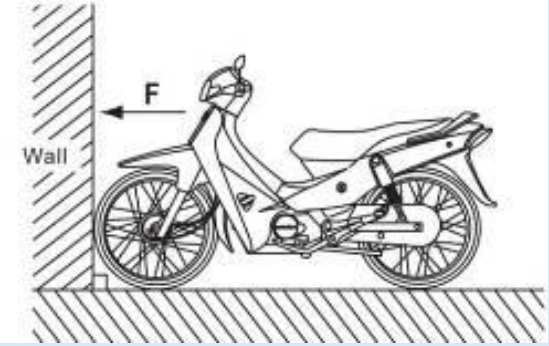
The Reality of Sustainable Transportation



GIZ
Dr. Horizon Gitano-Briggs
Focus Applied Technologies

Outline

- Fundamentals of Sustainability in Transportation
- Transportation Efficiency and CO2
- Transportation Question:
  Where are you going?

- Highlights from Malaysian Study
- Ramifications for ASEAN
- 2- Wheelers and e-Bikes
- Electric Vehicle Standards
- Recommendations for sustainable transport

This report was supported by GIZ:
The Deutsche Gesellschaft für Internationale Zusammenarbeit

Pillars of Sustainable Transport

Urban Planning 1: City Layout

- **Prevent necessity of moving people/goods large distances**
- **Design cities with efficient transport in mind**
- **Mass Transport Systems are much less expensive to build ahead, more difficult to "retrofit" in later**
- **Mass Transit requires first/last mile options**
- **People want "convenience" of private vehicles, even when inconvenient**

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**

A 30 min car trip shouldn't take 2 hours by bus!

GET THE DATA: Decisions need to be based on *real* data

Transportation Efficiency

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

Taxi	5.0 liters of fuel	(5.0l/pax)
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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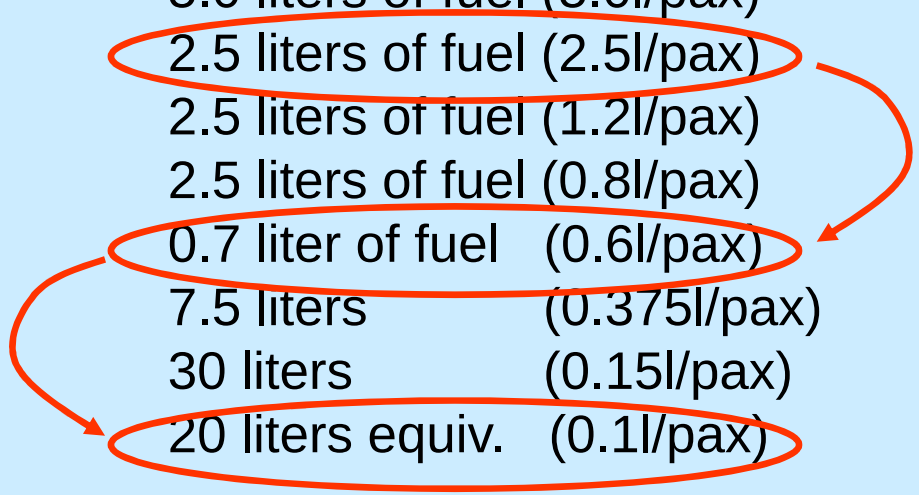


Taxis are the *least* efficient mode

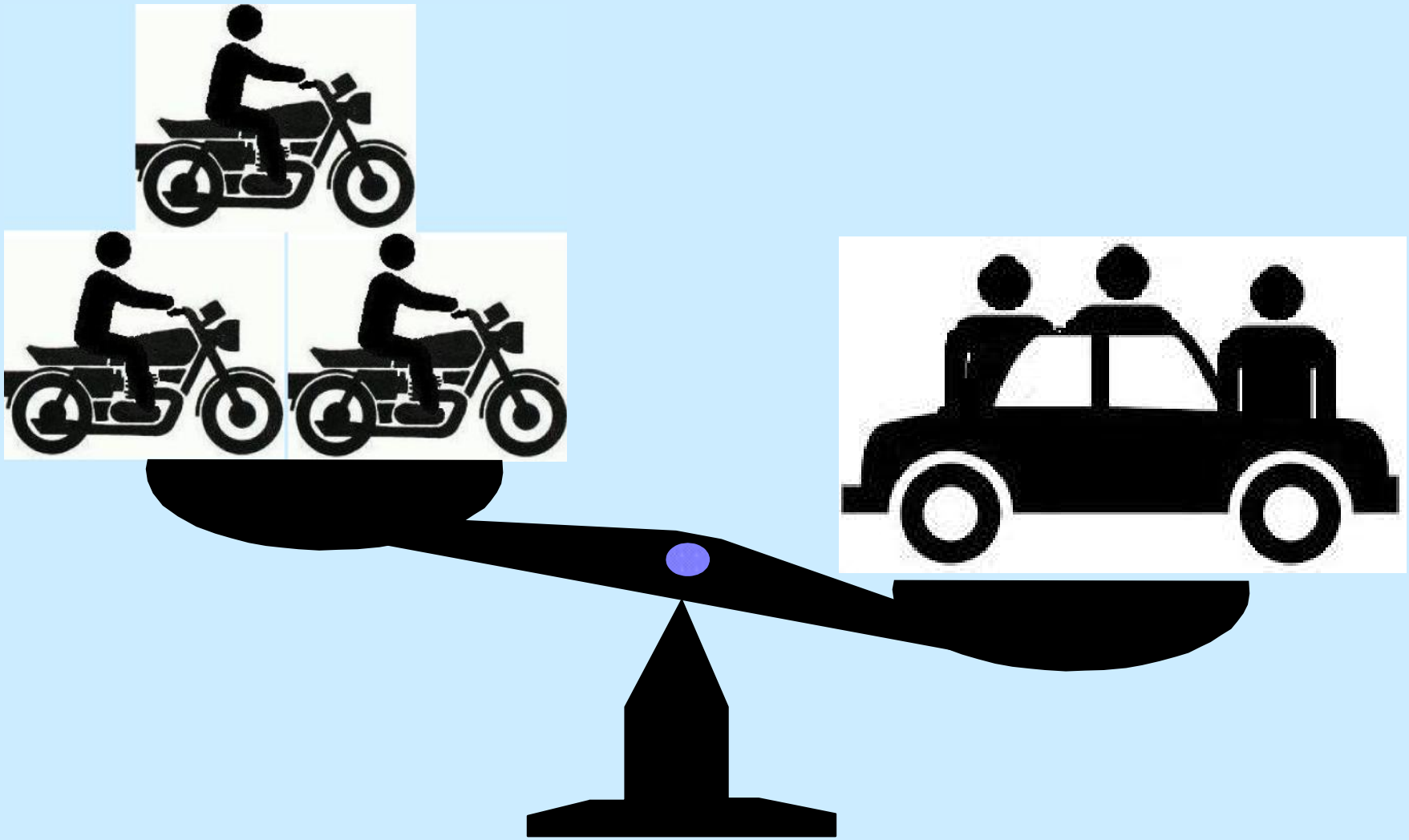
2-Wheelers are much more efficient than cars

Electric Mass Transit is the most efficient form of transport

More efficient transport modes require certain infrastructure, and first/last km options.

