Master's Thesis in Engineering

Estimating the Effects of Energy Subsidy Removal on Indonesia's Economic Sectors using Input Output Analysis

February 2016

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Technology Management, Economics, and Policy Program

College of Engineering

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이 논문을 공학석사 학위논문으로 제출함

2016년 2월

서울대학교 대학원

협동과정 기술경영경제정책전공

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아리프의 석사학위논문을 인준함

2016년 2월

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To my beloved wife, Ira and our lovely kids, Zidane and Tata

Estimating the Effects of Energy Subsidy Removal on Indonesia's Economic Sectors Using Input-Output Analysis

Arif Widiyanto

Abstract

Energy subsidies often have adverse effects on the economy and the environment, stimulating excessive energy consumption, wrongly targeted subsidy, and pressure on the state budget. The implementation of energy subsidy reform might not be easy to carry out, however, due to the strong objection to it and the political challenges involved, but the government should continuously work to reallocate the subsidy. Still, energy subsidy removal may have an impact on economic growth, resident welfare, energy consumption, etc. This paper estimates the effects of energy subsidy removal in Indonesia particularly in the oil fuel and electricity sectors, in relation with sustainable economic development indicators such as inducing price increase in the other economic sectors as well as in the GDP, employment, and energy consumption and environmental aspects. Input-output analysis is undertaken to explore the impacts in the short term. The estimation results showed that energy subsidy removal will have the largest impact on the refinery, electricity, and transportation sectors. In all these industries, the high energy consumption and energy cost account for a high proportion of the industry prices. Energy subsidy removal will lead to an about 1.2% (9.2 Peta Joule) drop in the total energy consumption and a 1% (3.3 million tons) drop in CO_2 emission compared with the 2009 levels. The price increases of the commodities produced by different sectors are likely to enforce knock-on effects on the final demand and potentially would be paid off by a 0.53% drop in the GDP compared with the 2009 level. A decline in the total output will lead to excess labor per unit output. It is estimated that employment will be reduced by 849,000 as a result of the energy subsidy removal. In addition, energy price removal will reduce the people's real income and purchasing power, with the higher-income group in the urban areas likely to be the most affected.

Keywords: Energy subsidy removal, oil fuel, electricity, Socio Economic, Environment, Input-output, Indonesia

Student Number: 2014-22103

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Abbreviations

ADO	Automotive Diesel Oil
BPS	Badan Pusat Statistik (Central Bureau of Statistic)
BOE	Barrel Oil Equivalent
CGE	Computable General Equilibrium
CPA	Classification of Products by Activity
CPI	Consumer Price Index
CO2	Carbon dioxide
GDP	Gross Domestic Product
GHG	Green House Gas
GOI	Government of Indonesia
GWH	Giga Watt Hour
ICP	Indonesian Crude oil Price
IDO	Industrial Diesel Oil
IEA	International Energy Agency
IISD	International Institute for Sustainable Development
ILO	International Labor Organization
IO	Input output
KWh	Kilo Watt hour
kt	Kilo Ton
LPG	Liquefied Petroleum Gas
MEMR	Ministry of Energy and Mineral Resources

MENA	Middle East and North Africa
ml	Million Liter
MOPS	Mid Oil Platt’s Singapore
NACE	Nomenclature statistique des activités économiques dans la Communauté européenne (Statistical classification of economic activities in the European Community)
OECD	Organization for Economic Cooperation and Development
OPEC	Organization of Petroleum Exporting Countries
PLN	Perusahaan Listrik Negara (Indonesia’s Electricity State-owned Company)
Rp.	Rupiah (Indonesian currency)
SUSENAS	Survei Sosial Ekonomi Nasional (Socio-economic National Survey)
UNEP	United Nation Environment Program
US	United States
WIOD	World Input Output Databas

Chapter 1. Introduction

1.1 Background

Indonesia's economy grew rapidly in recent years, since the Asian economic crisis hit in 1998. This situation was followed by an increasing demand for energy as an important component in supporting national economic growth. The energy demand in the period from 2000 to 2013 increased from 508.9 million BOE in 2000 to 926.3 million BOE in 2013 (MEMR, 2014). Nevertheless, in the supply side, from an oil-exporting country, Indonesia turned into a net oil-importing country in 2004 because its current oil production is less than its rising consumption. On the other hand, Indonesia also has quite diverse energy resources, from coal and gas to renewable energy (i.e., geothermal power and hydropower). Due to its practicality and low price, however, oil fuel is still dominant in Indonesia's energy mix. The condition was made more complicated by Indonesia's persistence in giving energy subsidy particularly in oil products and electricity, and by the fact that the country is not ready to shift to a better energy pricing policy. Similar to other oil-producing countries, Indonesia is still giving energy subsidy to its people to aid them through affordable prices. Every time there is a sharp change, however, in the minimum three components (i.e., crude oil price, currency exchange, and consumption volume), there will be a problem in the state budget. In recent years, the Indonesian government carried a high burden in their fiscal budget because the price of crude oil in the international market demonstrated sharp fluctuations, such as in the period from 2003 to mid-2008, when the price rose more than four times and reached record levels at almost US$140/barrel. In addition, numerous studies have found negative effects of giving energy subsidy, such as a more consumptive behavior and an environmental problem. Furthermore, in Indonesia, some researchers found that much of the energy subsidy goes to the higher-income groups because the government gives direct energy subsidy. Thus, phasing out the energy subsidy can ease the government budget allocation and can generate more productive sectors.

The implementation of energy subsidy reform may not be easy to carry out, however, due to the strong objection to it and the political challenges involved, but the government should continuously work to reallocate the subsidy. Despite the fact that there is no denying that the energy subsidy policy should be reformed, doing so may have adverse effects on the economy. Therefore, such effects are likely to be obtained if the subsidy is reduced or removed completely. To ascertain the impacts of removing the energy subsidy, this paper will describe the impacts of energy subsidy removal and will assess the short-term environmental and socioeconomic effects of energy subsidy reform in Indonesia.

1.2 Purpose of the Study

The purpose of this study is to estimate the effects of energy subsidy removal in Indonesia's economic sectors in the year 2009, using input-output analysis, and to assess the short-term environmental and socioeconomic effects of energy subsidy removal, in which removing the energy subsidy will result in an increase in the other sectors' prices because in most sectors, energy is needed to supply goods and services. The price increase that will result from energy subsidy removal will in turn have profound impacts on the output, energy consumption, emission, and employment. The results of this research will reveal the potential benefits and pay-offs of energy subsidy removal.

1.3 Thesis Structure

This thesis will first give an overview of the energy subsidy being provided in Indonesia, which will be presented in Chapter 2. In this chapter, the existing literature on energy subsidy development, the constraints of such, and the impact of energy subsidy removal will be reviewed. Chapter 3 will discuss the methodology to be used in this thesis, consisting of the price gap approach, the input-output price model, CPI change estimation, the partial equilibrium approach, and the energy savings, emission, and labor estimation using the input-output demand-driven model. Chapter 4 will conduct an empirical analysis of the estimation results. Finally, Chapter 5 will present the paper's conclusion and policy recommendation and will discuss the further study to be conducted as well as the limitations of the study.

Chapter 2. Overview of Indonesia' Energy Subsidy

2.1 Indonesia Energy Situation

Indonesia is an archipelagic country located in Southeast Asia. It has the fourth biggest population in the world, with more than 240 million people. The country's economic growth in recent years showed a high positive trend, and it is now a member of G-20. Last year, Indonesia's economy grew by more than 5%. This situation is certainly a positive one for the country, where the people's living standard is rising. On the other hand, the government should take measures to ensure that the country's economic growth will remain positive in the future. Several studies have shown that Indonesia's economic growth has affected its energy consumption. Soares et al. (2014) and Shahbaz et al. (2013) found a relationship between economic growth (GDP) and energy consumption. That is, to achieve economic growth, the energy being demanded should be fully supplied. The policymaker should consider this in the formulation of the country's energy policy.

To this day, Indonesia is still very much dependent on hydrocarbons for its primary energy needs, accounting for almost 75% of the total energy consumed in 2013 (MEMR, 2014). Oil held the top spot, accounting for

38% of total supply of primary energy, followed by coal (25%) and natural gas (15%), with renewable energy sources accounting for the remaining 22%.

In the global energy trade, Indonesia plays an important role as an exporter especially of coal and natural gas. Actually, before 2004, Indonesia was an oil exporter country, having joined the Organization of Petroleum-exporting Countries (OPEC) in 1962. Due to the decline of its oil production, however, combined with its growing oil consumption, Indonesia became a net oil importer in 2004 and suspended its OPEC membership in May 2008.

2.1.1 Oil and Gas

Indonesia has oil and gas deposit in its territory and estimated to have 7.5 billion barrel of oil resources, consisting of proven and potential reserves at the end of 2013. It's proven reserves which amounted around 3.7 billion barrels was equal to 0.2% of world's proven oil reserves in 2013 (BP, 2014).

Indonesia's oil production has been on decline since 1990's because of mostly the oil production is coming from mature oil fields and there is also no significant discovery in oil new blocks. The crude oil and condensate production dropped off at average 3-5% per year since 2004 to 2012. In 2013, national crude oil production only reached 300 million barrels lower than oil production in 2012 which accounted for

315 million barrel of oil and representing a more significant decline from 2000 production levels which reached 517 million barrel of oil (MEMR, 2014). This situation pushed the government to explore and operate the oil activities towards eastern part of the country in in deeper areas where the risk is higher.

