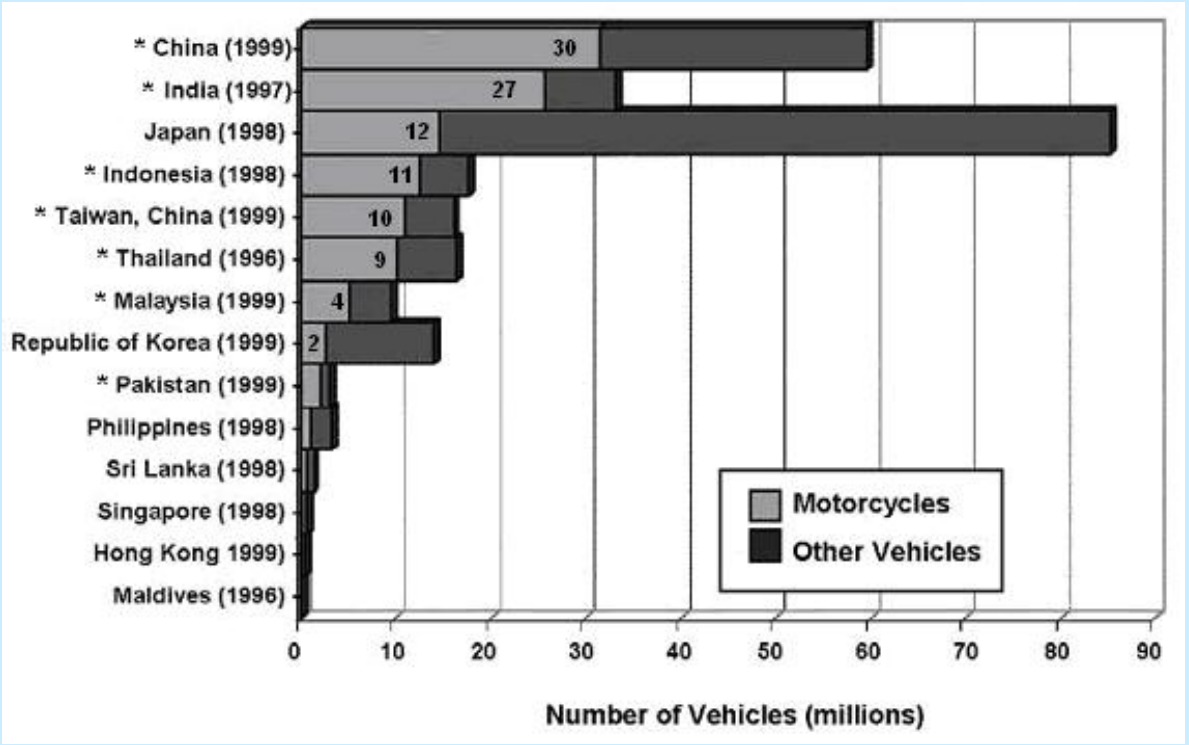
2) Rail Commonality
Better to lay down common gage Rails for easier integration tomorrow.

3) Vehicle Standards Harmonization
Harmonized standards makes ASEAN the 3rd largets trading block in the world: 650M people!

4) Universal data coverage: Some Data is missing in most countries, most data is missing in some countries.

ASEAN Automotive Market: 2W?

Due to their low cost 2-wheelers dominate small transportation units in developing countries.
Typical vehicle life spans are well over 20 years.
•Cost ~ 1,000$
•Top speed 55-70 mph
•130 mpg
It is estimated that there are 200M units worldwide.



China: 1.2 Billion
India: 1.1 Billion
ASEAN: 650M

For about half of the world, 2-wheelers are the basic transport of choice.

Indonesia Parking lot: 250M people

Association of SE Asian Nations

Within SE Asia there are some unique environmental and socio-economic factors. ASEAN countries are homogenizing standards and regulations to have a greater impact by acting as a trading block of 650M people.

Malaysia

Vietnam

Cambodia

Transportation Efficiency

How much energy should it take to get from Parit Buntar to Penang (30km)?

Car (Solo)	2.5 liters of fuel	(2.5l/pax)
Car (2 pax)	2.5 liters of fuel	(1.2l/pax)
Car (3 pax)	2.5 liters of fuel	(0.8l/pax)
Motorbike (1.2 riders)	0.7 liter of fuel	(0.6l/pax)
Bus (with 20 others)	7.5 liters	(0.375l/pax)
Diesel Train (with 200 pax)	30 liters	(0.15l/pax)
Electric Train (with 200 pax)	20 liters equiv.	(0.1l/pax)

One key point to recall is the total number of ***passenger kilometers per unit fuel consumed*** is the important measure.