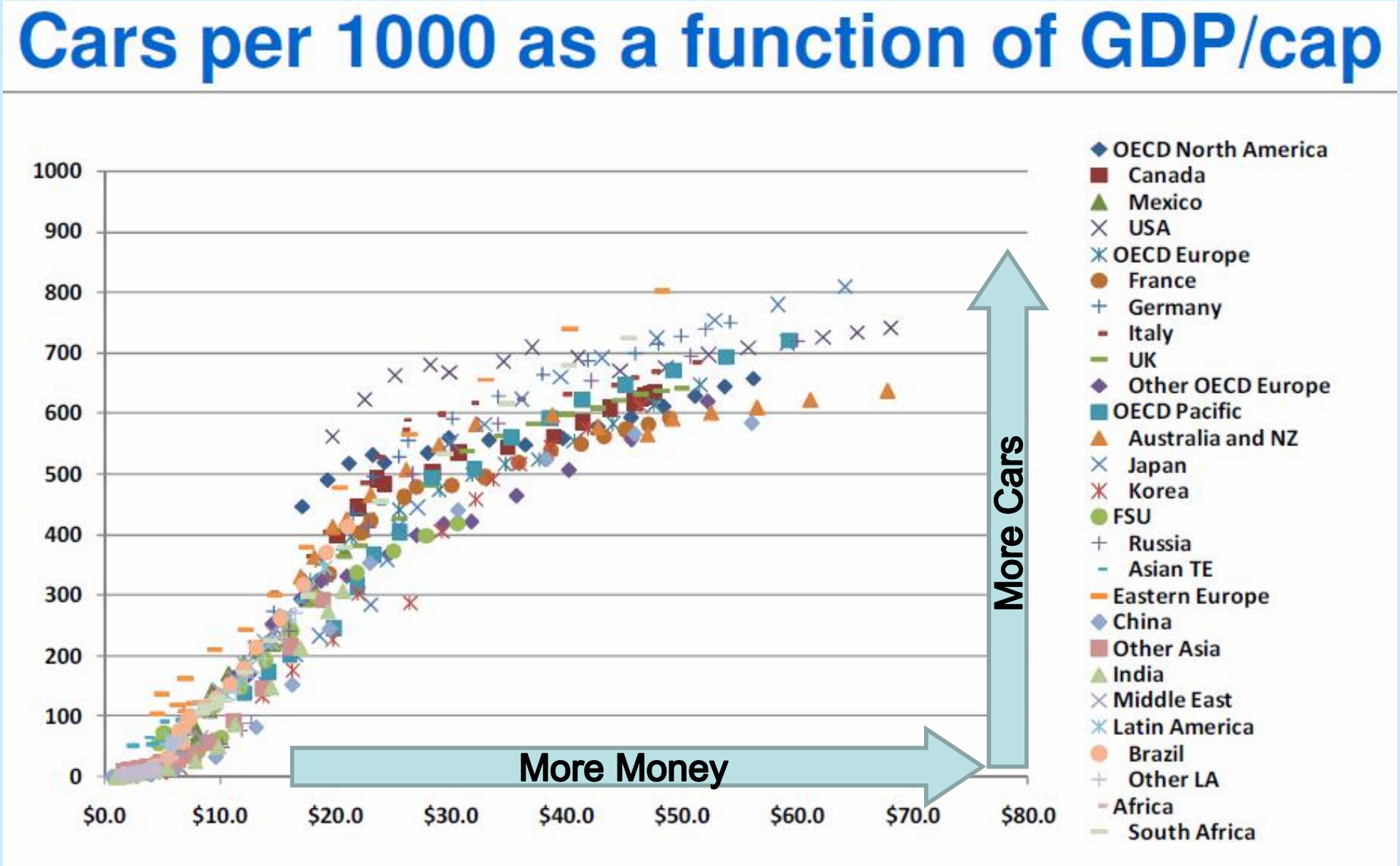
Transportation Efficiency

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 is a continual fight to keep people in smaller, efficient vehicles. One more area of government planning that requires *DATA*.

What data do we need?

Passenger km per year per vehicle + Modal Split: Car, motor, bus, taxi, train
Fuel Consumption per km (or per passenger km)
Emissions
Fuel Consumed per ton-km of freight

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

***Who* is moving *What* from *Where* to *Where, How* and *When*?**

Top Down Measurements

Oil Consumption

Good stats as there are only a few companies, and data is tracked
Mode split to various modes, vehicles difficult
“Leakage” to other uses

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

In Penang during one police check up to 25% of the vehicles were actually STOLEN vehicles!

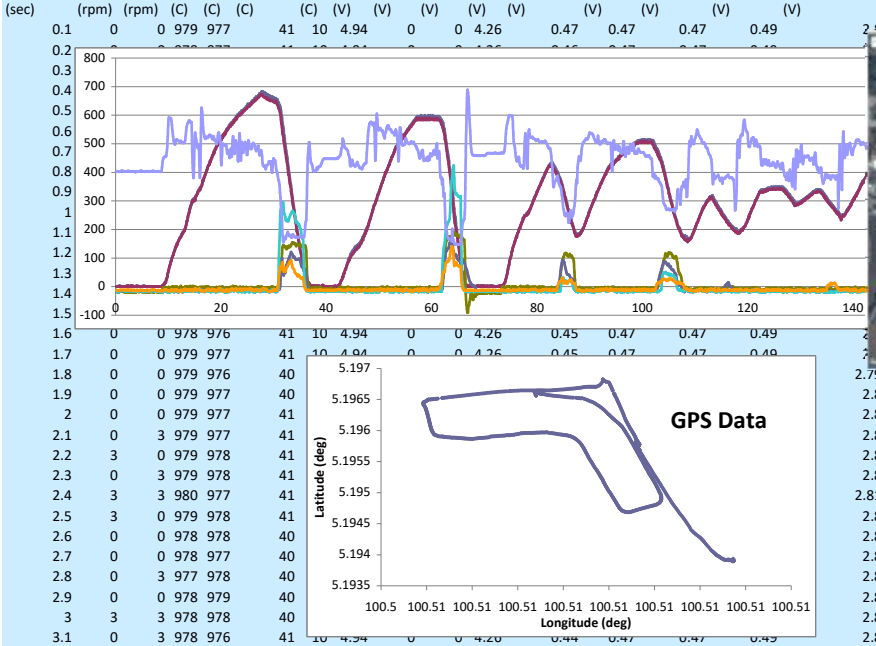
Bottom Up Measurements

Instrumented Vehicle

Eg. Portable Emissions Measurement System
Instantaneous measurements by location, time…
Determine Drive Cycle
Trip Purpose: From Origin/Destination
What's the passenger load?

