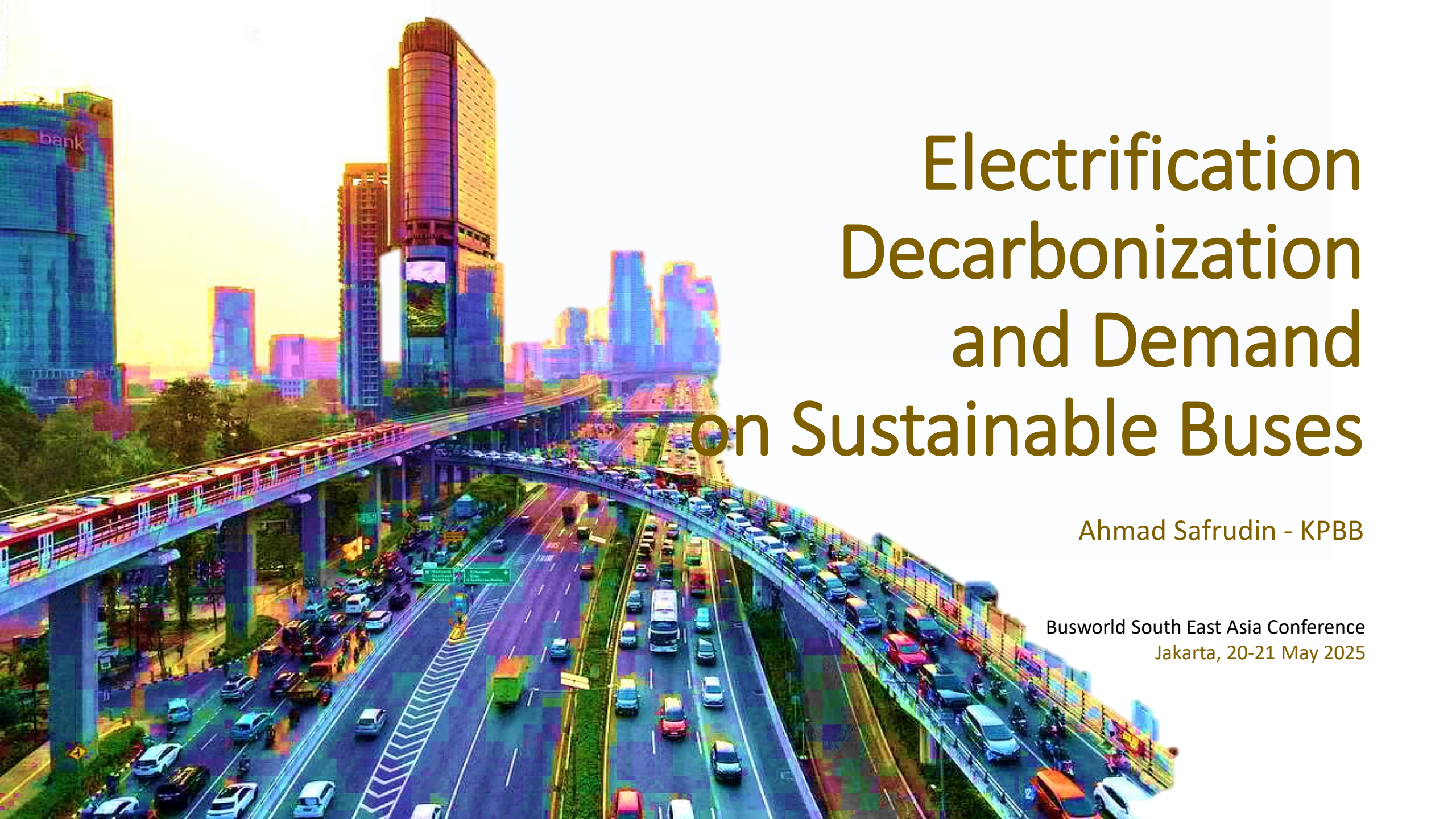


An aerial photograph of a major urban transportation hub. A multi-lane highway is filled with cars and trucks. An elevated train track runs parallel to the highway, with a train visible. In the background, a city skyline with several tall buildings is visible under a clear sky. The text 'Electrification Decarbonization and Demand on Sustainable Buses' is overlaid on the right side of the image.

Electrification Decarbonization and Demand on Sustainable Buses

Ahmad Safrudin - KPBB

Busworld South East Asia Conference
Jakarta, 20-21 May 2025

Outline

- Emission Load
- Fuel Supply Burden
- Progress on Sustainable Mobility
- Trend of Powertrain and Energy and It's Feasible Proposed Roadmap
- Resume and Recommendation.



