Review of Lead Phase Out for Air Quality Improvement in the Third World Cities Lessons from Thailand and Indonesia

Hirota, Keiko

Japan Automobile Research Institute

9 April 2006

Journal of Studies in Regional Science 2006; Special Issue on Urban Quality of Life, The Japan Section of the Regional Science Association
(Japan Society of Regional Science) *Journal of Regional Studies*. Tokyo: PRSCO July 25-28th. Vol.36 No.2, pp.527-541

Review of Lead Phase Out for Air Quality Improvement in the Third World Cities

Lessons from Thailand and Indonesia

Keiko Hirota*

*Research Planning and Project Division,
Japan Automobile Research Institute,
2530 Karima Tsukuba Ibaraki 305-0822, Japan.
Tel:+81-29-856-0767, Fax:+81-29-860-2388
khirota@jari.or.jp

Abstract

Due to the rapid economic growth, and increase of motor vehicle ownerships in Asian countries, people are suffering from serious air pollution problems, especially in large cities. There has been a worldwide movement to eliminate lead from gasoline since the 1970s. In accordance with lead elimination from gasoline, the concentration of lead in air and its health impact have also decreased.

This paper is an attempt to discuss about environmental measures in Thailand and Indonesia. From a point of view on environmental measures, the case studies show different problem and process of lead phase out policy because of different socio-economic backgrounds, the initial conditions of the oil industries and government capacity. Behinds environmental measures, the case studies indicate that the most important change driver is strong leadership to achieve consensus among different stakeholders.

JEL classification: N75, P41, Q53, Q56, R 48

Key words: Asia, Coordination, Air Pollution, Sustainability, Regulatory Policy

1. Environmental Measures of Lead Phase Out from World Wide Experiences

Due to the rapid increase of economic growth and motorization in Asian countries, people suffer from serious air pollution, especially in large cities. There is a wide range of health impacts of emissions from automobiles. Until 1970s almost all gasoline used around the world contained lead, however the concerns about the health effects of lead started to drive a steady movement of lead phase out in developed countries since 1970s. The literature has pointed out the various technical and economic aspects; however, lead phase out policy seems to be very country specific in terms of the local situation if we observe it in detail. The purpose of this paper is to focus on political consensus behind technical and economic aspects among different stakeholders in Thailand and Indonesian cases. The lead phase out policy needs to consider a complex of different factors that are specific for a given country. Political decision should next be taken to ensure that solution functions in appropriate timing for the country are taken into consideration.

Lead, in the form of tetra-ethyl (TEL) and tetra-methyl lead (TML), is used as an additive in gasoline for automobile use. It is the least expensive means of enhancing the octane number in gasoline ([28]). The more engine exhaust emission disperses lead compounds, the higher the lead concentration level in air. When lead enters the human body through inhalation, the lead level in the blood increases. This increases children's health risks such as lower IQ, behavioral problems and decrease of concentration ability. According to the World Wide Fuel Charter (WWFC) ([41]), the lead contents should be at 0.013 % wt. at maximum and RON 91 at minimum. Eliminating lead from gasoline will reduce the concentration of lead in air and in blood level. In this paper, lead in gasoline and in Blood Lead Level (BLL) will be measured as indicators of lead phase out policy impact.

With respect to the environmental policy measures, Jordan et al., [20] and Ekins [10] discuss that market based instruments, voluntary agreements and informational device has grown since 1990s in Europe ([13],[14],[15]) in response to dissatisfaction with regulatory measures. World-wide experiences of lead phase out ([19],[27],[28],[33]) **(Table 1-1)** represents 'policy mix' toward lead phase out from gasoline. From a view of technical requirements on refinery, the first obstacle is refining infrastructure. In general, refineries have very little or no alkylation or isomerization capacity in developing countries. These refineries have little flexibility for blending options to naphtha and a small amount of reformate so that the product results in a lower octane number. In a consequence, capital investments for updating isomerization units or in an alkylation plant are the main focus to produce unleaded gasoline. Each refinery has its own capacity and technical requirements, so the specific cost should be estimated case by case, but world-wide experience estimates the typical costs of refinery investment, annual operation of production and additives in the range of USD 0.01-0.02 per liter of gasoline ([27],[28],[33],[34]). However, the decision of updating refineries depends on not only the direct cost, but also on ownership status of oil industry so that we put the column "State Ownership of Refinery" in **Table 1-1**. When the share of state ownership is high, hidden costs such as privatization or deregulation may be high for updating the refineries.

The column of "non-lead lubricant additive" in **Table 1-1** means additive substitutes standard such as MTBE (methyl tertiary butyl ether). MTBE can increase octane number without capital investment ([9],[28],[33]), but water contamination is a major concern. Considering supply capacity and health impact costs, it may not be a panacea.

The column of “tax incentive” represents fuel tax differentiation between leaded gasoline and unleaded gasoline. This market based instrument is designed to encourage drivers to switch from leaded to unleaded gasoline. Some countries did not use tax incentive because unleaded gasoline is replaced immediately by regulation.

The column “cat. converter (catalytic converter)” is another important mandate for lead phase out. The availability of unleaded gasoline and introduction of catalytic converters are prerequisites for other emission reductions. The regulation promotes the sales and import new vehicle with catalytic converter. Some countries without implementation of catalytic converter mandate tend to delay introduction of strict emission standards. The introduction of catalytic converters is a driving force to penetrate unleaded gasoline and strict emission standards.

In accordance with increase of unleaded gasoline sales in market, there were also technical modifications at vehicle technology requirements and distribution infrastructure. At the vehicle technology requirements, soft valve seats might suffer from engine conditions if lead is eliminated from the fuel. Since the 1970s, most major car manufacturers have shifted vehicle technology from soft valve seats to hard valve seats ([28]). In order to avoid mis-fuelling, distribution infrastructure such as nozzle should be modified. When the government sets a lower price for unleaded gasoline than for leaded gasoline, the lead phase out will be completed in a short period.

Column of public awareness represents lead phase out campaign by governmental announcement or environmental movement by non governmental organization. The public awareness helps diffusion of unleaded gasoline in the market.