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										2.79	612	582.33	29	799	5.1938998	100.5083633
1.9	0	0	979	977		40										2.8	626	571.6	18	899	5.1938993	100.5083625
2	0	0	979	977		41										2.8	464	560.57	3	916	5.193897	100.5083616
2.1	0	3	979	977		41										2.8	555	566.17	6	921	5.1938954	100.5083608
2.2	3	0	979	978		41										2.8	483	565.63	38	895	5.1938948	100.5083595
2.3	0	3	979	978		41										2.8	652	567.43	29	803	5.1938964	100.5083562
2.4	3	3	980	977		41										2.81	615	565.53	32	743	5.1939015	100.5083517
2.5	3	0	979	978		41										2.8	531	563.3	6	822	5.1939055	100.5083468
2.6	0	0	978	978		40										2.8	596	563.07	18	857	5.1939093	100.5083418
2.7	0	0	978	977		40										2.8	501	565.43	158	924	5.1939119	100.5083377
2.8	0	3	977	978		40										2.8	545	571.93	109	903	5.1939151	100.5083333
2.9	0	0	978	979		40										2.8	600	577.1	65	851	5.193917	100.5083288
3	3	3	978	978		40										2.8	747	577.4	115	732	5.193919	100.508324
3.1	0	3	978	976		41										2.8	670	574.63	129	739	5.1939201	100.50832



Bottom Up Measurements

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

+ Fast

- Single point

- No info on purpose, destination, …

Bottom Up Measurements

Commuter Surveys:

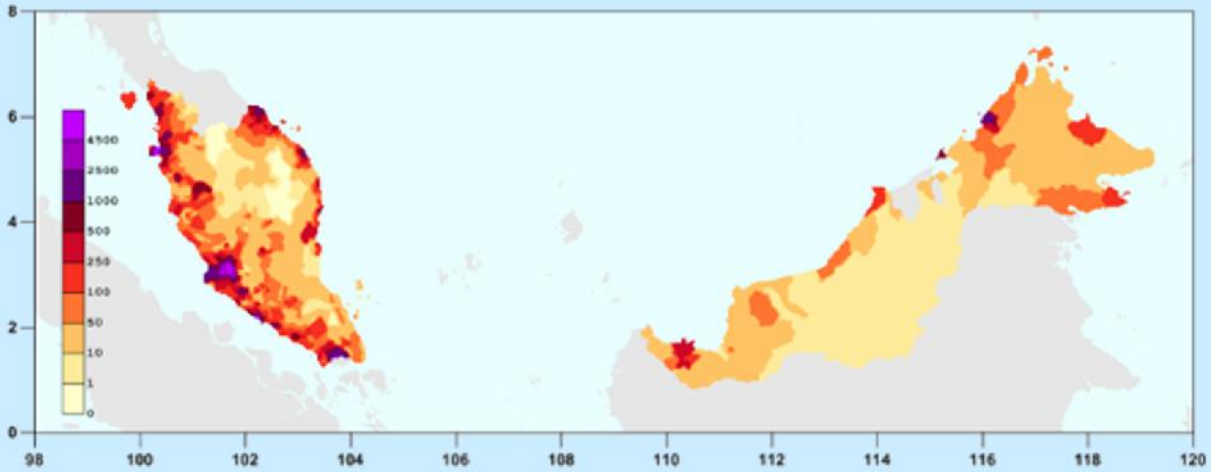
Trip Purpose
Origin, Destination
Approximate Distance
Approximate FC
Approximate Passenger Loads
Approximate Mode Breakdown
Costing info

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)

DATA:
WHO is moving WHAT from WHERE to WHERE, HOW, WHEN and WHY?