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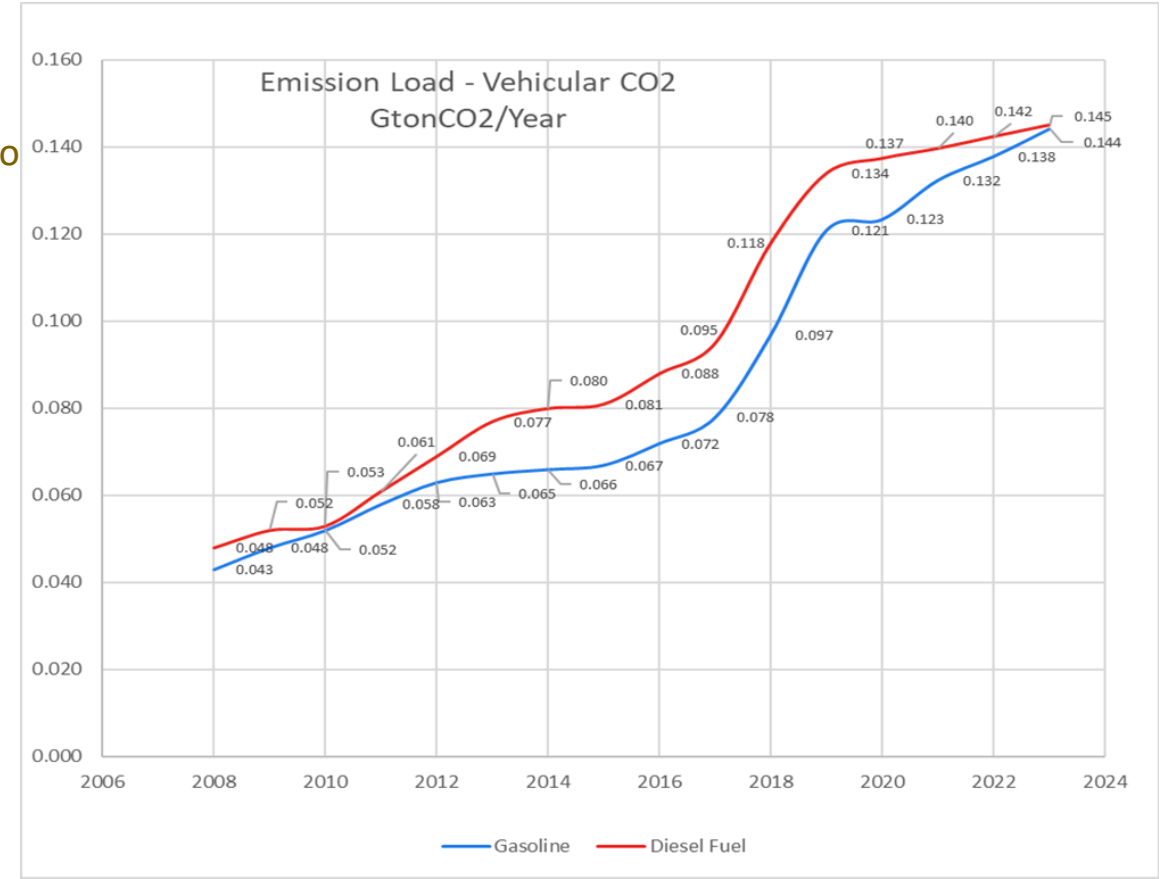
Trigger NZE/energy conservation

- For energy conservation and emissions mitigation, bicycles have enormous potential as a net-zero emission means of transportation.
- A nationwide shift to cycling could save millions of kilo-liters of fuel, and reduce millions of tons of CO2 emissions annually.

