Low Sulfur Fuel, Vehicle Emission and Fuel Economy Standard

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Conclave of Champion Cities of Asia and Africa in Clean Air and Sustainable Mobility
India Habitat Centre, Lodi Road, New Delhi
April 9-10, 2015

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Outline

- Background
  - Fuel shortage
  - Air pollution and health effect
  - Fuel quality and supply
- Fuel economy policy
- Vehicle emission reduction agenda
- Conclusion and recommendation

KPBB

1996 – now

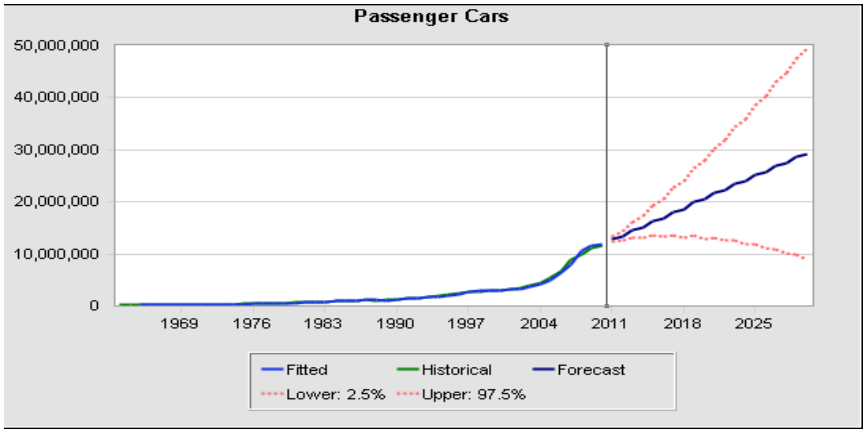
- Advocacy group for public policy reform (air quality improvement)
- Success to encourage Government of Indonesia to Implement Unleaded Gasoline (2001 for Jakarta and 2006 for nation-wide)
- Promoted Integrated Vehicular Emission Reduction Strategy (2002) together with other stakeholder
- Initiated with Car Free Day then adopted by mayor cities in Indonesia (2002)
- Policy formulation and promoted Jakarta Local Act on Air Pollution Control (2005)
- Promoted to issue Vehicle Emission Standard – Euro 2 (2007)
- Promoted to issue Governor Regulation on Utilization of Fuel Gases for Transportation (2007)
- Encouraging the effectiveness of utilization of fuel gases for transportation in Jakarta (2003 – now)
- To push the issuance of single price for CNG (2010) togather with other stakeholder
- Promoting Transport Demand Management (2010 – now)
- Cost Benefit Analysis on Fuel Economy Initiative in Indonesia (2010)
- Improving fuel quality campaign – include low sulfur fuel (2007 – now)
- Promoted Vehicle Emission Standard – Euro 3 for Motor Cycle (issued by 2013)
- Policy reform for Vehicle Emission Standard Euro 4 Standard and Fuel Economy Standard
- Movement on Enhancing Walkability Cities in Indonesia.

Background

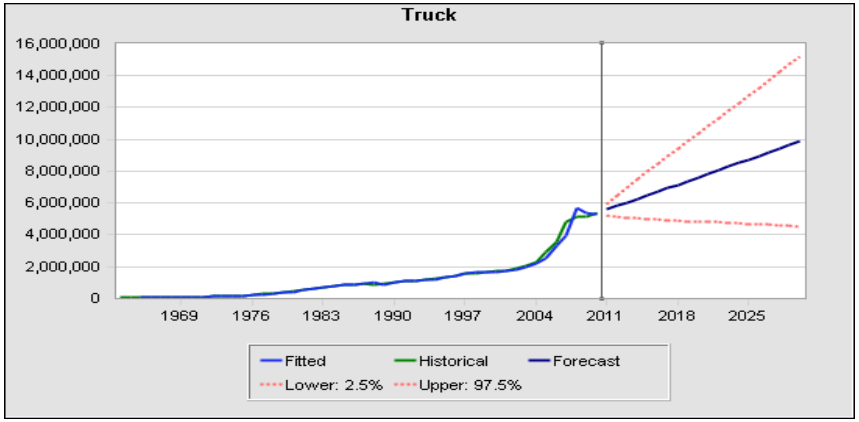
- "*Subsidized*" fuel in 2013 reahed Rp 199,9 trillion for 43,5 juta KL BBM (regular gasoline 26,05 mil KL, diesel fuel 17,22 mil KL) dand bio-fuel .23 mil KL-.
  - 2012: Rp 211 T
  - 2011: Rp 164,7 T.
- Air Pollution and GHG.
- The next step with Vehicle Emission and Fuel Economy Standard.


Photo: KPB

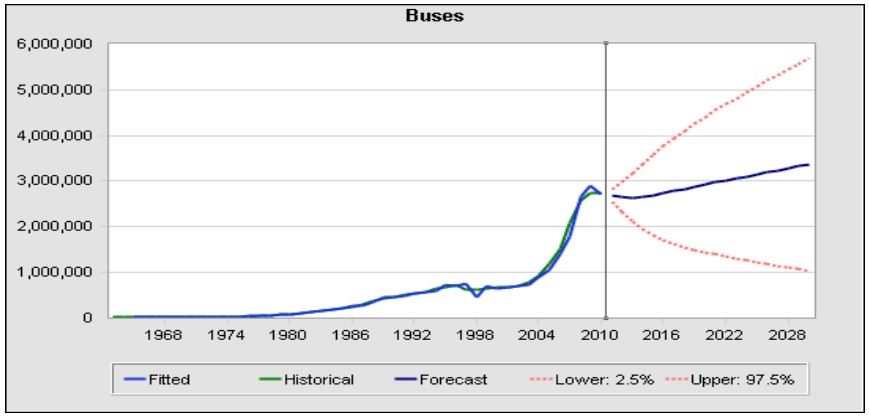
Forecasting of Vehicle number 2030



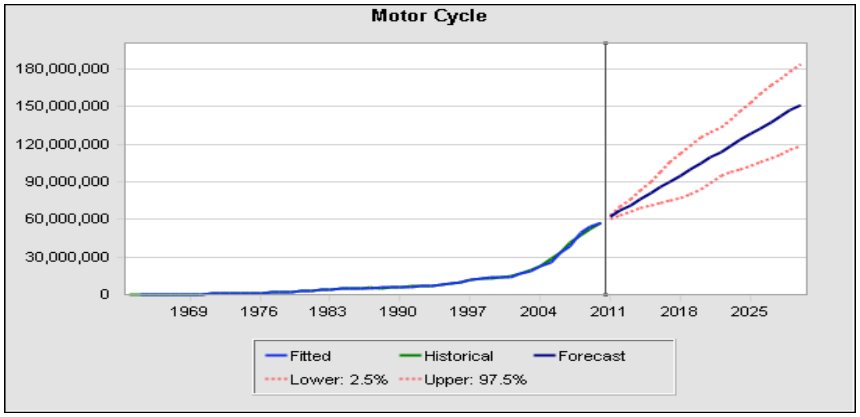
Best method : ARIMA(1,2,1)
Error measure (RMSE) : 232634.60