According to data from Ministry of Energy and Mineral Resources of Indonesia, Indonesia had proven reserves of 101 trillion standard cubic feet (TSCF) and potential reserves of 49 TSCF in 2013 which is the largest gas reserves in the Asia-Pacific region. Total gas production in 2013 amounted to 2,967,596 million standard cubic feet per day (MMSCFD) increased from 2007 gas production level which reached 2,805,540 MMSCFD.

Realizing the conditions, the government trying shifted from being a primarily gas exporting country to supplying increasing of domestic gas demand in order to increase the gas utilization in energy mix.

In terms of unconventional gas resources, Indonesia also has abundant of coal bed methane with 453 TCF resources. Since 2008 the government already offered CBM working areas to the investors and had 54 PSC's in CBM in 2014, which will be benefit for supplying future gas demand. For shale gas resources, the government still investigates of shale hydrocarbon potential.

Figure 2-1 shows the Indonesia's oil and gas production profile.

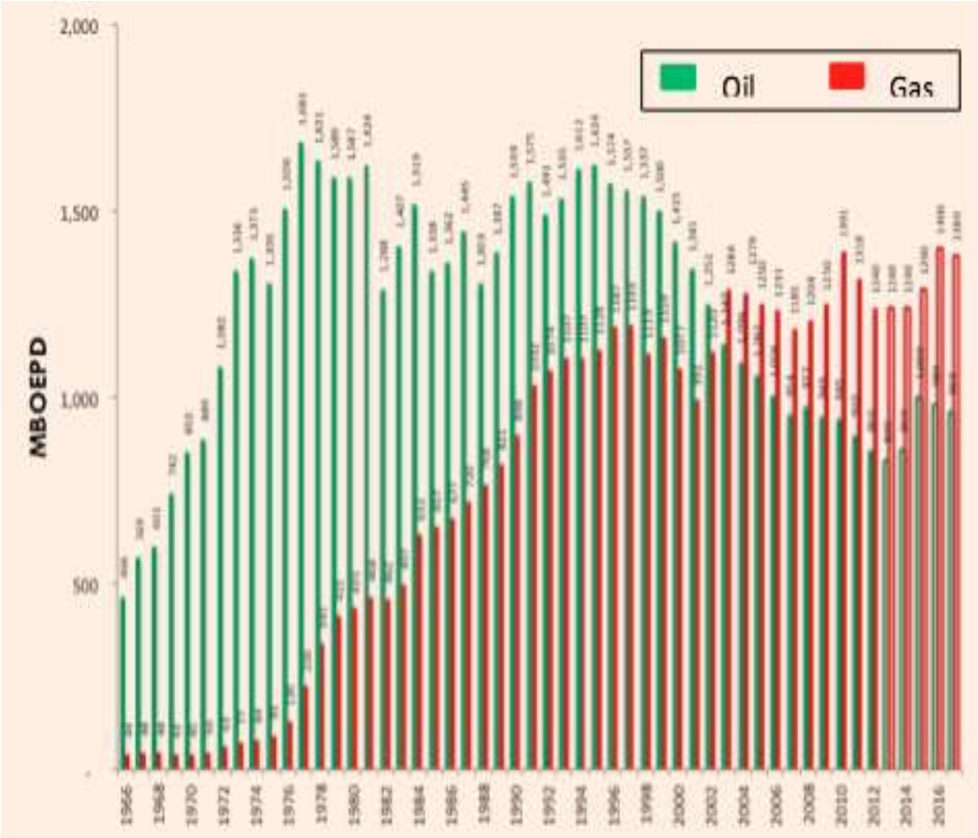

Figure 2-1. Indonesia's oil and gas production profile

(Source: SKK Migas, 2014)

The existence of natural resources, such as oil and gas, would bring benefits to the country's revenue, Indonesia is no exception. However, since the oil production keeps declining, the contribution to the country's revenue also dropped. Yet, oil and gas sector still vital and important contributor to the national economy.

In petroleum downstream sector, the consumption of oil keep increasing due to increasing demand mainly in the transportation sectors. Because of domestic production is not sufficient, Indonesia importing fuel and crude oil to supply domestic oil fuel demand. This condition exacerbated by domestic refineries capacity is not able to provide sufficient domestic fuel. Indonesia's refining capacity was just over 1 million bpd at the end of 2014 and refining is carried out mostly by Pertamina's domestic facilities. As shown in table 2-1 Indonesia's refinery capacity maximum capacity only reached 1.157 million barrel per day. With only around 70% of domestic demand met by country's existing capacity, Government is trying to expand current facilities or build new refineries to in order to guarantee the domestic petroleum products supply which continues to increase in line with Indonesia's economic and population growth.

Table 2-1. Indonesia's refinery capacity in 2013

Refinery	Refinery Capacity (MBSD)
Tri Wahana Universal	6
Dumai	127
Sungai Pakning	50
Musi	127.3
Cilacap	348
Balikpapan	260
Balongan	125
Cepu	3.8
Kasim	10
Tuban (TPPI)	100
Total	**1157**

(Source: Handbook of Indonesia Energy Statistics 2014)

Based on aforementioned facts, Indonesian government targeted transformation in its national energy mix to implement dramatic shift away from oil to gas and other energy resources such as renewables. In order to support the policy, the government already built and plan to expand gas infrastructures such as gas pipeline, liquefaction and regasification unit, CNG, gas fuelling stations, city gas and LPG refinery.

2.1.2 Coal

Regarding coal mining, Indonesian coal production has increased sharply from 77 million tones in 2000 to 449 million tones in 2014 (MEMR, 2014). However, even though high increasing in production of coal, demand for coal continues to outstrip supply. High demand for Indonesian coal mainly caused by the rapid manufacturing industry in China and India as two giant economic powerhouses.

The coal resources location is distributed primarily in the Western and central areas of the country which mostly located in southern Sumatra and east Kalimantan. Based on data from the Ministry of Energy and Mineral Resources of Indonesia, total coal resources amount to 120.5 billion tones while for coal reserves accounted by around 32 billion tones in 2013 as shown in figure 2-2.

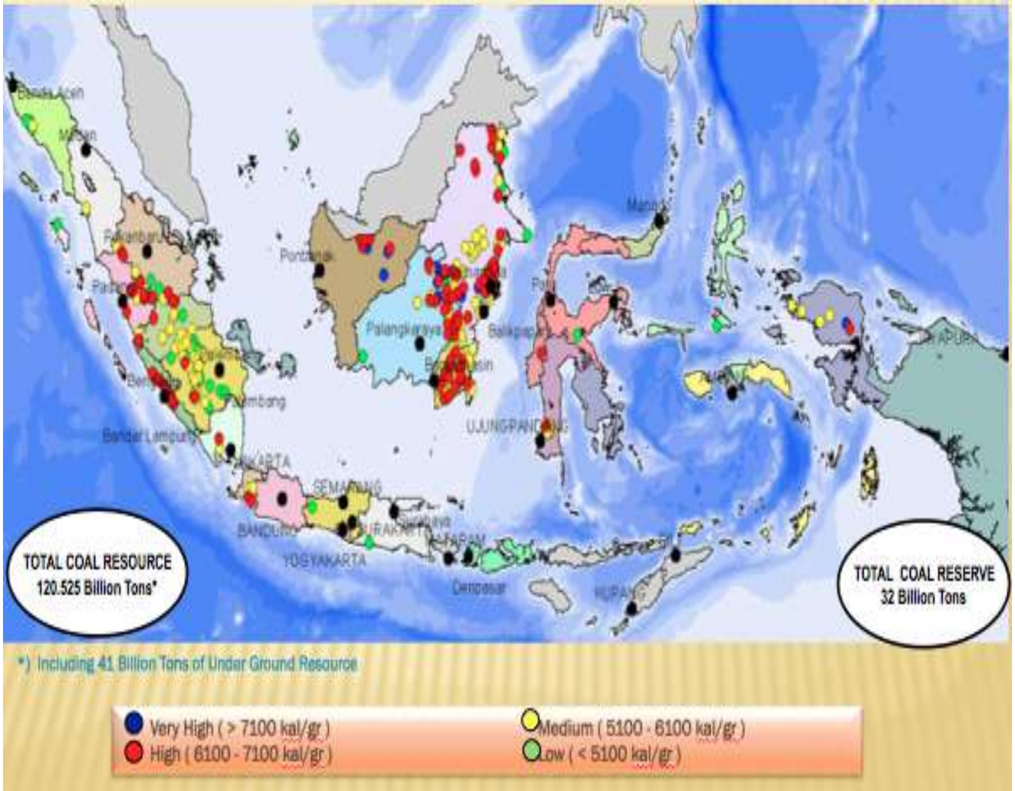

Figure 2-1. Indonesia's coal reserves and resources map

(Source: Geological Agency, 2013)

Majority of coal production in Indonesia is for export that reached almost 85% from total production. Country such as China, Japan, India, Korea and Taiwan are primary destination for Indonesian coal.

In recent years, while coal export still dominant, domestic coal demand is also increasing due to growing number of coal-fired power plants coming on-line.

To achieve more transparent process to ensuring its sustainable development in industry as well as to get more benefit from the sector and balancing its domestic and export commodity, the government has issued new coal and mining law in 2009. New regulations are banning exporting raw material for mineral and the company should build mineral smelting facility to get export permit. This applies to coal. The government will ban the export of lower quality coal products with calorific value less than 5100 kcal/kg to ensure a constant domestic supply of power since power generation in Indonesia is dominated by coal-fired power generation.

2.1.3 Renewable Energy

Regarding renewable energy, Indonesia also endowed with huge renewable energy potential which can support the country to gain more sustainable power generation capacity. According data from the Ministry of Energy and Mineral Resources of Indonesia in 2014, the renewable energy potential generation capacity such as hydro, geothermal, and biomass resources accounted to around 155 GW. Hydropower accounted for 75 GW followed by biomass with 50 GW, then geothermal with 29 GW and micro hydro with 770 MW. Table 2-2 shows Indonesia's renewable energy resources and its installed capacity.