Example: Malaysia Macro Data

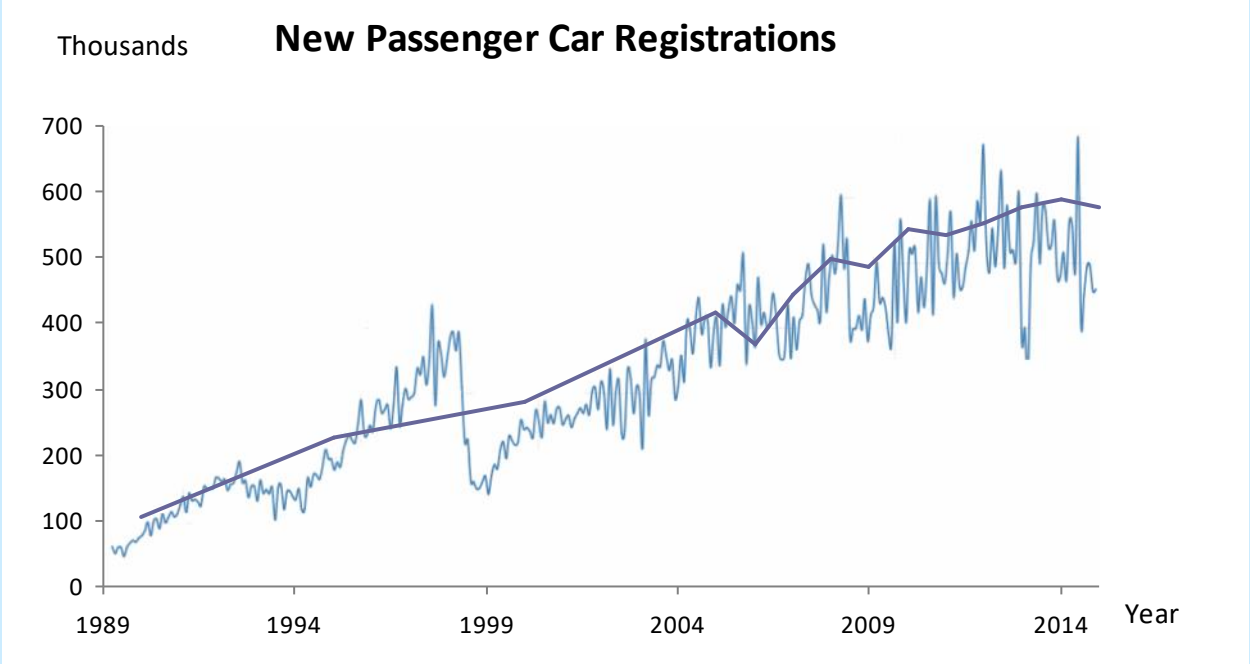
Population Concentration



30M
~2M undocumented

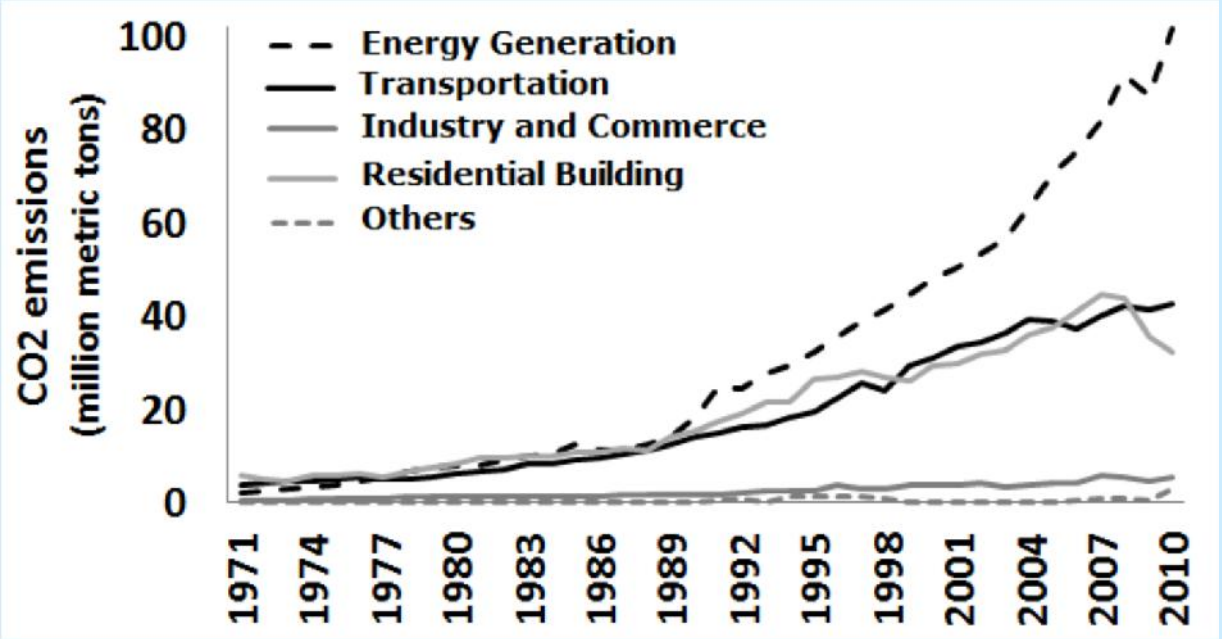
New car registrations 500,000/year

Fleet ~ 15M



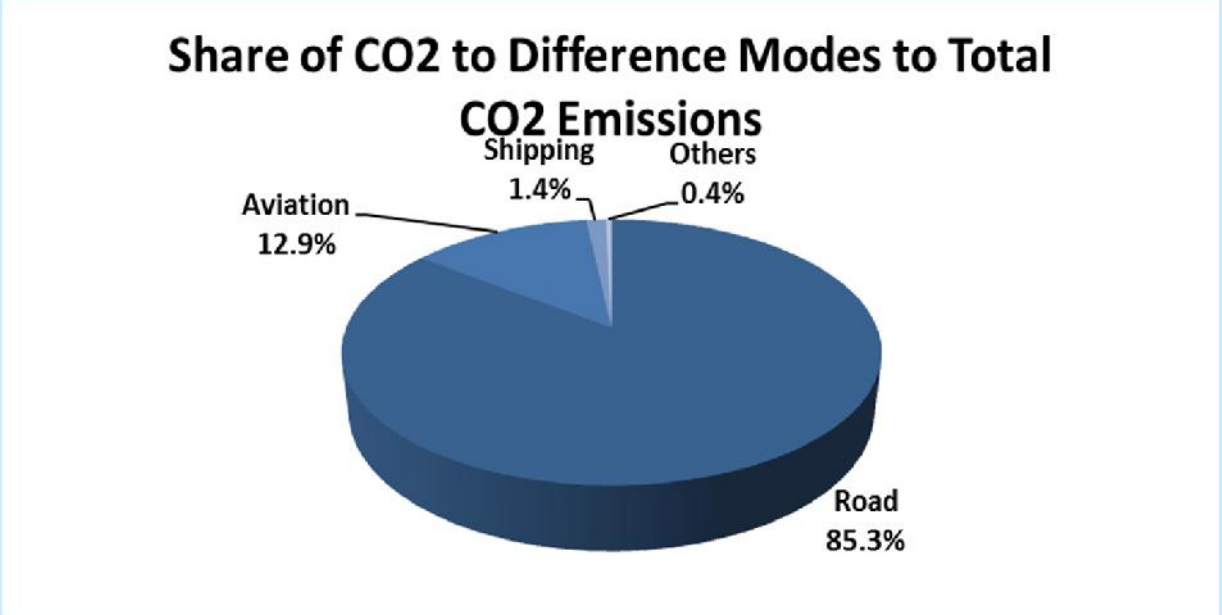
Example: Malaysia Emissions

Emissions by Sector
Transport is ~25%



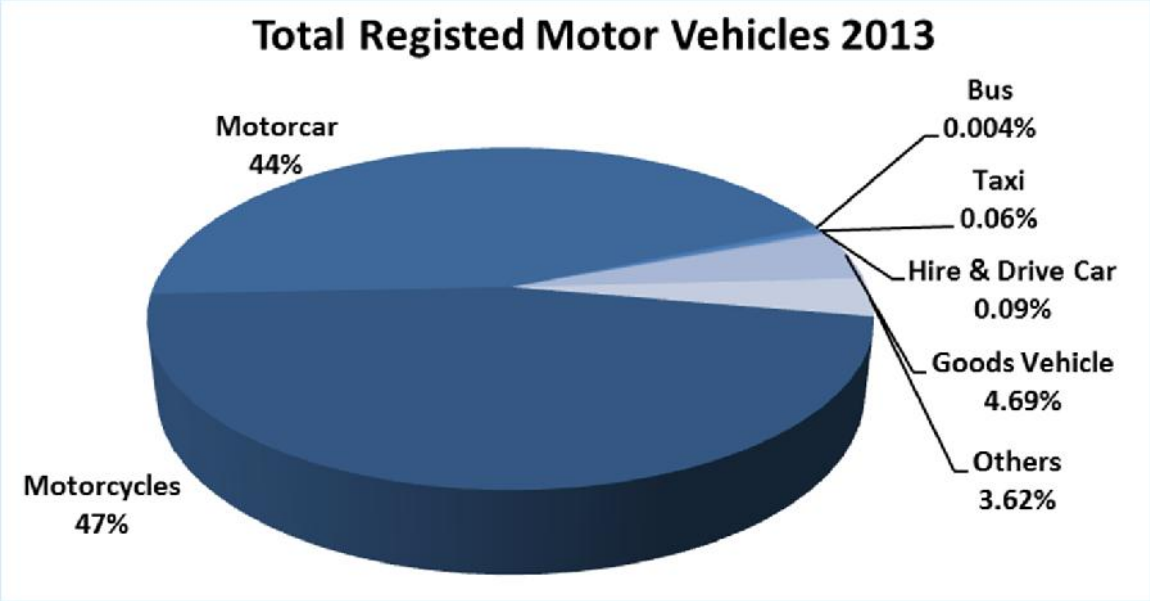
Transport Emission by Mode

Most comes from Road

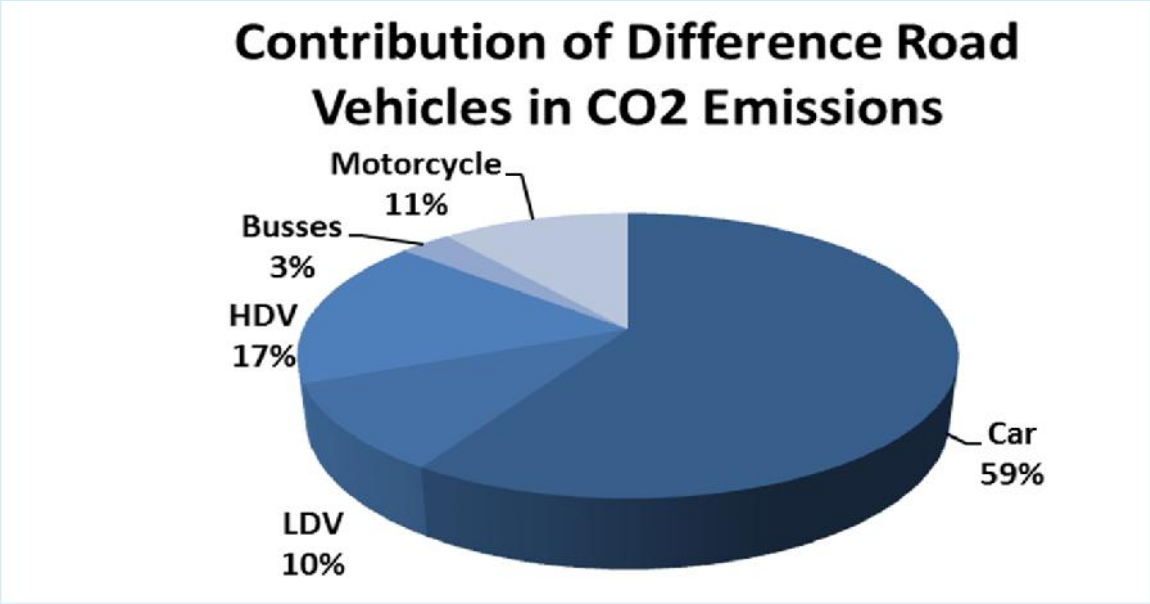


Example: Malaysia Road Emissions

Roughly equal number of motorcycle and cars

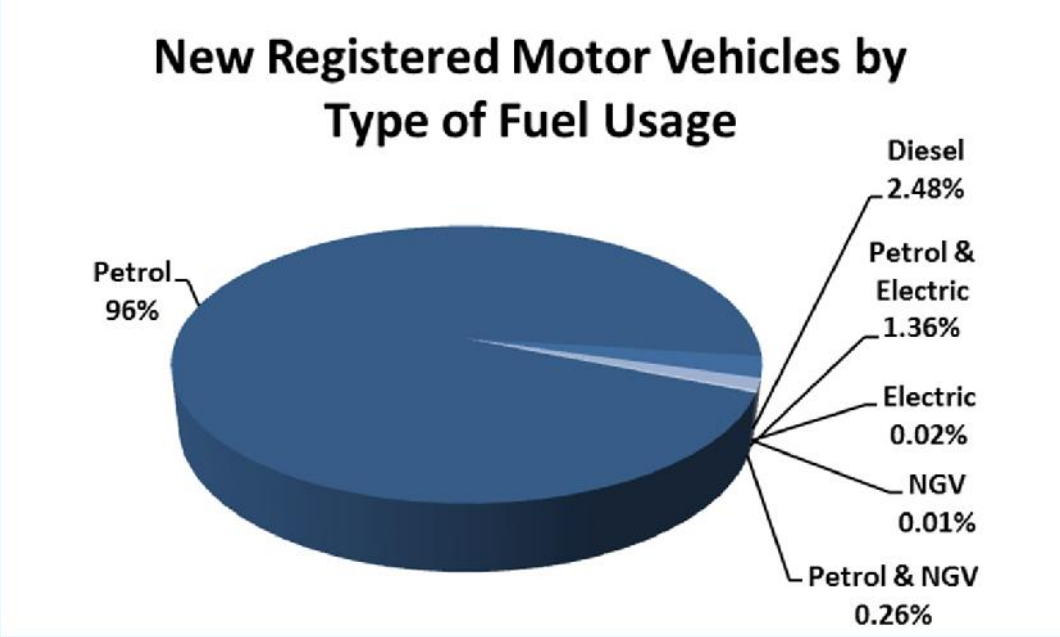