Enhanced NDC 2030

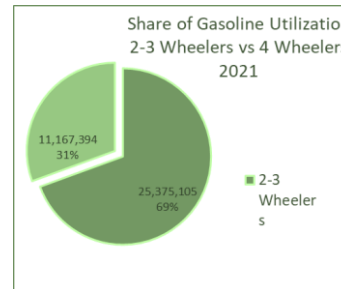
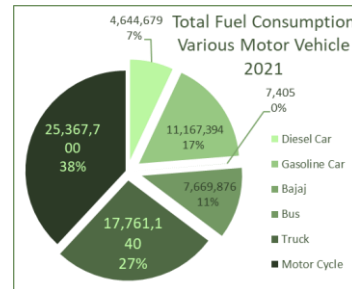
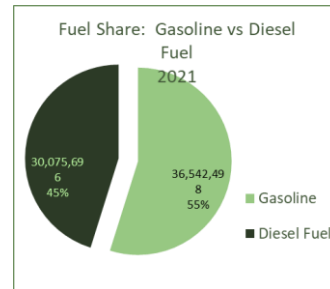
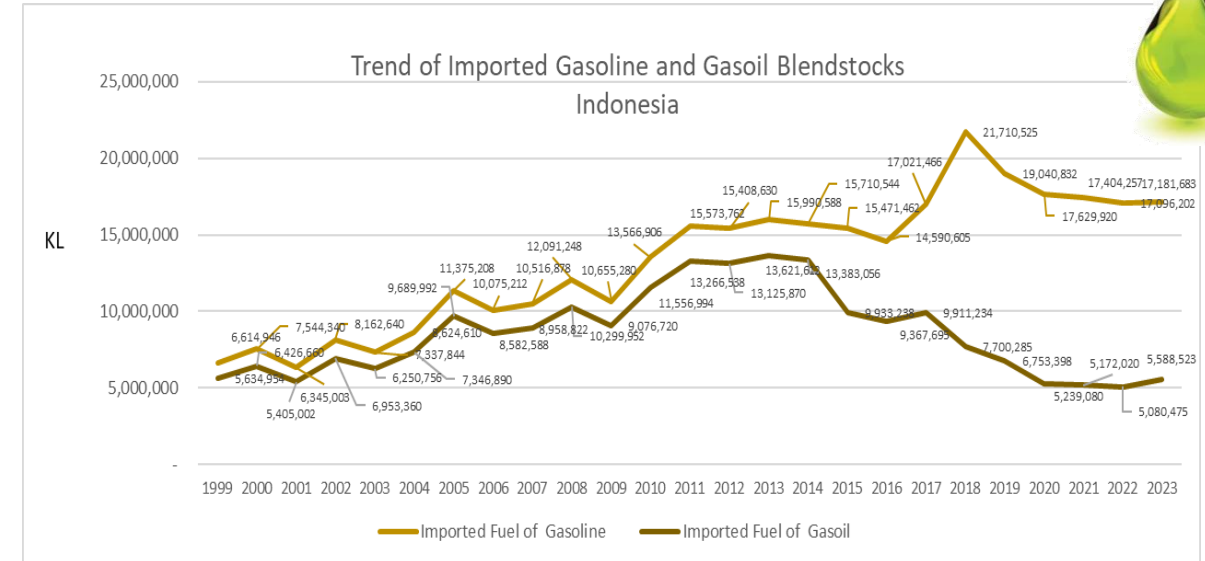
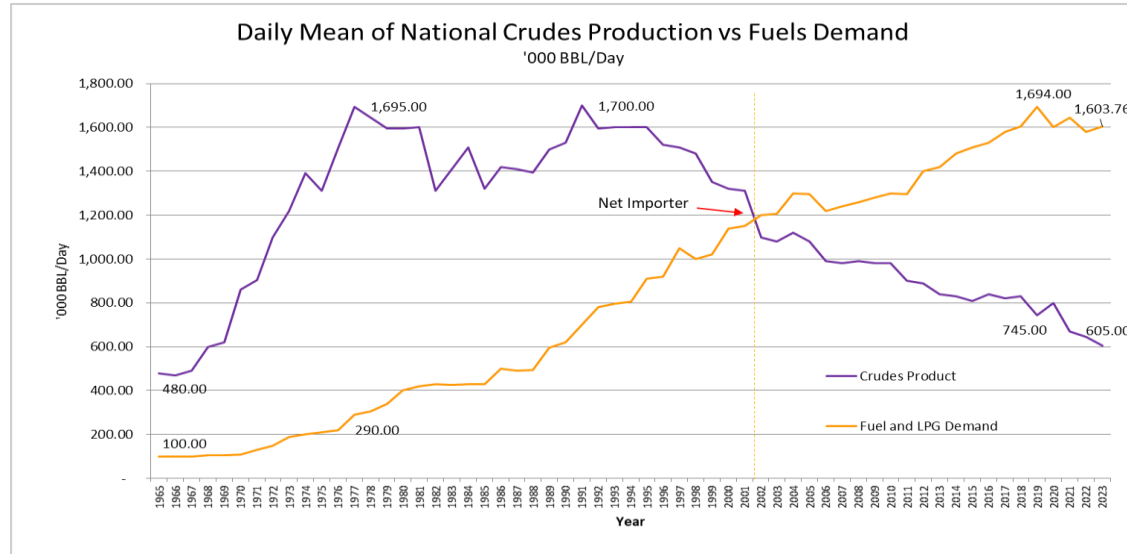
No	Sector	GHGs Baseline 2010 MtonCO2e	GHGs 2030 MtonCO2e				
			BAU	CM1	CM2	CM1	CM2
1	Energy	453.20	1,669.00	1,311.00	1,223.00	358.00	446.00
2	Waste	88.00	296.00	256.00	253.00	40.00	43.50
3	IPPU	36.00	69.60	63.00	61.00	7.00	9.00
4	Agriculture	110.50	119.60	110.00	108.00	10.00	12.00
5	LULUCF	647.00	714.00	214.00	- 15.00	500.00	729.00
	Total	1,334.70	2,868.20	1,954.00	1,630.00	915.00	1,239.50

- Based on Paris Agreement Dec 2015, and others following up global agreement, Indonesia Commitment 21 - UNFCCC => NDC; ENDC
- GHGs Reduction 29% (no condition) or 43% (condition)
- BAU GHGs 2030 ~2,82 GtonCO2e.
- Sectors: Energy incl transportation; LULUCF, IPPU, Agriculture, and Solid Waste.



Road transportation consumes 73.3 million KL of fuel and emits 295 MtonCO2e (2024) which is predicted to increase to 470 MtonCO2e BAU (2030): 16.66% Nat'l GHG BAU.

Fuels Supply Burden

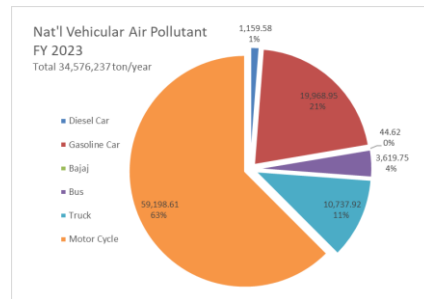
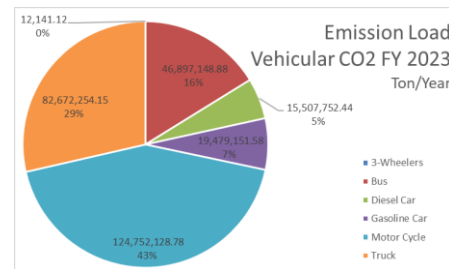
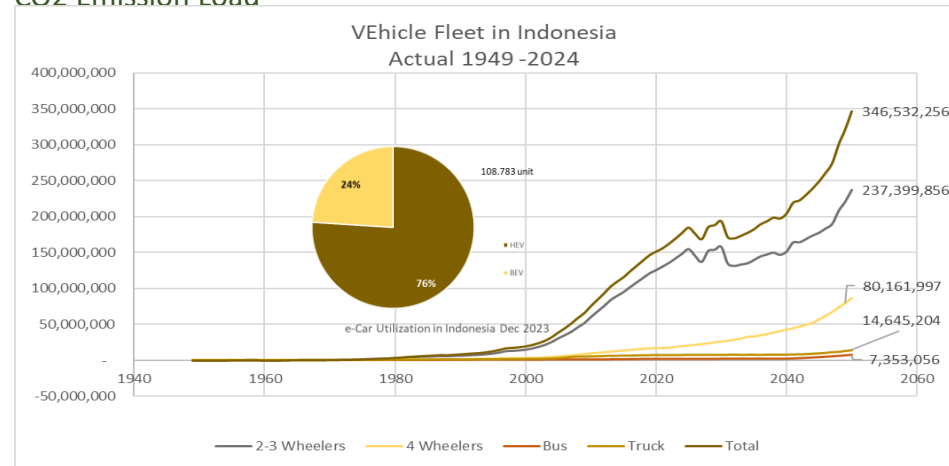