To increase the utilization of its renewable energy, the government issued Presidential Regulation No. 5 in order to reduce oil usage by 20 percent and increase the share of renewable/low-carbon energy as a share of consumption to 15 percent based on 5 percent biofuel, 5 percent geothermal and 5 percent biomass, nuclear, hydro and solar in 2025. Furthermore, the government produced energy policy plan in 2011which proposes an increase to 25 percent renewable share in total national energy mix by 2025.

To achieve the target, the government has prepared regulations and action plans needed to stimulate the utilization of renewable energy such as feed in tariff, fiscal incentive, etc. This policy is very essential in the future to reduce fossil fuel dependency while enhancing national energy security as well as to achieve national emission reduction target.

Table 2-2. Indonesia's renewable energy resources and it's installed capacity

Renewable Energy	Resources	Installed Capacity
Hydro	75,000 MW	7,572 MW
Geothermal	28,910 MW	1,403 MW
Biomass	32,654 MW	1,717 MW
Solar	4.80 $kWh/m^2/day$	48,05 MW
Wind	3-6 m/s	1,87 MW
Ocean	49 GW (National Energy Council)	0.01 MW (BPPT's prototype)

(Source: Directorate General of New and Renewable Energy and Energy Conservation, 2014)

There are currently 7 active large scale (with a capacity greater than 20MW) geothermal power plants producing electricity in Indonesia with total installed capacity of 815 MW. These power plants are located primarily around near capital city and in North Sulawesi. In addition, there are numerous small-localized geothermal projects around the country. In Hydro, currently 17 large scale hydropower plants with combined installed capacity of 3330 MW operated by PLN while two private IPP plants have installed capacities of 150 MW and 180 MW. However, to date, only around 9% of the country's hydropower resources have been tapped.

Currently, renewable energy technologies such as solar and wind, which more expensive technologies, have not been exploited much in Indonesia due to many option to utilized renewable energy such as geothermal and hydro power generation projects which relatively cheaper and easily implemented. However, even though large scale solar and wind power generation still have challenge, in case of Indonesia with its unique geographical challenges composed of thousand islands inhabitants makes small scale solar or wind power generation a viable option used in remote areas.

2.1.4 Electricity

In 2013, Indonesia had a total installed electricity capacity of approximately 51 GW composed primarily (87%) of hydrocarbons generation including coal, oil and gas. Hydropower generation contributes 10% of generation capacity and the rest is coming from other renewable energy such as geothermal generation.

In electricity downstream side, consumption for electricity has been growing from 100 TWh in 2004 to 187.5 TWh in 2013. Government projecting that electricity demand will increase 8.4% annually for the next 7 years. Substantial portion of growing electricity demand will come from the continued electrification since Indonesia still struggling to achieve fully electrification ratio in the country. National electrification rates have increased to 82.4% in August 2014.

In terms of electricity distribution, residential households utilization accounted for the biggest consumption with 77.2 TWh or 41% of the total distribution. Industrial consumption comes second with 64.4 TWh (34%) followed by commercial with 34.4 TWh (19%) and public with 11.5 TWh (6%).Table 2-3 shows installed capacity by type since 2004 to 2013.

Table 2-3. Electricity installed capacity by type, MW

Type	2004	2010	2011	2012	2013
Hydro	3200	3720	3881	4078	5059
Steam	9750	12981	16318	19714	23812
Gas	2803	3823	4236	4344	4389
Combined Cycle	6846	7590	8481	9461	9852
Geothermal	820	1193	1209	1344	1345
Diesel	2994	4570	5472	5974	5935
Gas Engine	12	93	170	199	448
New and Renewable energy (including micro and mini hydro)	-	15	133	140	148

(Source: Handbook of Indonesia Energy Statistics 2014)

In order to meet electricity demand projection, the government plans to increase domestic total power generation capacity to approximately 85.8 GW in 2019 according to Indonesia's supply plan for 2010-2019 established by PLN. This mean that the government outlined an ambitious plan to add around 35 GW of new installed power into the country's grid by 2019. Coal-fired power generation will be projected as the main power generation with additions of renewable and gas-powered generation base.

2.2 Energy Subsidy in Indonesia

Energy subsidy is a common action in developing countries and can be defined as any government action that lowers the cost of energy production, raises the revenue of energy producers, or lowers the price paid by consumers (IEA, OECD, 2010). In Indonesian context, energy subsidy is defined as government action that lowers the price paid by consumers which commonly called as consumer subsidies.

Indonesian government has been provide subsidy for Indonesian people to protect from huge effects (reached 500%) of inflation since early period of Independence, especially on rice (main food for Indonesian), (Beaton & Lontoh, 2010). Based on State Budget and Expenditure law, there are several types of subsidies given by the government to the society composed of non-energy subsidies and energy subsidies. For energy subsidy, it consists of oil fuel subsidy and electricity subsidy. While for non-energy subsidies consist of food subsidy, fertilizer subsidy, tax subsidy, etc.

Subsidies granted with a view to controlling the price of fuel in the country so it can be affordable to purchase especially for low-income people. The fuel subsidy were first introduced in 1967 by giving subsidy to the retail price of fuel products to keep the price affordable for the poor and to raise income (IISD, 2012). In the period of 1966-1973 in order to recover from previous economic crisis, partial liberalization exists. Government intervene the market to simultaneously keep economic growth. During 1980's, when Indonesia's oil production was high, fuel subsidies were more affordable although they were broadly criticized for their distorting effect of economy. In the late period 1990's marked with deregulation and renewed liberalization. Rapid export had improved economic growth, thus increasing the wealth of the country; consequently, high bureaucracy corruptions were very high during this period (Beaton & Lontoh, 2010). Financial crisis in Asia in year 1998 had forced Indonesian government to have agreement with international Monetary Fund to get loan. The agreement included dismantling of state and private monopolies and also a reduction of subsidies in several commodities (Beaton & Lontoh, 2010). Afterwards, the government started to announce increasing in subsidized fuel price. However, even after recovery, the subsidy was hardly phased out, mainly due to economic (e.g., Inflation and hoarding), political, social, and behavioral reasons (Widodo et. al., 2012).

After Asian financial crisis in 1998, gradual reform took place to restructure petroleum, fuel subsidy and electricity sector. The new Oil and Gas Law no. 22 year 2001 was enacted which intended to achieve more liberalized market structure in petroleum industry. In Oil and Gas Law, it is mentioned that the price of fuel and gas are based on a fair market mechanism. However, the law also noted that the government should considered social responsibility towards lower income society. So, based on the law, basically the government can still intervene the market.

The government set fuel and electricity retail prices after considering the costs of basic provision of from the State-owned companies, Pertamina for and Perusahaan Listrik Negara (PLN). The subsidy will be given through State-owned companies, Pertamina and PLN as consequences to carry out the task in providing and distributing of fuel oil for domestic needs which was stipulated by Law No. 8 of 1971 on Pertamina as community service tasks (public service obligation).

To supply oil products, Pertamina currently refining crude oil in their facilities as well as importing from abroad in the form of fuel and crude oil. This action needed due to limitation in its refinery capacity which could not meet demand rate. Pertamina has only has 1.1 million barrel per day refinery capacity, which is not enough to supply much higher domestic demand. As fuel price mostly affected by crude oil price in the international market, while Indonesia has turned into oil importing country, increasing price in global oil market will also increase the cost of import crude and import fuel. As a result, increasing in cost component and also consumption will make the government should allocate more budgets on subsidy which put pressure on the state budget. Energy subsidy in recent years became more significant because of the price of international oil market shows high tendency to keep stable in relatively high price. In fact, Indonesia has had experienced with subsidies on oil products as both a net exporter and net importer of oil. In petroleum sector, Indonesia was a member of

OPEC countries dates back in 1968 until suspended its membership in 2008 because of its production is lower than its consumption even though they still export their crude oil production because of design capability of its refineries not fit with domestic crude.

Related with subsidized fuels price, the government has done several fuel price adjustments since year 2000. Moreover, The government also limited the subsidy for several types of fuel and also the consumer target subsidy. Formerly, there were five types of fuel that were subsidized namely gasoline (RON 88), kerosene, diesel oil for automotive (ADO), diesel oil for industry (IDO) and also fuel oil. They limited the fuel products to be subsidized in 2005 where IDO and fuel oil were excluded from the subsidy. Nowadays, only three kinds of oil fuel products given a subsidy namely gasoline (RON 88), kerosene, and ADO. These fuels are mainly used for public services, transportation, fisheries and small-and-medium enterprises. For the consumer type, the government also limited the subsidy to general consumer with restriction for industry in using subsidized fuel. These price differentiations for consumer has made fuel smuggling and hoarding more common (Widodo et al., 2012). Figure 2-3 shows the subsidized fuel prices and Indonesia Crude Price (ICP) fluctuation from 2005 to 2013.

Related with kerosene, in 2005 the government has reformed kerosene subsidy where the current subsidy is only limited given to households and small-and-medium enterprise. Furthermore in the government continue the reform program with the introduction of kerosene to LPG program as a part to reduce kerosene subsidies. The program provides a free start-up package consisting of a 3 kg LPG tank, a compact LPG stove and its accessories. In addition to that, the government also subsidizes the price of LPG for the 3 kg cylinder tank.