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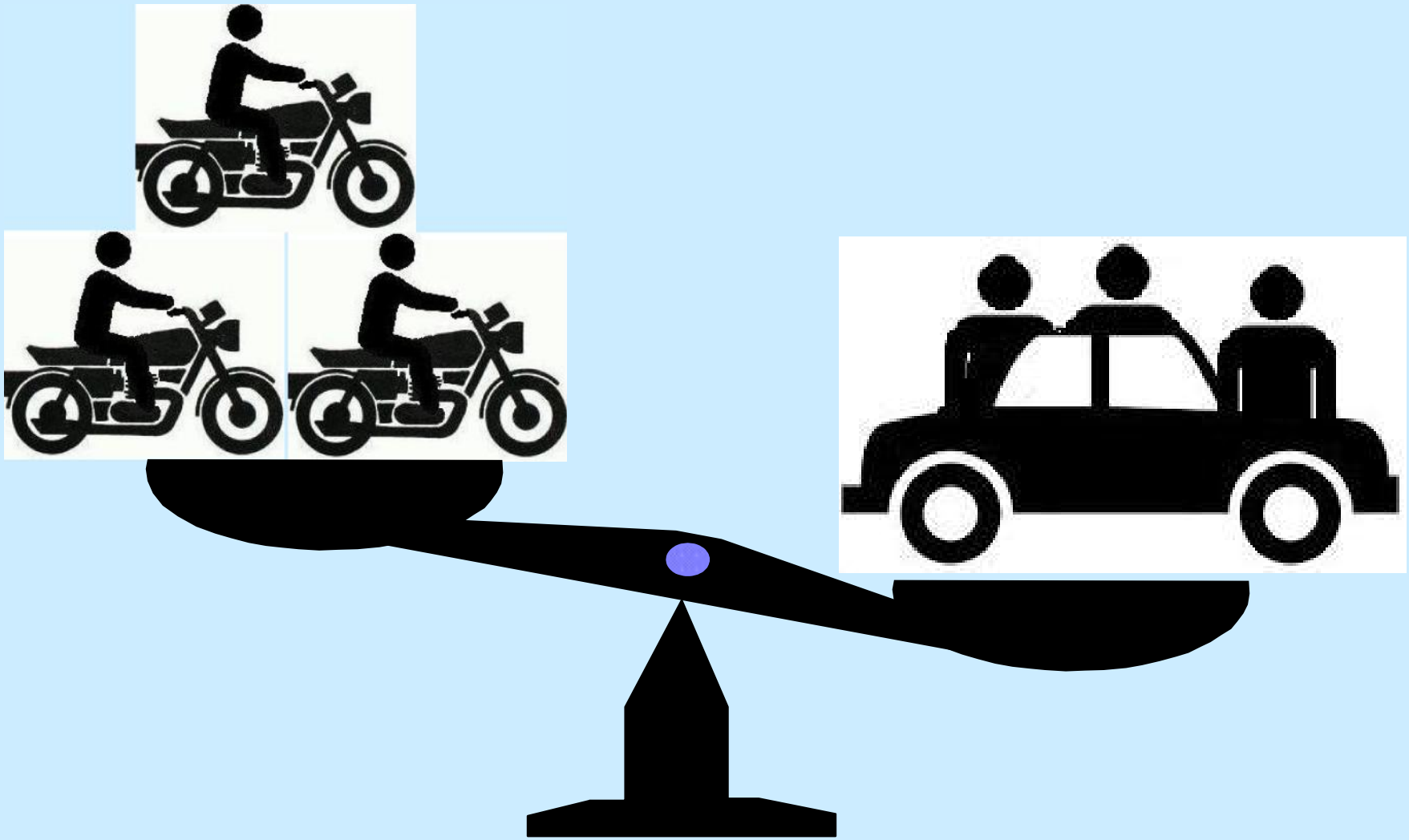
Conclusions:
2-Wheelers are much more efficient than cars
Electric Mass Transit is the most efficient form of transport

