Chapter 3

Impact Analysis of Removing Petroleum Product Subsidies in Thailand

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Chapter 3
Impact Analysis of Removing Petroleum Product Subsidies in Thailand

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Abstract

The objective of this study is to collect the related information on the mechanism of the major petroleum product subsidies and examine the impact of the subsidy removals in Thailand. The price-gap approach is used to estimate the past magnitude of the petroleum product subsidies. The impacts of the subsidy removals at the macroeconomic level are estimated using computable general equilibrium models. Since the Thai government has already started to reform the fuel price subsidies, a review of current policy and the implications for Thailand are also discussed.

1. Introduction

Thailand is a net energy importer, with over 60 % of its energy consumption coming from imported sources (Energy Policy and Planning Office, 2013). Although there has been a continuous discovery of oil and gas in Thailand, domestic demand for energy has also grown steadily since the early 1980s, with the exception of the period following the 1997 and 2008 financial crises. As a result, there has been little overall change in Thailand's import dependency. Petroleum products comprise the largest share of total consumption in Thailand, thus making them the main focus in this study. Given that the large majority of its petroleum is imported, Thailand is highly exposed to changes in prices in international markets.

Amid high petroleum prices during the past decade, many countries, including Thailand, are subsidising petroleum product prices. As with all public policies, governments began subsidising energy fuels with the best of intentions: to provide energy access for all citizens, especially the poor; to provide economic assistance to businesses; to protect domestic markets from international price volatility; and to curb inflation.

Thailand has stabilised and subsidised fuel prices for many years to shield consumers from volatile petroleum prices and improve access to energy. Fuel and electricity subsidies are clearly benefiting some consumers, including the poor, who rely on subsidised liquefied petroleum gas (LPG) for cooking and free electricity. However, a report from the World Bank (2010) shows that energy subsidies can have unintended consequences for the economy by encouraging overconsumption and benefitting wealthier citizens far more than the poor.

In addition, Thailand's determination to promote energy efficiency, a stand that put it at the forefront of many countries in the 1970s, has long been dimmed because of price distortions created by the petroleum products' price subsidy regimes. Thailand has an energy conservation law and energy conservation funds, but serious implementation is lacking. Currently, the transport sector is the largest energy consumer at 36 %, followed by the industrial and commercial sectors. Transport operators enjoy diesel that is priced below real market levels. Natural gas used as a vehicle fuel is also heavily subsidised. According to the World Bank (2010, most countries have improved their energy efficiency since the oil crisis in the 1970s, but a study from the Ministry of Energy in Thailand has stated that Thailand is among the countries with the highest energy intensity per unit of output due to the price distortions.

Clearly, someone must pay for these subsidies, which most often is the government. Whatever the good intentions may be, many previous studies have pointed out that there are unintended consequences of energy subsidies on energy fuels. An International Monetary Fund (IMF) report (IMF, 2008) points out several consequences. First, the main beneficiaries of fossil fuel subsidies are, in most cases, the rich and middle class rather than the poor. IMF research shows that the richest households (top 20 %) benefit 42 % from energy subsidy programmes, while the poorest households (bottom 20 %) benefit by only 8.9 %. The IMF

also explains that since the fuel subsidies are usually provided per unit of energy, such as per litre of gasoline or diesel, those who consume the most energy receive the largest share of the subsidy, with the largest consumers of energy and recipients of subsidies, therefore, being the wealthiest households and those in urban areas.

Second, maintaining energy prices at a low level on the domestic market makes the energy sector unattractive for investors. This restricts countries' capacity to provide better energy services to citizens. For instance, underinvestment means that countries cannot produce quality, refined petroleum products within their national borders, or extend and maintain their electricity infrastructure.

Third, by stimulating energy demand, energy subsidies encourage faster depletion of fossil fuel reserves. Thailand's energy reserves are now estimated to last only for another 20 years. Looking to the future, energy subsidies will lead to growing imports of fossil fuels from the current high level of 20 % of the total annual import value, thus affecting energy security for Thailand. Fossil fuel subsidies promote wasteful practices of energy consumption and make green energy technologies less competitive compared to conventional energy sources.

Fourth, subsidies result in a growing retail price disparity between different fuels or for the same fuel across national borders. This leads to fuel smuggling, the emergence of black markets, and the non-authorised use of subsidised fuels. Such practices as, for example, the installation of cooking LPG cylinders on cars, may not only be illegal but also dangerous. Last but not least, all the above-mentioned unintended outcomes of energy subsidies lead to increased air pollution and emissions of greenhouse gases.

Eliminating these subsidies poses considerable challenges. Energy access and affordability are critical factors for development. Thailand is in the midst of facing these challenges as the government phases out several energy subsidies, particularly the removal of petroleum product subsidies.

This leads to the objectives of this chapter. The first objective is to review the policy implications and mechanism of the petroleum product price subsidies in Thailand. Since diesel and LPG are the two main petroleum products that were subsidised by the Thai government, the study focuses on the subsidies for these products. The second objective is to analyse the impacts of the subsidy removal on the country's economy by observing the size of the subsidies in the past and examining the extent to which the subsidies removal may theoretically impact gross domestic product (GDP). Most the data and price information for the study are from the Energy Policy and Planning Office (EPPO) under the Ministry of Energy. The concepts of the study are drawn from previous studies by the International Institute for Sustainable Development (Leangcharoen, Thampanishvong, and Laan,2013), and the Asian Development Bank (2015).

The chapter is arranged in three parts. The first part provides an overview of petroleum product consumption in Thailand, including the price structures and the forms of the selected product subsidies, which are mainly for diesel and LPG. The second reports the magnitude using the price-gap approach and the impact of the subsidy removal using a computable general equilibrium (CGE) model with the basic assumptions. The final part summarises the

results and policy recommendations for the government to continue the petroleum product price reforms that have been already started.

2. Price Structure and Form of Petroleum Product Subsidies

This section reviews the information regarding the consumption of petroleum products and their price structure to analyse the impact of the subsidy removals in Thailand.

2.1. Overview of Petroleum Product Consumption in Thailand

The transportation sector is the largest consumer of petroleum products in Thailand. Before 2005, gasoline and diesel were the two major petroleum products consumed in this sector. Gasoline is sold as gasoline 91 (gasoline with octane 91) and gasoline 95 (gasoline with octane 95).

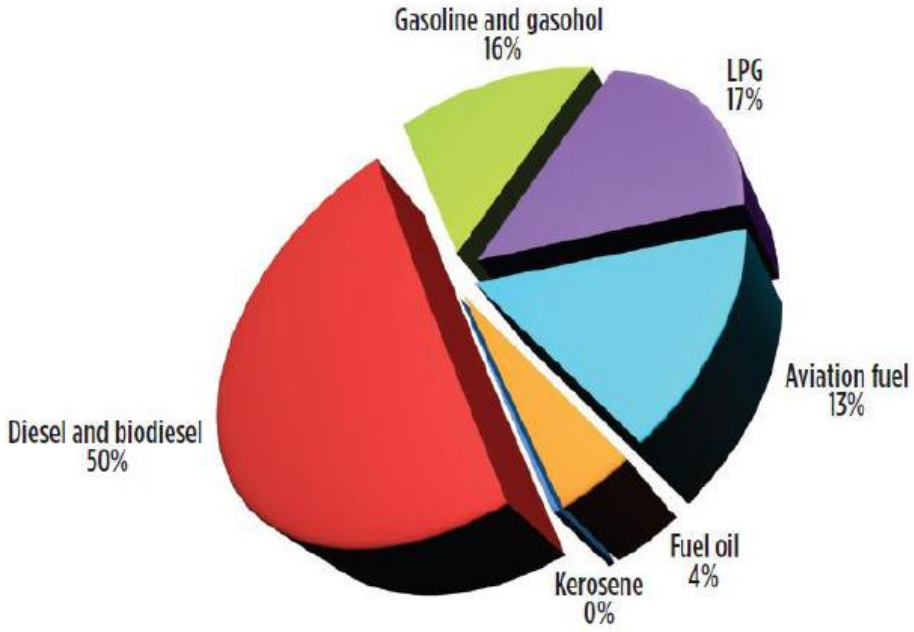
The main types of diesel used in Thailand are high-speed diesel (HSD) with a 0.05 % sulphur content and low-speed diesel (LSD). Diesel is sold almost entirely as HSD, with a small amount as LSD. HSD is the dominant fuel in the transportation sector as its consumption is more than twice the consumption of gasoline (see Figure 3.1). The dependence on these two products led to a cabinet resolution on 9 December 2003 to eventually replace gasoline 95 with gasohol, a mixture of gasoline and ethanol (NEPO, 2006). The available options for gasohol consumers are a mixture containing 10 % ethanol and 90 % gasoline (E10), a mixture containing 20 % ethanol and 80 % gasoline (E20), and a mixture containing 85 % ethanol and 15 % gasoline (E85).

Following the gasohol plan, the cabinet also approved the National Energy Council Committee's energy policy on 21 November 2006 to promote the consumption of biodiesel as a substitute for HSD by expanding the acreage and distribution channels of palm oil. Initially, the biodiesel proportion was set at 5 % biodiesel and 95 % HSD (B5). From February 2008, the government mandated that the remaining HSD be blended with 2 % biodiesel (B2). The proportion of biodiesel in HSD was then increased to 3 % on 10 June 2010 (B3). After the emergence of biodiesel, the consumption of pure HSD became insignificant after June 2010. Accordingly, the term diesel in this chapter refers to a biodiesel mixture.

