

Environmental Policies in Thailand and their Effects

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1. Introduction

Environmental pollution in urban areas has been remarkably concerned as a major problem in Thailand. Most of the environmental problems especially air pollution in urban areas are totally arisen from transportation which are caused by congestion in road networks. This paper concentrates on clarification of current environmental policies in Thailand, by considering their effects of car usage, fuel consumption and its emission. Implemented environmental policies can improve the fuel quality and reduce a rate of fuel consumption. These policies give effect to the purification and reduction of gas emission but it has little effect to a change of the selection of engine type. Recently high technology was developed, new types of car engine, e.g., CNG, LPG, hybrid, are being, each of which generates different pollutants. An environmental effect of a new possible policy, changing the proportion of engine types, is challenged to analyze.

2. Current situation

2.1 Number of registered vehicles and Trends

In the year 2000, the total number of registered vehicle in Thailand was 20,698,779 as shown in Table 1. From the presented market share, motorcycles, cars, vans and pick-ups were the major types at about 90% of all registered vehicles. The trend of vehicle registration increased at an average rate of approximately 22% annually (see Fig. 1). Almost 22% of vehicle registration in Thailand were registered in the Bangkok Metropolitan Area (BMA). However, more than 60% were actually used in the area. This implies that most of transportation problems were intensive in Bangkok and the surrounding areas.

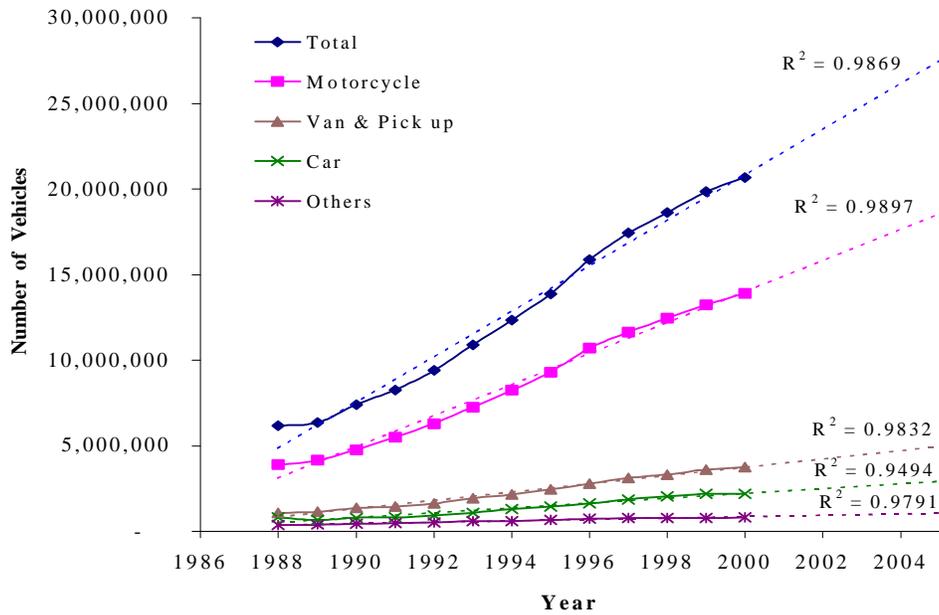
2.2 Energy consumption

The majority of energy in Thailand is predominantly consumed in the transport sector as shown in Table 2. The main fuel types are gasoline, diesel oil, and jet fuel. To look forward to the year 2025, the energy demand forecasting shows that the demand of transport sector is expected to reach 64.7 MTOE, a nearly 2.5 times increase from the year 1995. The share of energy consumption is projected to be: 51% for the freight transport mode, 32% for the non-urban passenger transport mode and 17% for the urban transport mode as shown in Table 3. The biggest increase in energy demand is from the urban passenger transport mode, growing rapidly from about 2.2 MTOE in 1995 to over 11 MTOE in 2025, an approximately 4 times rise. This may cause more severe air pollution.

Table 1 Total number of registered vehicles in 2000

Type of vehicle	Whole Kingdom	Bangkok	Out of Bangkok
Motorcycle	13,916,560	1,964,850	11,951,710
Tricycle	51,906	8,679	43,227
Car	2,188,534	1,315,016	873,518
Van & Pick up	3,763,767	1,033,003	2,730,764
Bus	122,187	26,128	96,059
Truck	600,995	104,470	496,525
Trailer	51,525	15,693	35,832
Automobile's Trailer	3,305	1,138	2,167
Total	20,698,779	4,468,977	16,229,802

Source: Department of Land Transport



Source: Department of Land Transport

Figure 1 Trends in the number of registered vehicles in Thailand

Table 2 Final energy demand in the business-as-usual case

Unit: MTOE

Sector	1995	2000	2005	2015	2025
Transport	18.82	21.31	26.15	40.65	64.67
Residential	10.30	12.74	14.33	16.97	19.75
Industrial	15.98	17.56	23.85	39.57	65.25
Agricultural	1.58	1.75	1.9	2.49	3.47
Commercial	2.05	2.34	2.71	3.88	5.72
Total	48.74	55.71	68.94	103.56	158.87