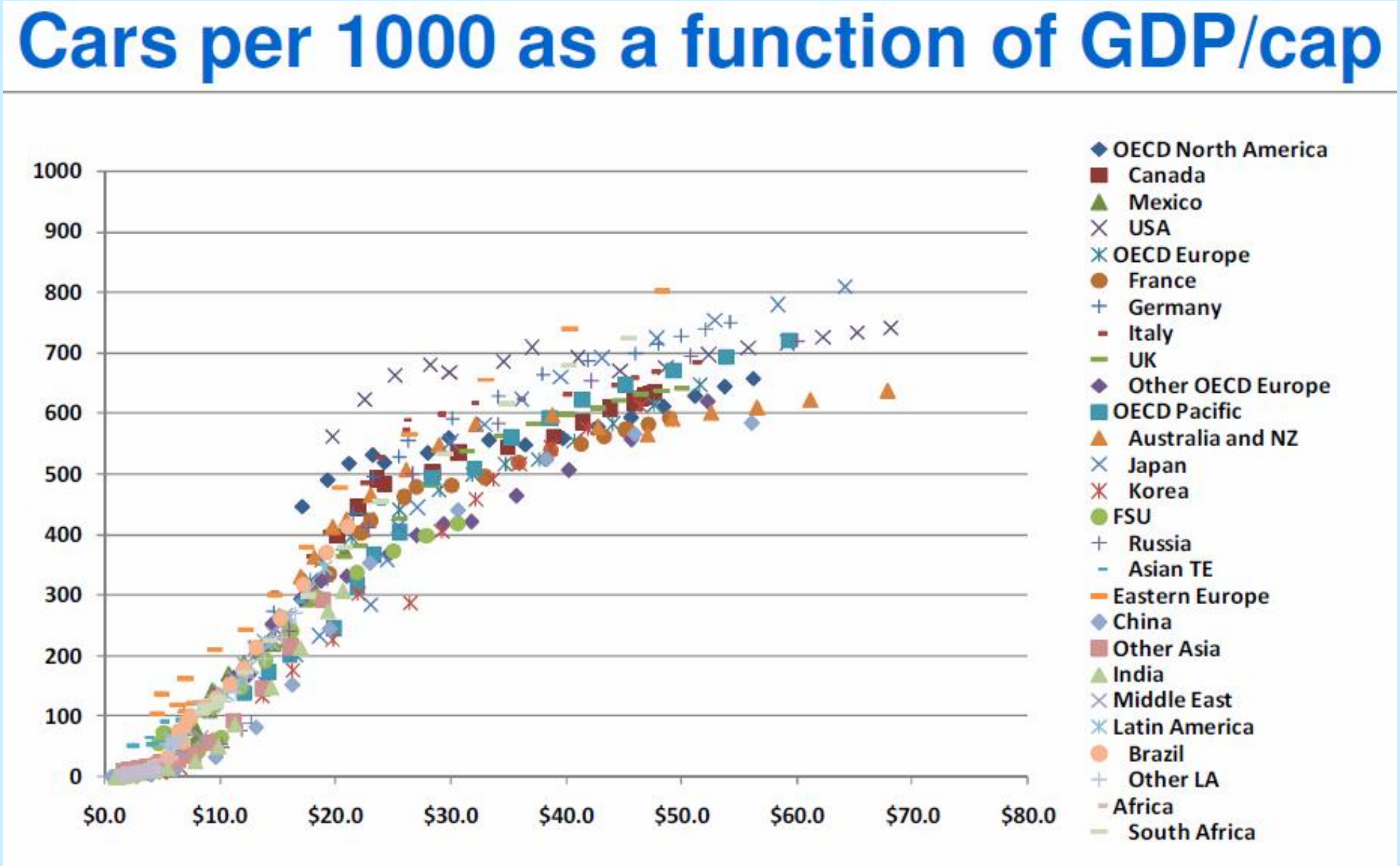
Transportation Efficiency

3 guys on 3 bikes is more efficient than 3 guys in 1 car!



2-Wheelers are so efficient, their actual efficiency is often overlooked.

Economy: More money means more cars



It will be a continual fight to keep people in smaller, more efficient vehicles.

Making 2-Wheelers safer

One way to encourage efficiency is to make 2-wheeler riding safer.
Malaysia leads in Motorcycle Only Infrastructure.