But cars consume the bulk of the fuel

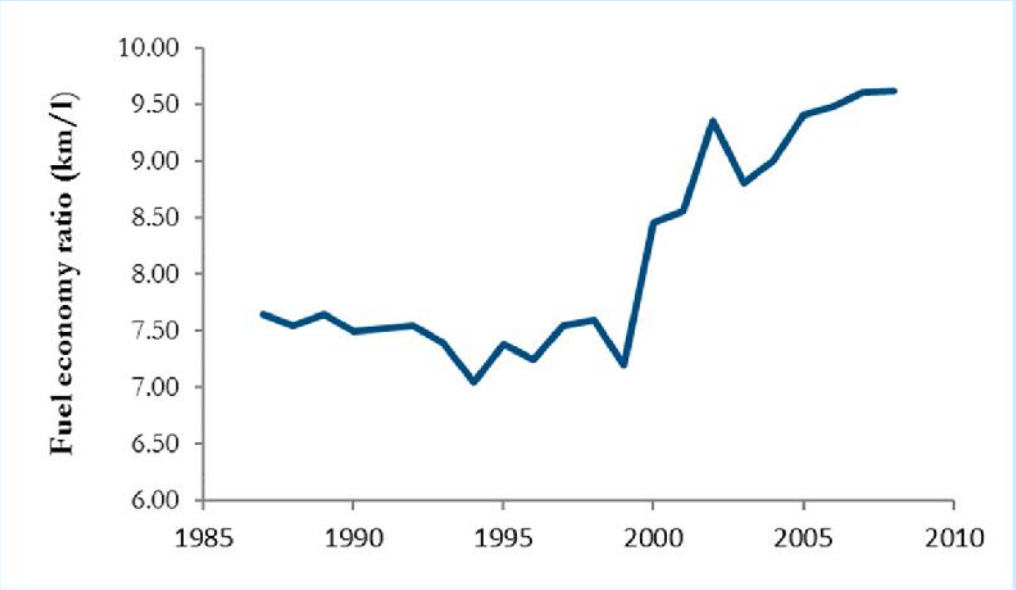


Example: Malaysia

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**

BUT the "top down" petrol consumption was only 12.3 Mtoe for 2013!

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

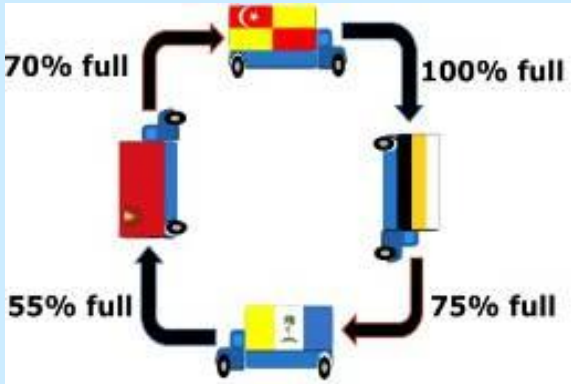
10.5M x (15.5k km / 9.5km/liter) x .720toe/1000liter = 12.3 Mtoe (Bottom up)

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

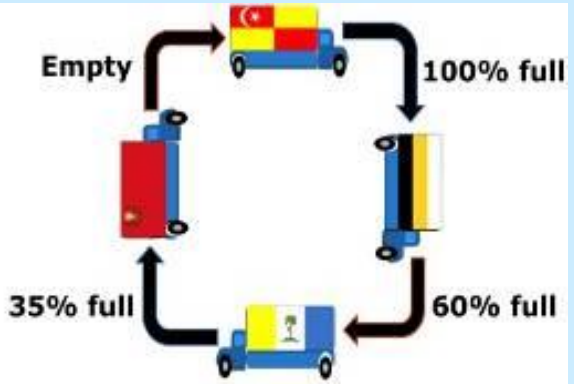
ASEAN level Results

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)