Table 1-1 Lead phase out Measures applied in Selected Countries (1998)

Country	State Ownership of Refineries (%)	Non-Lead Lubricanting Additives	Tax Incentive	Public Awareness	Cat. Converter	Other Measure
Austria	35	Yes	Yes	N.A.	Yes	Ban on leaded gasoline
Belgium	0	No	Yes	N.A.	Yes	
Demark	0	Yes	Yes	Yes	Yes	Scrapping
Finland	83	Yes	Yes	N.A.	Yes	
France	0	No	Yes	N.A.	Yes	
Germany	0	(Yes)	Yes	Yes	Yes	
Greece	2 state owned, 2 private	N.A.	Yes	N.A.	Yes	
Portugal	27	N.A.	N.A.	N.A.	Yes	
Italy	?	N.A.	Yes	No	Yes	Scrapping
Ireland	100	No	Yes	Yes	Yes	Scrapping
Netherlands	0	N.A.	Yes	Yes	Yes	
Norway	1 state owned, 2 private	Yes	Yes	Yes	Yes	Mandatory to unleaded gasoline supply at all gas stations
Sweden	0	N.A.	Yes	N.A.	Yes	
Switzerland	0	No	Yes	Yes	Yes	
UK	0	Yes	Yes	Yes	Yes	
Albania	100	N.A.	N.A.	N.A.	Yes	
Bulgaria	2 state owned, 1 small private	N.A.	(Yes)	N.A.	N.A.	
Croatia	100	No	Yes	Yes	Yes	
Cyprus	65	No	N.A.	N.A.	N.A.	
Estonia		N.A.	No	N.A.	Yes	
Czech	minor share of state owned	Yes, limited amount	(No)	No	Yes	
Hungary	0 ?	N.A.	(No)	Yes	Yes	
Latvia	N.A.	N.A.	Yes	Yes	Yes	Counterproductive tax favours old used cars
Lithuania	N.A.	N.A.	No	No	No	
Poland	100	Yes, limited amount	Yes	Yes	Yes	
Romania	51	No	No	N.A.	No	
Slovakia	73	Yes	Yes	Yes	Yes	Ban on leaded gasoline
Slovenia	45	No	(Yes)	N.A.	Yes	
Turkey	4	No	(Yes)	Yes	(Yes)	
Uzbekistan	N.A.	N.A.	N.A.	N.A.	N.A.	
Kazakhstan	N.A.	N.A.	N.A.	N.A.	N.A.	
Belarus	N.A.	N.A.	No	N.A.	No	
Russian F.	Joint venture	N.A.	(No)	N.A.	(No)	
Ukraine	1 state owned, 5 private majority	N.A.	Yes	No	Yes	
USA	0	Yes	Yes (Lead Trading and Banking)	Yes (Auto/Oil makers	Yes	
Japan	0	No	N.A.	Yes (Auto/Oil makers	Yes	
Thailand	21[*1]	Yes	Yes	Yes	Yes	
Indonesia	100	Yes	No	Yes	Yes	

1* estimated by author (Estimated with refining capacity by company)

Source: This matrix was produced by author based on the data from Indonesian Multi-Sect oral Action Plan Group on Vehicle Emission Reduction ([19]), Country Assessment Report 1998 in Ministry of Environment and Energy Denmark and Danish Environmental Protection Agency, 1998 ([28]), REC ([33]), US DOE ([37])

In Asian countries, however, effects of environmental measures (regulatory and market based instruments) seem to depend on socio-economic background in given countries from a point of view of governance capacity. Reviewing the environmental policy measures in Thailand and Indonesia, here are the unique points to influence the output of environmental governance.

1) While Thailand complete lead phase-out within only 4 years, Indonesia: takes more than 10 years. This timeframe difference can be explained by environmental management capacity with given economic condition. It is necessary to coordinate time schedule and mandate from different institutes by strong leadership under the constraint of human development and facilities.
2) Socio-economic backgrounds may impact greatly on output of environmental measures. For the application of environmental measures, it is necessary to consider which measure is workable and sustainable in given countries.
3) In Asian countries, regulatory measures are still major instrument. Application of market based instrument may need to include indirect costs such as lack of governmental capacity.

Next two chapters show the processes of regulatory and tax policies in Thailand and Indonesia from an environmental governance's point of view. As indicators of lead phase out effect, lead level in gasoline and blood lead level are presented at the end of each chapter.

2. Phase Out of Lead and Air Concentration -Case Study of Bangkok-

2.1. Socio-Economic Backgrounds

Before the successful lead phase out measures, Thailand experienced high economic growth from 1986-1996 at about 8 % per year. During 1984-1990, the car stock at a national level was double the growth rate at 14.6 % per year ([23]). The car stock grew at 10.4 % per year. In 1994, a report of Radian Corporation concluded that lead in air concentration comes mainly from transport sector (passenger vehicle: 55 %, motorcycles: 23 % and light trucks:13 % [34]).

Since the mid-1980s the rapid growth of urban areas and loose environmental regulation air pollution has caused health problems ([34]). In early 1990s, the awareness among different governmental institutes launched the political commitment. A strong initiative from the government shared responsibility among different stakeholders and kept an organized schedule for lead phase out activities. In accordance with lead phase out by the end of 1995, the vehicle emission standard EURO I was introduced in 1996.

The increase of vehicle use, congestion and air pollution began to draw the attention of residents, government and the media. In 1985, the government of Thailand (GOT) and automobile manufactures achieved a consensus toward lead phase out with the following three benefits to reducing Blood Lead Level.

- Refinery modification increases efficiency and lowers operation costs.
- Positive impact on neurological development and intelligence.
- Reduction of the mortality rate due to cardiovascular problems caused by lead.

GOT considered the feasibility of refinery modification. The Bangchak Oil Refinery Restructuring Project was launched by partial privatization with financial support of the World Bank. With oil refinery modification, the lead phase out program was launched from 1989.