Diesel is an important input in the transport and agricultural sectors, which account for over 40 % of final energy consumption. Diesel is the most widely used petroleum product in Thailand, followed by LPG, gasoline, and aviation fuel. Fuel oil and kerosene comprise less than 5 % of total consumption as shown in Figure 3.1. According to the Department of Energy Business, Ministry of Energy , biodiesel (B2, B3, and B5) consumption in Thailand is around 52 million litres per day, comprising about 97 % of the total diesel consumption and insignificant HSD. LPG is used in the industry, transport, and residential sectors, as well as by small businesses, such as street vendors. The consumption of gasohol exceeds the consumption of gasoline, with E10 constituting about 90 % of the total gasohol consumption

of around 12 million litres per day. Gasoline 91 is now the major product, with about a 99 % share of the total gasoline consumption of around 8 million litres per day.

Figure 3.1. Decomposition of Petroleum Product Consumption in Thailand

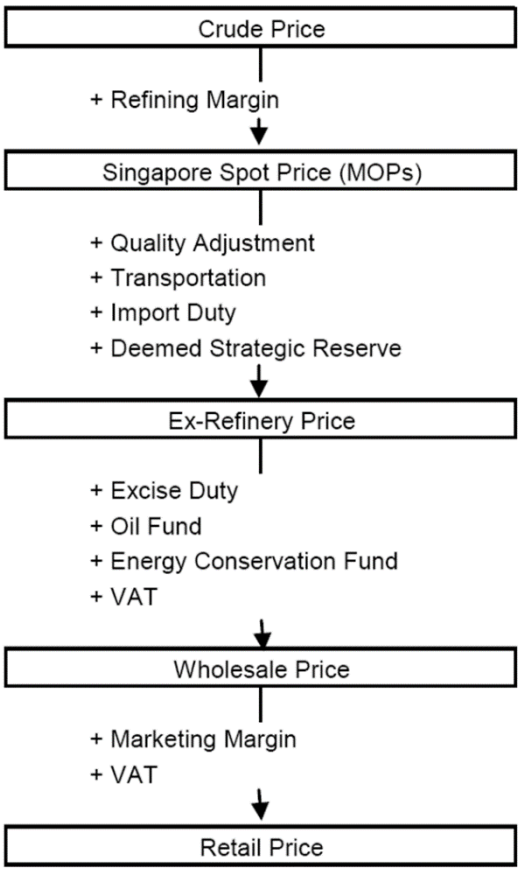


Source: EPPO (2013).

2.2. Petroleum Product Price Structure

Thai current petroleum product prices can be divided into the ex-refinery price, wholesale price, and retail price, as shown in Figure 3.2. The wholesale and retail prices of the petroleum products are published daily by the National Energy Policy Office.

Figure 3.2 Petroleum Product Pricing Structure in Thailand



Source: EPPO (2013).

The wholesale price comprises the ex-refinery price plus the excise tax, municipal tax, contribution to the Oil Fund, contribution to the Energy Conservation Promotion Fund, and value-added tax (VAT). The retail price comprises the wholesale price plus the marketing margin and VAT. The structures were initially set up and controlled by the government for a long time. In 1991, the government started to deregulate these price structures by allowing the ex-refinery price and marketing margins to be determined by a market mechanism. However, the government still controllsretail prices via oil funds, tax rates, and energy conservation funds. Since the energy conservation funds have been almost unchanged for many years, the government can mostly achieve its desired retail prices by manipulating the oil funds and tax rates.

The ex-refinery price and the marketing margin are the only two components in the price structure that are determined by market forces and reflect the production and distribution costs of a given petroleum product. The Singapore market, Means-of-Platts (MOPs), is used as the reference market in determining the prices of petroleum products because it is the largest export market in the Asian region that is nearest to Thailand, and hence has the lowest import costs; moreover, the trading volume in the market is enormous, making it difficult to speculate oil prices, and thus price volatility is less than other markets. In addition, the changes in prices in the Singapore market are in line with other markets worldwide.

The remaining price components in the price structure, including the oil fund, are transfer payment items that are controlled by the government. The municipal tax rate is directly related to the excise duty and its rate is set at 10 % of the excise duty. The energy conservation fund contribution is collected at a designated rate and is used to finance energy conservation projects under the jurisdiction of the energy ministry.

There are two collections for VAT. The first collection is on the wholesale price and its rate is set at 7 % of the wholesale price. The rate for the second collection is also 7 %, collected on the marketing margin. Figure 3.2 shows the overall components of the daily price structure of Thai petroleum products.

2.3. Forms of Petroleum Product Subsidy

Thailand subsidises the consumption of petroleum products in three forms: through the *Oil Stabilization Fund* (an oil price fund), *tax exemptions*, and *caps* on ex-refinery and retail prices. It caps retail prices for diesel, LPG, and natural gas for vehicles (NGV), and subsidises biofuel blends. For diesel and NGV, price subsidies are universal in that wealthy and poor consumers alike can access them. LPG prices vary depending on the consuming sector, and are subsidised for low-consuming households.

2.3.1. Role of the Oil Stabilization Fund

The first energy crisis in 1973 caused unprecedented increases in international oil prices. Thailand is one of the oil importing countries that was affected by the first energy crisis. The first energy crisis was a significant factor that led to the Oil Shortage Prevention Act in 1973 that empowers the prime minister to issue measures to prevent an oil shortage. This led to the establishment of the Oil Stabilization Fund in the same year, which requires oil traders to make contributions to the fund at designated rates. Compensation to fuel oil traders during certain periods is then drawn from the Oil Stabilization Fund.

Another version of the Oil Stabilization Fund (foreign exchange) was set up in 1978 with the objective of collecting the windfall profits of the oil traders from the baht appreciation. Later, the government decided to integrate the 1973 Oil Stabilization Fund with the 1978 Oil Fund Stabilization (foreign exchange) in 1979, when there were sharp increases in international oil prices. This fund was set up because the government did not want to change domestic prices according to changes in world oil prices. The new oil fund has been managed by the Energy Fund Administration Institute, which is responsible for the procurement of funds to stabilise domestic retail oil prices and for other tasks in compliance with the government policies relevant to the Energy Fund Administration.

The oil fund has been utilised as a tax instrument for gasoline and HSD, the two major petroleum products before the emergence of gasohol and biodiesel in 2007. Its utilisation has been found to increase fluctuations in the costs and retail prices of gasoline and HSD during 2007this period.

After the emergence of gasohol and biodiesel in 2007, the oil fund became a price stabilising instrument for reducing the fluctuations in the costs and retail prices of gasohol, biodiesel,

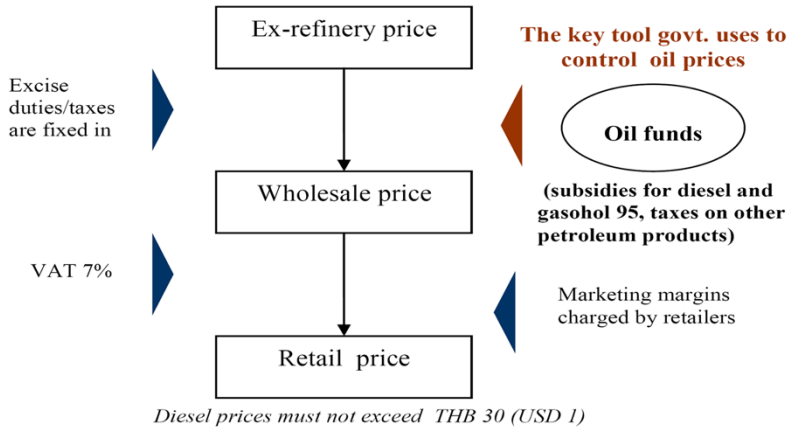
gasoline, and HSD. The utilisation of the oil fund after 2007 has also had a cross price subsidy feature, where the gasoline 91 consumers are the major contributors to the oil fund and the E85 consumers are the major recipients of the subsidies. The oil fund account can be either in surplus or in deficit in a given period depending on the degree of the cross-price subsidies.

The fund is a monetary reserve that acts as a means of reducing price volatility and allowing cross subsidisation. It has been used both to smooth price swings on the world market and to cross-subsidise socially sensitive fuels. Levies are imposed on fuels. Subsidies may be provided on a per-litre basis or as a lump sum to fuel producers or distributors. As such, over the years, the oil fund has been used to (i) reduce price spikes; (ii) cross-subsidise fuels for economic, political, or social reasons; and (iii) encourage greater use of domestically produced energy resources.

2.3.2. Diesel Subsidy: Cross Subsidy and Tax Reductions for Price Caps

The price subsidies for petroleum products are different for each product. Some are charged and some are subsidised. Gasoline, kerosene, and fuel oil are the petroleum products that most often face oil fund levies. The fuels that are most often subsidised are diesel and LPG, using the mechanism shown in Figure 3.3.

Figure 3.3. Thailand's Diesel Subsidy Scheme Using Oil Funds



Source: EPPO (2013).