E-bikes: Rapidly Growing Market

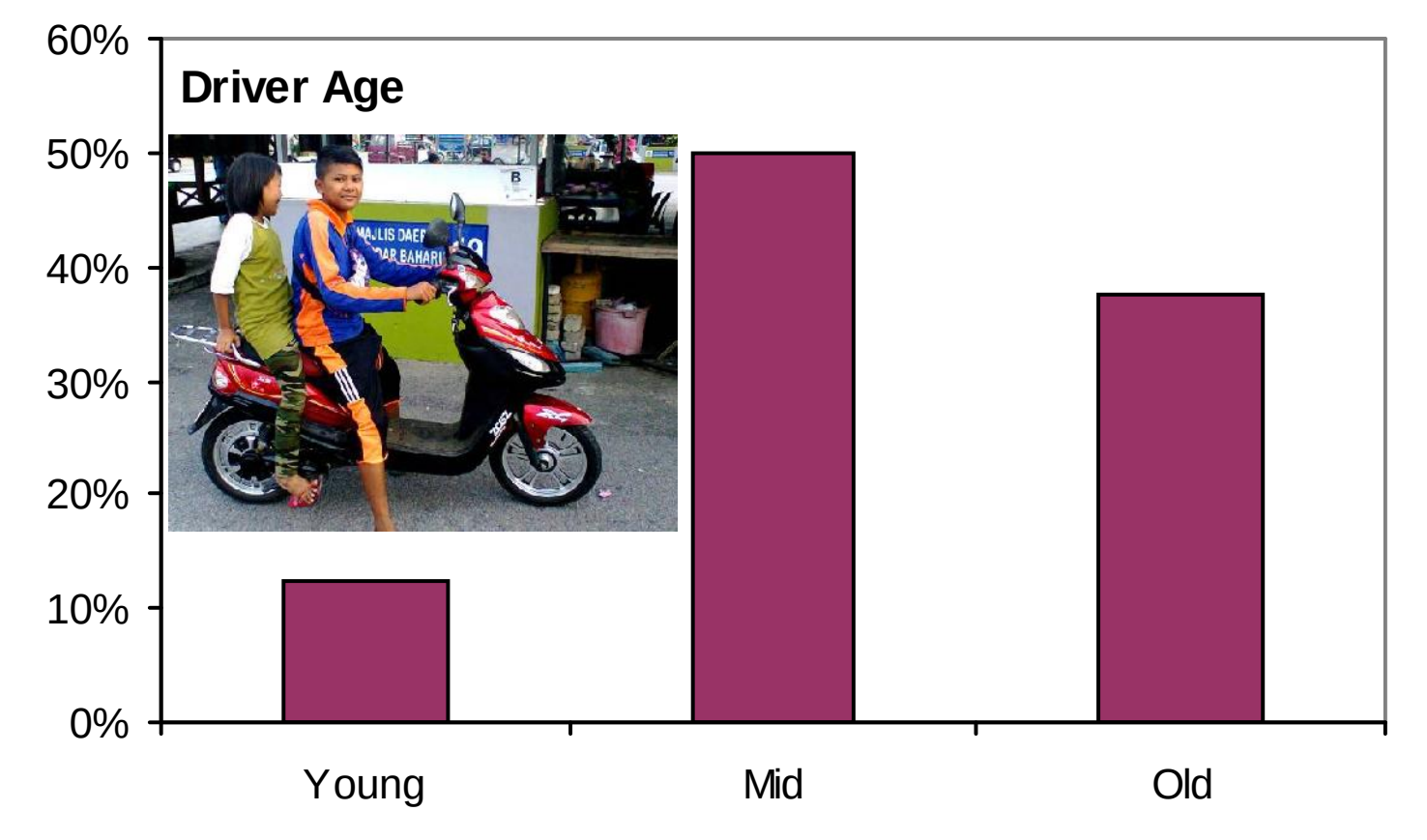
Our estimates show that “E-bikes” went from ~0% to ~1.5% of the 2-wheeler population in Malaysian in the last 10 years.

They are clean, easy to operate, inexpensive and reliable (if well designed).

Important Local Data: E-Bikes

Women tend to prefer them for short hops to the store, to pick up kids at school, or visit the kebun/giran.