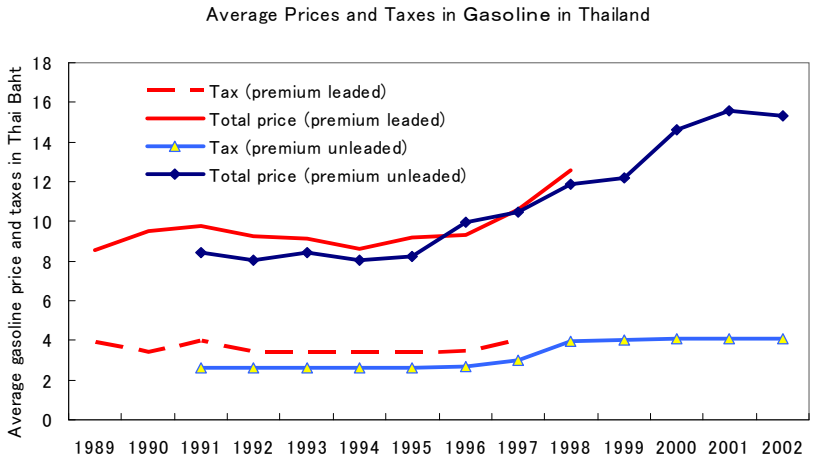
The government also worked closely with automobile manufacturers on catalytic converters. In the 1990s, the cost of a catalytic converter was $1200, which was a cost increase of 7-10 % on new car sales. The Ministry of Commerce imposed an inbuilt catalytic converter for all new passenger vehicles with tariff reduction for stabilization of vehicle prices.

2.2. Coordination between Regulatory and Economic Measures

In Thailand, a strong leadership and coordination of policy completed the lead phase out in a shot term. The Cabinet approved the proposal of various targets from the National Energy Policy Council (NEPC), which carried out overall coordination under the advice of the National Energy Policy Office (NEPO). NEPC also worked closely with the Pollution Control Department (PCD) ([34]).

With respect to regulatory measure, in 1990 the Pollution Control Department operated 8 monitoring stations in central Bangkok and 9 monitoring stations at the curbside. Along with the market introduction of unleaded gasoline from May 1991, the Public Works Department specified gasoline station equipment such as storage tanks, pumps and nozzles and labeling for unleaded gasoline in order that it not to be contaminated by leaded gasoline.

With respect to market based instrument, since 1991 the Excise department has imposed a lower tax on unleaded gasoline for market penetration. **Figure 2-1** shows average prices and taxes for leaded and unleaded gasoline. Instead of a higher production cost of unleaded gasoline than leaded gasoline, the unleaded gasoline prices have been lower than leaded gasoline except in 1996. The Government of Thailand (GOT) set a lower excise tax on unleaded gasoline to keep the unleaded gasoline price lower ([16],[17]).



Source: IEA, 2000 ([16]), IEA 2005 ([17])

Figure 2-1 Average Prices and Taxes in Gasoline in Thailand

2.3. Lead Phase Out Policy and Health Impact in Bangkok

In 1989, a report of the United States Agency for International Development (USAID) pointed out that lead is one of the most problematic components which lead to 400-1400 deaths per year. Since the lead level in the atmosphere was harmful enough for public health, Seventh Plan Urban and Regional Transport Project ([30]) placed a numerical target of lead reduction by 85 % from the level of 1991.

Due to efficient lead phase out policy, the share of unleaded gasoline rapidly increased. Leaded regular gasoline RON 83 and leaded premium RON 95 were available until early 1991. In the year 1991, unleaded premium gasoline was introduced to the Thai market for the first time. In the year 1993, regular unleaded was also introduced to the market for the first time. Leaded gasoline RON83 was replaced by RON 87 gasoline by September 1993 ([34]). The total consumption of unleaded gasoline (regular and premium) was 582 million liters, which dominates 31 % of the gasoline market for automobile use. Since most of the unleaded gasoline was sold in the Bangkok area at the end of 1991, there was a drastic reduction of lead concentration in the Bangkok area ([23]). In 1994, regular leaded gasoline was completely phased out. From January 1st of 1996, both kinds of leaded gasoline were prohibited **(Figure 2-2)**. After the lead phase out, unleaded gasoline RON 87, 91 and 95 are still available in Thailand ([9]). In accordance with the lead phase out, NEPC introduced the vehicle emission standard EURO I in 1996.

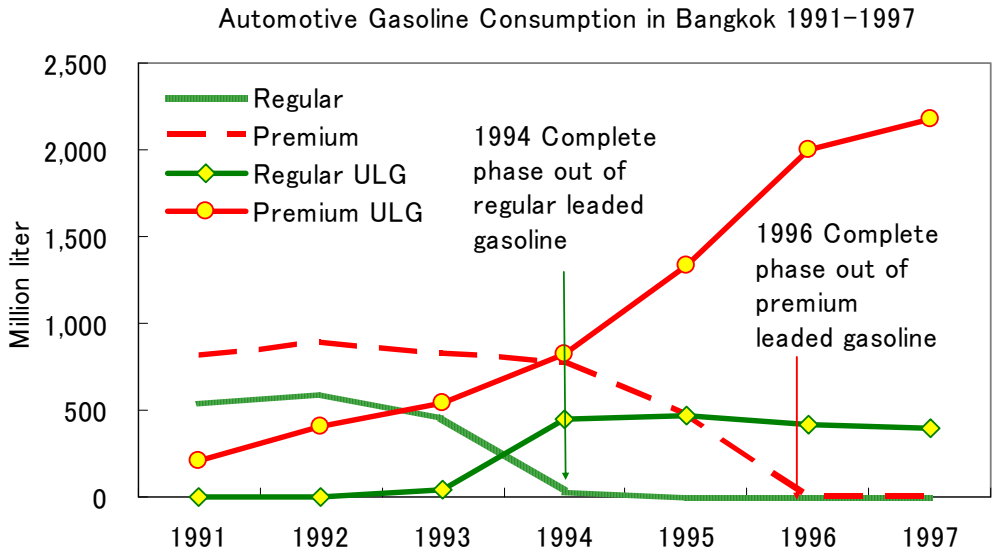


Figure 2-2 Automotive Gasoline Consumption in Bangkok 1991-1997

Source: Sayeg 1998 ([34]), Department of Commercial Registration Thailand in JARI 2005 ([23])