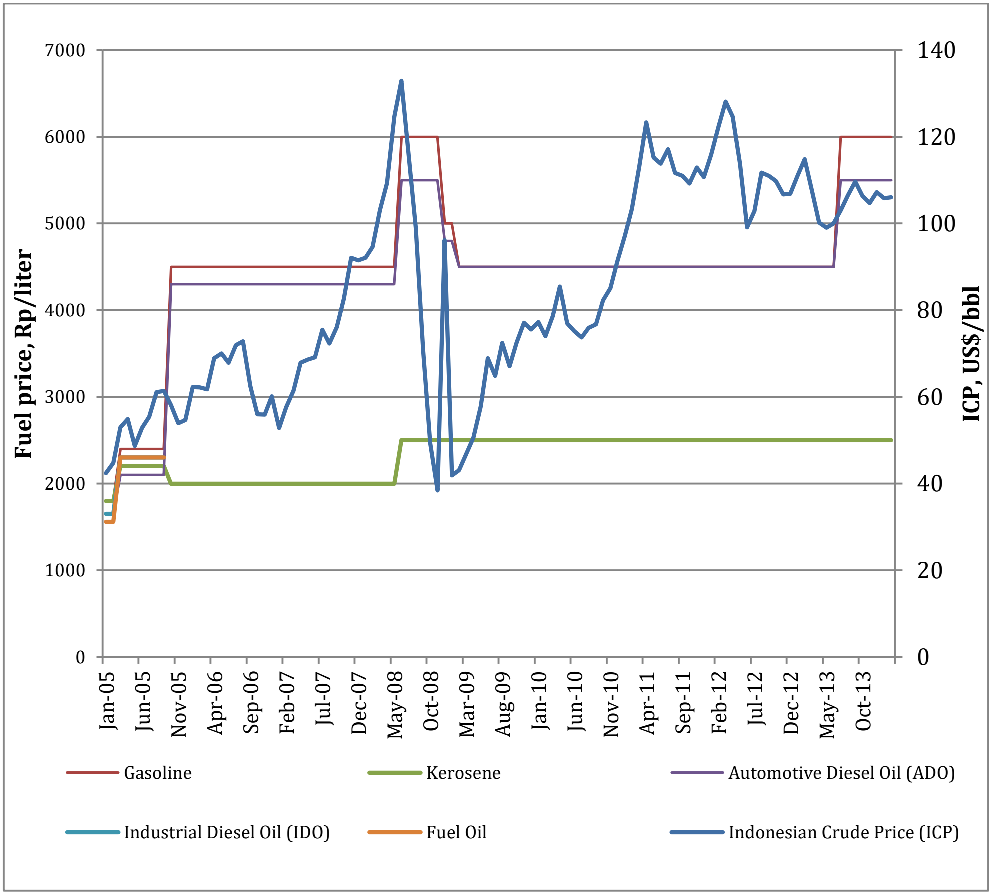

Figure 2-2. Retail price of subsidized fuels and ICP

(Source: Based on price data from the Ministry of Energy and Mineral Resources. Retrieved from http://esdm.go.id/publikasi/harga-energi/harga-bbm-dalam-negeri.html)

In electricity, the government also giving electricity subsidy to support its people for better source of energy. The government has set different electricity price subsidy for different type of consumers (i.e. industry, business, residential, public services, etc). Subsidy is given in the form of electricity base load tariff, which is lower than its average cost of production. The amount of subsidy is determined annually by the government, based on the difference between the average cost of electricity production proposed by Perusahaan Listrik Negara (PLN), State-owned electricity company and the average electricity tariff set by the government. The average cost of electricity production is based on an estimation of the composition of the energy inputs for generating electricity and the power plants, transmission, distribution and supply costs, and a margin for PLN.

2.3 Magnitude of Energy Subsidy

Since year 2000, the global oil price has fluctuated from 29.52 US$/Barrel in January 2001, 133.93 US$/Barrel in June 2008, 64.14 US$/Barrel in July 2009, 108.58 US$/Barrel in March 2011 and 45.10 US$/Barrel in September 2015. Due to the high steep in oil price in 2008, Indonesian government was forced to spend 27.93 % of its total national budget on energy subsidy which 80% of its share was coming from fuel subsidy. The magnitude of energy subsidy was equal to 5% of Indonesian gross domestic product (Agustina et al., 2008)

There are many factors that influencing the magnitude of energy subsidy in Indonesia such as:

- ICP (Indonesian Crude Oil Price), is the Indonesian crude oil selling price.
- Volume of subsidized oil fuel
- Currency exchange
- α, is the cost of which consists of distribution costs and margins.
- Retail price
- Type of subsidized oil fuel

It almost the same for electricity subsidy. The magnitude of electricity subsidy affected by several factors, namely:

- Currency exchange
- Price of energy sources such as coal, crude oil (ICP), etc
- Electricity tariff
- Margin

However the main components that influence the magnitude of subsidy are the crude oil in the international market and also the size of consumption. As a result of steep oil price in 2008 and 2011, the magnitude of energy subsidy was increased at that time. In 2008, the government increased the retail price in order to reduce its subsidy burden but cut the fuel retail price again in 2009 as a result in drop of crude oil price. Figure 2-4 shows magnitude of subsidy in 2007 to 2013 with ICP price.

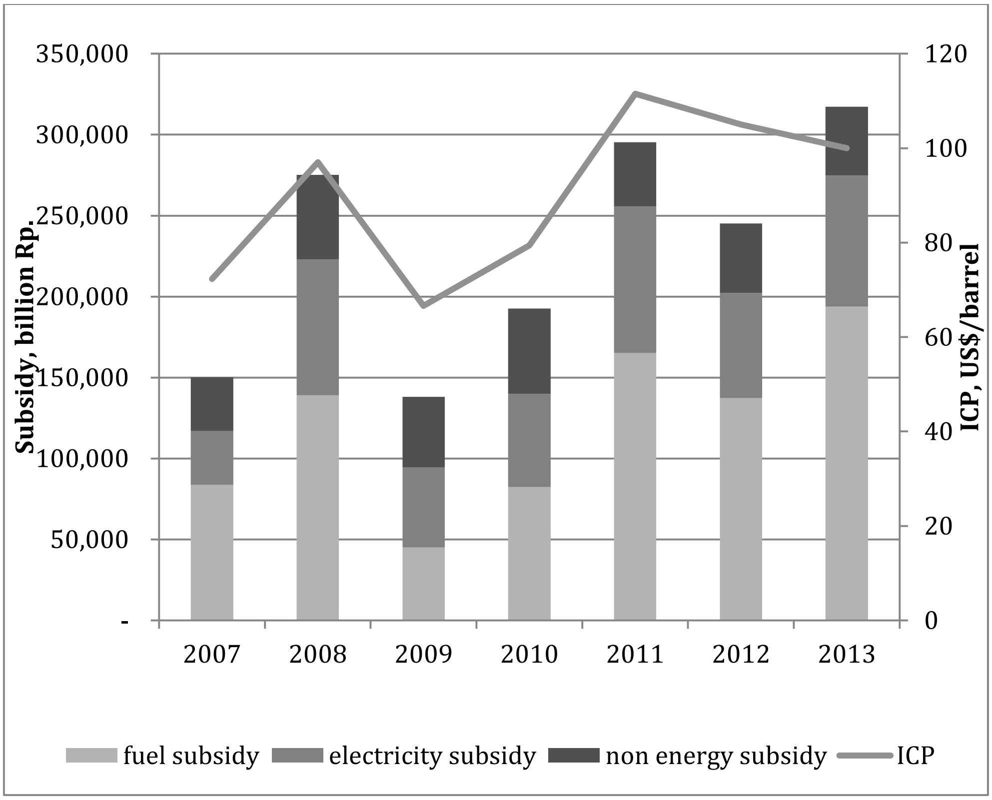

Figure 2-3. Subsidy allocation and ICP

(Source: State budget statistics 2007-2013. Retrieved from http://www.anggaran.depkeu.go.id/Content/10-08-24,%20Data%20Pokok%20RAPBN%202011_Indonesia_rev1.pdf)

Compared with non-energy subsidy, energy subsidy was larger in the budget allocation. If we see figure above, magnitude of energy subsidy correlated with ICP. Energy subsidy reaching the highest rate with Rp. 274,743 billion compared with earlier period. Table 2-4 shows the amount share of subsidy compared with other parameters.

Table 2-4. Magnitude of energy subsidy and other parameters

Parameter	2007	2008	2009	2010	2011	2012	2013
Energy subsidy (bilion Rp.)	116,866	223,013	94,586	139,952	255,608	202,353	274,743
Percentage to State budget exp.	15.4	22.6	10.1	13.4	19.7	13.1	16.3
ICP (US$/Barrel)	72.3	97	61.6	79.4	111.5	105	100
Exchange rate	9140	9691	10408	9087	8779	9000	9300

(Source: based on state budget statistics 2007-2013. Retrieved from http://www.anggaran.depkeu.go.id/Content/10-08-24,%20Data%20Pokok%20RAPBN%202011_Indonesia_rev1.pdf)

Nevertheless, the energy subsidy allocation in 2008 reaching the highest shares in state budget. This is due to the sharp increase in oil price at that time and made the government increase the fuel retail prices.

The amount of energy consumption also influenced the magnitude of energy subsidy. Table 2-5 shows the specific fuel and electricity consumption during 2007 to 2013. Gasoline, LPG and electricity consumption keep increasing during the period. However, kerosene consumption gradually decreases every year since the government introduced kerosene to LPG conversion program in 2007.