Source: National Energy Policy Office

Table 3 Projected energy demand (KTOE) and share (%) from transport sector, for the years 1995 and 2025, (business-as-usual case)

	1995		2025	
	(KTOE)	(%)	(KTOE)	(%)
BMA Urban Transport	2,236	11.9	11,052	17.1
Non-BMA Passenger	6,887	36.6	20,357	31.5
Freight Transport	9,702	51.5	33,270	51.4
Total	18,824	100.0	64,679	100.0

Source: National Energy Policy Office

2.3 Current ambient air quality

Pollution Control Department(PCD) reported that the air pollutants of greatest concern in Bangkok are suspended particulate matter, especially particulate matter (PM10), and carbon monoxide (CO) as shown in Table 4. They are accounted for mostly by the transport sector.

Table 4 Roadside air quality data in BMA, 1999

Pollutant	PM10 ¹	CO(1 hr) ²	CO(8 hr) ²	Lead ³	Ozone ⁴	SO ₂ ⁵	NO ₂ ⁶
Mean	80.1	2.29	2.29	0.09	6.9	8.3	33.2
Standard	120	30	9	1.5	100	300	170

Source: Pollution Control Department

Remarks: Roadsides are those within 2-5 meters from the main road.

Pollutants are 1 hour averages except noted, and PM10 is 24 hour average

¹Particulate Matter <10 microns, units µg/m³

²CO units ppm (1/1,000,000)

³Lead units ppm (1/1,000,000)

⁴Ozone units ppb (1/1,000,000,000)

⁵SO₂ units ppb (1/1,000,000,000)

⁶NO₂ units ppb (1/1,000,000,000)

3. Pollution control measures

The government has been attempting in respond to the environmental problems, in which several effective pollution control measures were initiated. The measures aim not only at exhaust gas emission controls but also at the improvement of fuel and vehicle specifications, implementation of in-use vehicle inspection and maintenance program, mass transit systems, and traffic management. The measures directed toward reducing vehicle emissions include:

2.1 Fuel reformulation

The fuel reformulation is separated into two types, gasoline and diesel.

Automotive gasoline reformulation

The ways of gasoline reformulation are implemented as follows:

- Leaded gasoline has been no longer available in Thailand since January 1, 1996.
- The benzene content is limited less than 3.5 percent by volume.
- The aromatic content is set to be lower than 35 percent by volume.

Automotive diesel reformulation

The ways of diesel reformulation are implemented as follows:

- The sulfur content is reduced from 1.0 to 0.5 percent by weight.
- The 90 percent volume distilled is reduced from 370 °C to 357 °C.

3.2 Control of vehicle emissions

Controls of CO and NO_x from gasoline vehicles are performed through the use of catalytic converters. After January 1, 1993, all cars having engine sized greater than 1600 cc must be installed catalytic converters. The cars with engine sized smaller than 1600 cc are required to install catalytic converters after June 1, 1993.

3.3 Emission standard

Emission standard for new vehicles in Thailand had been established since 1995, as shown in Table 5. The main part of vehicle emission standards, excepted motorcycle, is adopted from the European Union standard.

Table 5 Emission standards for new vehicles

Type of Vehicle	Level	Reference Standard	Implementing Date
Light Duty Gasoline Vehicle	6	96/69/EC	1 October 1999 for RM ≤ 1,250 kg 1 October 2000 for RM > 1,250 kg
Light Duty Diesel Vehicle	5	96/69/EC	1 October 1999 for RM ≤ 1,250 kg 1 October 2000 for RM > 1,250 kg 30 September 2001 for DI Diesel
Heavy Duty Diesel Vehicle	3	EURO II	1 January 1999
Motorcycles	4	- CO ≤ 4.5 gm/km - HC+NO _x ≤ 3 gm/km - White Smoke ≤ 15% - Evaporative 2 gm/test for sizes ≥ 150 cc.	1 July 1999 for sizes ≤ 110 cc. 1 July 2000 for sizes ≤ 125 cc. 1 July 2001 for all sizes
	5	- CO ≤ 3.5 gm/km - HC+NO _x ≤ 2 gm/km	Under Consideration

Source: Pollution Control Department

3.4 Inspection and maintenance program

To pass the inspection, emissions of in-use vehicles must meet the emission standards for in-use vehicles as shown in Table 6. The current decentralized inspection and maintenance program for in-use vehicles is being criticized for its effectiveness since authorized private inspection centers or garages are also allowed to do repair. The inspection procedure is questionable. The program will be evaluated in the near future and will be improved as necessary to increase its effectiveness.