Oil fund levies and subsidies are adjusted weekly, and it is not unusual for a levy to be applied one week and a subsidy the next to keep retail prices stable. For instance, diesel was subsidised in 11 out of 12 months in 2004, and diesel, but not gasoline, continued to be subsidised by the fund in 2005 until August. Diesel was again subsidised in 2008, in June 2009, in the first 4 months of 2011 leading up to a closely contested national election in July 2011, and again in August and September 2012. In addition, the oil fund levy was eliminated for both gasoline and diesel in the last 4 months of 2011. By April 2011, the oil fund reserves had been depleted. Aside from periodic subsidisation of gasoline and diesel, the oil fund has been used mainly to subsidise bioethanol and biodiesel. The government has committed to maintaining the diesel price at about B30/litre since late 2010. In theory, the oil fund is

revenue neutral. In practice, it has required injections of government funds during periods of prolonged deficits (most recently in 2004) and borrowings from commercial banks to allow ongoing deficits (most recently in 2012). The oil fund had a deficit of B22 billion in June 2012.

In addition to the cross-subsidy by the oil fund, the government also imposed tax breaks for diesel. In April 2011, the cabinet approved a cut in the excise tax for diesel from B5.31/litre to B0.005/litre, effective from 21 April until 30 September to keep the diesel price at or below B30/litre, a move widely criticised for being political even by the Federation of Thai Industries. Although launched initially as a temporary measure, this excise tax reduction has remained in effect to this day. In July 2011, the Excise Department said the decision had led to higher diesel consumption and the government had lost B9 billion a month. Table 3.1 shows the differences in the price structures for gasoline and diesel. The total subsidies for diesel from the lower oil fund levy and tax breaks relative to gasoline are about B16.17/litre in order to keep the retail price of diesel below B30/litre.

Table 3.1. Subsidies for Diesel Relative to Gasoline

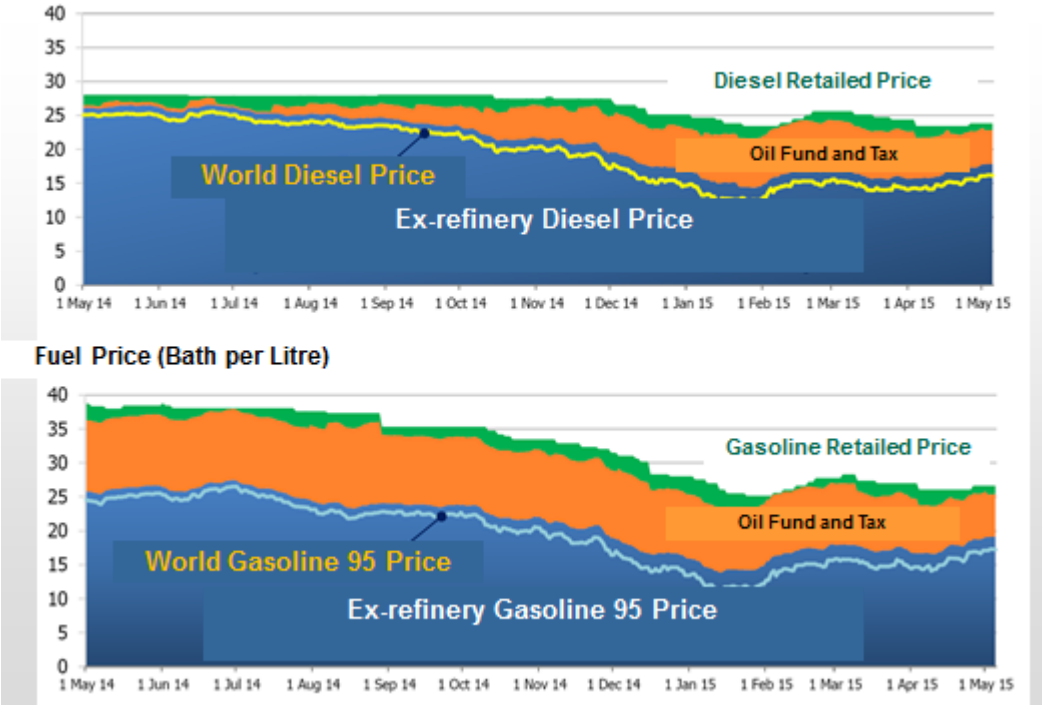
Unit: THB/litre	Gasoline (ULG 91R)	Diesel (HSD 0.035%S)	Tax reductions for diesel compared with gasoline
Ex-refinery price	25.20	25.49	
Excise tax	7.00	0.01	7.00
Municipality tax	0.70	0.00	0.70
Oil fund levy	7.70	0.30	7.40
Conservation fund levy	0.25	0.25	0.00
VAT on wholesale price	2.86	1.82	1.04
VAT on retail price	0.18	0.14	0.04
Retail	46.45	29.99	
(Total tax reductions for diesel compared with gasoline)			**16.175**

VAT = value-added tax.
Source: EPPO (2013).

Diesel consumption has risen steadily after its price was capped at B30/litre in 2011. The army seized power on 22 May 2014 in a bid to restore order and get the economy back on track after months of political unrest that had hurt economic activity. The energy price reform is among the military government's priorities. Under the current subsidies through the oil fund, diesel users pay lower prices at the expense of costly gasoline prices. However, with the decrease in the world oil price, the impact of the subsidy removal on the retail price is insignificant. This is the first time since April 2011 that Thailand has raised the levy on diesel as shown in Figure 3.4. The country's retail fuel prices have been distorted by various populist policies introduced by previous governments through the oil fund. As a result, retail prices of

gasoline will fall by B1.0–B3.89/litre, while diesel prices will rise by B0.14/litre but still below B30/litre. The oil fund and tax for diesel increase since mid-2014 is comparable to the stable gasoline are shown in Figure 3.4. This provides a good signal for the subsidy reform for diesel in Thailand, which needs to continue in the future even amid an environment of increasing world oil prices.

Figure 3.4. Removal of Diesel Subsidies by Increasing the Oil Fund and Tax Relative to Gasoline



Source: EPPO(2015).

2.3.3. LPG Subsidy: Cross-Subsidy and Price Caps

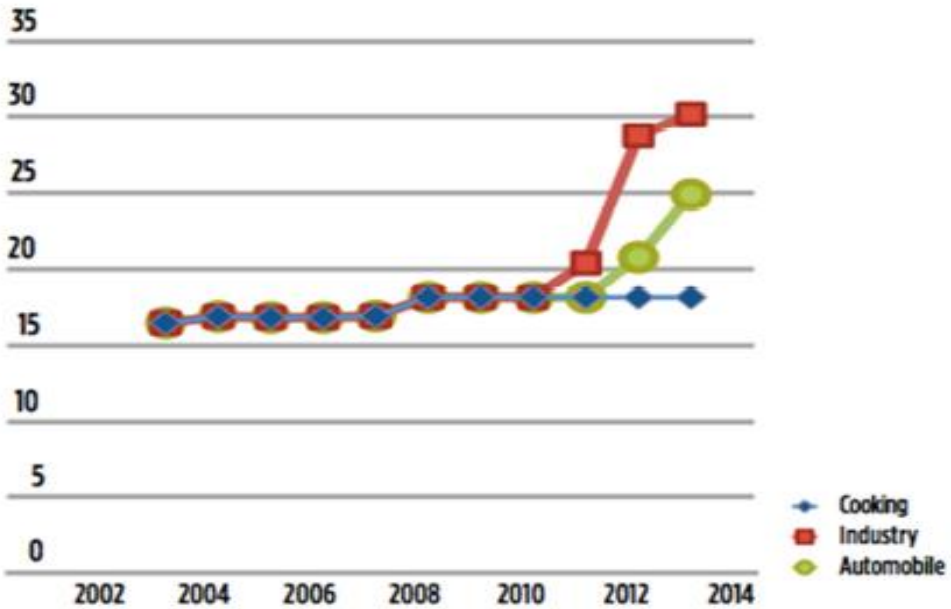
The major source of the subsidy for LPG is not the oil fund, but the subsidy applied at the refinery gate using the price caps. The ex-refinery price has been capped at US$333/tonne for more than 2 decades under a programme intended originally to help relieve the burden of households and food vendors. Retail prices are also capped for all sectors, except the petrochemicals industry. Oil fund levies are applied to the cooking, transport (automobile), and industry sectors. Lump-sum transfers are made from the oil fund to LPG producers and importers to compensate for the capped ex-refinery price. Domestic producers of LPG are only compensated for the difference between the cost of production and the ex-refinery price. They are not compensated for the opportunity cost of selling LPG domestically rather than at the higher international price.

The Saudi Aramco Contract Price for LPG is widely used as a reference price upon which producers and wholesalers base their negotiations. This benchmark price for LPG has been

consistently above US$333 since August 2004, rising to an average of US$850 a tonne in 2011 and US$920 in 2012. The government's plan to float the price of LPG for industries in 2008 faced strong opposition and was delayed until July 2011, when the government began to raise the price by B3/kg every 3 months until it reached B30.13/kg; price increases above B30.13/kg were to require the approval of the National Energy Policy Council, chaired by the prime minister. Many companies switched to 48-kg cylinders, normally reserved for household use. The government began to raise the price of automotive LPG in 2012. The LPG subsidy is borne by the government and the compressed natural gas subsidy by PTT (formerly known as Petroleum Authority of Thailand), and hence the government has used the oil fund to finance the conversion of taxis from LPG to compressed natural gas. PTT is eventually reimbursed for the LPG subsidy, but with a long delay.