Best method : ARIMA(1,2,1)
Error measure (RMSE) : 176449.44

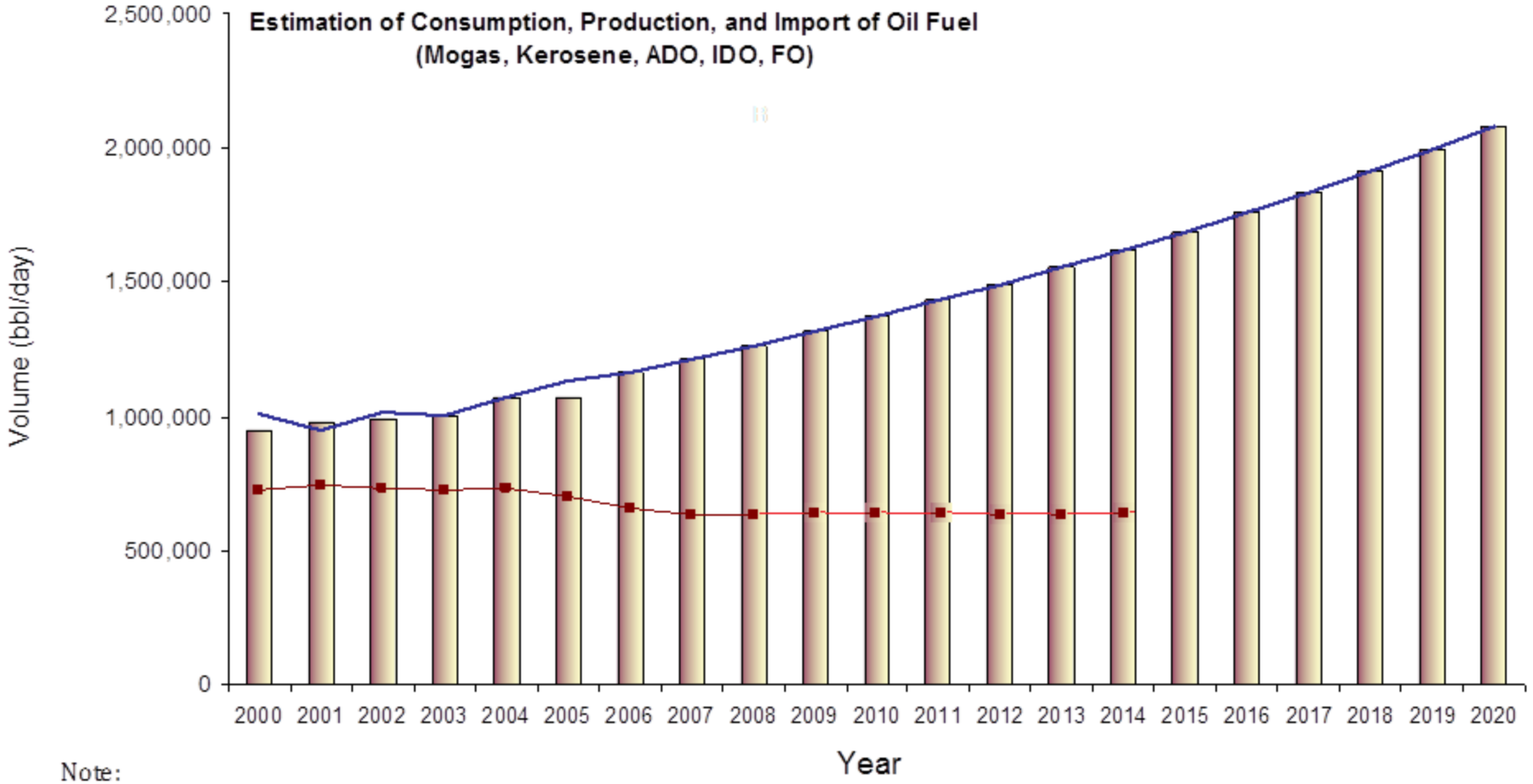


Best method : ARIMA(2,2,1)
Error measure (RMSE) : 69296.34



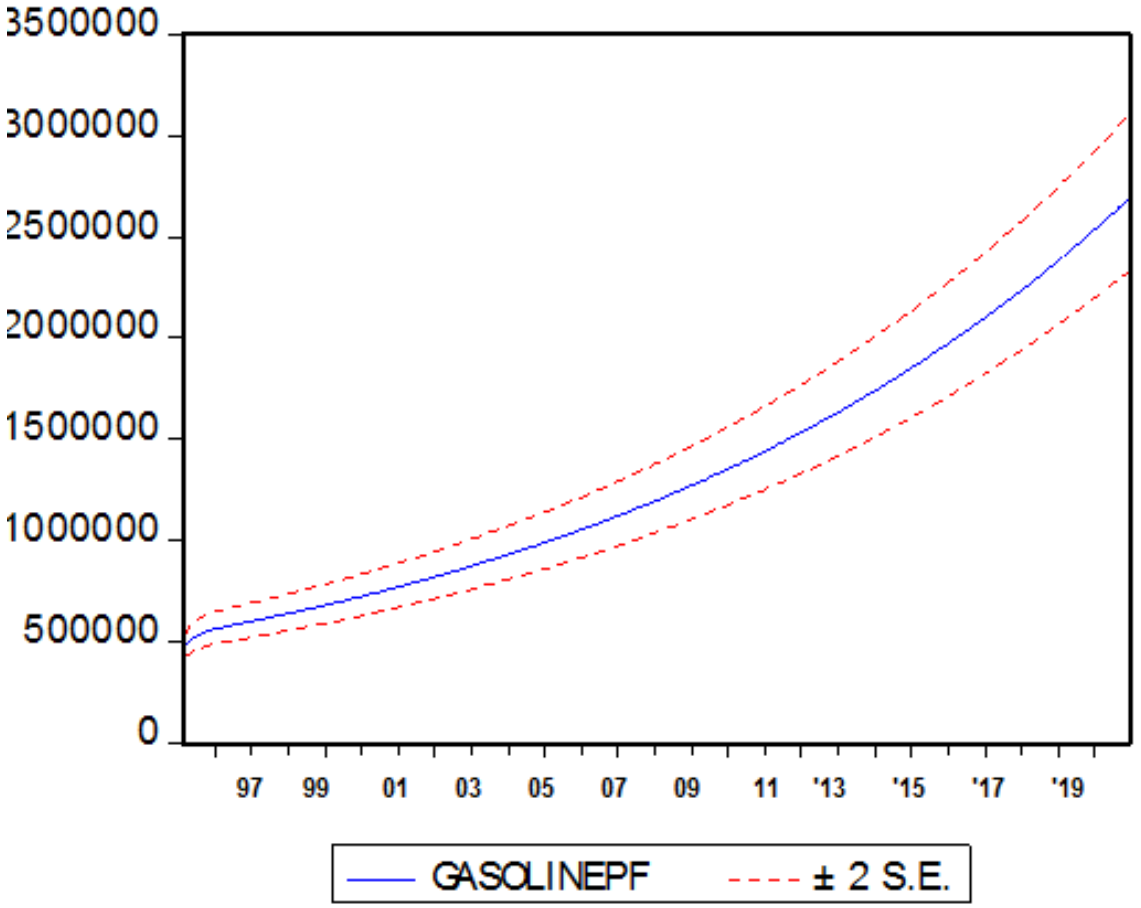
Best method : Double Exponential Smoothing
Error measure (RMSE) : 787400.81

- Total selling: 1.1 million cars, and 7 million motor cycles (per annum)
- Total population: 19 million cars of car and 59 million of motor cycles (2013)



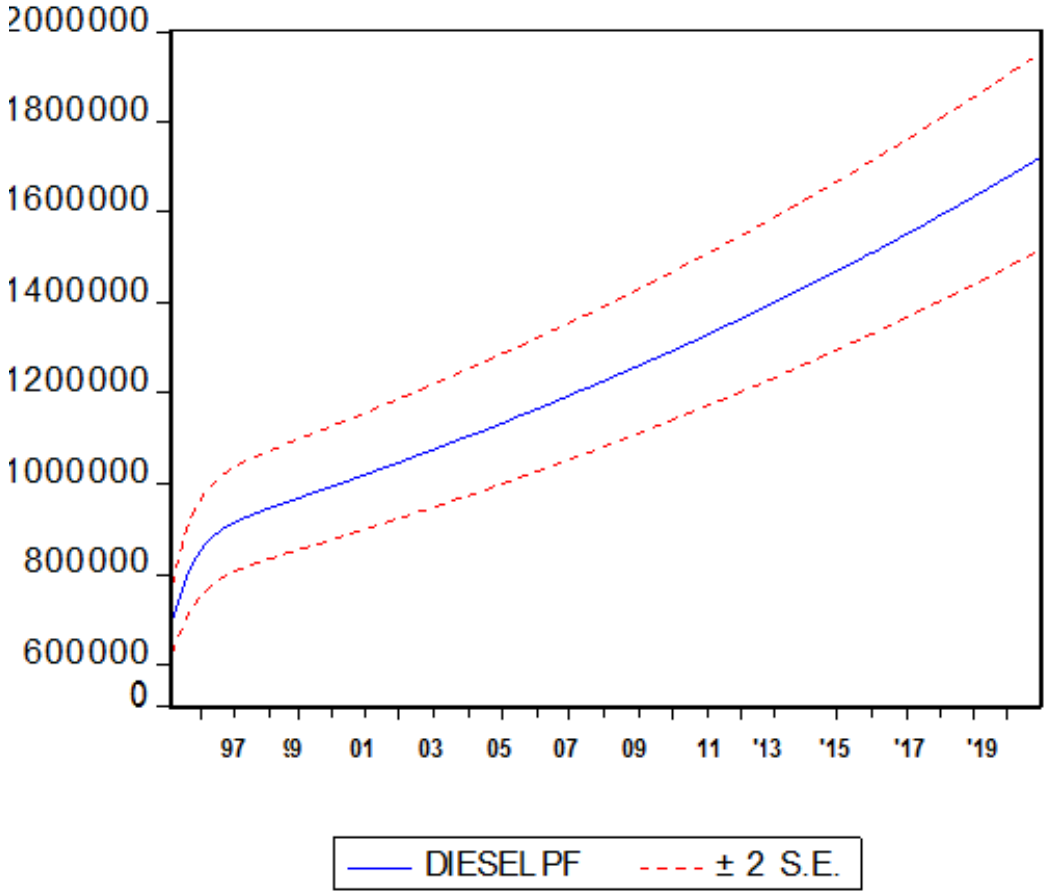
Note:
- Fuel Supply = Domestic fuel production + Import
- Data on 2006-2020 import = Consumption - Production
- Fuel consumption growth (average) 1995-2005 is 4,6%
- Assuming average fuel consumption growth of 4,5% in 2006-2020