In 1995, around 50 % of economic activities were concentrated in Bangkok. Around 45 % of personal trips in Bangkok were made by private cars and motorcycles. The average growth rate is 8.08 % from 1988-1999 for registered vehicles and motorcycles in Bangkok. Instead of heavy usage of private cars and motorcycles in Bangkok, the lead in the atmospheric concentration has been decreased by 1997 **(Figure 2-3)**. On January 1st of 1992, the maximum lead content in gasoline was reduced from 0.4 grams per liter ([23]). On January 1st of 1996, the maximum lead content was

0.013 grams per liter, which is categorized as unleaded gasoline with the definition of WWFC in 1998 ([41]). Thailand was able to phase out lead just before its period of rapid motorization.

In 1993, the Average Blood Lead Level (BLL) in traffic policemen was above WHO and US EPA standard (10 *μg/dl*) ([23],[39]) in Bangkok, but BLL was reduced below the standards in 2000 after the lead reduction in air in Bangkok. **(Figure 2-4)**.

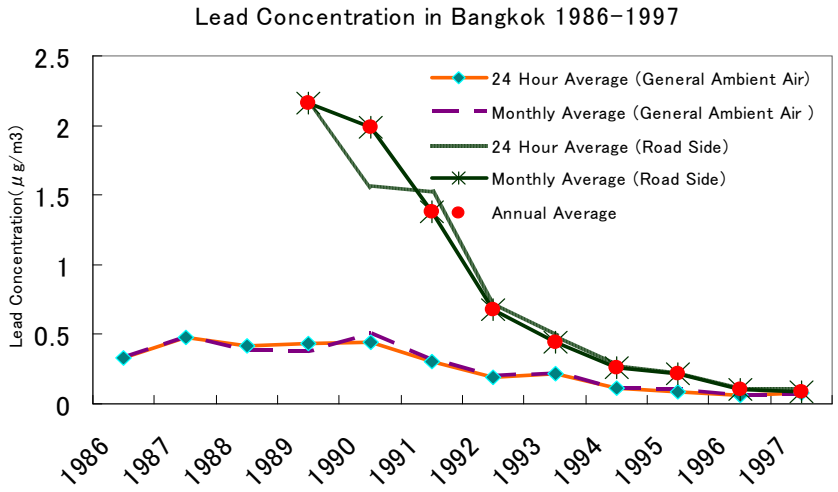
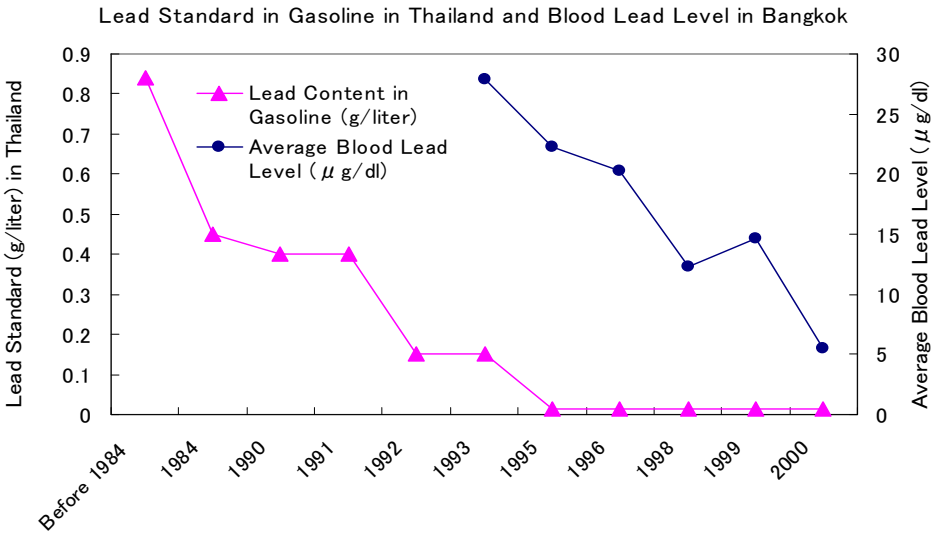


Figure 2-3 Lead Concentration in Bangkok 1986-1997

Source: Pollution Control Department in JARI 2005 ([23])



Source: JICA report in JARI 2005 ([23]), Sayeg 1998 ([34])
Wangwongwatana ([38])

Figure 2-4 Lead Standard of Gasoline in Thailand and Blood Lead Level in Bangkok

After the initial introduction of unleaded gasoline to the market in 1991, the lead phase out was completed within 4 years. At the beginning of the lead phase out process, GOT was the key agency formulating public consensus and providing analytical and financial support. The government leadership harmonized of regulations, requirements and mandate by different governmental institutes.

3. Lead Phase Out -the Case of Indonesian Cities-

3.1. Socio-Economic Backgrounds

As the financial crisis spread to Indonesia, the country was faced with very serious economic, social and political crises. Under Suharto regime since 1966, a fund-raising scheme was controlled by the Special Armed Forces Headquarters and the Government of the Special District of Jakarta sitting at the top of the pyramid. The "family values", Indonesian unique cultural structure, look after everyone in the organization, even those at the bottom of the hierarchy, helped increase the constituency for the regime in society. Following the 1990s, that structure gave rise to large government projects that were connected to the Suharto children, eventually building the family's business empire. Some point out that after the financial crisis, a high economic growth could not be expected unless the previous family business structure was reformed. Others comment that the difficulty of resolving debts in the private sector resulting from the family business transactions is a hindrance to sound economic activities. Rural areas of Indonesia are overpopulated and cannot absorb urban unemployed workers. Some believe that such a social problems are giving rise to acts of terrorism and riots unfolding throughout Indonesia. The 2002 terrorist bombs in Bali may soon trigger another terror attack by a Muslim extremist group, and such a threat will possibly lead to higher crime rates and heighten public anxiety.