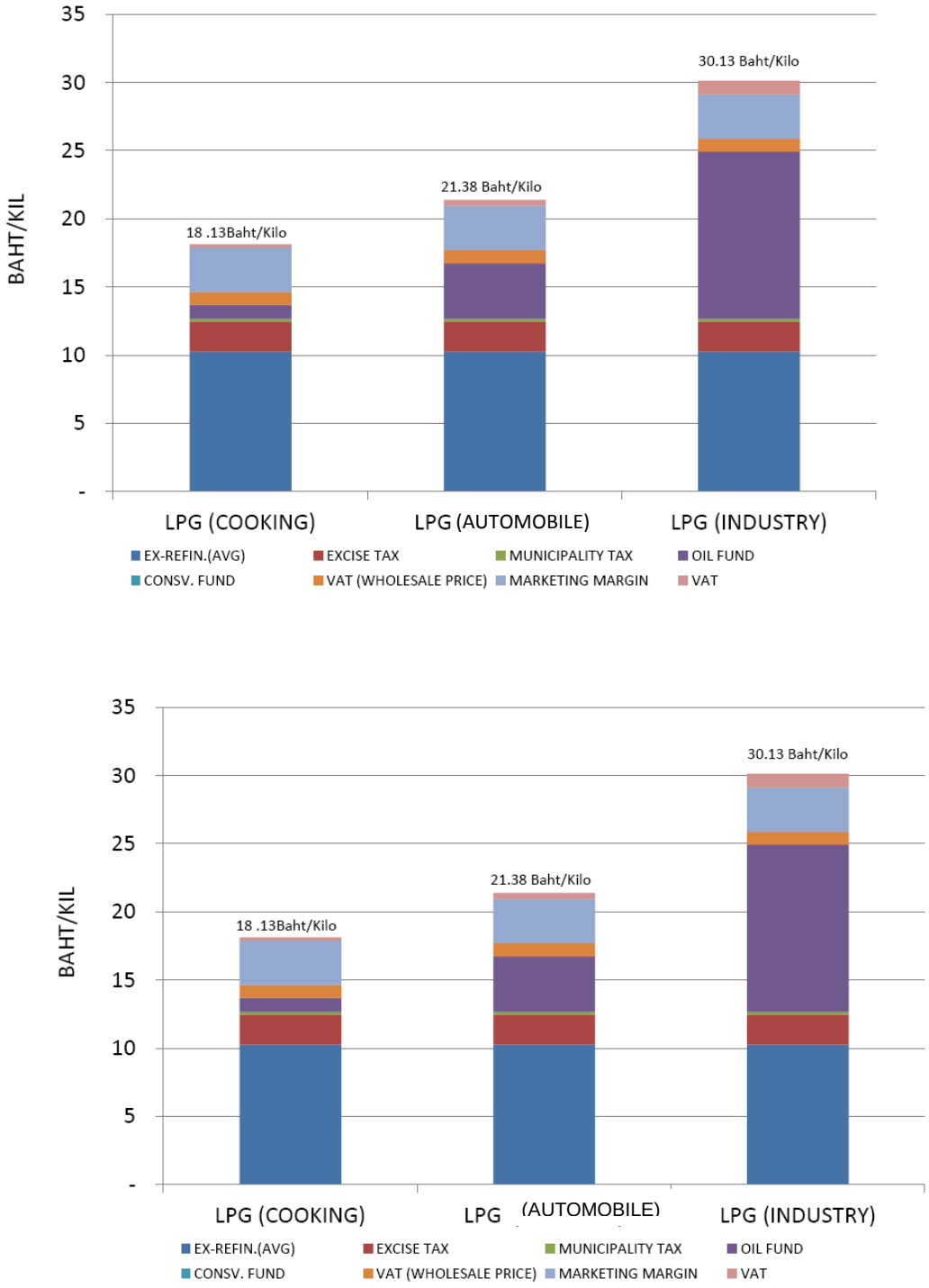
The price of LPG from 2003 to 2013 is shown in Figure 3.5. The LPG price for industry started to float in response to the world market in 2011, followed by the automobile sector in 2012. As shown in Figure 3.6, as of December 2012, LPG was sold at B18.13/kg to households, B30.13/kg to industrial consumers, and B21.38/kg as an automotive fuel, and these prices were maintained through early 2013. In November 2012, the government announced a plan to raise LPG prices for all consumers over time to B36/kg, based on an assumed benchmark price of US$0.90/kg in 2013–2014. The retail price was raised by B0.5/kg every month for residential and automotive consumers and by B1/kg a month for industrial users until B36 was reached.

Figure 3.5. Retail Price of LPG by Sector
(baht per kilogram)



Source: EPPO (2013).

Figure 3.6. LPG Price Structures for Different Sectors (as of December 2012)

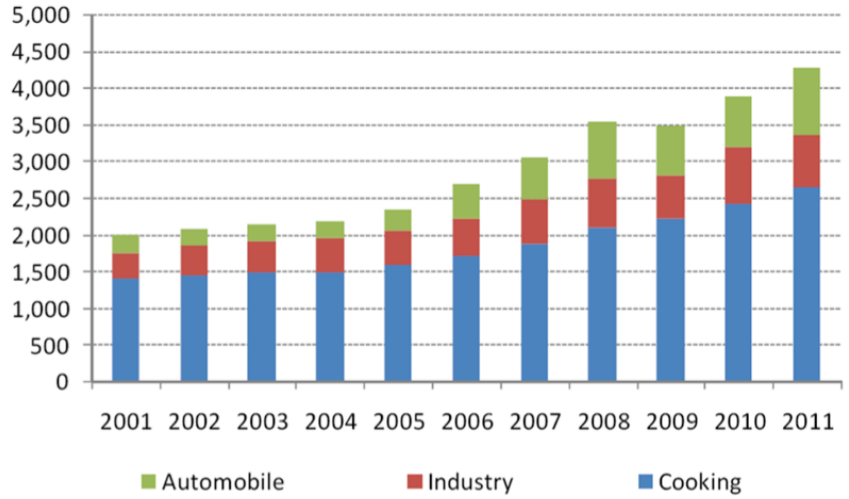


LPG = liquefied petroleum gas, VAT = value-added tax.
Source: EPPO (2013).

The impact of the different LPG price structures for the different sectors creates market distortions and encourages demand to increase in the low-LPG price sector, which comprises mainly use by households for cooking. Figure 3.7 shows the stagnating consumption of LPG

by industrial users and the sharply rising consumption of LPG by households, supporting reports that some industrial users may have switched to residential LPG for cost savings.

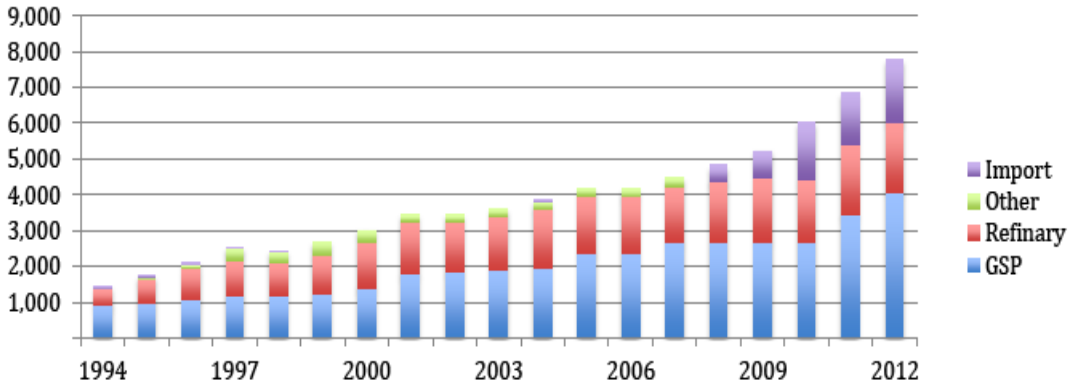
Figure 3.7. Consumption Growth of LPG in the Residential Sector
(kg million)



Source: EPPO (2013).

The supply of LPG comes from three mains sources, as shown in Figure 3.8. The first source are the gas separating plants, which uses natural gas in the Gulf of Thailand as raw material. This accounts for around 50 % of the total supply. The second source of LPG comes from refineries that use crude oil as the raw material. The last source of LPG is direct imports. Thailand has imported LPG since 2008 at three times the domestic price, with the import amount increasing by 47 % per year on average. Since the gas separating plant uses domestic resources, it can produce LPG at the lowest cost, while refineries have higher costs because the crude oil is imported and the price is more expensive and fluctuates more than the price of domestic natural gas.

Figure 3.8. Sources of LPG in Thailand



Source: EPPO (2013).