Forecasting Statistic: Gasoline Consumption



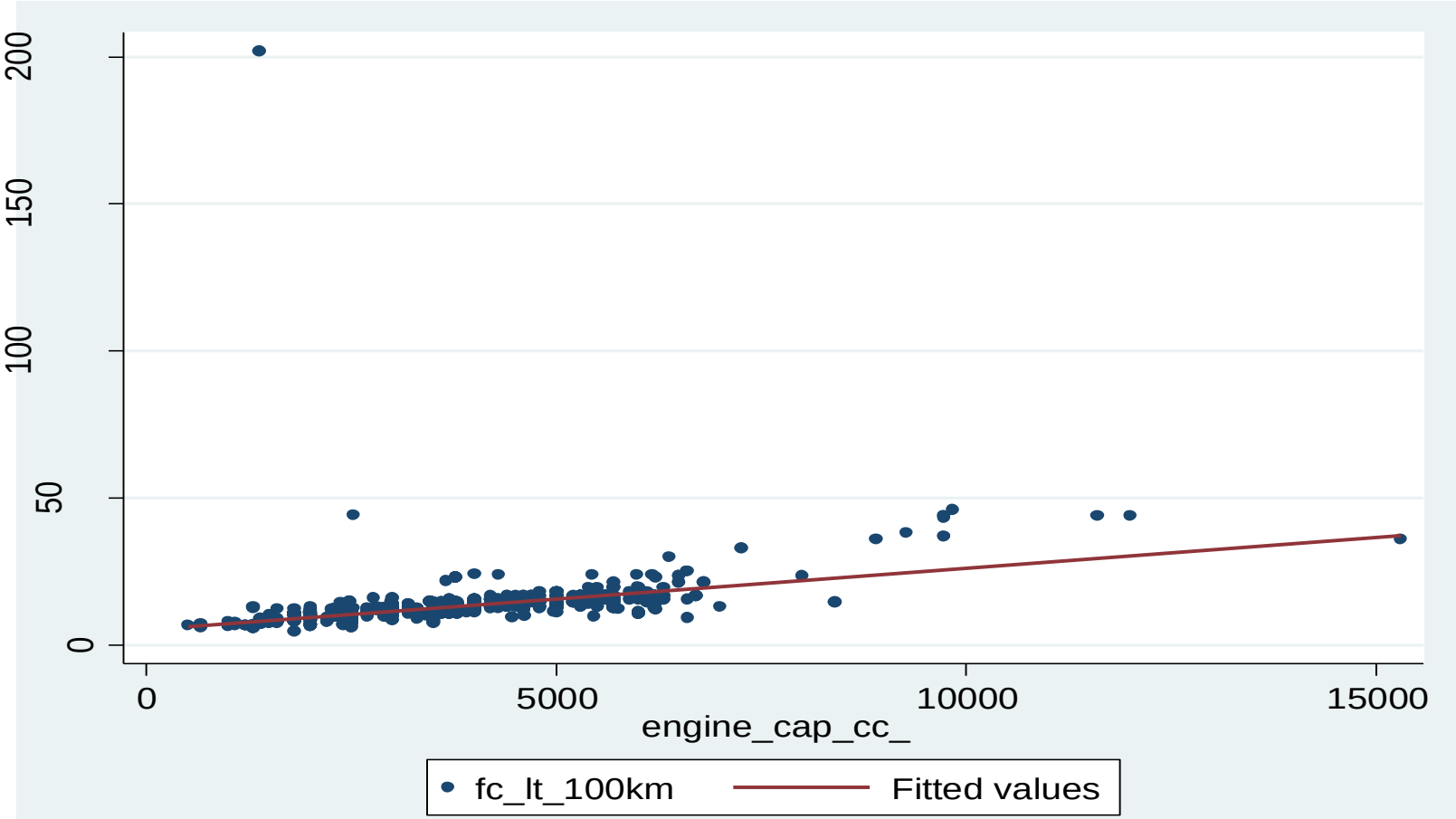
Forecast: GASOLINEPF	
Actual: GASOLINEP	
Forecast sample: 1990:01 2015:	
Adjusted sample: 1990:03 2015:	
Included observations: 250	
Root Mean Squared Error	90472.29
Mean Absolute Error	60365.46
Mean Abs. Percent Error	5.222652
Theil Inequality Coefficient	0.038502
Bias Proportion	0.001759
Variance Proportion	0.028894
Covariance Proportion	0.969347

Forecasting Statistic: Diesel Consumption



Forecast: DIESELPF
Actual DIESELP
Forecast sample: 1990:01 2015:
Adjusted sample: 2006:03 2015:
Included observations: 58

Root Mean Squared Error	59738.64
Mean Absolute Error	50832.85
Mean Abs. Percent Error	5.010395
Theil Inequality Coefficient	0.028749
Bias Proportion	0.005894
Variance Proportion	0.075141
Covariance Proportion	0.918965



Fuel economy base on engine size in Indonesia 2008

Baseline Fuel Consumption

ℓ/100 km

Fuel consumption by engine size

Engine size (cc)	Obs.	Descriptive statistic				
		Mean	Median	Minimum	Maximum	st.deviation
Below 1,000	6	6.95	6.93	5.97	8	0.66
1,000 up to 2,500	363	9.4	9.41	4.7	20.2	1.66
2,500 up to 3,500	274	11.18	11.2	6.03	44.23	2.47
3,500 up to 10,000	622	14.46	13.84	7.84	46	4.21
Above 10,000	4	31.95	39.95	3.92	44	19.06

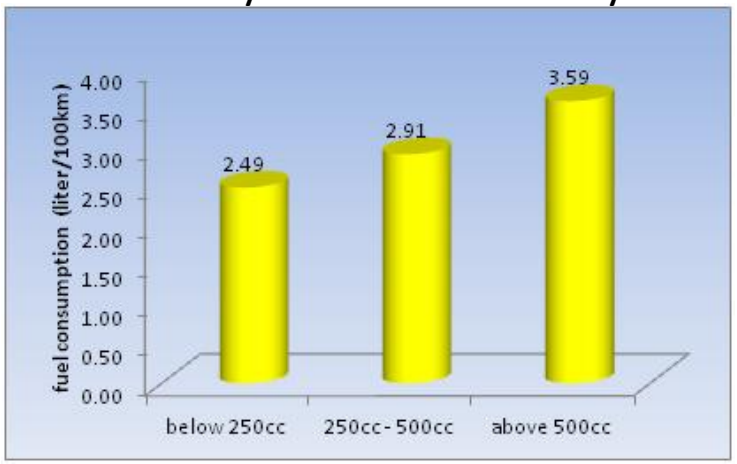
Fuel consumption by vehicle type

Type of vehicle	Descriptive statistic				
	Mean	Median	Minimum	Maximum	st.deviation
Passenger Car	12.5	11.76	3.9	46	4.3
Bus	11.8	11.76	6.5	19.6	3.0
Truck	12.2	11.2	4.7	44	4.3
Motorcycle	2.9	2.8	1.4	3.9	0.61

Fuel consumption by fuels type

Fuel type[1]	Descriptive statistic				
	Mean	Median	Minimum	Maximum	st.deviation
Gasoline	12.4	11.8	4.7	44.2	5.0
Diesel	12.3	11.8	3.9	46	3.7

Motorcycle's Fuel Economy



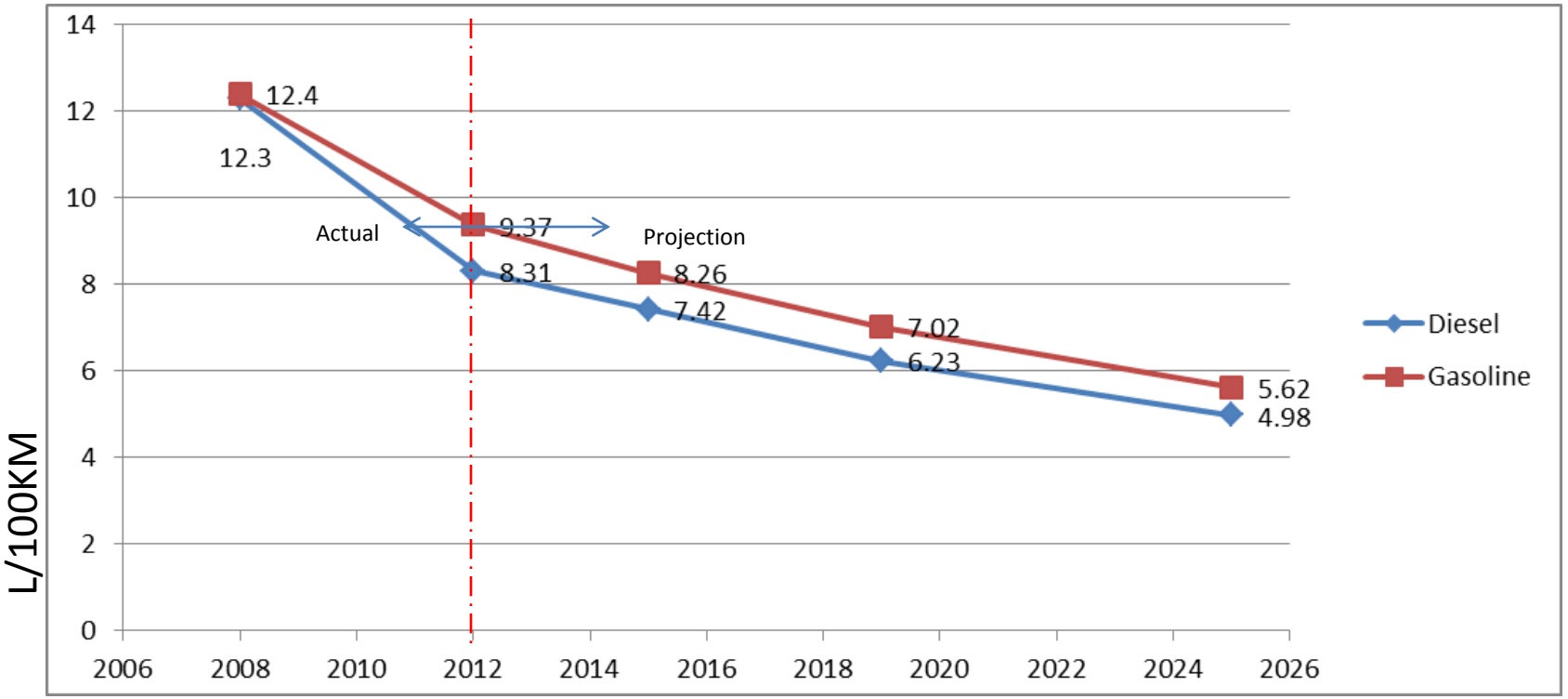
Vehicle Standard:

- Euro 3 Standard for Motor Cycle (August 2013)
- Euro 2 Standard for Car and Motor Cycle since 2007

Fuel Economy Standard:

- Light Car=> LCGC 2013

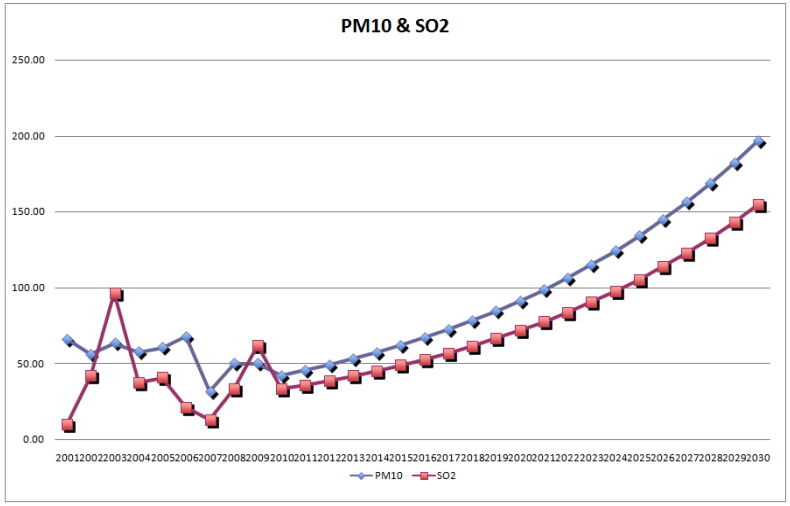
Fuel Economy Status and Proposal



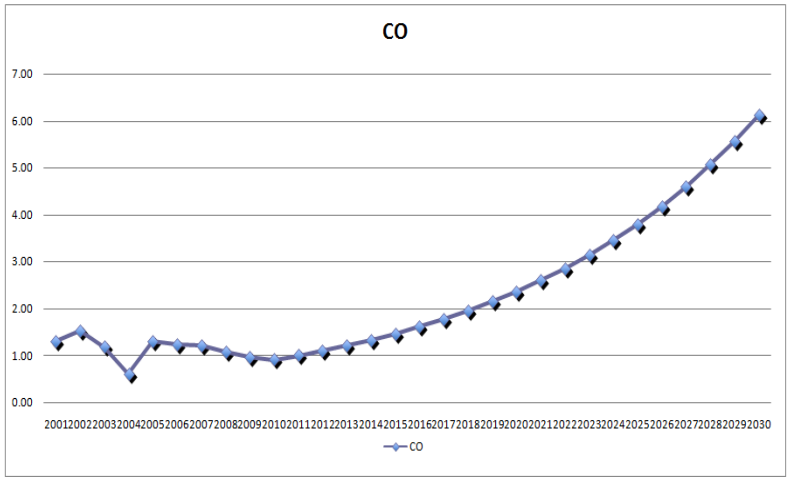
- The Mandatory Disclosure on Emissions and **Fuel Economy** (Minister of Environment Decree No 141/2003 toward New Type and Current Production Emission Standard)
- Preliminary Study on Baseline of Fuel Economy (2008)
- Cost-benefit Analysis Fuel Economy in Indonesia (2012)
- Minister of Industry Decree No. 33/M-IND/PER/7/2013 toward Fuel Economy Vehicle Standard (5 L/100KM for passenger car)
- Government Regulation No 41/20013 toward Tax of Luxury Goods, give opportunity for vehicle which comply to the standard to get incentive “exception of the tax of luxury goods”.
- Vehicle Emission Standard Euro 3 Standard for Motor Cycle (August 2013)