Fuel Demand Proportion				
Fuel Type	Brand	Volume - KL	%	Spec Comply to
Gasoline	Pertalite	33,225,947	41.83%	Non Euro Standard RON 90 S200
	Pertamax	12,066,919	16.38%	Euro2 Standard RON 92 S150
	Green Pertamax	189,985		Euro4 Standard RON 95 S50
	Pertamax Turbo	407,326	0.55%	Euro4 Standard RON 98 S50
Gasoil	Biosolar	29,390,571	39.53%	Non Euro Standard CN48 S1400 FAME B30
	Dexlite	569,282	0.78%	Non Euro Standard CN51 S1200
	PertaDEX	296,405	0.40%	Euro3 Standard CN53 S300
	PertaDEX HQ	390,000	0.53%	Euro4 Standard CN53 S50
		76,536,435	100.00%	

The national fuel supply is a burden on the government, both in terms of quantity and quality: net-importer oil, trade balance deficit, monetary and fiscal threats

Total Fleets, and Emission Load/ Concentration

CO2 Emission Load



Air Pollutant Concentration - dominant parameter PM2.5, PM10, SOx NOx and O3



Health Effects

2010 Case	2016 Case	DIESES/ILLNESS
1,210,581	1,489,014	Astma
173,487	214,256	Broncho-pneumonia
153,724	172,632	COPD
2,449,986	2,731,734	ARI/ISPA
336,273	373,935	Pneumonia
1,246,130	1,386,319	Coronary artery diseases

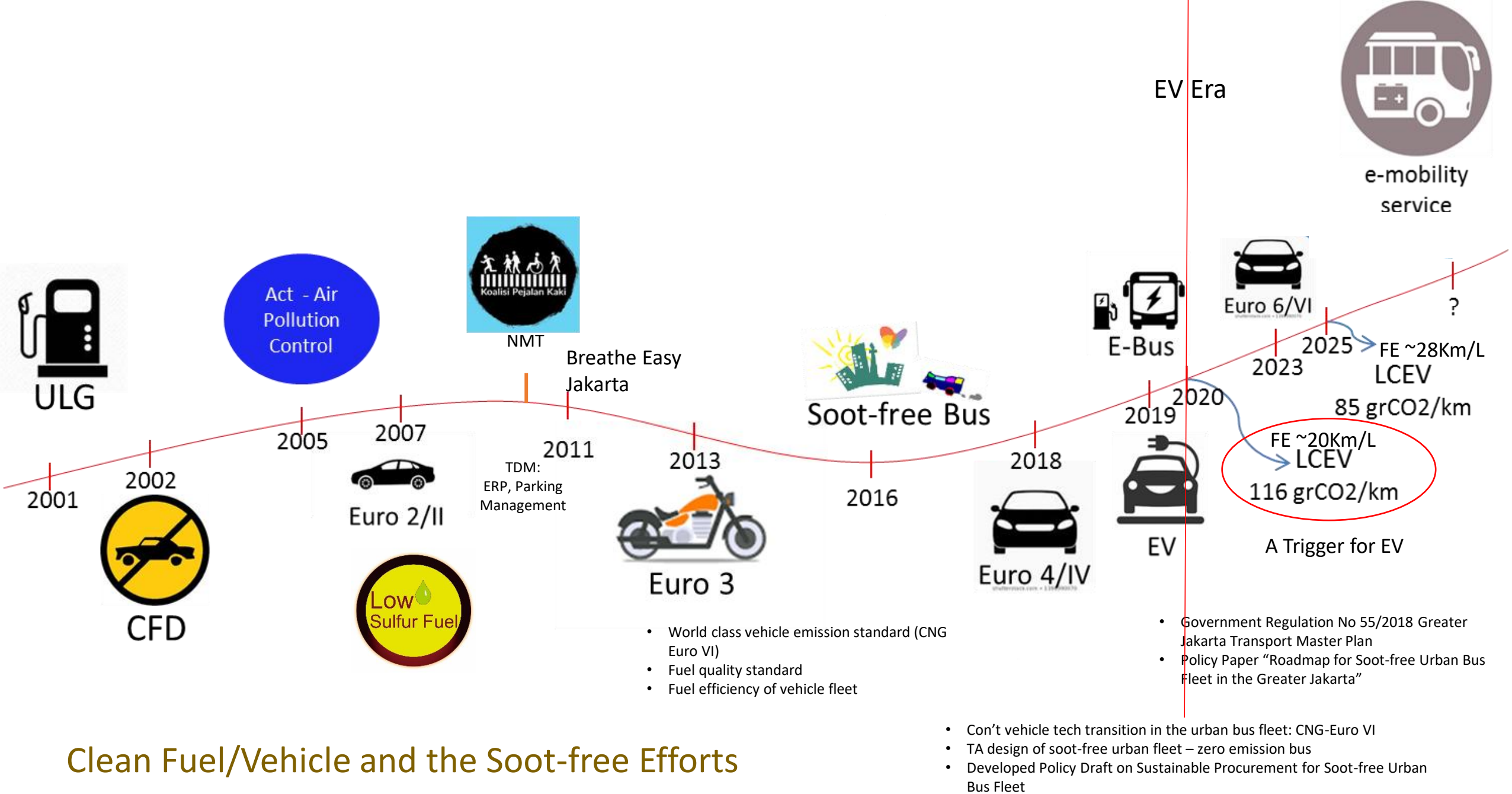
- WHO released the report (Release WHO/06, 25 March 2014) that 1/8 death worldwide (2012) or ~ 7 millions people die due to air pollution exposure:
- 68.000 people died in Indonesia.
- Premature death of mother and baby, children with asthma, ARI, pneumonia, etc. in various cities.
- Health Effect - Jakarta Case, 2016:**
 - Total population of Jakarta is 9,983,281
 - 58.3% of the Jakarta population were suffered by various air pollution-related diseases.
 - Total direct medical cost, IDR 51.2 trillions ~ USD 3.9 billions