With respect to updating refineries, President Soeharto promoted lead free gasoline by 1999 through the "Blue Sky Program ([26])", but the state owned company Pertamina did not change because of the low feasibility of upgrading refineries. To complete the phase out for all Indonesia, Pertamina requires 250 USD million ([26],[31],[35]) to construct an isomerization and reformer unit to produce High Octane Mogas Component (HOMC) to substitute for tetraethyl lead used as an octane booster. Since Pertamina did not have the funds to build additional refining capacity, the Presidential Decree No.31/1997 loosened Pertamina's hold on refining by allowing private refineries into the domestic market. In 2001, Oil and Gas Law No. 22 marked the removal of the monopoly toward liberalization step in the downstream by November 2005 ([18]). The Presidential Decree decreased the investment burden of Pertamina and enhanced capital market development from the private sector. Pertanima has been controlled from upstream (exploration and exploration) to downstream (processing, transportation, storage and marketing) for the last 30 years. In 2004, the first foreign firms, BP and Petronas of Malaysia, got licenses to develop retail and distribution ([11]) due to the deregulation. In September 2005, a joint venture was established between Pertamina and Chinese Oil Company Sinopec to conduct a feasibility study for building a petrochemical facility in East Java ([12]). Pertamina will finish modifying the Balongan Refinery (Catalytic Reformer) by July 2004 and start to supply unleaded gasoline for all of Java Island by October 2005 ([14]). The modified refinery capacity will produce unleaded gasoline with octane 92.8, where it will be allocated to supply the unleaded gasoline demand for Java Island ([27]).

3.2. Coordination between Regulatory and Economic Measures

The Indonesian cultural structure may cause to prolong a long process of lead phase out until the present. First, it was difficult for a monopolistic state owned oil industry 'Pertanima' to upgrade its refineries for the production of unleaded gasoline. Second, Pertamina and GOI controlled the oil price. The price differentiation between leaded gasoline and unleaded gasoline is counter productive from an environmental point of view. Third, a consensus of lead phase out could not be achieved because of different perspective among governmental institutes. In consequence, a civil movement finally took an initiative to promote lead phase out. Since July 2001, the Greater Jakarta Area has phased out lead from gasoline, but lead still remains in other cities. According to the R&D Center for Oil & Gas Technology (LEMIGAS) , lead will be expected to be phased out from 2006 to 2010 ([1]) for all Indonesia

After the first phase out program in 1999, the lead phase out will be completed by 2010. Unleaded gasoline has been sold since July 2001 in the Greater Jakarta Area. The lead phasing out policy is supported by civil society movements cooperating with international cooperation in Indonesia. To strengthen the movement against lead poisoning, UNEP, Environmental NGOs KPBB, Lead Center and the Ministry of Environment conducted a public campaign in 2005.

In February 2000, the Ministry of Energy and Mineral Resources agreed with state owned oil company Pertamina on the elimination of leaded gasoline in the Greater Jakarta Area by June 2000 and in the whole country by January 2003. Pertamina and the government of Indonesia (GOI) started to supply unleaded gasoline in Greater Jakarta and the Cirebon district from in 2001. Political disagreements among different governmental institutes made difficult to re-schedule for lead phase out ([26]). **(Table 3-1)**

According to the R&D Center for Oil & Gas Technology (LEMIGAS) under the Ministry of Energy and Mineral Resources, lead will be expected to be phased out from 2006 to 2010. By the end of 2005, Indonesia will introduce the EURO2 vehicle emission standards for new passenger vehicles ([1]).

Table 3-1 Pertanima's Proposal on Lead phase Out Rescheduling in Indonesia

Area	Scheduled	Implemented (Start to supply)
Jakarta Greater Area Cirebon District	June 2000	July 2001 Oct 2001
All Indonesia	December 1999 January 2003 January 2004	2006-2010 (Phase-out)
Bali	Jan 1, 2003	Nov 22, 2002
Batam	June 1, 2003	June 28, 2003
Java Island (North Beach) Java Island (South)	August 2003 December 2003	(Oct, 2005 All Java Island) 2006-2010

Source: Indonesian Ministry of Environment in KPBB 2003 ([26])

ACFA 2005 ([1])

With respect to the regulatory measure of fuel quality, all domestic fuel products are required to meet the fuel specifications mandated by GOI. Indonesia produces 6 types of gasoline, leaded Premium (RON 88), unleaded Premium (RON 88), Premix (RON 94), unleaded Premix (RON 94), Super TT (RON 95) and unleaded 2 stroke motorcycle gasoline (RON 80 Min. and RON 85 Max). The lead specification for leaded gasoline (Premium, Premix) is 0.3 g/liter. The lead specifications for unleaded gasoline (Premium TT, Premix TT) are 0.013 g/liter. The lead specification of Super TT is 0.005g/liter ([19]).

With respect to the gasoline price policy in Indonesia, gasoline prices are lowered by GOI with subsidies to minimize the impact on lower income groups ([16],[31]). The domestic gasoline price, which is a half of international price, may increase domestic fuel consumption and smuggling oil export.

From January 2002, the GOI applied a new fuel pricing policy for the domestic market. Premium gasoline prices are set at the market price ([11]) with reference to the Mid Oil Platt Singapore (MOPS) basket of wholesale fuel prices for price stabilization ([19]). In addition, the market price is adjusted only at the beginning of the month by Pertamina and GOI to prevent sharp fluctuation of domestic fuel price. The reduction of the price difference between domestic and international prices decreases subsidies and smuggling. However, a uniform tariff for each fuel type still make unleaded gasoline price higher than leaded gasoline price. **Figure 3-1** shows that the leaded gasoline has been sold at a lower price than unleaded gasoline except in 2002 and 2003. The prices of Premium gasoline increased after 1988 due to the fluctuating exchange rate.