2.4. Impacts of the Petroleum Product Subsidy Reform

In Thailand, it is estimated that the approximate cost of energy subsidies in 2011 was about B168.8 billion in energy tax reduction and subsidies. In particular, the diesel excise tax reduction costs the government about B106.5 billion annually, while the LPG subsidy adds another B45 billion per year, and the NGV policy another B17 billion. It is indeed a huge cost to society that also creates economic distortions. Keeping retail diesel prices below gasoline prices will only lead to more consumers shifting to diesel vehicles. According to the Nation, Thailand's former Energy Minister Piyasvasti Amranand said in June 2014: "*Energy prices reform must be carefully considered. The previous governments have turned energy policies into populist policies. Subsidizing diesel and LPG with the Oil Fund finances does not save the country's expenses, but raise the country's burden. Diesel subsidies have led to a loss of over 100 billion baht in annual revenue. In three years, the amount has risen to 300 billion baht. Combined with LPG subsidies, that ran up to 500 billion baht. Some parties will need to shoulder the cost if the subsidies continue.*"

The impact of the subsidy reforms will vary depending on their nature. Sudden price changes tend to have the greatest impact on vulnerable consumer groups. Price hikes will also translate into higher input costs for businesses, affecting their profits and sales. Due to the indirect impact on other goods and services, energy subsidy reforms will affect the inflation rate. A policy framework for sustainable energy subsidy reforms is needed in Thailand. Looking ahead, policymakers will need come up with a sustainable energy reform plan. Challenges lie ahead in decontrolling energy prices, assessing and managing the negative impacts of the reforms, and finding ways to build public acceptance of the reform plans. Thailand should continue to remove the price subsidies and directly provide other social programmes to help low-income groups.

3. Impact Analysis of Petroleum Product Subsidy Removals

There are two sets of methodologies used in this study. The first is to measure the magnitude of petroleum product subsidies using a price-gap approach, and the second is to quantify the impacts of subsidy reform using a basic CGE model.

3.1. Estimating the Size of the Petroleum Product Subsidies

Assessing the magnitude of the petroleum product subsidies is a task challenged by poor data quality, limited data availability, and lack of data comparability, as there is no harmonised or consistent reporting structure for such subsidies. Direct financial transfers are generally the easiest to quantify, as they are usually included in government budgets. In addition, some market transfers to consumers through lowered prices and tax credits are also straightforward to estimate. Different approaches are applied to estimate energy subsidies. The *effective rate of assistance* covers any direct and indirect action that affects the price of a good. The *producer subsidy equivalent*, developed by the Organisation for Economic Co-operation and Development, looks at the value of subsidies to their recipients as a measure of their impact. The price-gap approach focuses on end-use energy consumption subsidies and quantifies the gap between world energy prices and domestic (subsidised) end-user prices. While the effective rate of assistance has the virtue of capturing the full extent of the subsidy, in theory, such a measure is difficult to use in practice because it requires a wealth of reliable information and data, which in many cases are difficult to obtain. The producer subsidy equivalent offers a feasible way to pursue the magnitude of impacts over time but provides no information about the effects on economic efficiency.

The price-gap approach is a widely used method that focuses on consumer-side subsidies and quantifies the gap between the reference price and the subsidised end-user price (Koplow, 2009). This study applies the price-gap approach to estimate the scale of the petroleum product subsidies in Thailand over the past period. The price-gap approach has the advantage of conceptual and analytical simplicity. It is the most pervasive approach in analysing energy subsidies and the majority of Thai energy subsidies are in the form of end-use subsidies. The theoretical foundation of the price-gap approach was proposed by Corden (1957). It is based on the idea that subsidies to consumers of energy lower the end-user prices of energy products and thus lead to more consumption than would occur in their absence. IEA (1999, 2008) and Coady et al. (2010) used this method to estimate the magnitude of energy subsidies in other countries.

However, the price-gap approach also has limitations. Firstly, it only captures the subsidies on end use. Secondly, it requires accurate data on world reference prices, domestic taxes, and transport costs, all of which can only be collected from the historical data that may or may not be possible to obtain. Thirdly, and in the context of this study, it identifies only the static effects. It compares the given situations with and without subsidies, holding all other things equal. The dynamic effects of the removal of energy subsidies may well bring larger benefits than the static results. This suggests that the estimate itself may underestimate rather than overestimate the impact of energy subsidies (IEA, 1999). The results should, therefore, be

seen as a lower bound of the true costs of the energy subsidies.

For its simplicity and the data availability, we first utilise the price-gap approach to estimate the energy subsidies. We determine the consumer price and reference price, and then compute the price gap:

Price gap = Reference price − Consumer price

Subsidies = Price gap x Quantity of subsidised products

However, from the background information provided in the previous section, the petroleum product price subsidies in Thailand use the oil fund and taxes as a means for the subsidy policy implementation. Therefore, the negative oil fund levies represent the amount of subsidy imposed for each petroleum product from the fund. Table 3.2 shows the past annual average oil fund levels for each petroleum product based on the government policy in that period. The annual consumption in litres for each petroleum product multiplied by the average subsidy for the product relative to the other products can be estimated as a part of the annual subsidy amount.

Table 3.2. Annual Average Oil Fund Tax Levels Levied on Petroleum Products
(baht per litre)

	Gasoline		Gasohol				Diesel				LPG
	ULG95	ULG91	E10	ULG95 E20	E85	ULG91 E10	Kerosene	HSD 0.035%S	LSD	Fuel Oil	cooking (THB/kg)
1996	0.11	0.11					0.03		0.12	0.03	-0.64
1997	0.08	0.08					0.06		0.04	0.03	-1.89
1998	0.16	0.16					0.10		0.13	0.06	0.40
1999	0.09	0.09					0.10		0.08	0.06	-2.94
2000	0.34	0.22					0.10		0.11	0.06	-7.31
2001	0.50	0.30					0.10		0.50	0.06	-5.55
2002	0.50	0.30	0.27			0.27	0.10		0.50	0.06	-2.45
2003	0.49	0.30	0.27			0.27	0.10		0.50	0.06	-3.05
2004	-0.34	-0.59	0.24			0.27	0.10		-2.27	0.06	-2.55
2005	1.28	1.03	0.13			0.16	0.10	-0.92	-1.02	0.06	-2.54
2006	2.70	2.50	0.84			0.84	0.10	1.47	1.47	0.06	-1.93
2007	3.67	3.37	0.85			0.62	0.10	1.39	1.39	0.06	-1.02
2008	3.78	3.31	0.77	-0.21		0.28	0.10	0.40	0.31	0.06	0.30
2009	6.94	5.31	1.78	-0.80	-7.88	1.17	0.10	0.78	1.20	0.06	0.22
2010	7.50	6.65	2.74	-0.41	-10.93	1.43	0.10	0.66	1.20	0.06	0.61
2011	4.90	4.38	1.87	-1.80	-13.50	-0.40	0.10	-0.60	1.20	0.06	1.14
2012	5.23	4.73	2.03	-1.30	-12.40	-0.16	0.10	0.69	1.20	0.06	0.89*

* Different oil fund levies were applied to LPG for different sectors in 2012. The average levy for industry was THB 10.55 per kilogram and for automotive use THB 3.34.

LPG = liquefied petroleum gas.
Source: EPPO (2013).

3.1.1. Estimation of Diesel Subsidies

Two successive Thai national governments have capped the retail price of HSD diesel in the Bangkok metropolitan region to below B30/litre. The policy first emerged in December 2010 when the public and industry expressed concerns after the diesel price rose above B30/litre. The government initially applied a subsidy from the oil fund to reduce diesel prices. The oil fund became depleted and in April 2011 the decision was taken to temporarily reduce the diesel excise tax from B5.30/litre to B0.005/litre. The VAT of B0.40 was also removed, leading to a total tax exemption of B5.70/litre. Since that time, the excise tax exemption has been repeatedly extended and an oil fund levy or subsidy has been applied to maintain the price close to B30/litre. The cost of the excise tax exemption was over B100 billion in foregone revenue in 2012 alone, as shown in Table 3.3. The policy to reduce the excise tax reduced the price paid by consumers and hence is classified as a subsidy.

Table 3.3. Excise Tax Forgone for Diesel due to Tax Reduction

(B billion)

	2005	2006	2008	2009	2011	2012
Diesel	10.74	4.77	10.99	2.74	74.97	108.23

Source: Excise Tax Department (2013).