National-wide - Vehicular Emission Load:

- CO2 emission load of motor vehicles (national) is 289 million ton p.a. originating from motorcycles (43%), trucks (29%), buses (16%), gasoline-powered cars (7%), diesel-powered cars (5%) and bajaj/3-wheelers (0.0037%).
- While the air pollution emissions of motor vehicles (national) are 34,576.237 tons p.a. originating from motorcycles (63%), bus (4%), trucks (11%), gasoline-powered cars (20.95%), diesel-powered cars (1%) and bajaj/3-wheelers (0.05%).

The Greater Jakarta - Vehicular Emission Load:

- Meanwhile, the largest sources of CO2 emissions from motor vehicles come from trucks (42%), articulated trucks (27%), buses (15%), gasoline-powered cars (9%), diesel-powered cars (7%), and bajaj/3-wheelers (0.012%).
- The sources of air pollutant emissions from motor vehicles (23,887.57 tons/day) in Jabodetabek are (64%), gasoline-powered cars (22%), trucks (7%), buses (4%), diesel-powered cars (3%) and bajaj/3-wheelers (0.17%).



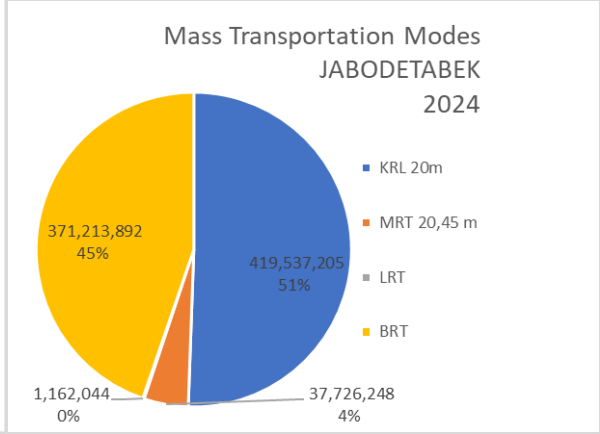
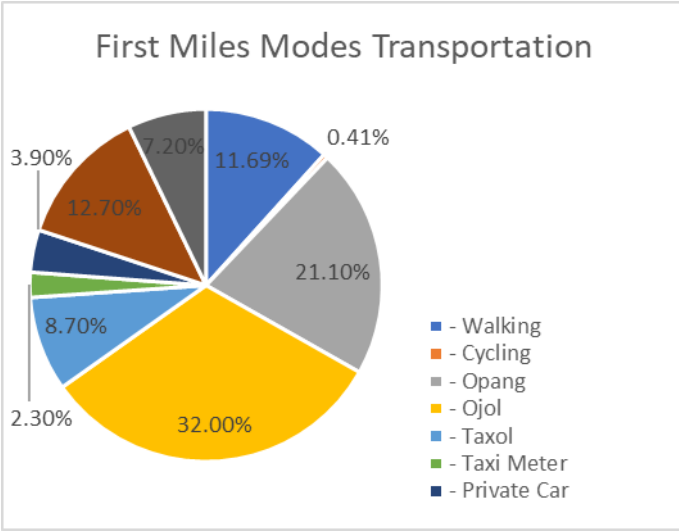
Clean Fuel/Vehicle and the Soot-free Efforts