Table 2-5. Fuel and electricity consumption trend

Year	2007	2008	2009	2010	2011	2012	2013
Gasoline (ml)	16,962	19,112	20,802	22,391	24,766	27,616	28,622
Kerosene (ml)	9,898	7,902	4,780	2,845	1,985	1,382	1,261
ADO (ml)	17,115	18,845	20,864	21,906	18,491	18,932	17,086
IDO (kl)	257,124	153,419	132,894	160,805	118,499	91,088	69,363
Fuel oil (ml)	2,349	1,688	1,421	2,122	1,375	1,871	1,077
LPG (kton)	1,282	1,844	2,861	3,761	4,347	5,031	5,607
Electricity (GWh)	121,332	129,100	134,582	147,972	161,741	173,991	187,541

(Source: based on data from Handbook of Indonesia Energy Statistic 2014. Retrieved from: http://esdm.go.id/publikasi/indonesia-energy-statistics-leaflet.html)

In addition, in the late 2005, where the subsidy cut was reaching its highest (148% increase), the fuel consumptions decreased drastically. Total consumption decreased from 63.9 million m^3 in 2005 to 16.5 million m^3 in 2006 (Fathurrahman, 2014).

2.4 Literature Review

The debate regarding the energy subsidies and it's impact has attracted vast literature in recent years and has important implications from theoretical, empirical as well as policy standpoints.

Energy subsidy defines as any following government actions that lowering cost of energy production, raises the revenue of energy producers, or lowering the price paid by energy consumers (IEA, 1999). Subsidy can be formed in a variety of support mechanisms. They might be in the form of direct cash transfer to producers or consumers or may be reflected as tax exemptions and rebates.

Economic and social purposes are usually the objective of giving subsidy. The intention of giving subsidies are to stimulate economic growth, protecting employment, investment or providing infrastructure access (Van Beers and De Moore, 2001). It is also valid for Indonesian context.

In the case of energy subsidy, energy subsidies are often used to promote economic growth and alleviate energy poverty. Reddy (2002) shows that energy subsidy has played an important role in improving the living standard of the poor. Rubens et. al. (2006) also point out that smaller energy input can realize greater improvement of life quality in poor area. Therefore, government, especially developing countries consider energy subsidies as an essential aid of macroeconomic growth policy, in relation to social and environmental targets (UNEP, 2008).

In fuel subsidy practice, Pradiptyo and Sahadewo (2012) argued that the government of Indonesia giving subsidies to its people in order to received full benefit from the resources they got. The government provided fuel subsidy for the people because of they received high revenue from oil sector which intended to accelerate economic growth.

Furthermore the discussion of energy subsidy impacts is much more on the debate over inefficient subsidies. Subsidy may result in inefficient allocation of resources and may fail to meet its intended objectives. Fattouh & El-Katiri (2013) studied the energy subsidies in the Middle East and North Africa region (MENA). They pointed out on energy subsidy have been disturbed resulting in misallocation of resources.

Energy subsidy often misses the ideal target which is basically subsidy intended to support the low income to be able to purchase energy. It also creating disincentives for households to consume fuels in efficient way, distorting price signals to industry and households and creating opportunities for speculation and smuggling (Agustina et. al., 2008).

Since energy price in recent years experienced fluctuating changes, the higher energy price the higher subsidy budget allocations should be provided by government which will become a burden to fiscal balance that lead to unsustainable fiscal balance. IEA (2011) stated that energy subsidies could create more volatile by protecting the parts of the market. If the higher international prices of fossil fuels will then increase the state budget. In the standpoint of sustainable development, particularly fossil fuel subsidies will provide wasteful consumption resulting in increased pollution and greenhouse gas emissions. In the context of net-exporting countries, subsidies may restrict exports with increments of domestic demand leading to lower export earnings in the long term.

In short, considering the facts that energy subsidy causes many negative effects to the economy and society, which made the government to put energy subsidy reform as an important agenda. Afterwards, the Indonesian government's policy for fuel subsidy is clear which is to phase out the subsidy. Yet, the implementation of energy subsidy reform might not be easy to carry out due to strong objection and political challenges. However the government should work continuously to reform energy subsidy in order to achieve better economic condition and growth while in the other side keep supporting lower income with necessary measures. The key elements of a successful strategy should comprise: making subsidies explicit, making pricing mechanisms more robust, combining reductions in subsidies with measures to protect the low income, using the resulting savings well; and transparency and consultation (Baig et al., 2007). In the case of Yemen, a promising strategy for a successful reform combines fuel subsidy reduction with direct income transfers to the poorest one-third of households during reform, and productivity-enhancing investment in infrastructure, plus fiscal consolidation (Breisinger et al., 2012). In addition, subsidy reform also should be well planned to avoid the possibility of further harming the economy, welfare of society, and possible environmental impact. Energy subsidy reform will have a series of comprehensive impact on economic growth, resident welfare, international trade, energy consumption and CO2 emission (Saunders and Schneider, 2000). A number of studies were carried out previously to examine effects of energy subsidy reform in developing countries. Birol et. al. (1995) used econometric model to carried out the impact of energy subsidy removal on energy sectors in Iran, Algeria and Nigeria. They found the policy that favors more rational energy use would able to save guard oil to meet future increases in demand while maintaining stability in oil productions. In addition, such policy will further increase the oil revenue. In China, Jiang & Tan (2013) using Input and Output model found that energy subsidies removal would have the substantial impact on the energy intensive industries which will increase the general price level. Lin & Jiang (2011) also studied energy subsidy reform impacts in China economic sector using Computable General Equilibrium (CGE). In their finding, removing energy subsidies would result in a significant drop in energy demand and green house gasses emissions, but negatively affect macroeconomic variables. In order to reduce energy intensity and benefiting the environment, several offsetting policies should be pursued. Ogarenko & Hubacek (2013) using Input-Output model also studied the impact of energy subsidy removal in Ukraine context. They stated that by energy subsidies reform, particularly in the gas and electricity sectors, would lead a declining of 2.5% and 3.6% in energy consumption and GHG emissions respectively. Siddig et al. (2014) also made study on the impact of subsidy reform in connection with poverty rate in Nigeria. They found interesting result where energy subsidy reform will generally increase GDP in Nigeria. But it also has negative effect on household welfare which will hurt lower income households the most.

In the case of Indonesia, Dartanto (2013) studied on evaluating the impact of fuel subsidy reform and the fiscal balance to the poverty. He applied simulation based on CGE micro simulation. In his paper, he found that fuel subsidies reform and reallocation of it for government spending will able to decrease poverty incidence. In addition to that he also plots that 25% fuel subsidy removal will increase poverty by 0.259%. Furthermore if the subsidy money were reallocated to other government expenditure, the poverty rate will decrease by 0.27%. While Setyawan (2014) also studied the impact of fuel subsidy removal by using IO model. He found that if the fuel price increase by 10%, it would impact mostly to the electricity sector by 18.7% followed by transportation sector.

Overall, existing studies mainly focused on the analysis of the impact on energy subsidy removal. Yet, as stated by Ellis (2010) “few studies to date have effectively integrated the assessment of all economic, environmental and social impacts”. In the context of Indonesia, assessment mainly focus on the impact of subsidy removal on economic sector only as well as its reallocation scenario of fuel subsidy budget to other sectors. Furthermore, analysis on the impact of energy subsidy removal on economic sectors, environmental and energy issue specifically using Input-Output in Indonesia has never been done before. Therefore this study may enrich the analysis on energy subsidy removal in Indonesia especially in providing a picture on the potential effects caused by the removal of subsidies on economic sectors (generating price), energy consumption, labor as well as environmental issue (emission).

Chapter 3. Methodology and Data

3.1 Price-gap Approach

There is no uniformity in the measurement of energy subsidy, but the method and data should be carefully considered because one might over- or underestimate when the data and method used in the calculation are questionable. There are several approaches to calculating energy subsidy, as shown in Table 3-1.

Table 3-1. Subsidy calculation approaches

Approach	**Strength**	**Limitation**
Price-gap	Good indicator of pricing and trade distortions and can be estimated with relatively little data	Sensitive to assumptions regarding free market and transport prices. Understates full value of support by ignoring transfers that do not affect end-market prices
Resources rent	Relative for natural resources sectors such as forest and water	Sensitive to assumptions and data intensive
Marginal social cost	Most comprehensive approach and used for transport	Data intensive and requires significant amount of modeling. Sensitive to assumption
Programme-aggregation	Captures transfers whether or not affect end-market prices. Can capture intermediate value of government lending and insurance	Does not address questions of ultimate incidence of pricing distortions. Requires programme-level data
Producer/consumer support estimate	Integrates budgetary transfers with market price support into holistic measurement of support	Data intensive and currently calculated for agriculture and coal production but not for other sectors.

(Source: Koplow and Dernbach, 2001)

The price gap approach is the most commonly used method for quantifying consumer subsidies (Coady et al., 2010; IEA, 1999; Kosmo, 1987) due to its conceptual and analytical simplicity. The price gap is the difference between the final consumer prices and the reference prices that would dominate in competitive markets where no subsidies are provided to either the consumers or the producers (IEA, 1999). The basic idea in the price gap approach is to compare the end-user energy (retail) prices with the reference prices. The application is less simple, however, because some assumptions need to be made for the reference prices. The end-user prices correspond to the retail energy prices paid by the consumers while the reference prices usually indicate the prices at the international market and reflect the full opportunity cost of energy consumption. For this study, the reference price being used by the government in giving compensation (subsidy) to the state-owned energy companies that distribute energy-subsidized products to the people was used to capture the more realistic price gap in the subsidy. The transportation and distribution costs are also incorporated in the reference price. In addition, value-added taxes (VAT and other country-specific general transaction taxes) should be included because these taxes “are part of the cost of doing business” (IEA, 1999). In the government formula for the reference price, the distribution cost, VAT, and margin benefit is also included.