In the late 1990s, new cars were still not equipped with catalytic converters ([34]). Since 2001, unleaded gasoline sales (unleaded Premium and unleaded Premix) have been available only in the Greater Jakarta area and the Cirebon District ([15]). In the year 2003, unleaded gasoline was available in the Greater Jakarta Area (30 % of national demand), the Cirebon District (5 %), Bali (4 %) and Batam, which is around 40 % ([26],[32],[39]) of total gasoline supply. Even if unleaded gasoline was cheaper in Indonesia, the sales would not have increased because the share of vehicles with catalytic converters was so limited in the region.

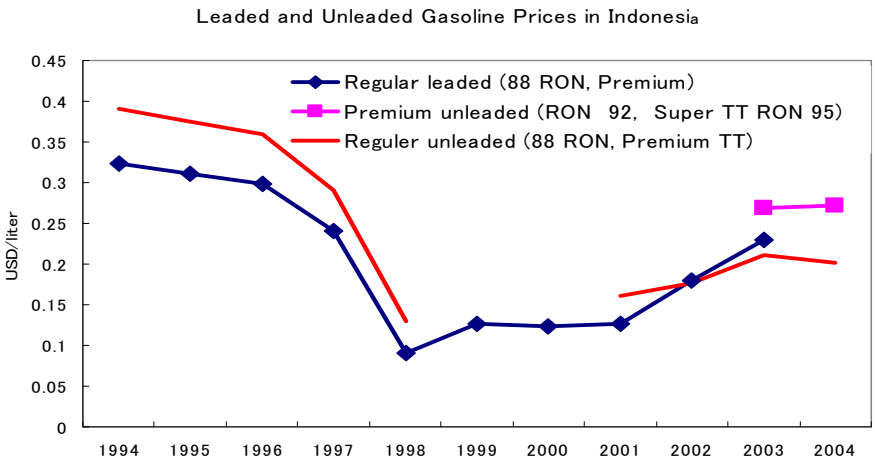


Figure 3-1 Leaded and Unleaded Gasoline in Indonesia

Source: IEA 2000, 2005 ([16],[17]),Bapedal and Lemigas 1997 ([4],[5],[6]),Bapedal and Lemigas 1998 ([7])

3.3. Lead Phase Out Policy and Health Impact in Jakarta

After the financial crisis in 1997, the transportation sector had the fastest recovery compared to other sectors. Between the periods of 1998-2002, the number of vehicles increased significantly at 6.1 % annually. The fastest increase was motorcycles (6.93 % annually), followed by passenger vehicles (4.58 %) ([2],[3],[23]). Motorcycles dominates at 73.97 % ([2],[3]) of total vehicle stock in 2000. The motorcycle became affordable private transportation among the medium and low income level households. They are not only private use but also create an informal public transportation service and delivery services. With the urbanization process, Jakarta has experienced serious air pollution, with 70 % ([1]) of its air pollution caused by vehicle emissions. The level of lead exceeds WHO guidelines for acceptable limits ([31],[36]).

According to a survey by the Environment University of Indonesia, **Figure 3-2** shows the average of lead levels in air concentration in the same period from July to September 2002-2003 in the Greater Jakarta Area ([29]), after the lead phase out. The survey concluded that there was a positive impact of the unleaded gasoline program since July 2001 to decrease lead concentration in the atmosphere of the Greater Jakarta Area.

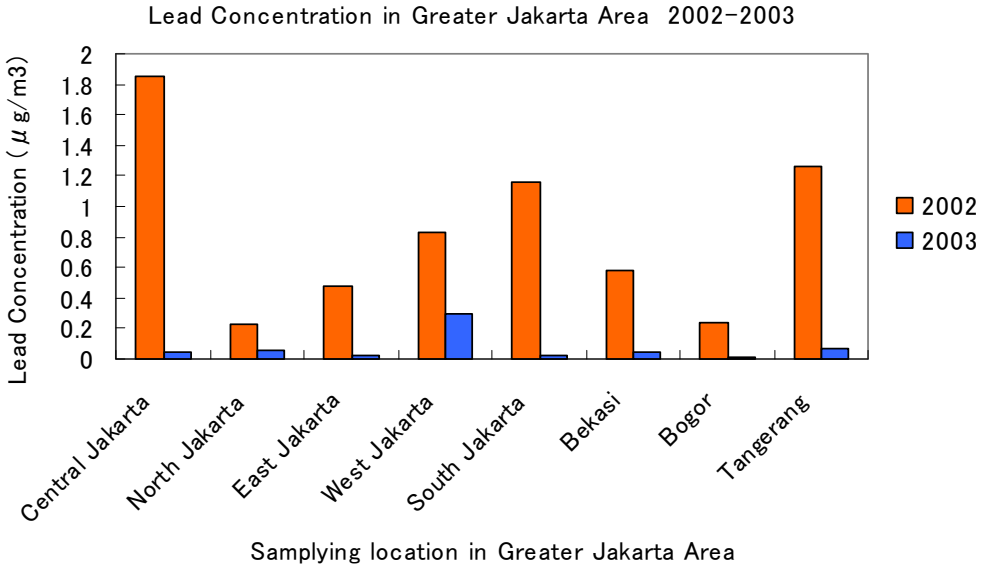


Figure 3-2 Lead Concentration in Greater Jakarta Area 2002-2003

Source: Nugroho 2003 ([29])

In 2001, a US EPA/CDC survey found that 35 % of Jakarta children had Blood Lead Level (BBL) above WHO or US EPA standards (10*μg/dl*), which is the tolerable lead content in human blood. A follow-up study held by the University of Indonesia, Environmental Health Department from January 2005 to March 2005, showed that the lead content in blood samples from elementary school students has dropped to 4.2*μg/dl* from 8.6 *μg/dl* in 2001 ([21]).

decreasing to a half level within 4 years. In Jakarta, the average BBL is below the tolerable lead level in 2005 **(Figure 3-3).**