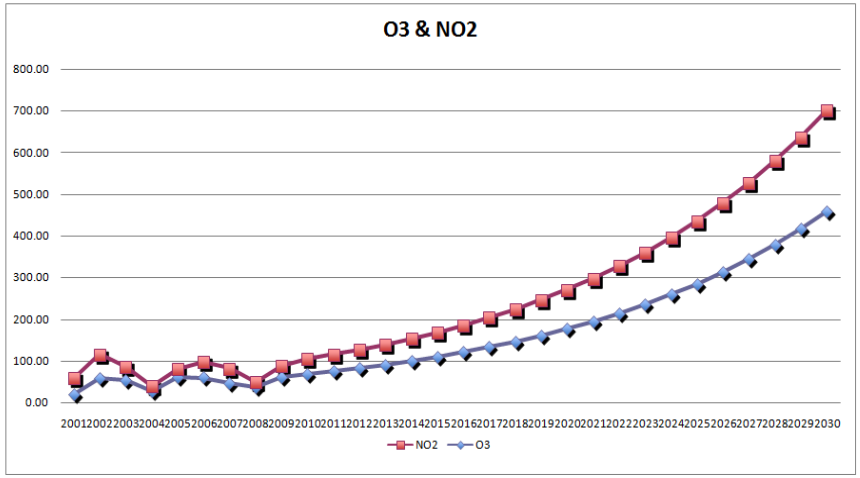
Air Pollution and Its Health Effect

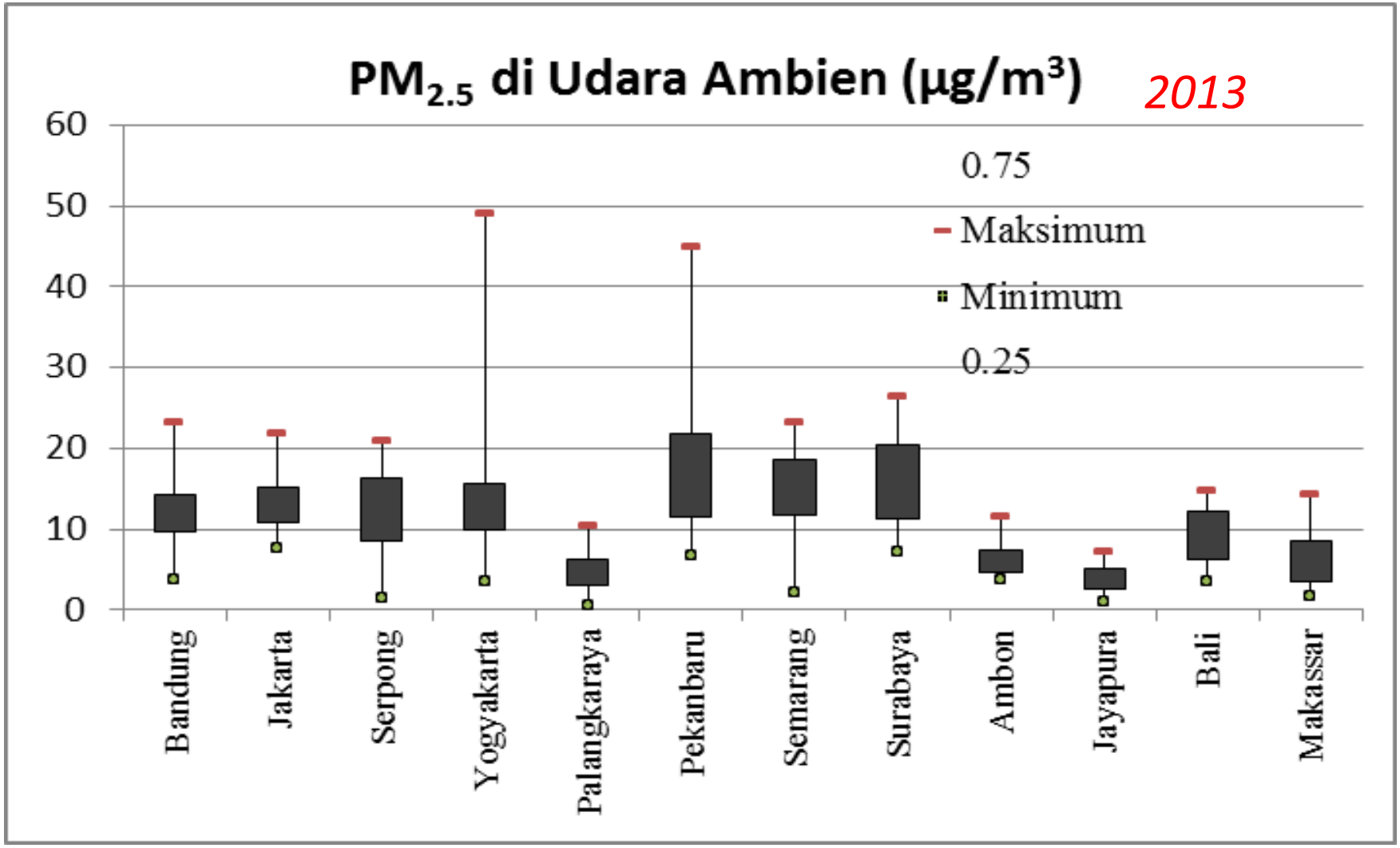
Case: Jakarta - 2010



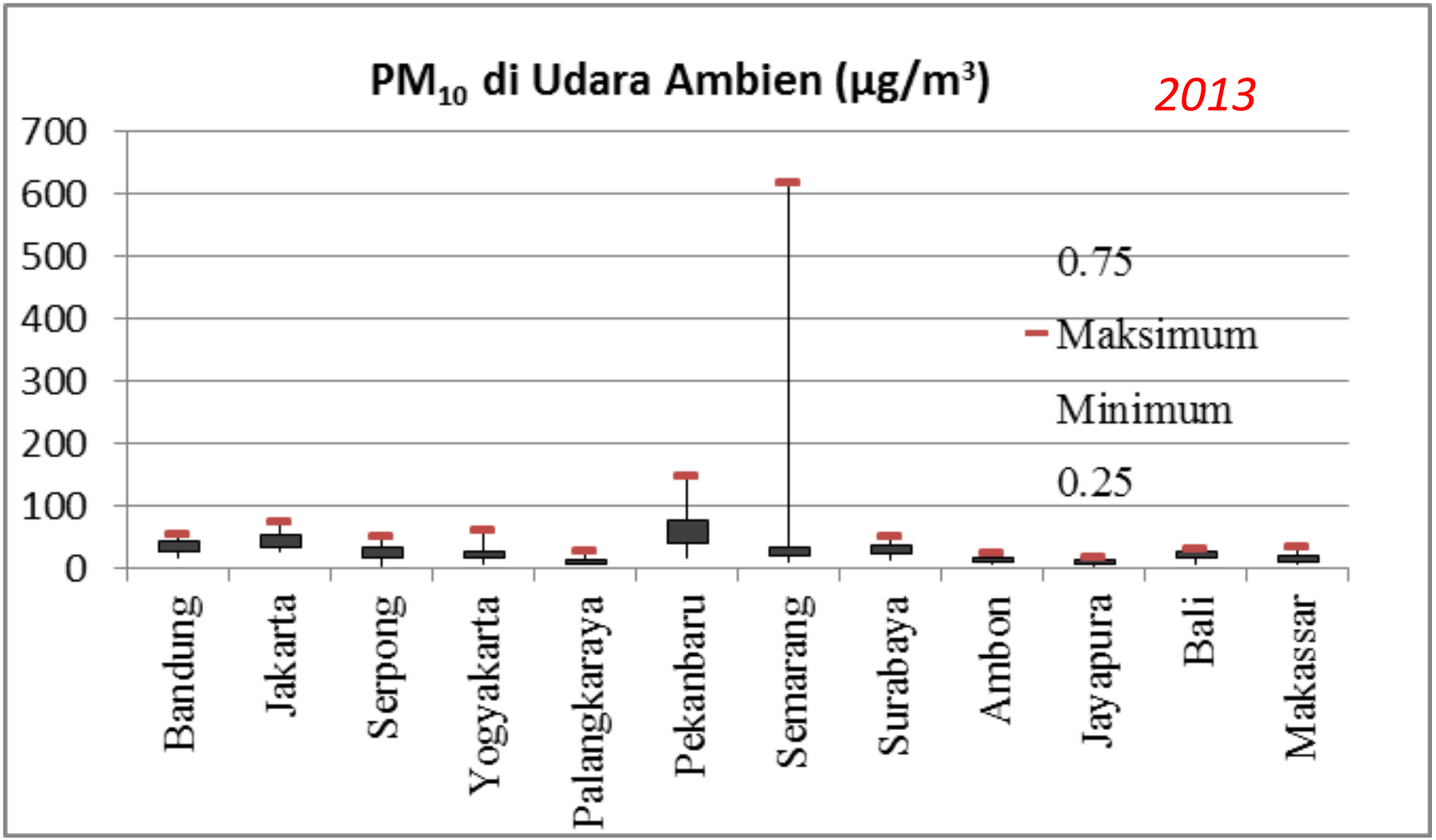
- Total population of Jakarta is 9,607,787
- 57.8% of the Jakarta population were suffered by various air pollution-related diseases :
  - 1,210,581 people suffered by asthmatic bronchiale (compared with 500,000 population founded by Ostro 1994);
  - 173,487 people with bronchopneumonia;
  - 2,449,986 with ARI;
  - 336,273 people with pneumonia;
  - 153,724 people with COPD, and;
  - 1,246,130 people with coronary artery diseases.
- Total direct health cost IDR 38.5 trillions ~ USD 41 billions



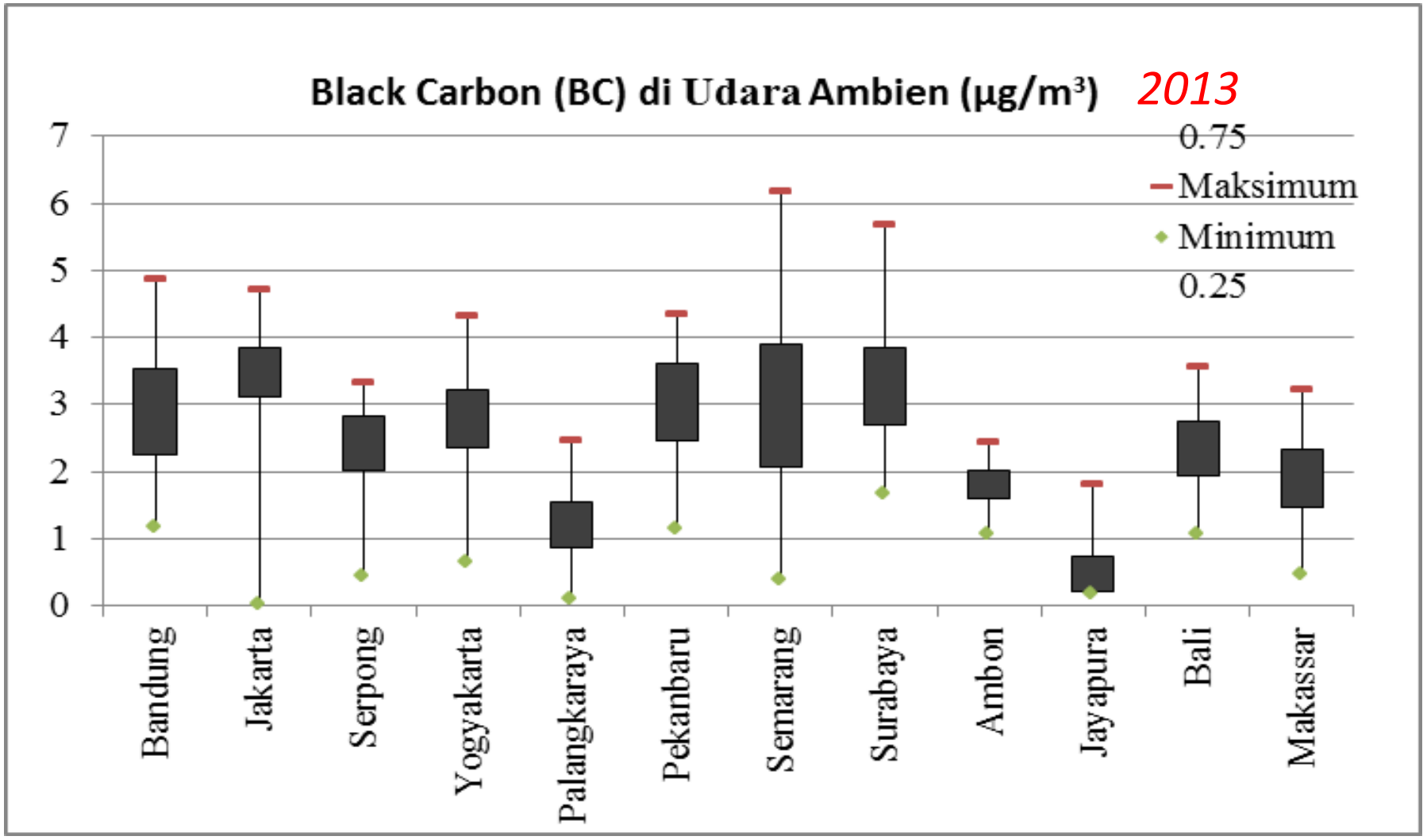




	Bandung	Jakarta	Serpong	Yogyakarta	Palangkaraya	Pekanbaru	Semarang	Surabaya	Ambon	Jayapura	Bali	Makassar
Maksimum	23.08	21.71	20.88	48.93	10.32	45.00	23.25	26.38	11.52	7.13	14.74	14.29
Mean	11.88	13.54	11.96	13.48	4.77	18.60	14.49	16.40	6.16	3.76	9.44	6.35
Minimum	3.79	7.54	1.36	3.51	0.42	6.72	2.12	7.03	3.73	0.98	3.44	1.55