So, the amount of energy subsidy will be calculated based on following equation:

$$\boldsymbol{S = (P_{rf} - P_{rt})xV} \qquad (1)$$

where:

S : Subsidy for fuel or electricity

P_{rf} : Reference price

P_{rt} : Retail or selling price to consumer

V : Volume or consumption of fuel or electricity

In the fuel sector, P_{rf} used in this calculation based on the government's reference price that used to measure the amount of fuel subsidy. Reference price is the price that calculated based on MOPS (Mid Oil Platt's Singapore) plus α. MOPS itself can be calculated by Indonesian Crude Oil Price (ICP) plus δ MOPS where δ MOPS is the difference (average) between ICP subtracted by MOPS. The taxes consist of the value-added tax (10%) and the fuel tax (5%).

For electricity, the formula that was set by the government for electricity was also used. The reference price is the basic cost of electricity production, including the margin (Rp/KWh) of each tariff class, and the retail price is the average selling price of electricity (Rp/KWh) of each tariff class. The basic cost of electricity provision is calculated based on a formula that includes the transmission and distribution network loss, which is determined by the government.

3.2 Estimating Price Effects and Other Factors

3.2.1 Input-output Price Model

To estimate the price increase in other sectors caused by a price increase in the fuel and electricity sector, this study applied the input-output (IO) model developed by Wassily Leontief. The IO model is a quantitative economic technique that represents the interdependencies between different sectors of a national economy or different regional economies. The IO approach was used herein because it is a well-established and transparent methodology that is appropriate to be used in addressing the research questions that were set in this thesis. According to Ellis (2010), there are mainly two modeling methods that can be used to calculate the impact of subsidy removal: partial- and general-equilibrium modeling. Input-output models can be regarded as simplified general-equilibrium models or satisfactory approximations of the general-equilibrium models when the modeling focus is the short-term analysis of one-shot policy shocks like the removal of energy subsidy (Ginsburgh & Keyzer, 1997).

To construct a link between the changes in the relative prices and the quantities of goods demanded, the demand-driven and price IO model was utilized, accordingly incorporating the core of the CGE model without complicating the matter with the use of big data and the complex work of modeling. Although the CGE model is capable of assessing the structural- and technological-change effects of policy shocks, Ogarenko and Hubacek (2013) argue that it is important to study the short-run consequences for the purpose of developing mitigation strategies as the unwillingness to incur additional costs usually impedes the necessary policy reforms.

The other benefit of the IO model is that it allows the examination of the industry interdependency and of how the elimination of subsidies in the oil fuel and electricity sectors triggers changes in other sectors.

The IO model that was used in this study was the Leontief price model, which holds that the total price of one unit of output is equal to the total cost of production, including the intermediate purchases and the primary inputs.

The prices are determined with an input-output system from a set of equations stating that the price that each sector of the economy receives per unit of output must equal the total outlays incurred in the course of the production. The outlays comprise not only the payments for the inputs purchased from the same and from other industries but also the value added, which essentially represents the payments made to the exogenous factors, such as the capital, labor, and land.

In the input-output table, the cost of production is reported for each sector in the corresponding column of the matrix. The transposed columns are reported in the following system.

Basic equation of the Leontief price model is usually expressed as follows:

$$\boldsymbol{p} = (\boldsymbol{I} - \boldsymbol{A}')^{-1}\boldsymbol{Q}\boldsymbol{v} \qquad (2)$$

where:

p	:	vector of prices (price indices) for commodities
I	:	Identity matrix
A’	:	transposed matrix of input coefficient for intermediates (technology matrix)
(I-A)	:	Leontief matrix
$(I\text{-}A')^{-1}$	:	transposed Leontief Inverse
Q	:	diagonal matrix with unit factor price for primary input
v	:	column vector of input coefficients for primary input

The objective of the price model is to calculate the unknown product prices (price indices) for the given primary input coefficient, which is weighted with the factor price. This is because there is no available information on the quantities and prices so the input coefficients for the primary input should be weighted with a unit price index (Eurostat, 2008; Miller & Blair, 2009).

To estimate the changes in the relative prices of the economic sectors as a result of energy subsidy removal, the IO price model was adopted. The price changes in one sector could result in a price change in other sectors. In this study, energy subsidy removal was shown to lead to price increases in other sectors requiring oil fuel and electricity for production and resources from other sectors, which in turn purchase energy as intermediate inputs. The price shock caused by energy subsidy removal in the oil fuel and electricity sectors could be recorded as a change in the value added of these sectors.

3.2.2 Estimating CPI Changes for Different Income Groups

The price changes in the economic sectors will affect the economic welfare. By using the IO price model as well as the data on the consumption patterns of households per income group and area of residence, the welfare impact of energy subsidy removal can be quantified.

To measure the welfare impact, the change in the consumer price index (CPI) adopted from the standard Laspeyres price index (ILO, 2004), which assumes a fixed structure of goods and services, was estimated. The change in the CPI or in the additional income required for purchasing the same basket of goods and services can be estimated using the following equation:

$$\Delta CPI_h = \sum_j \beta_{hj} \Delta p_j \qquad (3)$$

where:

ΔCPI : Change in consumer price index (in %)

h : Indexes households with different income levels and areas of residence

βhj : Budget share of commodity j for each group of households (from Bureau Statistical Agency in 2009)

Δpj : Relative price changes of each sector' estimated with equation 3. Subscript j denotes the element in column of the matrix.

The assumption in this study was that technological change could not be foreseen in the methodology that was to be adopted, and that the direct input coefficient would remain constant because only the short-term effects were to be studied assuming that the economy would not have time for structural adjustment and substitution between the energy and non-energy factors of production.

3.2.3 Partial-Equilibrium Approach

The price model's assumption is that the changes in the value added lead to changes in the relative prices of goods and services, but the quantities of products demanded remain constant. Nevertheless, the economic theory suggests that in response to the higher prices of normal goods, rational consumers will reduce their purchases of the given commodities, shift to cheaper products, or maintain the same level of consumption at the expense of other products. Therefore, the objective of this study was to estimate the response of the final consumers to the higher prices of goods and services. Meanwhile, industries are unable to adjust their input structure as the technical coefficients are fixed in the input-output model. This is one of the most important limitations of the IO methodology, but it is still consistent in the short term because industries are unable to change their technological processes immediately and will need more time and additional investments to do so (Ogarenko & Hubacek, 2013). Thus, it was assumed that all costs would be passed on to the final consumers, which are more capable of responding to price shocks in the short run.

To establish a link between the price changes estimated by the price model and the changes in the final demand derived from the classical demand-driven model, the partial-equilibrium approach was utilized in this study. The basic relationship between the changes in prices and the quantities of the final demand can be expressed as follows:

$$\boldsymbol{\varepsilon} = \frac{\boldsymbol{\Delta QP}}{\boldsymbol{Q\Delta P}} \qquad (4)$$

where ε is the price elasticity of the final demand for output, P and Q are the initial price and quantity, respectively, and ΔP and ΔQ are the changes in the prices and quantity. As a result of the price changes, a change in the quantity demanded (ΔQ) can be estimated as follows:

$$\boldsymbol{\Delta Q} = \frac{\boldsymbol{\varepsilon Q \Delta P}}{\boldsymbol{P}} \qquad (5)$$

while in matrix form it can be expressed as

$$\boldsymbol{\Delta y} = -\boldsymbol{\Delta p \varepsilon y_o} \qquad (6)$$

where $\boldsymbol{y}_0$ is the initial vector of the final demand, Δy the column vector of the change in the final demand, Δp is the diagonal matrix (a matrix with the elements of the vector in the main diagonal and the zeros outside the main diagonal) of price changes (in % or share of unity), and ε is the diagonal matrix of elasticity.

It is especially difficult, however, to find elasticity for certain industries, especially for effects in the short run. Price elasticity for most sectors is often not available. Several studies on the price sensitivity of energy consumption showed that energy consumption (i.e., fuel and electricity) is likely to be relatively inelastic in the short run because few substitution options are available for households (Bentzen & Engsted, 1993; Bernstein & Griffin, 2006; Prosser, 1985). Qi et al. (2009) estimated the price elasticity of China's industrial and residential electricity demand as −0.60 and −0.2, respectively. Atakanova and Howie (2007) estimated the short- and long-run price elasticity of residential electricity consumption as −0.22 and −1.10, respectively. Espey (1998) showed that the average short-run price elasticity of gasoline was −0.26, and that the long-run elasticity was −0.58. Andrikopoulos et al. (1987) and Russo et al. (2008) conducted a study on the demand sensitivity of agricultural commodities and food products to price changes, which are also likely to be inelastic in the short term. Considering the limited availability of real estimates of price sensitivity for all economic sectors, Ho et al. (2008) derived elasticity from a macroeconomic model for the U.S. under constrained conditions. This study assumed that primary products such as fuel, electricity, and foods are more inelastic than the products of other sectors. Ogarenko and Hubacek (2013) assumed that similar sectors would have similar levels of price elasticity, as shown in Table 3-2. In this study, similar price elasticity levels were utilized due to the limited price elasticity findings, especially in the case of Indonesia.