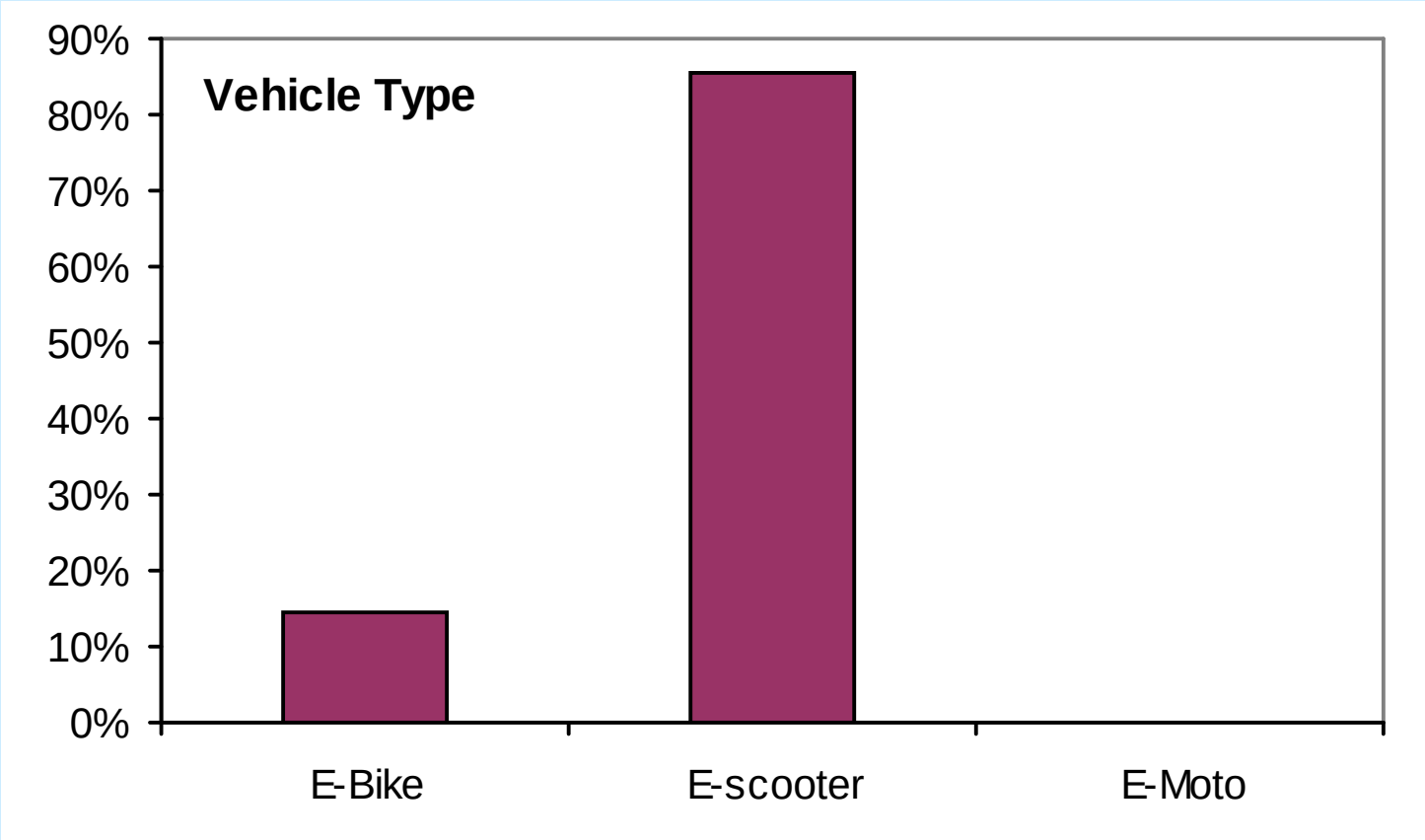
Important Local Data: E-Bikes



Older riders like that there is no kick starting, shifting or filling up with gasoline.

Important Local Data: E-Bikes

Malaysian Standards regulate all three categories



EV Standards Development

2010: Electrical Motorcycle Standards (MS 2413) developed

2012 Electric Bicycle Standards (2 wheelers <25kph)

2014-2015 Both standards were updated and simplified based on actual conformity testing as well as public feedback.

2015 Electric Motorcycle standard applied to small Electric Cars (which also require additional JPJ approvals)

2017 E-Moped class standard passed: Includes Mandatory Battery Lifetime Testing

General Standards Development

Standards need to address 3 main areas:

Safety
Safety for consumer and other road users

Product Quality
Basic quality measurements, not ultra stringent
Does the product achieve it’s advertised claims?

Compatibility
Interoperability, compatibility with infrastructure

Quality Factors in Vehicles

What do customers care about? Just look at adverts:

Cost
Speed
Range
Power
Vehicle Life Span
Carrying Capacity

Our standards cover the highlighted areas above.

PROPOSAL: Transport Data Team

We all need the same type of data, but currently many countries are “under represented” in terms of data coverage.

Instead of *reacting*, and collecting data piece-meal, why don’t we put together a team with the right tools and training, and *systematically* collect the data for all of ASEAN?

Team would travel to countries as required, survey traffic, instrument vehicles, take and compile data.

The data would all be made publically accessible.

The team can train local personnel on tools and techniques for future

Conclusions

- There is a need to encourage efficient vehicles, including 2-wheelers

- Electric 2-Wheelers are becoming more popular

- Harmonized STANDARDS should be established including Electric Vehicle Range and Life Span

- International Freight Share service is important to improve Freight Efficiency

Conclusions

•There is a need to create an ASEAN transportation analysis team which can quickly and inexpensively asses the transportation scene in ASEAN

•There is a huge opportunity to tap into user-generated transport data (eg. purpose of trips, distances, costs, …) using smart technologies, and simple “website surveys”.

But, how do we collect, organize, verify and analyze this?

End of Main Presentation

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