	Bandung	Jakarta	Serpong	Yogyakarta	Palangkaraya	Pekanbaru	Semarang	Surabaya	Ambon	Jayapura	Bali	Makassar
Maksimum	53.2	73.3	50.1	61.1	25.9	148.6	618.4	51.3	25.4	15.8	31.4	35.5
Mean	33.4	46.4	26.0	22.9	12.1	60.8	54.5	29.9	14.7	9.6	22.5	17.5
Minimum	15.9	27.0	4.4	5.9	6.4	16.7	9.0	13.5	8.4	4.4	7.4	8.3



	Bandung	Jakarta	Serpong	Yogyakarta	Palangkaraya	Pekanbaru	Semarang	Surabaya	Ambon	Jayapura	Bali	Makassar
Maksimum	4.85	4.72	3.32	4.31	2.47	4.33	6.17	5.69	2.44	1.82	3.56	3.22
Mean	2.87	3.20	2.21	2.70	1.20	3.04	2.93	3.39	1.79	0.58	2.29	1.83
Minimum	1.16	0.00	0.42	0.64	0.09	1.14	0.38	1.65	1.06	0.17	1.04	0.44

Fuel Economy Policy

Policies Formula

Policy Option	Title	Description	Parameter and Its Source
1	**Emission Standard**	Implement Euro 2 at 2005, Euro 3 at 2015, and Euro 4 at 2020	Table Appendix 3. Adopted Emission Factors (g/km) at 80,000 km, source : Coffe (2005)
2	**Fuel Efficiency +Option 1**	Enhance fuel Efficiency 10 % by 2009	
3	**CNG +Option 1**	Convert to Gas for Passenger Cars and Bus, at least 1 % at 2009, 2 % at 2011, and at 5 % at 2021	Assume Cost for Gas Coverter = $1000 , Gas Fuel CO NO HC PM Reduction 0.89 0.53 0 0.85 Sources Evaluating the Emission Reduction Benefits of WMATA Natural Gas Buses, www.eere.energy.gov
4	**Catalytic Coverter+Option 1**	Use Catalytic Converter to Diesel vehicles (25 % of Passenger Car, Bus, and Truck)	Cost for Catalyc Coverter = $1000 , Gas Fuel CO NO HC PM Reduction 0.0 0.15 0 0.5 Sources: Michael P.Walsh (May,2006)
5	**Hybrid Technology + Option 1**	Use Hybrid technology for Passenger cars and Bus, at least 0.05% at 2009, 0.1 % at 2011,0.5 % at 2016, and 1 % at 2021	Cost for Catalyc Coverter = $10,000 Assume fuel efficiency increases about 4.1 times than non hybrid technology.
6	**Scapped + Option 1**	Scrapped the 50 % vehicles that more than 20 years old from 2009	
7	**Biofuel + Option 1**	Convert to Biofuel for Passenger Cars and Bus, at least 1 % at 2009, 2 % at 2011, and at 5 % at 2021	Cost for processing biofuel = IDR 4,584/Liter is taken from Hadi et.al,(2010),http://psp3.ipb.ac.id/jurnal/index.php/artikel/article/view/23 Gas Fuel CO NO HC PM Reduction 0.47 -0.22 0.46 0.55 Sources: Xue, J., Tony, E.G and Alan C.H (2011)
8	**Public Transport + Option 1**	Result passenger car and motor cycle shift to public transport at least 5% and 1% at 2011, 10% and 5 % at 2014, 20% and 10% at 2018 and 40% and 20% at 2025	Invest on bus rapid transit and busway (2005-2015), commuter line (2010-2020), and MRT (2015-2025). Cost for Investment is provided in table 9. We have limitation to consider operating and maintanance cost as well as expected reveneue from tariff.
9	**Leapfrog Emission Standard + Option 1**	Implement Euro 2 at 2005, Euro 3 at 2013, and Euro 4 at 2016	Implement Euro 2 at 2005, Euro 3 at 2013, and Euro 4 at 2016

Economic Benefits

Cost and Benefit Analysis (2005-2030)

	Option 1	Option 2	Option 3	Option 4	Option 5	Option 6	Option 7	Option 8	Option 9
Cost									
Refinery Production	467,416	428,932	431,091	467,416	338,794	464,669	458,053	421,638	466,745
Technology Utilization	493,312	664,566	15,863	643,108	784,586	30,911	342,032	117,541	493,312
Total Cost	960,728	1,093,497	446,954	1,110,523	1,123,380	495,580	800,086	539,179	960,057
Benefit									
Health Improvement	1,656,264	2,646,587	1,532,923	2,012,137	2,854,542	1,667,728	1,667,729	1,649,883	1,648,305
Production Saving	27,712	157,826	52,277	27,712	448,393	36,237	57,138	169,923	31,387
Subsidy Saving	286,392	1,640,422	539,615	286,392	4,601,071	373,975	589,473	1,746,763	324,084
Total Benefit	1,970,368	4,444,835	2,124,816	2,326,241	7,904,005	2,077,940	2,314,340	3,566,569	2,003,776
FY 2005-2030									
Net Benefit	1,009,640	3,351,338	1,677,862	1,215,717	6,780,625	1,582,360	1,514,255	3,027,390	1,043,719
NPV; SDR 8 %	38,963	803,680	310,516	374,486	1,563,678	290,778	275,887	599,926	47,736
Net Benefit Average	38,832	128,898	64,533	46,758	260,793	60,860	58,241	116,438	40,143
FY 2009-2030									
Fuel Saving	286,392	1,640,422	539,615	286,392	4,601,071	373,975	589,473	1,746,763	324,084
NPV; SDR 8 %	71,395	469,465	127,900	71,395	1,098,827	91,202	144,873	388,089	84,727
Net Benefit Average	13,018	74,565	24,528	13,018	209,140	16,999	26,794	79,398	14,731

Cost of Effectiveness (2005-2030)

	Option 1	Option 2	Option 3	Option 4	Option 5	Option 6	Option 7	Option 8	Option 9
Cost (IDR Billion)	960,728	1,093,497	446,954	1,110,523	1,123,380	495,580	800,086	539,179	960,057
Emission Reduction (Million ton)									
CO	9,142	12,869	9,231	9,142	13,565	9,156	9,190	12,488	11,519
NOx	6,269	11,548	6,524	7,596	13,621	6,327	6,204	6,799	7,903
HC	2,178	3,057	2,178	3,244	3,244	2,438	2,196	2,697	2,741
PM	663	768	671	776	776	664	668	684	858
Cost Effectiveness (IDR Billion per million ton)									
CO	105	85	48	121	83	54	87	43	83
Nox	153	95	69	146	82	78	129	79	121
HC	441	358	205	342	346	203	364	200	350
PM	1,449	1,424	667	1,431	1,447	746	1,198	788	1,120