Table 3-2. Price elasticities

Economic sectors	Price elasticity
Agriculture, Hunting, Forestry and	-0.35
Mining and Quarrying	-0.2
Food, Beverages and Tobacco	-0.2
Textiles and Textile Products	-0.7
Leather, Leather and Footwear	-0.7
Wood and Products of Wood and	-0.7
Pulp, Paper, Paper , Printing and	-0.7
Coke, Refined Petroleum and	-0.2
Chemicals and Chemical Products	-0.7
Rubber and Plastics	-0.7
Other Non-Metallic Mineral	-0.7
Basic Metals and Fabricated Metal	-0.7
Machinery, Nec	-0.7
Electrical and Optical Equipment	-0.7
Transport Equipment	-0.7
Manufacturing, Nec; Recycling	-0.7
Electricity, Gas and Water Supply	-0.2
Construction	-0.7
Sale, Maintenance and Repair of	-0.7
Wholesale Trade and Commission	-0.7
Retail Trade, Except of Motor	-0.7
Hotels and Restaurants	-1
Inland Transport	-0.7
Water Transport	-0.7
Air Transport	-0.7
Other Supporting and Auxiliary	-0.7
Post and Telecommunications	-0.8
Financial Intermediation	-0.8
Real Estate Activities	-0.8
Renting of M&Eq and Other	-0.8
Public Admin and Defence;	-0.5
Education	-0.5
Health and Social Work	-0.5
Other Community, Social and	-0.5
Private Households with Employed	-0.5

(Modified from Ogarenko & Hubacek, 2013)

3.2.4 Input-output Demand Driven Model

As a decrease in final demand will induced the decline in output, IO model can also be utilized to estimate changes of several factors such as changes in energy consumption, CO2 emissions and also employment.

The change in total output as a result in change of demand (calculated in equation 6) is estimated as:

$$\boldsymbol{\Delta x} = (\boldsymbol{I} - \boldsymbol{A})^{-1}\boldsymbol{\Delta y} \qquad (7)$$

Decrease in output would result in decline in energy consumption, CO2 emissions and other factors. Using similar method to calculate input coefficients, for this purpose we calculate physical coefficients (b) by dividing each input factors of each sector by sectoral output (x) which can be formulated as follows:

$$\boldsymbol{b_i} = \frac{\boldsymbol{e_i}}{\boldsymbol{x_i}} \qquad (8)$$

subscript i denotes the element in row of the matrix. After estimation change of output, which would result in change in resource inputs or emission factors could be calculated as

$$\boldsymbol{\Delta e} = \boldsymbol{b}\ \boldsymbol{\Delta x} \qquad (9)$$

where Δe is vector of change in resource input or emissions and b is diagonal matrix of physical coefficients.

3.3 Data

To estimate the effects of energy subsidy removal on Indonesia's economic sectors, the most recent data for Indonesia's IO table for the year 2009 were utilized. The IO table was obtained from the World Input-Output Database (WIOD), which consists of 35 sectors. The column explains the economic activities that developed based on the classification of the economic activities in the European Community (NACE). The classification of commodities and services (in the rows of the table) is in line with the state classification of commodities and services based on the European Classification of Products by Activity (CPA).

Table 3-3 illustrates the inter-industry transactions between sectors, the final uses for each industry's outputs. The use table is a product by industry based on the final uses and import in the columns. A use table shows the uses of goods and services by product and by type of use (i.e., for intermediate consumption by industry, final consumption, gross capital formation, or export). Furthermore, the table shows the components of the value added by industry (i.e., the compensation of the employees, other taxes, less subsidies on production, consumption of fixed capital, and net operating surplus). The table of intermediate use shows the intermediate consumption by product and by industry;

the table of final uses shows the uses of products for final consumption, gross capital formation, and export; and the table of value added shows the components of the value added by industry. The totals over the columns of the intermediate- and final-use table show the total use by product, and the totals over the rows of the intermediate- and value added table identify the total inputs by industry. The columns of industries in the use table reflect the cost structure of each specific industry. The intermediate-consumption table thus identifies the goods and services that are necessary for the production of the primary and secondary outputs of industries. This table has much more entries than the output matrix because in many industries some products are required to produce the output. For example, electricity is a product that is required in more or less all industries. On the other hand, there are certain products that are required in only one or few industries. An example of such products is crude oil, which is being used only in refineries.

As the IO table does not provide a detailed breakdown of each energy sector (in this case, oil fuel and electricity), it was assumed that the other sectors that were included in the classification do not use significant amounts of oil fuel and electricity. As oil fuel is included in coke, refined petroleum, and nuclear fuel sector, it was assumed that coke and nuclear fuel are not significant in the sector because Indonesia does not use nuclear fuel. This is similar to electricity, which is under electricity, gas, and water supply.

Data for Input-output table used for this study is available in appendix.

Table 3-3. Simplified Input-Output Table

<table>
<tr><td rowspan="2"></td><td colspan="3">Industries</td><td colspan="3">Final uses</td><td>Total</td></tr>
<tr><td>Agriculture</td><td>Industry</td><td>Service activities</td><td>Final consumption</td><td>Gross capital formation</td><td>Export</td><td rowspan="4">Total use by product</td></tr>
<tr><td>Agriculture</td><td colspan="3" rowspan="3">Intermediate consumption by product and by industry</td><td colspan="3" rowspan="3">Final uses by product and by category</td></tr>
<tr><td>Industry</td></tr>
<tr><td>Services</td></tr>
<tr><td>Value added</td><td colspan="3">Value added by components and by industry</td><td colspan="3"></td><td>Value added</td></tr>
<tr><td>Total</td><td colspan="3">Total output by industry</td><td colspan="3">Total final uses by category</td><td></td></tr>
</table>

(Adopted from Eurostat Input-output Manual, 2008)

For fuel and electricity price data in this thesis is based on the information from the Ministry of Energy and Mineral Resources of Indonesia in 2009. Figure 3-1 describes the fluctuation of reference and retail oil fuels price in 2009.

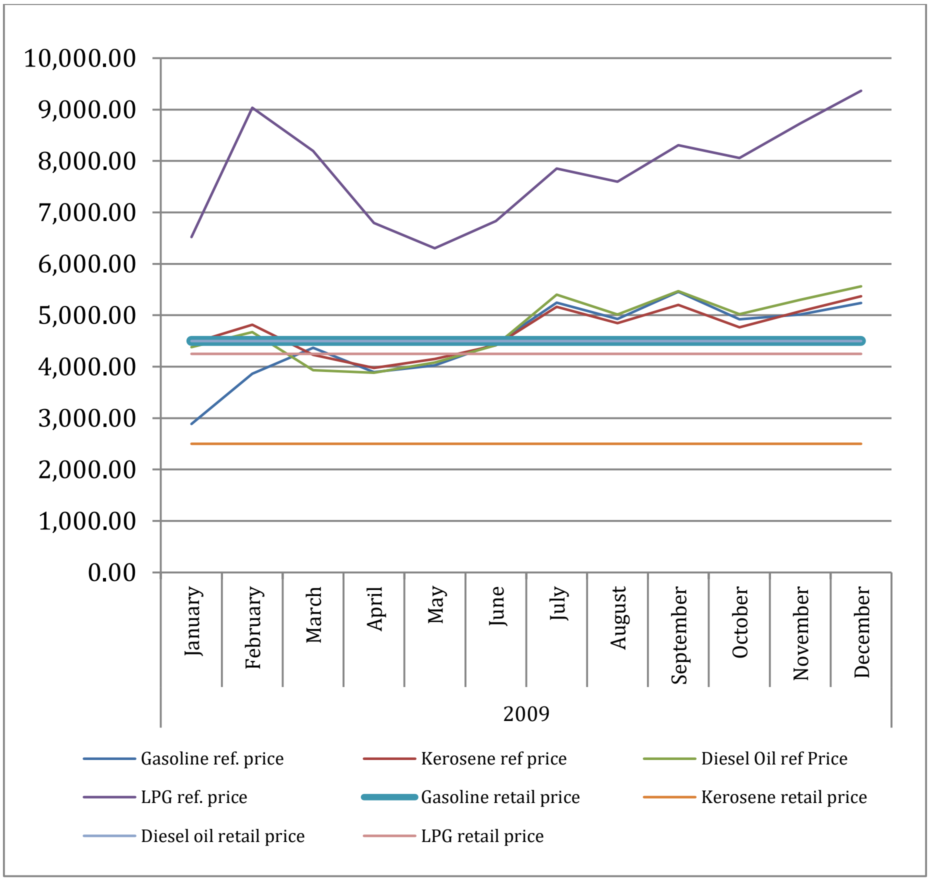

Figure 3-1. Oil fuels reference and subsidized retail price

For the price of electricity, the government differentiates it based on tariff group classification, such as social, households, industry, business, public, and multi-purpose. In each group, there is price differentiation based on the installed power. Table 3-4 indicates the average electricity price tariff in each tariff group.

Table 3-4. Average electricity tariff group price in 2009

Tariff group	Retail price (Rupiah/KWh)	Reference price (Rupiah/KWh)
S (Social)	476.4	1109.1
R (Household)	714.6	1132.6
B (business)	731.1	1105.1
I (Industry	663.6	1085.2
P (Public)	774	1109.1
M (Multipurpose)	675.3	976.6

For measuring the CPI index, the average monthly expenditure per capita for urban and rural areas with different income groups based on the 2009 data of the Statistical Bureau Agency (BPS) was used, as shown in Table 3-5 and 3-6. Group categories 1-8 reflect the low- to high-income groups.