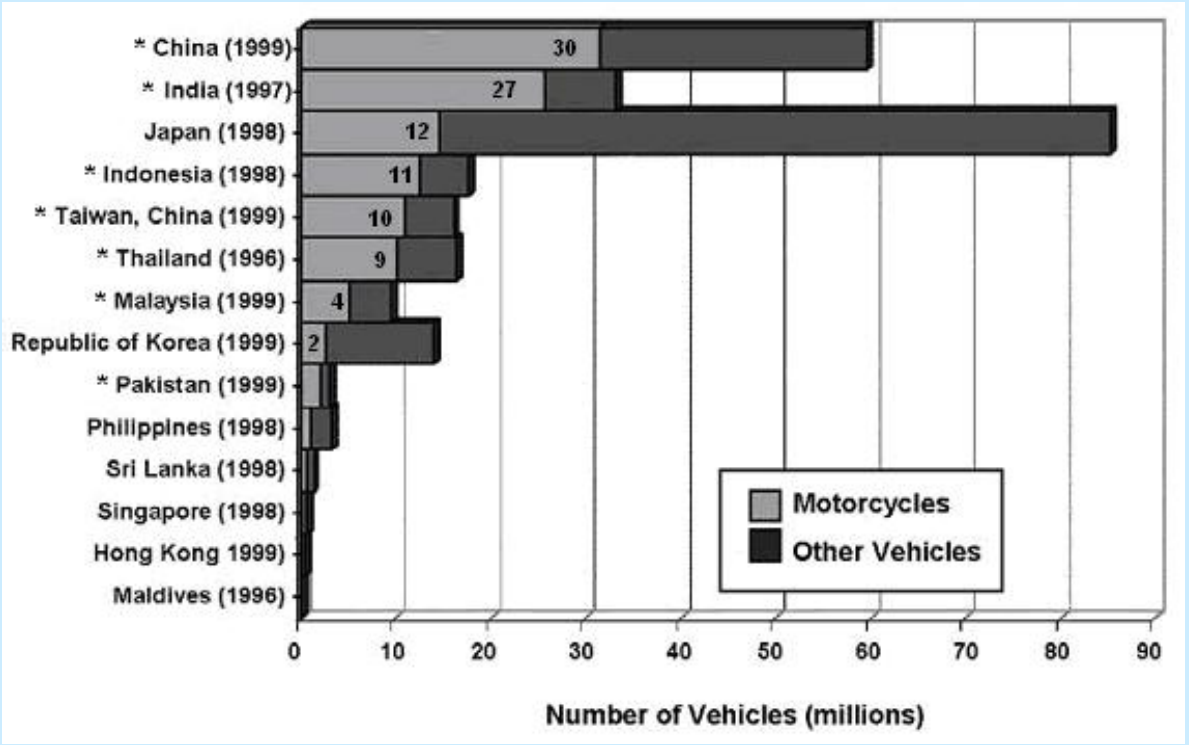
Above inefficient (example) shipment journey with no backload (no pick up freight from destination drop off points)

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!

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

Making 2-Wheelers safer

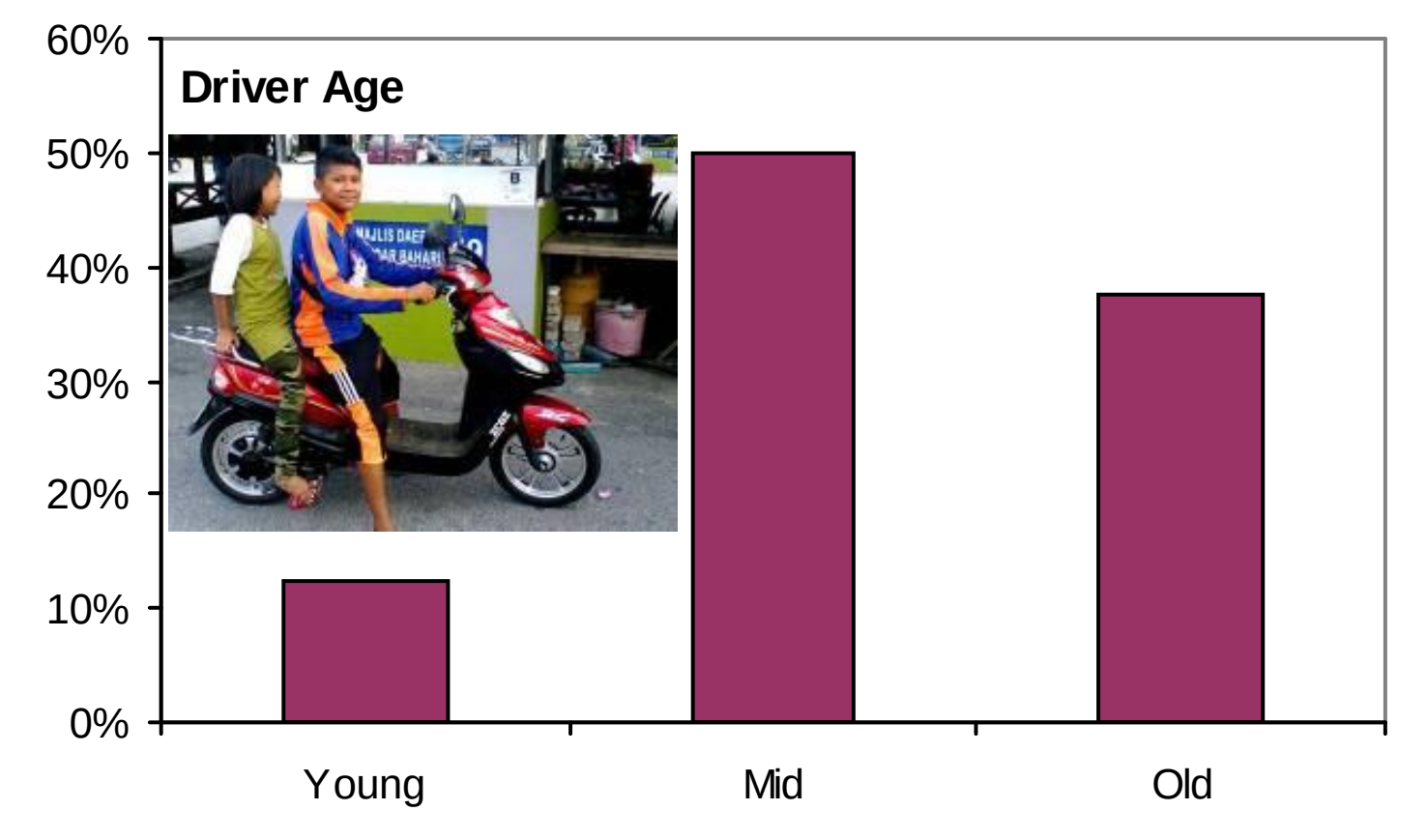
One way to encourage efficiency is to make 2-wheeler riding safer.
Malaysia leads in Motorcycle Only Infrastructure.

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).