- Economic Benefit by implementing Euro 4 2016 is IDR **3,973 T ~ USD 350 B.**

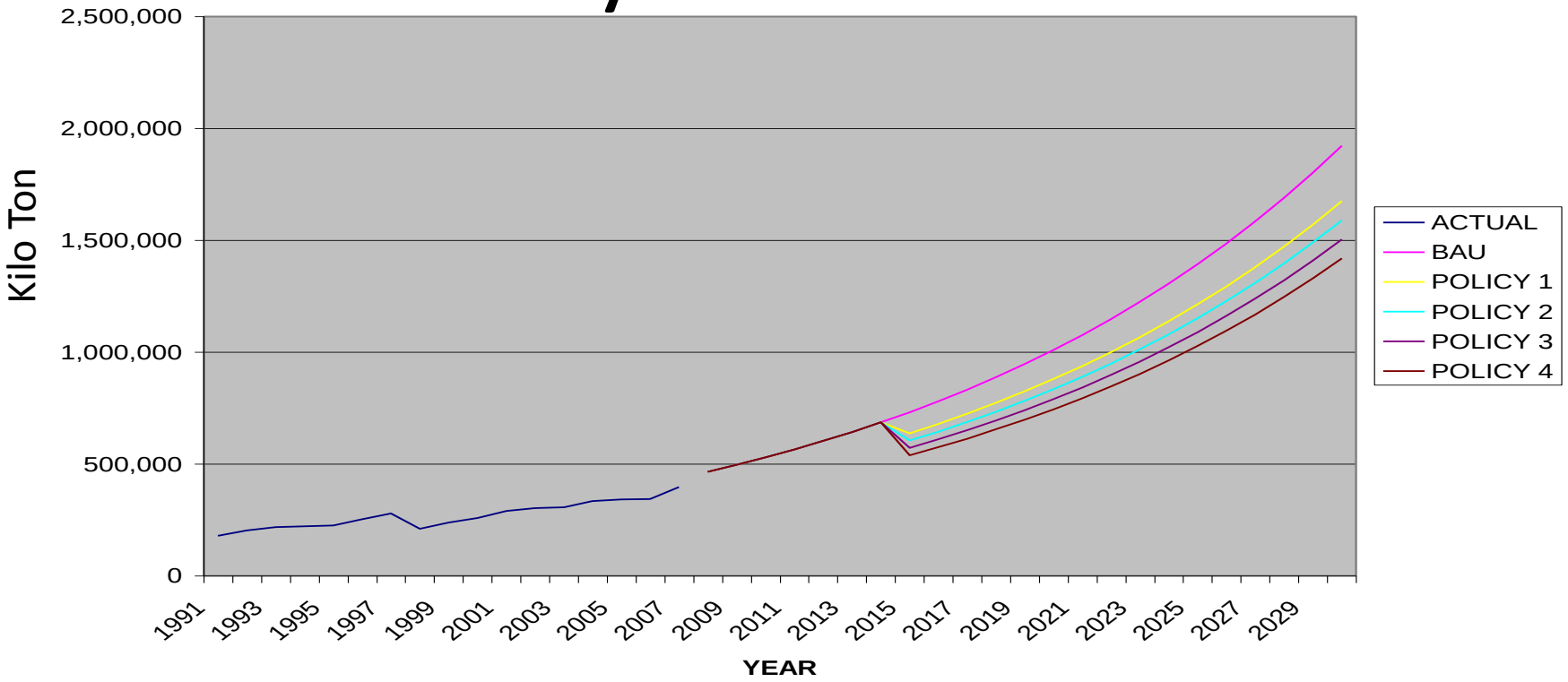
Policy Simulation

- Based on econometric result, we estimate the impact of fuel quality improvement on CO2 emission level and PM 10 level
- We assume that the government implement a regulation on emission on transport sector, such that, it would require a better fuel quality to meet the standard
  - I.e., moving to higher Euro level would only effective if the fuel quality is compatible
  - In our simulation, sulfur content is reduced from 500ppm to 50 ppm
- As the result of moving to higher standard, the efficiency is improved
  - However, we do not have information on the improved efficiency caused by moving toward higher emission standard
  - Thus, we use four assumption; 5%, 10%, 15%, 20% fuel efficiency improvement
- The result is presented in the following table.

Estimated Effect of Sulfur Reduction – 500 to 50 ppm – on CO2 Emission and PM10 level in 2019

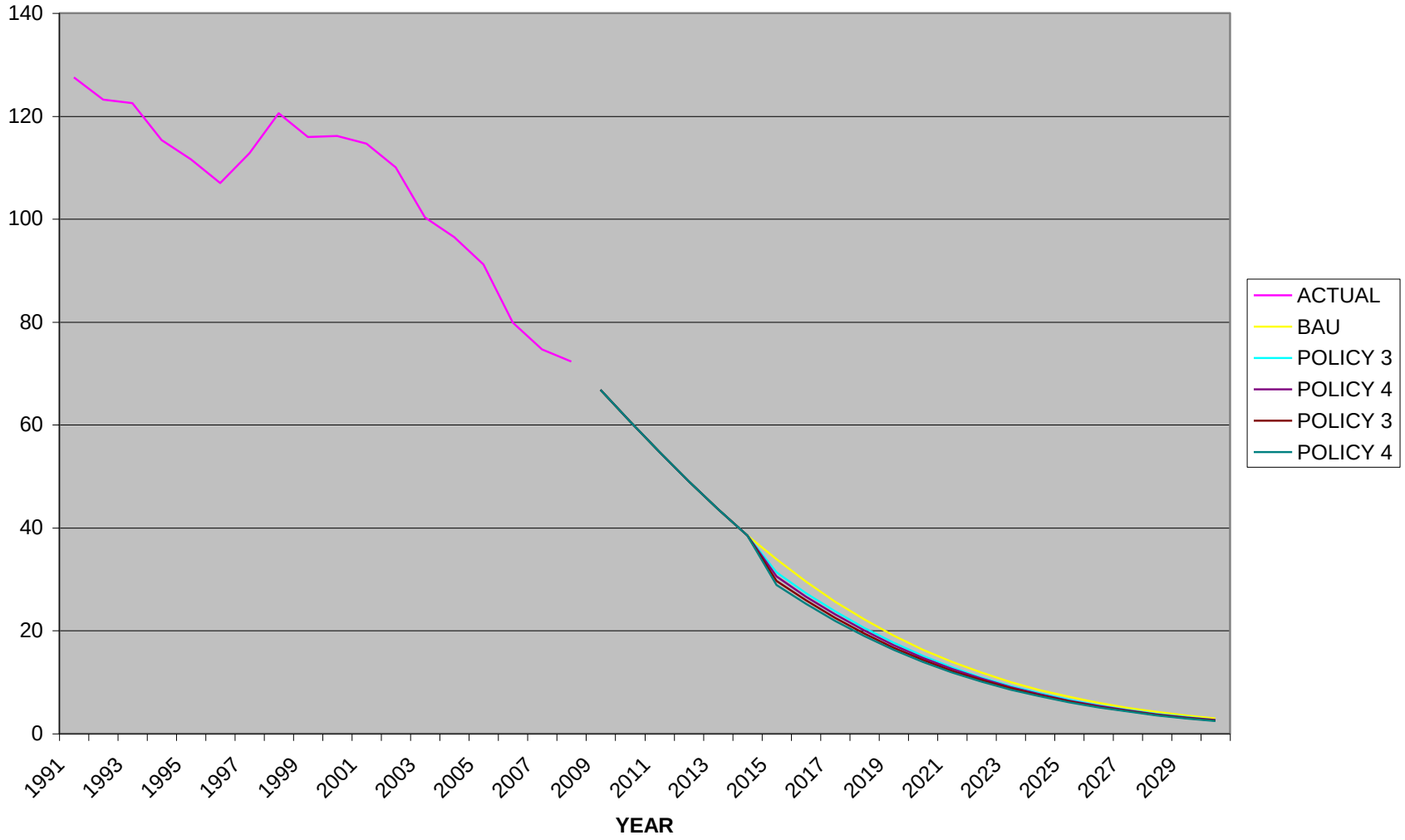
Scenario Fuel Economy	CO2 Reduction		PM 10 Reduction	
	%	kilo ton	%	kilo ton
5%	12.89	94,266	7.5	10.52
10%	17.35	126,831	9.8	10.86
15%	21.8	159,395	12.26	11.19
20%	26.25	191,960	14.64	11,51

Long-run Estimate of CO2 Emission by Scenarios



- Penerapan Vehicle Emission Standard – Euro 4 dan Fuel Economy Standard pada 2016 menjadi titik tolak bagi agenda penurunan emisi di masa yad. Kegagalan penarapan pada 2016, maka akan berimplikasi gagalnya agenda:
  - Penurununan local air pollution (CO, HC, NOx, SOx, PM, O3) maupun global green house gas (CO2)
  - Pengurangan beban Pemerintah akan penyediaan BBM yang berdampak pada penurunan nilai tukar Rupiah (konsekuensi import produk BBM untuk pemenuhan total konsumsi BBM Nasional.