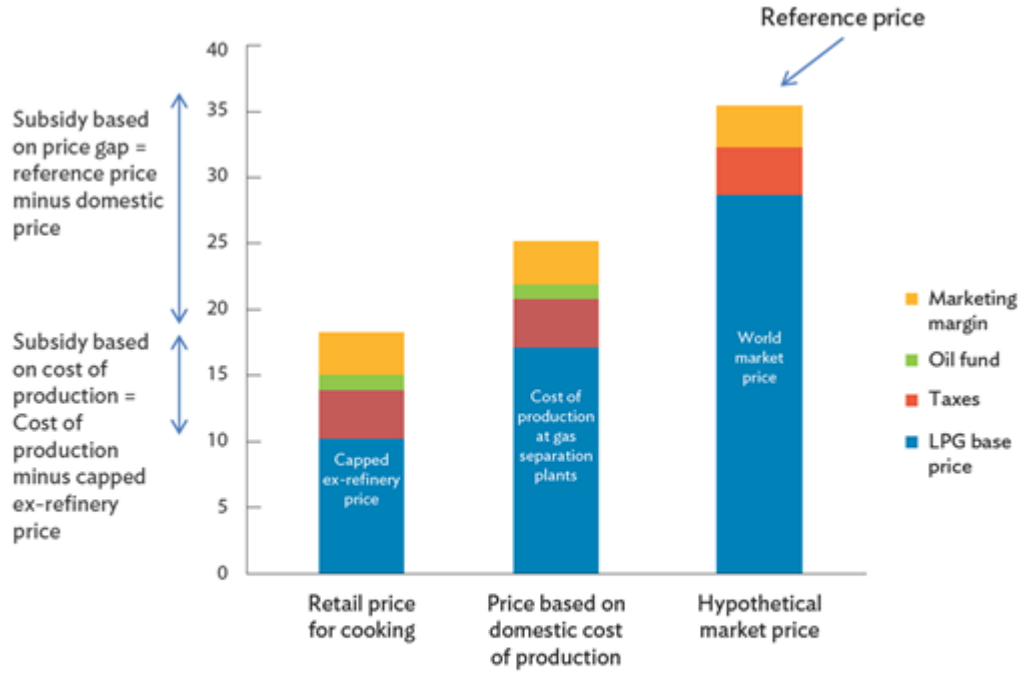
A tax reduction is distorting if taxes remain unchanged (or are higher) for other fuels. Compared with gasoline, diesel benefits from multiple tax and levy reductions. This distorts the market in favour of diesel, despite having a similar ex-refinery price as shown earlier in Table 3.1. The policy also creates a major hole in the government's budget compared with a scenario where the policy is not implemented. Capping the price at B30/litre has also reduced margins for fuel retailers. PTT (2012) reported in late 2012 that the diesel marketing margin for that year will likely settle at an average of B1/litre, lower than the B1.50 retailers expect to gain. PTT said that retailers were losing a total of around B30 million per day and that the marketing margin for gasoline (B3.2 for octane 95 and B2.5 for octane 91 on 27 February 2013) was not sufficient to compensate for this loss, given the relatively low amounts of gasoline sold compared with diesel.

3.1.2. Estimation of the LPG Subsidies

The subsidies for LPG are complex. The government sets prices for four different consumer categories and free-market prices prevail for the petrochemicals industry. The price structure of subsidised LPG is made up of the capped ex-refinery price, oil fund levies (which are used to partly compensate LPG suppliers for the capped ex-refinery price), and some taxes and margins. In addition, there is the opportunity cost of selling LPG at below-world-market prices. A price-gap analysis can be used to cut through some of these complexities and provide a

total figure for the full cost of LPG subsidies. The conceptual price gap estimation is shown in Figure 3.9.

Figure 3.9. LPG Subsidies Estimation on Price Caps



LPG = liquefied petroleum gas.

Note: An oil-fund levy was not included in the reference price because the government, to keep prices down, is unlikely to apply a levy to market-priced LPG.

* Based on 2012 average prices.

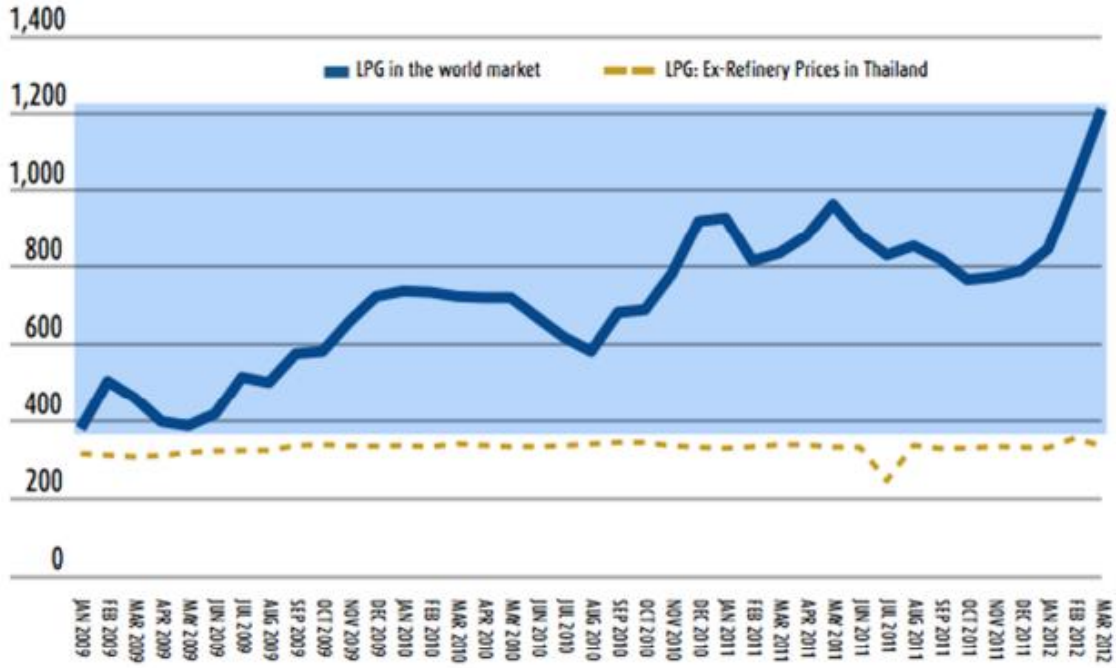
Source: ADB (2015).

The Saudi Aramco Contract Price for LPG generally moves in line with the crude oil price. However, to manage domestic LPG prices, the Thai government has determined marketing margins for retailers in the cooking segment and has subsidised LPG wholesale prices at PTT's storage terminals.

The domestic retail prices of LPG comprise four main elements. Firstly, the ex-refinery price normally refers to the average cost of production, but the LPG price is an exceptional case. The ex-refinery price of LPG is directly regulated by the government, and the price is in fact much lower than the actual cost of production. The real LPG ex-refinery price has decreased over time compared with other petroleum prices, which have fluctuated and increased, as shown in Figure 3.10. Secondly, taxes and VAT are kept in the same as for other products, except for the municipal tax, which varies slightly among provinces. Thirdly, the oil fund is a form of tax that the government takes from every petroleum product in order to subsidise and stabilise the domestic petroleum price during fluctuating periods. While LPG also pays

into the oil fund, it is a main expense for the fund. Lastly, the marketing margin is the difference between the wholesale price and the retail price. In other words, it is that profit that retailers or gas stations receive from selling the gas. Therefore, if the marketing margin is low, a gas station has a low incentive to provide good services to its customers, which may lead to security problems.

Figure 3.10. LPG Ex-Refinery Price Gap to the World LPG Market Price



LPG = liquefied petroleum gas.
Note: The LPG world price is taken to be the Saudi Aramco Contract Price, a major international price benchmark.
Sources: EPPO (2013).

As mentioned, there are three sources of LPG in Thailand with different costs of production. Subsidised LPG by source in 2012 is shown in Table 3.4. The subsidy for imported LPG (which started in 2008) is the highest at around B36 billion, followed by LPG from the refineries, which was subsidised by around B14 billion. The lowest subsidy is for LPG from the gas separation plant, which uses domestic natural gas as a raw material, at around B7 billion. The total subsidy for 2012 was around B57 billion.

Table 3.4. Estimated LPG Subsidies by Source, 2012

(B billion)

Source of LPG	LPG production for subsidized markets (million tonnes)	Benchmark price (production or import cost) (US$ per tonne)	Subsidy rate (THB per kg)	Subsidies (THB billion)
Refineries	1.00	779	13.85	13.86
Import	1.68	1024	21.48	36.02
Gas separation plant	2.04	450	3.64	7.43
Total				57.32

LPG = liquefied natural gas.
Source: EPPO (2013).

The oil fund has not provided a per litre subsidy for LPG since 2007, with the exception of 2 months in 2008. However, the oil fund has continued to fund the LPG subsidy, reaching B47.21 billion in 2012. These funds are used to partially compensate producers and importers for losses incurred from the capped LPG ex-refinery price (Energy Policy and Planning Office, 2013).

The retail price of LPG for all users was constant at B18.13 from March 2008 until July 2011. To stem mounting subsidies, the government decided in 2011 to raise the price of LPG for industrial and automotive users. The price for industries was to increase by B3/kg per quarter starting in July 2011 until the price reached B30.13/kg (achieved in March 2012). Increases above B30.13/kg required the approval of the National Energy Policy Council, chaired by the prime minister.

The price for automotive LPG was to increase by B0.75/kg per month starting in January 2012. Between January 2012 and January 2013, the price of automotive LPG was raised seven times. On only three of those occasions was the full B0.75 added to the price (Energy Policy and Planning office, 2013). LPG price increases are primarily achieved through higher oil fund levies (see Table 3.5). The retail price of LPG for cooking continues to be capped at B18.13/kg.

Table 3.5. LPG Price Structure, 2013

LPG Price Quoted on 2 November 2013				
Unit:Baht/ kilogram	Low income	Cooking	Automobile	Industry
Ex-Refinery	10.4330	10.4330	10.4330	10.4330
Tax	2.1700	2.1700	2.1700	2.1700
Municipal Tax	0.2170	0.2170	0.2170	0.2170
Oil Fund1	0.8663	0.8663	0.8663	0.8663
Conservative Fund	0.0000	0.0000	0.0000	0.0000
Wholesale Price	13.6863	13.6863	13.6863	13.6863
VAT	0.9580	0.9580	0.9580	0.9580
Oil Fund 2	-	1.4019	3.0374	11.2200
Marketing Margin	3.2566	3.2566	3.2566	3.2566
VAT	0.2280	0.3261	0.4406	1.0134
Retail Price	**18.13**	**19.63**	**21.38**	**30.13**

VAT = value-added tax.
Source: EPPO (2013).