grCO2/km – Passenger per Day and First/Last-miles Transportation Modes - Jakarta

Vehicular Emission of Various Transportation Mode											
grCO2 of Passenger/day											
Particular	KRL 20m	MRT 20,45 m	LRT	e-Bus 12m	Diesel Bus 12m	CNG Bus	Car 3000 cc	Car 2000 cc	Car 1500 cc	Car 1000 cc	Motor Cycle <150 cc
Powertrain (kW or CC/centimeter cubic)	120.00	140.00	135.00	145.00	9,000.00	9,000.00	3,000.00	2,000.00	1,500.00	1,000.00	150.00
Passenger (person)	180.00	82.00	81.00	53.00	85.00	85.00	2.00	3.00	3.00	3.00	1.00
Energy Economy per Wagon (km/kWh or km/L)	1.57	1.35	1.83	1.30	1.70	2.1	8.00	10.00	14.00	18.00	28.00
Total Wagon in One Series (unit)	12	6	8	1	1	1	1	1	1	1	
Total CO2 Emission (grCO2/kWh)	581.00	581.00	581.00	581.00	2,640.00	1,665.00	2,392.00	2,392.00	2,392.00	2,392.00	2,392.00
grCO2/km/gerbong	369.87	431.51	318.19	446.92	1,552.94	792.86	299.00	239.20	170.86	132.89	85.43
Mean of grCO2 of Passenger/km	2.05	5.26	3.93	8.43	18.27	9.33	149.50	79.73	56.95	44.30	85.43
Mean of VKT of Passenger/day	97.00	25.00	51.60	66.40	45.00	45.00	27.50	27.50	27.50	27.50	45
Mean of grCO2 of Passenger/day	199.32	131.56	202.70	559.92	822.15	419.75	4,111.25	2,192.67	1,566.19	1,218.15	3,844.29
Sources: Ahmad Safrudin et al, Vehicular Emission, KPBB, 2022											

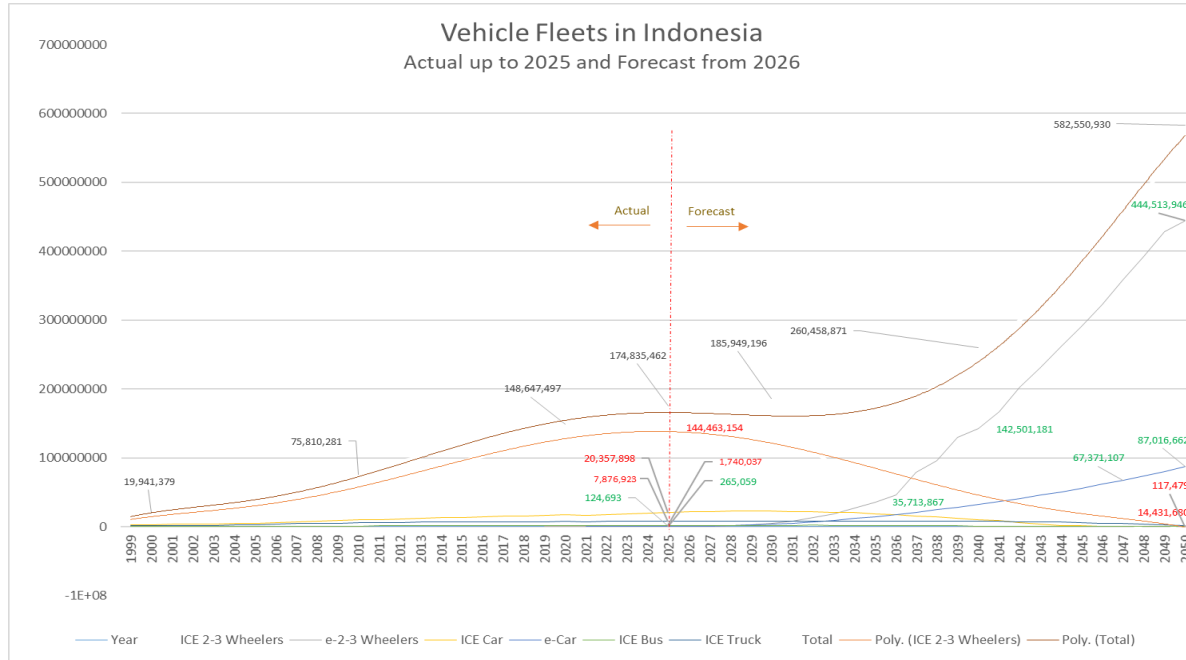
First/Last-miles Mass Public Transportation di Jabodetabek 2024

Tot+A32:E57al Passengers	KRL 20m	MRT 20,45 m	LRT	BRT
Total Penumpang (2024)	419,537,205	37,726,248	1,162,044	371,213,892
First Miles Modes Transportation				
- Walking	11.69%	6.21%	2.10%	8.31%
- Cycling	0.41%	0.37%	0.11%	0.21%
- Opang	21.10%	6.60%	7.50%	9.14%
- Ojol	32.00%	53.63%	67.00%	39.59%
- Taxol	8.70%	14.97%	2.46%	2.10%
- Taxi Meter	2.30%	8.57%	1.20%	1.22%
- Private Car	3.90%	4.30%	6.23%	1.47%
- Private Motorcycle	12.70%	1.78%	7.13%	4.23%
- Angkot/Feeder Bus	7.20%	3.57%	6.27%	33.73%
	100.00%	100.00%	100.00%	100.00%
Last Miles Modes Transportation				
- Walking	13.27%	12.77%	8.92%	10.68%
- Cycling	0.39%	0.27%	0.09%	0.19%
- Opang	14.22%	1.75%	8.24%	11.23%
- Ojol	47.82%	57.73%	57.22%	39.22%
- Taxol	8.43%	12.02%	11.30%	2.30%
- Taxi Meter	3.20%	10.18%	8.28%	1.90%
- Private Car	1.40%	1.20%	0.80%	0.78%
- Private Motorcycle	2.86%	0.87%	0.92%	0.89%
- Angkot/Feeder Bus	8.41%	3.21%	4.23%	32.81%
	100.00%	100.00%	100.00%	100.00%