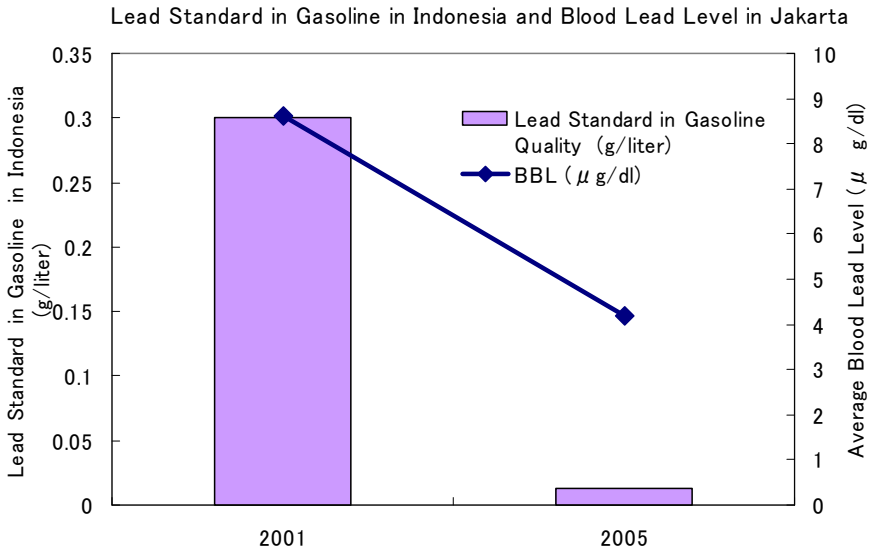


Figure 3-3 Lead Standards in Gasoline in Indonesia and Blood Lead Level in Jakarta

Source: Fuel Quality data: Standard of leaded gasoline (2001) in IMSAPIGVER 2002 ([19])
Standards of unleaded gasoline (2005) in IMSAPIGVER 2002 ([19])
BBL: USA/CDC (2001) in Billharz 2005 [8], Univ. Indonesia (2005) in Billharz 2005 ([8])

4. Is a System of Environmental Measures Applicable in Thailand and Indonesia?

The case studies show that socio-economic backgrounds may impact greatly on output of environmental measures. Both Thailand and Indonesia have introduced regulatory instruments for deregulation for upgrading refineries and emission standards to attract bidder from overseas in a joint ventures to enter the local markets. This is the prerequisite of lead phase out from gasoline and fuel price policy. Both countries also had already set technical requirement which is a driving force to penetrate unleaded gasoline and strict emission standards for vehicle. However, the system operation may not be efficient enough due to lack of monitoring. The real fuel quality and real emission from vehicle should be monitored in a fuel quality management system or periodical vehicle inspection. Only standardization test procedure can ensure the effectiveness and quality of environment. In addition, regulation dealing with punishment, penalties and sanction is urgently required for inspection system to identify non-compliance and improprieties.

Application of market based instrument may not be effective because of governmental capacity limit. While Thailand has the clear fuel tax differentiation, Indonesia has subsidy policy on fuel price with consideration of low income group. The link of a charge to pay by fuel quality and emission guarantees government funding. Usage of the funding should also be designed for environmental sustainability purpose.

Effects of environmental measures would depend on governmental capacity. Under the constraints of human development and facilities, it is necessary to coordinate time schedule and function of each governmental institute by strong leadership. The case of Thailand show that the strong government intervention is indispensable for environmental management, sharing responsibility among different stakeholders and keeping an organized schedule for lead phase out. In Indonesia, weak coordination among different political institutes may delay of lead phase out time schedule. Instead of the weak environmental governance, environmental campaign by non-governmental organization became a driving factor for changing the attitude of GOI toward lead phase out.

It is important for a given developing country that the proposed solution is workable and appropriate for the country's condition because the lacks of monitoring and of coordination capacity may be hidden costs of policy implementation in developing countries. Regulatory instrument is major tool. Market based instrument should be lined to environmental sustainability in given countries. Behinds the environmental measures, the consensus, coordination among different stakeholders and leadership by government is main factors to penetrate of environmental governance in a short transition period.

5. Concluding Remarks

In this paper, the cases of Thailand and Indonesia show different socio-economic situations and political implementations toward lead phase out. The periods of lead phase out were different because the economic backgrounds, the initial conditions of the oil industries and the level of motorization are different between Thailand and Indonesia. These case studies show the importance of strong governmental leadership to coordinate environmental measures.

There are still other components to be considered to reduce air concentration. If the government of a country phases out lead from gasoline at an earlier stage, they can prepare earlier for other emission reductions in the future. From the point of view of the automobile industry, lead phase out is just a prerequisite of other emission reductions. At the AMEICC Working Group held in Cambodia in May 2004, it was agreed to set a target for introducing EURO2 at least by the end of 2005 and EURO4 by the end of 2010. At the same time, there was consensus regarding the necessity of taking immediate action to improve fuel properties toward the target of emission gas regulations, and an action plan was adopted to improve properties with a target year of 2010.

References

[1]Asian Clean Fuels Association (ACFA), "Indonesian Moves toward Sulfur and Lead Limits with Growing Fuel Demand." *ACFA News*, Vol.3 Issue 5, Singapore: ACFA, 2005, p.1.

[2]Badan Pusat Statistik (BPS), *Statistik Perhubungan Transportation and Communication Statistics*, Jakarta: BPS, 2000, p.113.

[3]Badan Pusat Statistik (BPS), *Statistik Perhubungan Transportation and Communication Statistics*, Jakarta: BPS, 2002, pp.97-99.

[4]Bapedal and Lemigas, *Directorate General of Oil and Gas Decree No.108 on Premium*, Jakarta: Bapedal and Lemigas, 1997.

[5]Bapedal and Lemigas, *Directorate General of Oil and Gas Decree No.108 on Premi*x, Jakarta: Bapedal and Lemigas, 1997.

[6]Bapedal and Lemigas, *Directorate General of Oil and Gas Decree No.112 on Super TT*, Jakarta: Bapedal and Lemigas, 1997.

[7]Bapedal and Lemigas, Directorate *General of Oil and Gas Decree No.108 on BBK 2L*., Jakarta: Bapedal and Lemigas, 1998.