The Thai government plans to reform LPG subsidies by increasing the retail price to reflect the cost of production and providing direct subsidies to the poor. The Energy Policy and Planning Office (EPPO) indicated that prices for LPG for households and transport sectors will rise to B24.82. This new price reflects the cost of production for LPG from gas separation plants, but is still lower than for LPG purchased on the international market, which is around B36/kg. A government study (Pusayanawin, 2012) found that if the price of LPG rises by B6/kg, each household would pay B20 more each month. For food vendors, the cost would rise by B0.35 per dish. The Committee on Energy Policy Administration indicated that assistance would be provided to street vendors and poor households (identified as those using less than 90 kilowatt hours of electricity per month) (Pusayanawin, 2012. The committee approved the use of B50 million from the oil fund to develop a database of street vendors, of which there are about 500,000. Approximately 9 million eligible households would be subsidised at a rate of 6 kg per household per month via a system of planned credit cards, while street vendors would receive help not exceeding 150 kg per month per shop (Pusayanawin, 2012).

3.2. Economics Impacts of Subsidy Removals

Petroleum products subsidies have an economic impact by distorting prices and therefore affecting production and consumption decisions. Increases in oil and natural gas prices would ripple throughout other sectors of the economy, affecting the costs of production, and therefore the prices of other goods, particularly energy-intensive ones. In turn, this may affect the competitiveness of goods from certain sectors and countries in the global economy and could result in changes in trade flows. All these changes have effects on global emissions from fuel combustion. Many of the environmental and social impacts of petroleum products subsidies stem from this economic distortion – both through increased consumption in

countries where energy prices are kept artificially low, and through the continued operation of less efficient, and often less clean fuel producers in countries where prices are kept artificially high to support domestic producers. Subsidies also affect government budgets by imposing fiscal burdens, which in turn reduce the amount of money available to spend on social programmes.

It should not be assumed that removing all petroleum product subsidies will necessarily have positive economic, environmental, and social effects across the board. The results of removing such subsidies are highly complex and some groups within certain countries may be negatively affected. Removing the subsidies could also have negative terms of trade effects for some countries. This study performs economic modelling approaches for quantifying the impacts of fossil fuel subsidy reform.

Computable general equilibrium (CGE) models simulate markets for production factors and goods using sets of equations that specify supply and demand behaviour across a multitude of markets. In theory, a general equilibrium analysis is supposed to look at the economy as a whole and therefore take account of linkages between all markets, including labour markets and markets for all goods that require energy as an input. Numerous CGE models are currently in use, each containing a set of complex non-linear equations that must be solved, based on assumptions regarding economic behaviour, including the price elasticities of supply and demand. The models are first run using values with the subsidy in place, and then again with the subsidy removed to estimate the overall net benefits and costs associated with the subsidy removal.

The data requirements for the general equilibrium model are massive, so the accuracy of the results is dependent on the accuracy of the assumptions and data. Energy is a fairly ubiquitous input to the production of most goods in the market, and changes in energy prices will affect almost all goods. Some key industries, particularly energy-intensive ones, should be included in the model in a disaggregated manner. However, in practice, most of the CGE models that have been used to simulate petroleum product subsidy reforms require choices as to what is modelled in detail and what is left in aggregated form, and the disaggregation of markets is not always undertaken.

Based on the data set and the developed CGE model available, this study will apply the CGE model, which is developed from the standard model by the Partnership for Economic Policy. The model will be modified for one region, 40 activity sectors, and 49 commodities. The database used in this study is based on the social accounting matrix, which was developed based on the input-output table for 2005 by the office of the National Economic and Social Development Board (NESDB, 2010). The CGE model used in this study was developed by Prinyarat Leangcharoen of the Thailand Development Research Institute and Kridtiyaporn Wongsa of Chiang Mai University.

For all these models, two main scenarios were explored: *business as usual*, where no policy change takes place; and *subsidy removal*, where all quantified subsidies are eliminated. The analysis assumes that subsidies are removed and the saved expenditure is entirely withdrawn from the economic system. This is clearly an unrealistic scenario, but it isolates which groups

of households and businesses are most likely to be affected in the short term by a price shock before the impacts of reallocated savings are felt.

The future baseline growth of GDP was based on projections in the IMF's World Economic Outlook, National Development Plans, and economic growth expectations. Population projections are based on the United Nations Department of Economic and Social Affairs using medium-variant estimates. Assumptions on the projected growth of fossil fuel prices are based on the IEA's *World Energy Outlook 2012* and current policies scenario. For Thailand, assumptions used in the projections include GDP growth (4.6 %), population growth (0.086 % average), and fossil fuel growth (2.2 % average).

Assumptions are also made about the nature of subsidies to simplify the analysis. All subsidies are taken to be "on budget" and, as such, subsidy reform is assumed to increase government budgets by the amount of the quantified subsidies. It is also assumed that consumers paid the official prices before the reforms took place. In reality, however, some consumers may pay higher prices, because the diversion of subsidised fuels constrains supply. This kind of complex relationship is not captured in the models. Changes to the supply of energy after reform are also not considered in the macroeconomic projections.

All impacts are measured as a percentage change from Scenario 1 (business as usual). Generally, the removal of large consumer subsidies for widely used energy sources can be expected to have a significant impact across areas as varied as government finances, the economy, consuming sectors (households, businesses, and industry), energy supply, the environment, and governance.

The results are highly dependent on the model assumptions and methodologies. Both the social accounting matrix and macroeconomic models conclude that reallocating a greater proportion of savings to households would deliver more positive results than allocating a greater proportion to government budgets. These results are due to structural assumptions in the models on the important role played by wealthier households in stimulating economic demand, and the relative effectiveness of household expenditure in stimulating economic growth, compared to government expenditure or debt reduction. In particular, the structure of the macroeconomic model includes no relationship between increasing government expenditure or reducing debt, and the impacts on GDP or welfare.

The removal of fossil fuel subsidies in Thailand, with reallocation to households and the government budget, is projected to have very low impacts (some positive, some negative) under the CGE model. Under the subsidy reallocation option, the CGE model projects impacts that are slightly negative: a fall in GDP against the business-as-usual scenario of 0.048 % and 0.042 %, respectively, in the scenarios that reallocated a share of savings to all households and all savings to all households. However, these impacts are not considered to represent an accurate outcome of the scenario being tested, as the structure of the CGE model is only capable of projecting GDP impacts in response to an increase in the factors of production, and not from transfers that stimulate household consumption and reduce government debt. The results do, however, indicate that in the non-realistic scenario, if subsidy savings are not reinjected into the economy at all, the reform will have fairly minimal impacts on GDP growth.

The CGE analysis projects small, negative impacts on household consumption under the "all reallocation" scenarios, including when all savings are allocated to households. In the case of the compensation scenarios, it is likely that these net negative impacts are projected because only direct effects are compensated. Direct increases in household expenditures from higher fossil fuel prices are only one part of the increase in household costs. Reallocation of all savings to households is still insufficient to reduce the negative impact of the subsidy removal.

Among other literature on the social impacts of subsidy removal, Tangkitvanich and Kansuntisukmongkol (2007) conclude that oil price control mainly benefited high-income households in rural areas and low-income households in urban areas. Although low tax rates on diesel generally contribute to social well-being, less-than-optimal tax rates led to a social burden of B74.65 million per quarter on average between 1995 and 2009 (Muangkum, 2011).

Using the basic CGE model created by Prinyarat Leangcharoen and Kridtiyaporn Wongsa, the sectors projected to be most affected by the removal of petroleum subsidies are related to motor vehicles and to petroleum. This indicates that the energy sector is typically the most vulnerable to reforms. Impacts on the energy-intensive rubber industry make up the next-largest negative impacts, but these are small, at about 0.3 % of output. The sensitivity of the analysis, however, is limited because the CGE model distributes subsidies across the entire petroleum sector, without further disaggregation by fuel type. Given that the majority of Thailand's subsidies are related to diesel, LPG, and NGV, this suggests that some of the impacts indicated by the CGE analysis may relate to sectors more reliant on gasoline than other fuels.

At the sector level, the greatest decrease in energy consumption is projected for the transportation sector. This is because the removal of subsidies is projected to result in the substitution of LPG boilers with advanced natural gas boilers and coal boilers in 2015 and 2020. On the other hand, the removal of subsidies makes natural gas boilers more expensive than coal boilers in the short term. As a result, less efficient coal boilers are adopted, leading to a small increase in energy consumption in 2030.

The government has implemented policies to reduce the fiscal burden of fuel subsidies by gradually increasing the LPG price while protecting the poor. In their current form, however, these policies have only a limited impact on helping the poor and reducing the budgetary impacts of fossil fuel subsidies. Of the 7.7 million eligible recipients, only 2 % have registered to access the cheapest LPG. This may be because retail prices for all household consumers are still only marginally above the rate for poor consumers. If the price disparity grows, more may register for the cheapest gas. But it may also be because the process for registering and accessing subsidised LPG is difficult or cumbersome. Raising the LPG price to B24/kg, equivalent to the domestic cost of production, for other consumers of cooking and transport fuels will still provide significant subsidies. Moreover, the price is significantly lower than the price PTT pays for imported LPG – and it is exempt from the usual fuel taxes.