Long-run Estimate of PM10 Emission by Scenarios

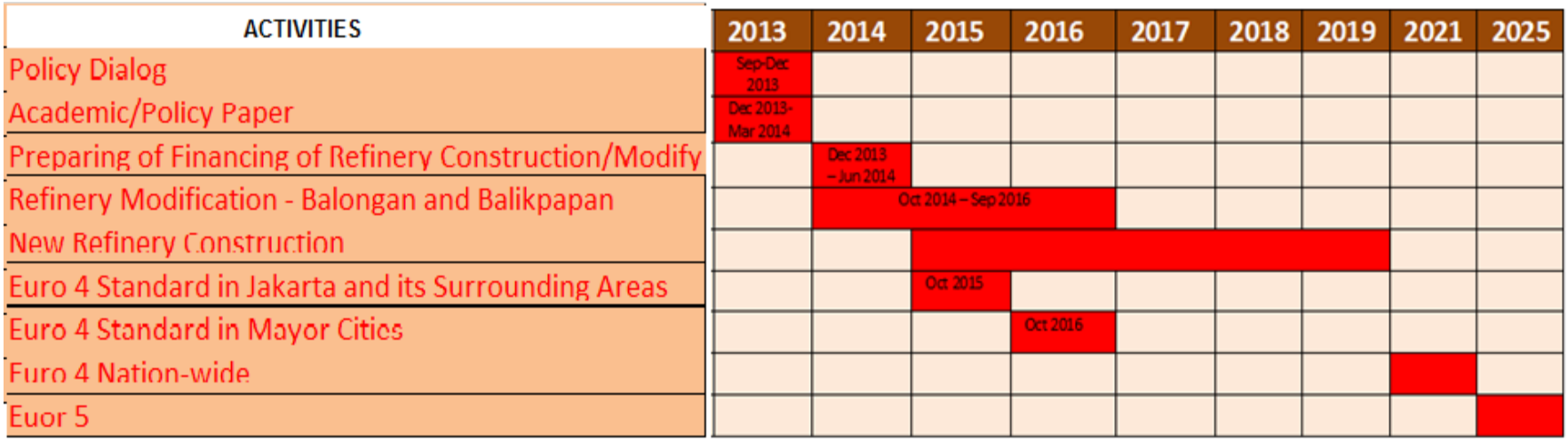


Actual and Forecasting CO2 and PM10 Emissions

YEAR	CO2			PM10			
	ACTUAL	BAU	POLICY 1	ACTUAL	BAU	POLICY1	POLICY2
1991	179,584	155,686		127.52	126.54		
1992	202,410	166,049		123.21	122.26		
1993	218,422	177,103		122.51	119.69		
1994	221,232	188,893		115.35	118.18		
1995	224,757	201,468		111.62	117.26		
1996	253,083	214,880		106.96	116.55		
1997	278,431	229,185		112.80	115.76		
1998	210,039	244,443		120.56	114.67		
1999	237,402	260,717		115.94	113.11		
2000	257,909	278,074		116.11	110.97		
2001	288,829	296,587		114.68	108.18		
2002	303,258	316,333		110.04	104.71		
2003	305,816	337,393		100.28	100.59		
2004	333,505	359,856		96.46	95.87		
2005	340,814	383,814		91.13	90.64		
2006	342,547	409,367		79.89	85.01		
2007	396,819	436,621		74.66	79.07		
2008	420,890	465,690	461,608	72.35	72.97		
2009	455,230	496,695	488,025	65.70	66.81	62.28	62.05
2010	496,978	529,764	515,953	59.87	60.70	52.72	52.33
2011	528,768	565,034	545,480	54.11	54.75	44.28	43.79
2012	567,890	602,653	576,697	48.98	49.03	36.90	36.36
2013	612,306	642,776	609,700	43.54	43.61	30.53	29.97
2014	646,897	685,571	644,591	38.56	38.55	25.09	24.54
2015		731,215	681,480		33.86	20.48	19.95
2016		779,897	720,480		29.57	16.61	16.12
2017		831,821	761,711		25.68	13.40	12.95
2018		887,202	805,303		22.19	10.75	10.35
2019		946,271	851,388		19.09	8.57	8.23
2020		1,009,271	900,112		16.34	6.81	6.51
2021		1,076,467	951,623		13.94	5.38	5.13
2022		1,148,136	1,006,083		11.84	4.24	4.02
2023		1,224,576	1,063,659		10.03	3.33	3.14
2024		1,306,106	1,124,530		8.46	2.60	2.45
2025		1,393,064	1,188,885		7.12	2.03	1.90
2026		1,485,812	1,256,922		5.98	1.58	1.47
2027		1,584,734	1,328,854		5.01	1.22	1.14
2028		1,690,243	1,404,902		4.19	0.95	0.88
2029		1,802,776	1,485,301		3.49	0.73	0.67
2030		1,922,802	1,570,302		2.91	0.56	0.52

Vehicle Emission Standard

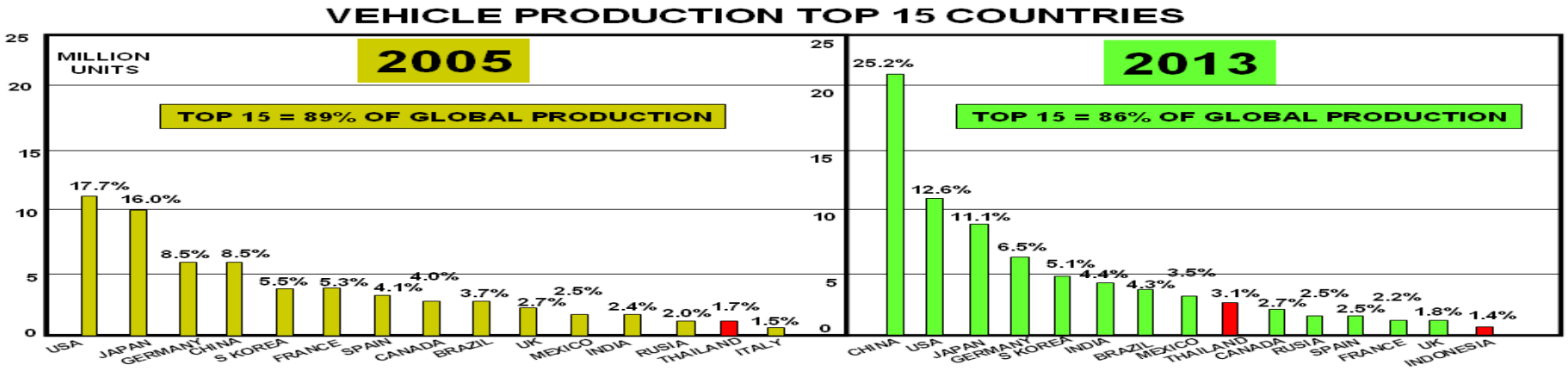
Euro 4 Standard Roadmap

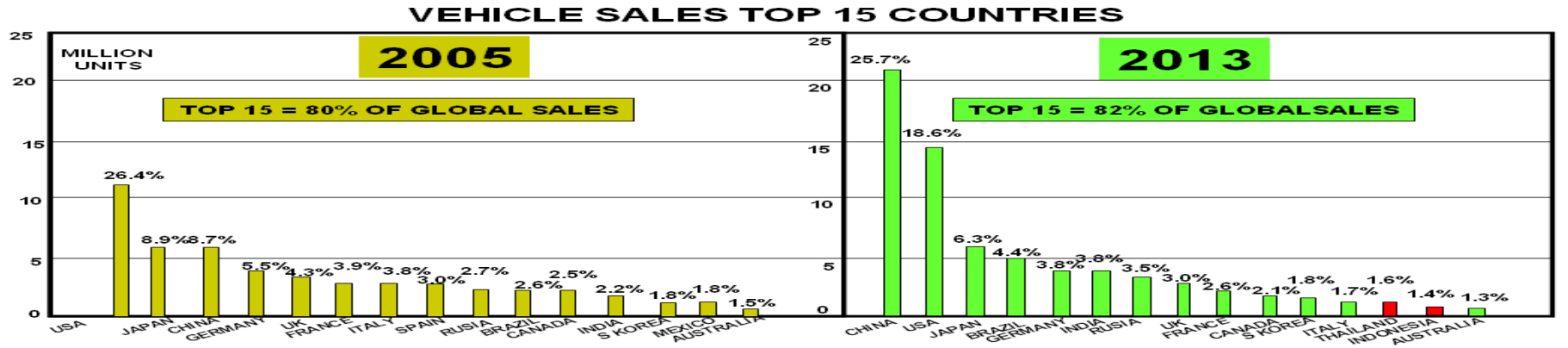


- Intensive Dialog on Roadmap of Fuel Economy and Vehicle Emission Standard – Euro 4:
  - Various constultative meetings among stakeholder
  - Policy dialog toward “preparedness of refineries to supply fuel for Vehicle Emission Standard Euro 4 by 2016”:
    - Jakarta
    - Kilang Balongan
    - Kilang Balikpapan
- Academic Peper Vehicle Emissions Standard – Euro 4
- Vehicle Emission Standard – Euro 4 on 2016 gradually:
  - Refinery modification for Balongan and Balikpapan to supply for Jakarta and mayor cities.
- Policy decision making process on refinery construction/modification :
  - Ministry of Finance, Parliament, Ministry of Energy, Donor Agency, etc to discuss on financing issue
- Breathe Easy Jakarta Program toward Vehicle Emission Standard Euro 4 Implementation in Jakarta by using of CNG.
- Implement Euro 4 nation-wide by 2019.
- Implement Euro 5 nation-wide by 2025.

World Automotive Sales and Production

In 2005 Thailand production was no: 14 in the world, however in 2013 Thailand production has been achieving no: 9 , while Indonesia production is no: 15 in the world.





OICA

- Thailand adalah leading market di Asia Tenggara mengalahkan Indonesia sejak 2002 untuk sektor transportasi berkat kecepatannya dlm mengadopsi Standard Euro 2 sejak 1997, sementara Indonesia baru mengadopsi pada 2007.
- Malaysia adopsi Euro 2 sejak 2000, sehingga sejak 2002 sering berposisi sebagai runner up dalam leading auto-indusgtry market mengalahkan Indonesia.

Conclusion and Recomendation

- The needs to implement Vehicle Emission Standard and Fuel Economy Standard on time to curb government burden on fuels supply.
  - To avoid increasing of fuel consumption
  - Total fuel consumption by 2019 is 33 million KL gasoline and 19 million KL diesel fuel.
  - Co-benefit to mitigate *local air pollution* and *global green house gas*.
- Economic benefit of Vehicle Emission Standard is IDR 3,973 T (2030) by reducing health cost, production saving an fuel efficiency. Meanwhile by implementing 10% fuel efficiency now, will got economy benefit IDR 4,400 T (2030).
- The needs the effort to keep the consistency of agreement among stakeholder to implement Vehicle Emission Standard and Fuel Economy Standard on time:
  - International support
  - Public campaign – public pressure.

Thank you

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