3.5 Roadside inspection

Roadside inspection for smoky vehicles in Bangkok is carried out every day by four agencies, i.e., Police Department, Land Transport Department, Department of Pollution Control, and

Table 6 Emission standards for in-use vehicles

Pollutant	Type of Vehicle	Standard	Measuring Device	Test Procedure
Black Smoke	Diesel vehicle	50%	Filter	Snap Acceleration Test
		45%	Opacity	Snap Acceleration Test
		40%	Filter	Full Load Test
		35%	Opacity	Full Load Test
CO	Gasoline vehicle registered from November 1, 1993	1.5%	NDIR	Idle Test
	Gasoline vehicle registered before November 1, 1993	4.5%	NDIR	Idle Test
	Motorcycle	4.5%	NDIR	Idle Test
HC	Gasoline vehicle registered from November 1, 1993	200 ppm	NDIR	Idle Test
	Gasoline vehicle registered before November 1, 1993	600 ppm	NDIR	Idle Test
	Motorcycle	10,000 ppm	NDIR	Idle Test

Source: Pollution Control Department

Bangkok Metropolitan Administration. Drivers violating emission standards for in-use vehicles will be fined and vehicles will not be allowed to use until they are repaired and pass the re-inspection. Currently, there are about 40 teams doing roadside inspection every day.

3.6 Traffic management and VKT reduction

To increase traffic speed in Bangkok and reduce vehicle kilometers traveled (VKT), the specific measures are implemented as follows:

- Two mass rapid transit systems, i.e. an elevated sky-train system and a subway system
- Bus system reform
- Extension of road network and expressway
- Automatic area traffic control
- Parking restriction on major streets
- Flexible working hours
- Strict enforcement of traffic regulation
- Bus lane
- Reversible lane

3.7 Other measures

Recent pollution control measures are started to implement as follows:

- Alternative fuel such as natural gas, LPG, electricity, bio-diesel, ethanol
- Public campaign, such as car pool, car-free-day, walking street
- Tax penalty and incentive for promoting the use of cleaner vehicles and cleaner fuel
- Controlling the use of used engines
- Special inspection and maintenance for bus fleet

4. Effects of the automotive air pollution control strategies

Effects of current automotive air pollution control strategies are analyzed and shown in Table 7. The effects are categorized into 3 parts: car usage, fuel consumption and gas emission. Different kinds of car engine consume different fuels. Consequently, each fuel causes distinct proportion of exhaust gas emission.

Table 7 Effects of the automotive air pollution control strategies

Strategy	Car Usage	Fuel consumption	Gas Emission
Improvement of Fuel Quality	Not change	Increase effectiveness of fuel usage	Reduce pollutants ; Lead, CO, SO and MP
Improvement of Emission Standards	Little effect	Increase effectiveness of fuel usage	Reduce all pollutant
Inspection and Maintenance Program	Shorter vehicle usage life	Little effect	Little effect
Roadside Inspection	Not change	Not change	Little effect
Traffic Management and VKT Reduction	Reduce traffic congestion	Reduce total fuel consumption	Reduce pollution
Other Measures	Little change in number & type of car usage	Alternative fuel become more criticize	Decrease generally

From the result, it is observed that all current policies are stressed on a reduction of fuel consumption and a purification of gas emission, less effect to change in proportion of car usage. To understand the effect of changing of proportion of car usage, the following three conditions are set.

Current Condition: Car 30%, Pick up 23%, Motorcycle 44%, Truck 3%

Condition 1 : Shift in vehicle composition 10% from Pick up to Car

Condition 2 : Shift in vehicle composition 10% from Motorcycle to Car

Condition 3 : Substitute 50% of fuel by NPG in Car and Pick up

From the observation in the first condition, 10 percent of PU's were changed to PC's, that is NO_x and PM decreased 4.2 and 8.0 percent while CO increased 4.0 percent. In the second condition, 10 percent of MC's were changed to PC's, the emissions of NO_x and CO increased 1.4 and 7.3 percent, respectively, while PM dropped only 0.3 percent. In the third condition, 50 percent of NGV's were introduced, the emissions of NO_x, CO, PM and HC decreased 7.6, 4.9, 8.9 and 0.8 percent, respectively.

Table 8 Forecasting of different conditions

	Emission (10 ⁹ g.)							
	NO _x		CO		PM		HC	
Current Condition	126.67	-	78.62	-	8.57	-	28.56	-
Condition 1	121.29	-4.2%	81.79	+4.0%	7.89	-8.0%	28.71	+0.5%
Condition 2	128.42	+1.4%	84.36	+7.3%	8.55	-0.3%	28.65	+0.3%
Condition 3	117.00	-7.6%	74.80	-4.9%	7.81	-8.9%	28.33	-0.8%

5. Conclusion and recommendation

Replacement of the gas engine can be a key to a possible strategy applied for a new policy of car usage in Thailand. This policy can make a predominant effect to gas emission for a long-term plan while the current policies only focuses on a purification of gas emission and reduction of fuel consumption. However, exclusive schemes, e.g., taxation policy, to motivate the change of car usage are needed to examine.

References

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