4. Discussion and Recommendations

Product price subsidies do not reduce the cost of the product, they just change the proportion paid by consumers or producers and move the rest of the costs onto other parts of the population. Someone still pays, but through taxes, higher prices, reduced government revenue, expenditure on other priorities, or lack of investment in energy infrastructure. Indeed, the inefficiency of subsidies can actually increase the overall cost burden on society.

Policymakers often justify energy subsidies with the argument that they contribute to economic growth, poverty reduction, and security of supply (World Bank, 2010). However, subsidies are rarely the most efficient tool for promoting these objectives. In reality, the main motivation behind energy subsidies is typically political, as seen in Thailand over the past years. Subsidies are a tangible way for governments to show that they are supporting their people. This is particularly important in countries that lack the administrative capacity to offer social and economic support through other policy mechanisms.

Since partial deregulation of the energy market in Thailand in 1991, subsidies were initially used to reduce price peaks for gasoline and diesel during times of high oil prices. Since the mid-2000s, subsidies have become more widely used to encourage the use of domestically produced resources, such as natural gas and biofuels, and to reduce the price of socially important fuels, such as LPG for cooking and diesel for transport and agriculture.

Raising the cost of different fuels will affect the economy in different ways. Cheap diesel primarily provides benefits by reducing the costs of personal transport and of energy-consuming economic sectors, like agriculture and fisheries. Even where people do not own vehicles, it still provides indirect benefits by reducing the cost of public transport, like buses. Cheap diesel can also provide indirect benefits by reducing the cost of goods that require transportation, such as food. Low prices of LPG for vehicles decrease the fuel costs for minibuses, taxis, and tuk-tuks (three-wheeled motorcycle taxis). This creates economic opportunities by enabling travel and sustaining jobs for drivers.

The majority of the benefits, however, are likely to accrue to the better-off, who can afford to purchase these fuels at quantity. Subsidised fuel may also “leak” to be used for unintended purposes (such as in the case of cooking LPG, being used illegally in the automotive or industrial sectors). Indeed, some benefits are not even enjoyed by Thais – LPG is smuggled across Thailand’s borders and sold for a profit in neighbouring countries.

The net benefits of energy subsidies must also consider the opportunity costs of subsidisation. Money spent on making energy cheap cannot be spent on other priorities. This is a far more complex consideration, but one consumer’s gain comes at a loss to others. Additionally, low energy prices cause inefficient economic allocation, reducing the size of the economy.

As people get used to low prices, subsidy reform becomes difficult. Powerful beneficiaries oppose it and governments fear social unrest when prices rise due to reforms. But this mindset must change, as the benefits of subsidy reform are potentially immense. The substantial drop in oil prices over the past years has opened a new window of opportunity to put an end to these harmful subsidies.

The largest quantifiable subsidies in Thailand were tax breaks for diesel and market-price support for LPG, as mentioned earlier, resulting from caps on retail prices. Market-price support is provided through cross-subsidies from the oil fund and PTT's under-recoveries by the majority state-owned oil company.

The single largest subsidy, a diesel tax exemption, arises from a government policy to keep diesel prices below B30 per litre. Initially intended as a temporary measure, the excise exemption has been rolled over each month since 2011. Significant decline and variations in world oil prices may lead to lower subsidy estimates since 2015 until present with lower world oil prices, but without policy change this would be expected to simply rise again when world oil prices rise.

Based on analysis of the complex interactions between the economic, social, energy, and environmental issues, the study shows that the initial rise in energy prices due to subsidy reforms will nudge households and businesses to shift to alternative fuels and to adopt energy-efficient appliances. Using the money freed up from subsidies to compensate poorer households and to increase government budgets will cancel out the negative effects of the initial price rise. These changes should allay the fears of reform.

The study measures the actual subsidies, such as the direct transfers, tax exemptions, subsidised credit, and losses of state enterprises by different fuel types. For example, the excise tax forgone for diesel due to tax reduction was around B108 billion in 2012 (as shown in Table 3.3) and the LPG subsidy around B57 billion in 2012 (as shown in Table 3.4). This information should help countries better sequence and prioritise reforms. The study contributes to international and national efforts to develop knowledge to ensure reforms are well-planned, sustainable, and politically acceptable. We hope the findings of this study will promote further discussion and sharing of knowledge on the best ways to anticipate the impacts of fossil fuel subsidy reforms. This can help ensure that subsidies are not simply removed, but that the funds they release are put to best use in helping the poor cope with the changes.

Energy price reforms are currently an ongoing process. In response to rising subsidy costs and the leakage of subsidies to unintended recipients, Thailand has attempted to reduce some subsidies, but progress has been erratic. Gasoline has been largely unsubsidised since 2005 and eligibility for free electricity was further restricted in 2012. Diesel, meanwhile, has since 2005 been unsubsidised at some times and subsidised at others. Since December 2010, an excise tax exemption on diesel has resulted in significant foregone revenue.

LPG use illustrates the pattern of household energy consumption and the impact on disposable income, with consumption following a general pattern of increasing with income. But although poorer, lower-income households consume less fuel, this constitutes a larger proportion of their income. The CGE model found that impacts on households would be small, but only the reallocation of all subsidy savings to households would reduce the incidence of poverty.

This study agrees with the previous study by ADB (2015) that provides some recommendations to improve social assistance programmes for the poor, including the following:

- Phase out subsidies for diesel and LPG, and replace them with targeted cash transfers for the poor that compensate for the direct and indirect impacts of subsidy removal. This can be achieved using the funding liberated from the reforms. Imposing the excise on diesel would generate over B110 billion per year in government revenue, almost double the annual cost of the old-age allowance. This would provide a survival pension to over 7 million people (more than 10 % of the population). Funds from imposing taxes on diesel would be sufficient to fund a similar scheme for the poor who need a social assistance regime. The poor who earn income below the poverty line comprise 13 % of the population, but there is likely to be an overlap between this group and those already receiving the old-age allowance.
- Utilise pro-poor programmes. Thailand has numerous pro-poor programmes that could be used to help develop a unified registry of the poor as well as proxy means testing. As an upper-middle income country, identification of poor households should be readily achievable.
- Use subsidy savings to increase funding for education and health services in poor areas. The key structural issues facing Thailand are the need to extend access to quality education and health care to the underprivileged, and reducing the environmental impacts of growth. Fossil fuel subsidy reform can address both of these by liberating funds for social spending and reducing emissions by eliminating distortions in fuel pricing. Allocating some subsidy savings to new social insurance schemes could also help to increase support for subsidy reform among the non-poor.

References

Asian Development Bank (2015), *Fossil Fuel Subsidies in Thailand: Trends, Impacts and Reforms*. Manila: Asian Development Bank.

Coady, D., R. Gillingham, R. Ossowski, J. Piotriwski, S. Tareq and J. Tayson (2010), *Petroleum Product Subsidies: Costly, Inequitable, and Rising*. IMF Staff Position Note, SPN/10/05,Washington, DC: IMF

Corden, M. (1957), "The Calculation of the Cost of Protection", *Economic Record* 33, pp. 29-51.

Department of Energy Business (DOEB) (2012), *Oil Plan* (in Thai)

Energy Policy and Planning Office (2013), Energy Statistics: Petroleum. http://www.eppo.go.th/info/2petroleum_stat.htm (accessed May 20, 2016).

Energy Policy and Planning Office (2015), *Thailand Energy Report* (in Thai).

Excise Tax Department, Ministry of Finance. (2013). *Data provided in response to a formal request by K. Thampanishvong, Interviewer*. Bangkok: Thailand Development and Research Institute.

International Energy Agency (IEA) (1999), *Energy Balances of Non-OECD Countries, 1996-1997*, Paris: IEA

International Energy Agency (IEA) (2012), *World Energy Outlook 2012*. Paris: IEA.

International Monetary Fund (IMF) (2008), *Food and Fuel Prices—Recent Developments, Macroeconomic Impact, and Policy Responses*. Washington, DC: IMF.

National Economic and Social Development Board. http://eng.nesdb.go.th/ (accessed June 12, 2016).

National Energy Policy Office (NEPO) (2006), *Report of Energy Development inThailand*, Bangkok: NEPO

Koplow, D. (2009), *Measuring Energy Subsidies Using the Price-Gap Approach: What does it leave out?* Manitoba: International Institute for Sustainable Development (IISD).

Leangcharoen, P., K. Thampanishvong, and T. Laan (2013), *A Citizens' Guide to Energy Subsidies in Thailand*. Geneva: Global Subsidies Initiative of the International Institute for Sustainable Development.

Ministry of Energy (2013), *LPG Frequently Asked Questions* (in Thai). http://www1.lpg4u.net/FAQ.aspx (accessed May 21, 2016).

Muangkum, L. (2011), *The Optimal Diesel Tax Rate in Thailand* (in Thai). Bangkok: Kasetsart University Press.

PTT Public Company (2012), *Annual Report 2012*. Bangkok: PTT.

Pusayanawin, W. (2012, December 20), Bid to Ease LPG Price Fears. The Nation.

The Nation (2014, June 24), Fuel subsidies must be short-term. Available at: http://www.nationmultimedia.com/news/business/aec/30237034 (accessed May 25, 2016)

Tangkitvanich, S., and C. Kansuntisukmongkol (2007), *Impacts from Oil Price Intervention Policy* (in Thai), Bangkok: Thailand Development Research Institute.

World Bank (2010), *Subsidies in the Energy Sector: An Overview*. Washington, DC: World Bank.