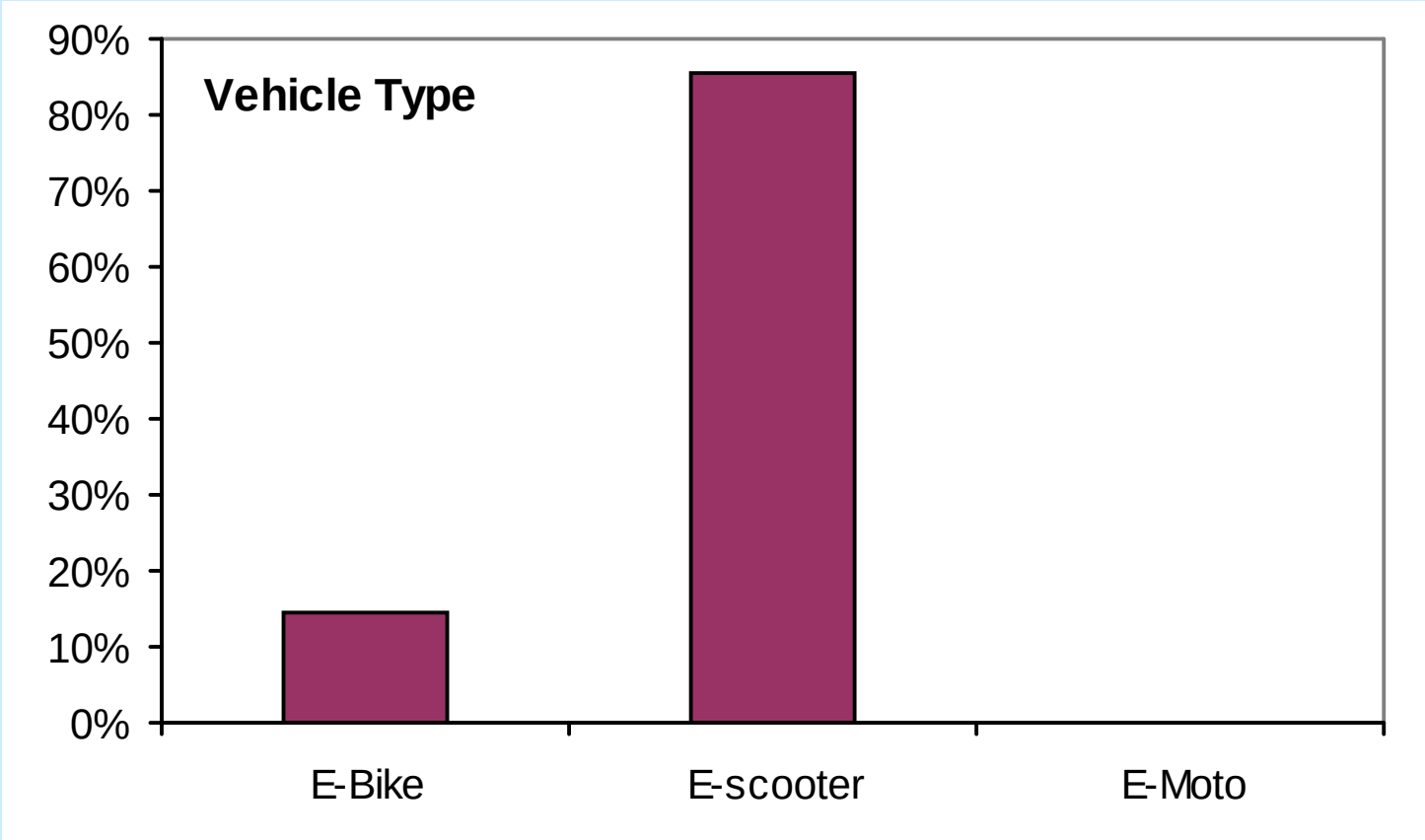
Important Local Data: E-Bikes



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

Important Local Data: E-Bikes

Malaysian has distinct Standards for these three categories



<25kph

25-50kph

>50kph

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:

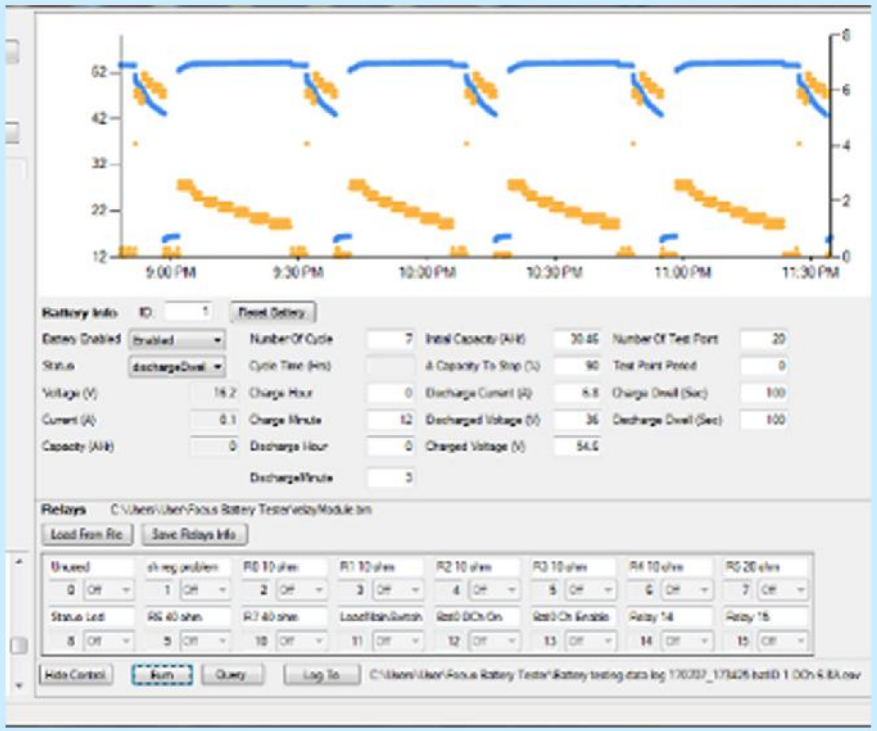
Cost
Speed
Range
Power
Vehicle Life Span
Carrying Capacity

Our standards cover the highlighted areas above.

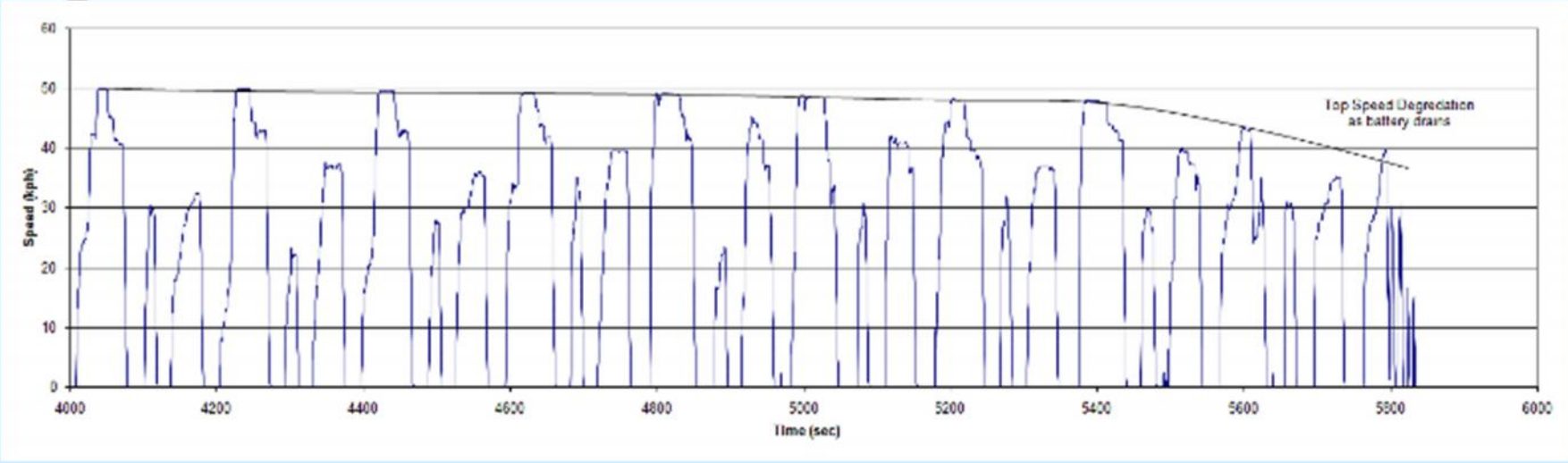
EV Standards Testing

Battery Life Test:

80% capacity for >=300 cycles



Range Test: Automated as vehicles run >130km on ECER40



Recommendations to Government

- Establish centralised authority for fuel efficiency and CO_2/km as unit
- Public education pertaining to sustainable transportation
- Coordinate land use/urban planning on all municipalities

- Better Interconnectivity of Transport Hubs: Park and Ride
- Expansion of the light-rail network
- Encouragement of non-motorised transport in urban areas

- Single passenger cars restriction @ peak transit hours: Car-pooling

- Efficiency label and standards

Example: Airport – City Transport

Sibu (or Melaka, or 20 other cities) has no bus from airport to city.
- 10 planes per day
- 100 passengers per plane
- 50RM per taxi to town

That's 50,000 being spent taxis per airport every day!

In 2 days you can buy a bus, and charge passengers 10RM per trip.
4 busses keeps you on 15 minute intervals, employ ¼ of the old taxi drivers as drivers, mechanics and etc.

Even if only 25% of the passengers use it you can still develop a functional transport system which reduces emissions by 90% AND save everyone money!

Recommendations to Government

2 Wheelers:

Expansion of motorcycle-only infrastructure

Free, priority parking for motorcycles and helmet storage at all transportation hubs and government offices

Subsidised road usage fees and insurance

Continuing “Share The Road” public education underscoring the efficiency and vulnerability of two-wheelers

Freight:

Freight Restrictions in Rush Hour

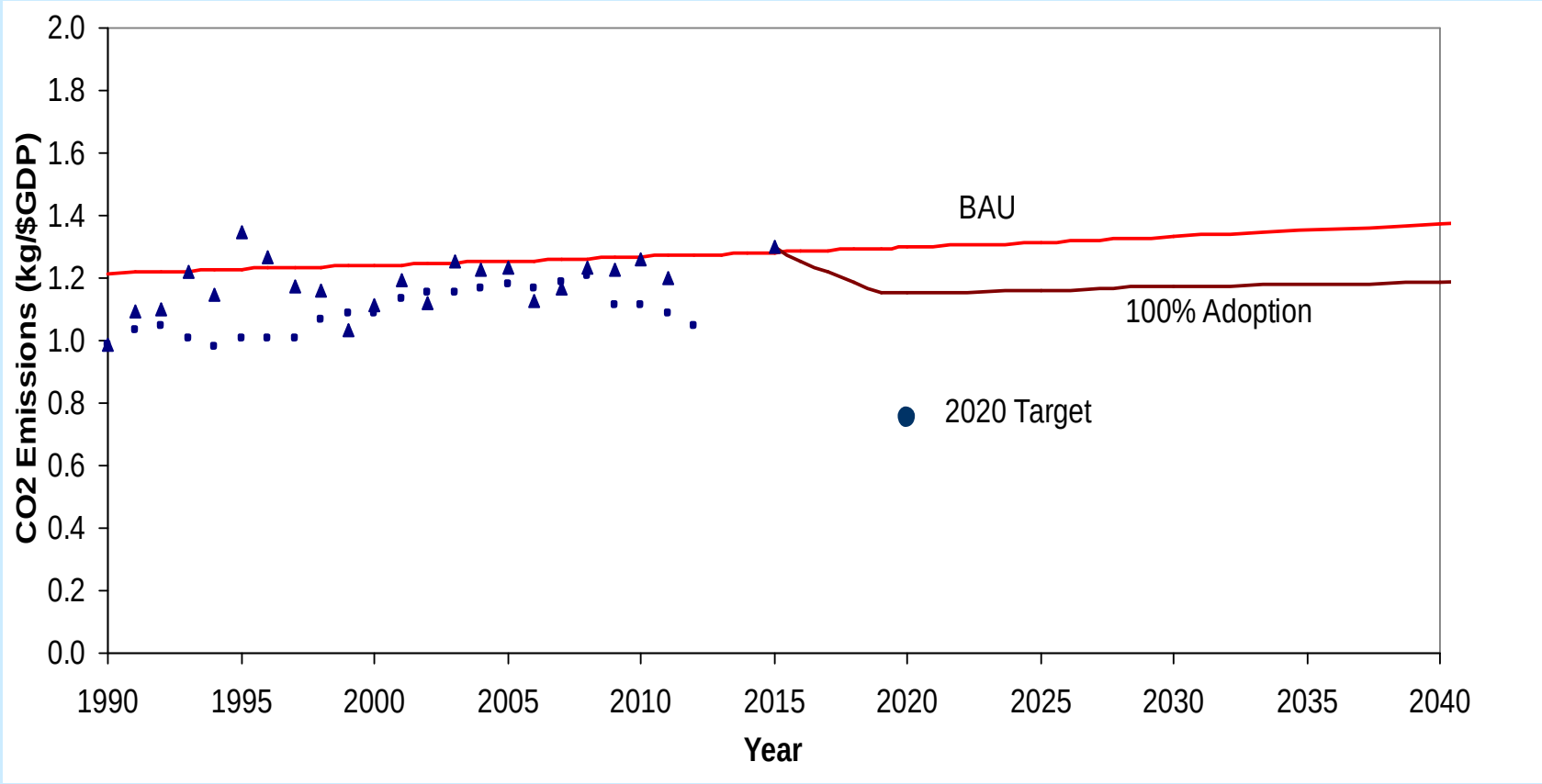
Regional Freight Exchange

Fleet inspection and maintenance and scrapping programme

PROPOSAL: Transport Data Team

Even with 100% adoption of these suggestions,

we won't make our CO2/GDP goal!



NON-Transport: INSULATION!

It costs ~350RM to insulate the roof of a taman house.
This will reduce aircon costs by about 50RM/month.
The ROI is about 6 months.

Thermal Insulation is one of the cheapest, most efficient investments you can make, BUT Malaysian developers don't, as the cost (of electricity) is paid for by the customer, AND the customers are "kedikut"!

Conclusions

Efficient transport is a fight against human nature

We want the “convenience” of traffic jams, road accidents, tolls, expenses, and parking associated with individual cars.

Social competition demands bigger, fancier, more expensive vehicles than the neighbors have

The government needs to bias the playing field to reward efficient practice, and tax inefficiency:

Petrol should be expensive
Trains and busses should be cheap, clean and reliable

Conclusions

There is a need for greater ASEAN integration

Interconnectivity to transport hubs is needs improvement

Why is there no bus from airport @ Melaka to Melaka?
Or Sibu?
Or between the Ipoh train station and bus station?

Consumers are financially “short sited”, and need to have data in their face to help them make better decisions.

And finally: INSULATE! We live in a tropical country!

End of Main Presentation

For more information please contact me:

HorizonUSM@yahoo.com

www.FocusAppliedTechnologies.com

+(6016) 484-6524