Vehicle Fleet, and Sales Trend

Indonesia

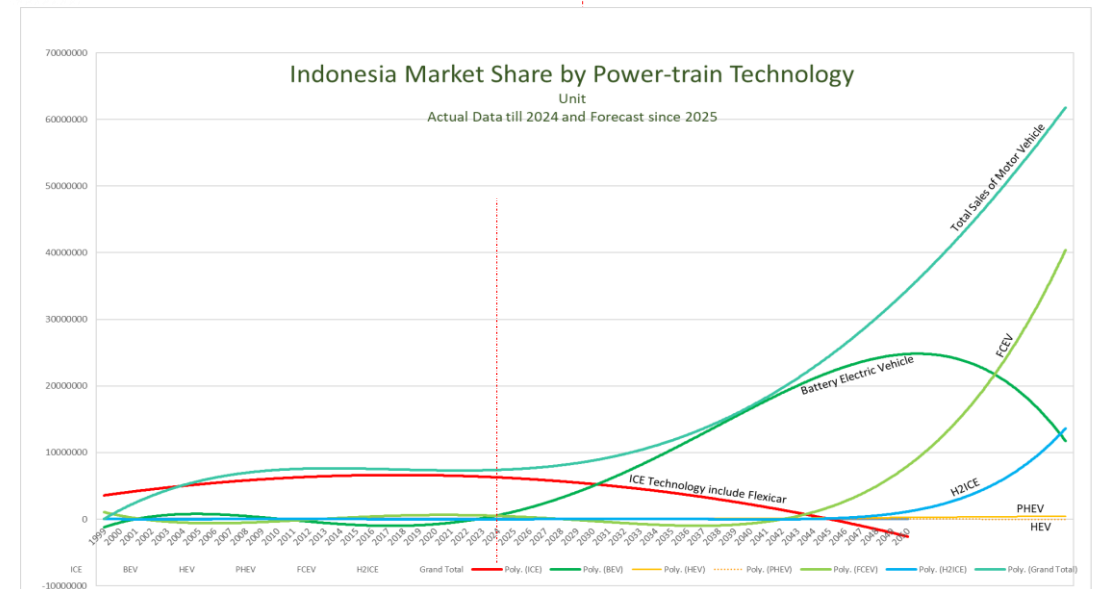
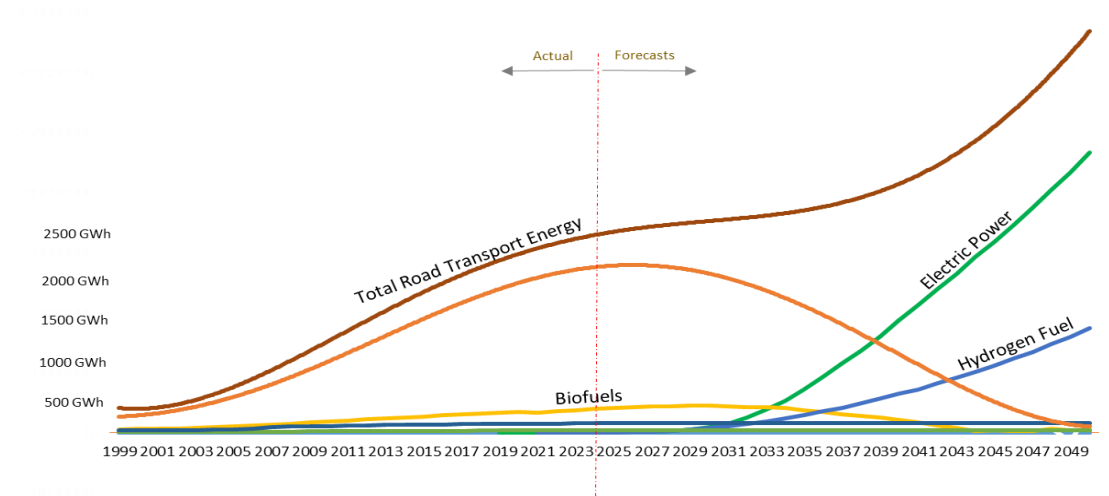


Trend of Powertrain Technology:

- The EV sales trend is very high for all off 2-3 Wheelers, 4 Wheelers, Bus and Truck where each average increase by 148%, 652, 103% and 43% respectively for the periods 2019-2024.
- The sophistication of energy-efficient powertrain technology, low emissions and especially the ease of operation and entertainment features have attracted public interest.
- With the trend series with a baseline year of 1999 and with the rise of BEV 1999, it is predicted that the market share of e-2-3 Wheelers will surpass ICE 2-3-Wheelers in 2032 (5,342,080 units) and even e-Car will be even faster, namely in 2030 (646,123 units).
- While the market share of e-Bus and e-Truck will surpass ICE technology in 2035 (22,675 units) and 2040 (259,374 units) respectively.
- Refer to the above trend, the total population of e-2-3 Wheelers, e-Car, e-Bus and e-Truck will surpass ICE technology of 2-3 Wheelers, Car, Bus and Truck respectively in 2039 (80,826,047 units), 2036 (17,650,185 units), 2040 (1,273,236 units), 2046 (5,613,261 units).
- BEV inevitability, unless there is a counterattack effort from ICE technology powertrain motor vehicles by spreading myths about the badness of electric vehicles: BEV just moving the emission without reduction to net zero, potentially threat of harmful used BEV battery, if a fire occurs due to damage to the battery function then the fire cannot be extinguished, depleting Ni, Co etc. mines, etc.
 - The fact, the recycling process of ULAB (Used Lead Acid Battery) which is used by ICE tech vehicle has become a fatal problem for the lives of people surrounding the smelter, various cases of ICE vehicle fires in fact cannot be extinguished especially when they have reached the fuel tank, not only electric vehicles but all parts of conventional vehicles are also greedy for Ni and CO.