[8]Billharz, S., "Blood Lead Level Tests in Bandung, Indonesia Show Encouraging Results," in CAI-Asia internet list serve, 2005. http://www.cleanairnet.org/caiasia/1412/article-60001.html

[9]Deadalus LLC and ERM-Siam, Co Ltd, *Final Report*, Bangkok: National Energy Policy Office (NEPO), 2002, pp.39-175.

[10]Ekins, P. "European Environmental Taxes and Charges," *Ecological Economics*, 31,1, pp.39-62.

[11]Embassy of the United States of America, *Petroleum Report Indonesia 2002-2003*, Jakarta, Embassy of the Unites States of America, 2004, p.29.

[12]Energy Information Administration (EIA), *Country Analysis Brief: Indonesia*, Washington D.C.: EIA, 2005, pp.8-10. http://www.eia.doe.gov/emeu/cabs/Indonesia/Full.html

[13]Hirota, K., "Vehicle Related Tax for Environmental Sustainability," *JARI Research Journal*, Vol.26, No.2, 2004, pp.21-24.

[14]Hirota, K., and Poot, J., "Taxes and the Environmental Impact of Private Car Use: Evidence from 68 Cities," in Aura Reggiani and Laurie Schintler (eds), *Methods and Models in Transport and Telecommunications: Cross-Atlantic Perspectives* , Berlin: Springer Verlag, 2005, pp.299-317.

[15]Hirota, K., and Minato, K., "Vehicle Related Taxes and Environmental Impacts in Large Cities," *Proceeding of The 19th Energy system, Economy, Environment Conference*, 2003, pp.411-414.

[16]International Energy Agency (IEA), *Energy Prices and Taxe*s, Paris: IEA, 2000, p.435.

[17]International Energy Agency (IEA), *Energy Price and Taxes*, Paris: IEA, 2005, p.434.

[18]Indonesian News. http://www.indonesian-lic.org/en/newsdetail.php?id=9

[19]Indonesian Multi-Sect oral Action Plan Group on Vehicle Emission Reduction (IMSAPGVER), *Integrated Vehicle Emission Reduction Strategy*, RETA 5937, 2002, pp.39-40.

[20]Jordan, A. Wurzel, R. and Zito, A., "How 'New' Environmental Policy Instruments (NEPIs) Spread in the European Union: An Analysis of the Role of the EU in Shaping Environmental Governance."http://www.uea.ac.uk/env/cserge/research/fut_governance/Home.htm

[21]*The Jakarta Post*, May 5th 2005.

[22]Japan Automobile Research Institute (JARI), *Project Report of Fuel Quality Management System*. JARI-JETRO, 2005, p.38.

[23]Japan Automobile Research Institute (JARI), JARI Database, 2005.

[24]JASIC, *JASIC Report*, Tokyo: JASIC, 1999.

[25]King Mongkut's University of Technology Thonburi (KMTT), *Thailand: A Research on Proper Automobile Usage Strategy towards Environmental Impact Abatement in Large Cities in Asia,* A Research Project Submitted to JARI, Bangkok: KMTT, 2001, p.7.

[26]Komite Penghapusan Bensin Bertimbel (KPBB), "Why did Indonesia Failed to Phase-out Leaded Gasoline for Whole Country?," Jakarta; KPBB, 2003, p.2. http://www.kpbb.org

[27]Lovei, Magda, *Phasing Out Lead from Gasoline: World-Wide Experiences and Policy Implications*, Washington D.C., the World Bank, 1996, p.10.

[28]Ministry of Environment and Energy Denmark and Danish Environmental Protection Agency, *UN/ECE Task Force to Phase Out Leaded Petrol in Europe. Fourth Ministerial Conference Environment for Europe Main Report.* Denmark, Ministry of Environment and Energy Denmark and Danish Environmental Protection Agency, 1998, pp.23-25.

[29]Nugroho, S. B., "Lead Monitoring for Ambient Air Quality in Jabotabek Areas," paper presented at the *Better Air Quality*, Manila, 2003, pp.2-6.

[30]Office of National Economic and Social Development Board, *Seventh Plan Urban and Regional Transport. Final Report*, 1991.

[31]Petroleum Product Consumption and Refining, *Indonesia Report*, p.7.
http://www.indonext.com/rep@ort/report422.html ,

[32]Puput, "ULG Progress in Indonesia," on CAI-Asia internet list serve, Jakarta, Komite Penghapusan Bensin Bertimbel (KPBB), 2005.

[33]Regional Environmental Center for Central and Eastern Europe (REC), Chapter 4.
http://rec.org/REC/Publications/LeadOut/

[34]Sayeg, P., *Successful Conversion to Unleaded Gasoline in Thailand*, World Bank Technical Paper, No. 410, Washington D.C.: The World Bank, 1998, pp.10-44.

[35]The Seventh Meeting of AMEICC Working Group on Automobile Industry, Estimation of Oil Refinery Upgrading Investments for Automotive Fuel Properties Improvement in ASEAN Countries, paper presented at the AMEICC Meeting, Doc.16, Agenda Item 6.3., Cambodia Siem Reap, AMEICC, 2004, p.1.

[36]UNEP, The State of the Environment- Asia Pacific –Atmosphere, UNEP, 2000, p.3.
www.unep.org/GEO/geo2000/english/0069.htm

[37]Unites States Department of Energy, "An Energy Overview of the Kingdom of Thailand," 2005.http://www.fossil.energy.gov/international/East Asia_and Oceania/thaiover.html

[38]Wangwongwatana, S., "Thailand Experiences in Fuel Conversion and Alternative Fuels," paper presented at CAI-Asia Meeting, 33. www.cleanairnet.org/caiasia/1412/article-36926.html

[39]Wirahadikusumah, K., "Jakarta Air Quality Management: Trends and Policies," paper presented at *The Regional Workshop on Better Air Quality in Asian and Pacific Rim Cities* 2002, Hong Kong, 2002, pp.3-5.

[40]The World Bank*, World Wide Experience and Policy Implications*, the World Bank, Environment Department Papers, No.040, 1996, pp.38-40.

[41]*World-Wide Fuel Charter*, Brussels: AAMA, ACEA, EMA and JAMA, 1998, p.7.