New Energy Trend in Indonesia

Actual and Forecast in Indonesia 1999 - 2060
GWh equivalent



net_ZEV Roadmap Proposal

- Net-ZEV (LEV dan LCEV) perlu keselarasan roadmap antara fuel quality/supply dengan vehicle standard:
- Kepastian regulasi antara KLHK, Kemenperin, Kementerian ESDM dan Kemenhub.
- Tidak ada superioritas antar K/L sehingga regulasi dari K/L lain diabaikan.
- Keselarasan antara LEV dan LCEV, di mana LEV ditempuh dengan penerapan Euro Vehicle Standard, sementara LCEV ditempuh dengan Carbon Standard.

Mandates of:

- Law No 16/2016 toward Ratification on Paris Agreement.
- Government Regulation No 41/1999 jo 22/2021 toward Air Pollution Control
- Government Regulation No. 14/2015 toward Nat'l Industrial Development Master Plan (RIPIN).
- Government Regulation No 73/2019 toward Fiscal Incentive for LCEV.
- Presidential Decree No. 22/2017 toward Nat'l Energy Strategic Plan => Fuel Economy Standard by 2020.
- Presidential Decree No 55/2019 toward BEV.
- Various regulation on fiscal incentive (tax deduction/redemption for BEV).

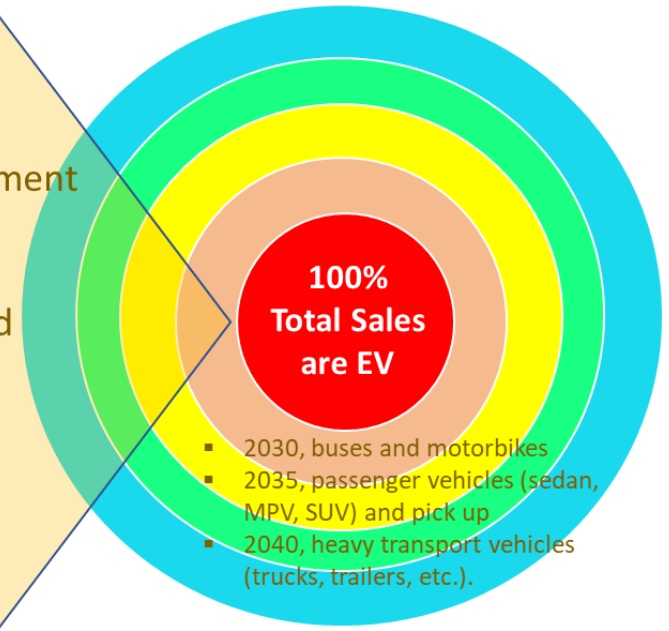
LCEV Technology, the ultimate to achieve NZE:

- EV (BEV, FCEV, PEV/trolley bus)
- Hybrid (HEV, PHEV)
- ICE:
 - Tech improvement
 - Flexi-car Tech/biofuels
 - CNG/LGV/LNG

LEV, a transition to NZE:

- Euro4/IV
- Euro6/VI

- Smart Government Policy
- Business Leadership and Action
- People Power Coalition



LEV

Euro2/II
Standard

Euro3
Standard 2W

Euro4/IV
Standard

Euro6/IV
Standard



1970

2005

2013

2017

2020

2022

2025

2027

2030

2035

2040

ICE CV
Based
Platform

LCEV
200 gr/km of CO₂

132 gr/km of CO₂ ~ 17,9 Km/L

LCEV
81 gr/km of CO₂ ~ 28,7Km/L

LCEV

Source: Low Emission Vehicle and Low Carbon Emission Vehicle Scheme in Indonesia, KPBB, Rev 2022

Resume and Recommendation

1. Motor vehicle fleet in Indonesia continues to increase dramatically along with the community's need for mobility; with a trend to shift towards BEV powertrain technology.
2. The population of motorized vehicles (ICE powertrain) has had an impact on the burden of fuel supply and emission burden (air pollution and GHGs) with its impact on public health and various climate disasters.
3. Tightening vehicle emission standards and the use of fuel with adequate quality, including biofuel (BE5 and B30) and adopt net-Zero Emission powertrain such as BEV are positively correlated with a decrease in GHGs, air pollution; and generating economic benefits in the form of fuel savings, improving public health and community work productivity.
4. e-Bus will accelerate emissions mitigation, both through their more efficient and low-emission powertrains and through their significantly lower per-capita emissions compared to other modes of motorized transportation.
5. The trend in total motor vehicle sales at 2016 - 2025 indicates that vehicles with BEV powertrains will dominate over the next 20-30 years.
 - The dominance of BEV demand in the automotive industry (national and global), including e-buses, over the next two to three decades is inevitable.



Terimakasih

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