Table 3-5. Average monthly expenditure in different income groups level in urban area in 2009 (percentage)

Items	Urban							
	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Group 7	Group 8
Food and beverage	0.718	0.653	0.627	0.623	0.532	0.459	0.400	0.272
Housing and utilities, fuel and water	0.145	0.174	0.184	0.179	0.214	0.237	0.244	0.272
MISC goods and services	0.053	0.063	0.076	0.081	0.105	0.122	0.137	0.157
Education	0.028	0.031	0.031	0.026	0.034	0.040	0.047	0.051
Health	0.014	0.022	0.022	0.021	0.027	0.030	0.035	0.044
Clothing and footwear	0.030	0.040	0.038	0.033	0.033	0.033	0.032	0.030
Long terms goods	0.004	0.009	0.012	0.022	0.038	0.055	0.071	0.113
Tax and insurance	0.002	0.004	0.005	0.006	0.010	0.014	0.018	0.028
Restaurant and hotels	0.005	0.005	0.005	0.008	0.008	0.010	0.015	0.032

(Source: Author calculation based on SUSENAS 2012, BPS)

Table 3-6. Average monthly expenditure in different income groups level in rural area in 2009 (percentage)

Items	Rural							
	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Group 7	Group 8
Food and beverage	0.694	0.675	0.689	0.665	0.592	0.521	0.457	0.300
Housing and utilities, fuel and water	0.156	0.158	0.147	0.150	0.167	0.172	0.170	0.163
MISC goods and services	0.054	0.061	0.063	0.074	0.092	0.099	0.103	0.118
Education	0.029	0.029	0.024	0.022	0.023	0.023	0.021	0.018
Health	0.017	0.017	0.017	0.019	0.024	0.030	0.032	0.036
Clothing and footwear	0.035	0.039	0.035	0.035	0.037	0.035	0.033	0.027
Long terms goods	0.009	0.011	0.014	0.022	0.045	0.093	0.137	0.246
Tax and insurance	0.003	0.004	0.005	0.006	0.009	0.011	0.015	0.015
Restaurant and hotels	0.003	0.005	0.006	0.007	0.011	0.017	0.032	0.076

(Source: Author calculation based on SUSENAS 2012, BPS)

For estimation the impact to employment, this study utilized satellite table for each sector/industry published by WIOD. Table 3-7 indicates the size of employment for each sector in Indonesia in 2009.

Table 3-7. Employment in economic sectors in 2009

Sector	Employment (Thousand people)
Agriculture, Hunting, Forestry and Fishing	81,297
Mining and Quarrying	2,228
Food, Beverages and Tobacco	3,123
Textiles and Textile Products	7,261
Leather, Leather and Footwear	364
Wood and Products of Wood and Cork	951
Pulp, Paper, Paper , Printing and Publishing	1,300
Coke, Refined Petroleum and Nuclear Fuel	47
Chemicals and Chemical Products	1,634
Rubber and Plastics	501
Other Non-Metallic Mineral	3,399
Basic Metals and Fabricated Metal	2,660
Machinery, Nec	1,119
Electrical and Optical Equipment	700
Transport Equipment	1,472
Manufacturing, Nec; Recycling	2,711
Electricity, Gas and Water Supply	1,187
Construction	26,749
Sale, Maintenance and Repair of Motor Vehicles and Motorcycles; Retail Sale of Fuel	0
Wholesale Trade and Commission Trade, Except of Motor Vehicles and Motorcycles	2,440
Retail Trade, Except of Motor Vehicles and Motorcycles; Repair of Household Goods	5,790
Hotels and Restaurants	2,739
Inland Transport	9,190
Water Transport	141
Air Transport	59
Other Supporting and Auxiliary Transport Activities; Activities of Travel Agencies	415
Post and Telecommunications	1,687
Financial Intermediation	2,574
Real Estate Activities	313
Renting of M&Eq and Other Business Activities	2,831
Public Admin and Defence; Compulsory Social Security	6,695
Education	9,816
Health and Social Work	2,711
Other Community, Social and Personal Services	1,977
Private Households with Employed Persons	0

(Source: WIOD, 2012)

This study also intended to investigate the impact of energy subsidy on the environment and on the energy demand. To assess these indicators, data regarding energy consumption and the environment are required. Table 3-8 shows the energy consumption and CO_2 emission data that were used in this study.

Table 3-8. Energy consumption and CO_2 emission in economic sectors in 2009

Sector	Energy consumption (TJ)	CO2 emission (kt)
Agriculture, Hunting, Forestry and Fishing	255727.6371	18407.34806
Mining and Quarrying	554300.8451	44640.99035
Food, Beverages and Tobacco	363601.3751	9298.97575
Textiles and Textile Products	253953.7856	15492.52352
Leather, Leather and Footwear	14333.49792	743.4413896
Wood and Products of Wood and Cork	72448.49841	2975.369338
Pulp, Paper, Paper , Printing and Publishing	102135.1058	5961.722234
Coke, Refined Petroleum and Nuclear Fuel	2150035.548	6176.714315
Chemicals and Chemical Products	427264.4776	10498.79183
Rubber and Plastics	36011.5688	1926.565714
Other Non-Metallic Mineral	288316.9617	33228.15177
Basic Metals and Fabricated Metal	129972.2331	14785.71381
Machinery, Nec	10535.88213	516.2038702
Electrical and Optical Equipment	95970.86054	4625.098766
Transport Equipment	68955.80058	3185.730843
Manufacturing, Nec; Recycling	42331.73555	1831.867528
Electricity, Gas and Water Supply	2218632.623	104859.2746
Construction	217159.2917	12135.68668
Sale, Maintenance and Repair of Motor Vehicles and Motorcycles; Retail Sale of Fuel	0	9.7623367
Wholesale Trade and Commission Trade, Except of Motor Vehicles and Motorcycles	76187.76711	3522.417832
Retail Trade, Except of Motor Vehicles and Motorcycles; Repair of Household Goods	51144.7521	2373.979032
Hotels and Restaurants	49332.86251	2280.369526
Inland Transport	205349.3316	15194.84826
Water Transport	94325.19868	7034.294142
Air Transport	2995.74437	214.8263289
Other Supporting and Auxiliary Transport Activities; Activities of Travel Agencies	27523.61989	1910.982061
Post and Telecommunications	20472.49031	1131.315846
Financial Intermediation	4786.77462	243.9199406
Real Estate Activities	17946.24875	533.4346081
Renting of M&Eq and Other Business Activities	10311.03963	466.9345801
Public Admin and Defence; Compulsory Social Security	27044.73984	1414.148304
Education	22115.49275	1272.178602
Health and Social Work	5569.393643	380.6077504
Other Community, Social and Personal Services	39930.64397	1928.272146
Private Households with Employed Persons	0	0

(Source: WIOD, 2012)

Chapter 4. Empirical Results and Analysis

4.1 Energy Subsidies in Indonesia

In this study, the consumer subsidies for oil fuel and electricity, which were described in the Methodology section, were investigated. Based on the data from the Ministry of Energy and Mineral Resources, the difference between the retail and reference prices was calculated. The average retail fuel price for oil products (gasoline, diesel, kerosene, and LPG) is only 68% of the reference price. The price of fuel is highly sensitive to the fluctuations in the global oil market because some of the Indonesian fuel components are dependent on a foreign benchmark. In the first quarter of 2008, the international crude oil price reached its highest level: almost US$ 140/barrel. Consequently, the government increased the retail price from Rp. 4,500/liter to Rp. 6,000/liter to reduce the subsidy burden in the state budget. Due to the steep decline during the third quarter of 2008, however, the government cut the retail price of fuel.

For the electricity prices, those for the consumer groups are lower than the reference price, only around 62% of the reference tariff. Basically, the government has set tariff classes with the aim of differentiating the amount of electricity subsidy as well as the electricity price. To simplify the calculation, the electricity reference price was set as the average end-user price in all the tariff classes.

Based on the data from the Ministry of Energy and Mineral Resources of Indonesia, the reference and retail prices for oil fuel and electricity in the year 2009 are as shown in Table 4-1.

Table 4-1. Average fuels and electricity retail and reference price in 2009

Type	Retail price	Reference price
Gasoline (Rp/liter)	4500	5110
Diesel (Rp/liter)	4500	5347
Kerosene (Rp/liter)	2500	4933
LPG (Rp/kg)	4250	7800
Electricity (Rp/KWh)	672.5	1084.8

(Based on the government fiscal budget in 2009, the subsidy for energy sector reached Rp. 94,585.9 billion or US$ 9.1 billion[1])

The amount of energy subsidy includes Rp. 45,039.4 billion (US$4.33 billion) oil fuel subsidy and Rp. 49,546.5 billion (US$4.76 billion) electricity subsidy. If we compared the amount of fuel subsidy with refining petroleum & coke industry (US$ 16.59 billion) input in the IO table, it equal to 26%. As for electricity, the amount of subsidy compared with those for electricity, gas and water (US$ 10.37 billion)

[1] Exchange rate in 2009 is Rp. 10408 per 1 $, based on Bank Indonesia

reach 46% in 2009.

4.2 Effects on Relative Prices, Output and Employment

As a result of energy subsidy removal, the price of fuel and electricity will increase, and this will also affect the prices in the other sectors that have a correlation with the energy subsidy sectors. It should be noted, however, that this estimation uses the assumption of the IO model that the input coefficient will remain the same. This assumption, if used for the short-term effects of price shocks, is still valid assuming that the economy does not have enough time to allow for restructuring and to substitute the energy and non-energy factors in production process. It is estimated that energy subsidy removal and the corresponding 32 and 38% price increases for oil fuel and electricity, respectively, will have an impact on the economic sector, with the highest impact being that on the refining petroleum and coke sector, which will see a 19% price increase. The impact on this sector will mostly come from the oil fuel price shock. This is obvious because the subsidy is intended to benefit the oil refinery sector; as such, the elimination of fuel subsidies will have the greatest impact on the sector. The second sector that will be most affected by the price shock from energy subsidy reform is the electricity sector. The impact on the electricity sector will reach 16.9%, with the highest impact coming from the electricity price shock (13.8%), followed by the oil fuel price shock (3.1%). In 2009, electricity power was still generated from oil fuel in Indonesia, reaching about 9 TWh (17% of the total power generation). Furthermore, compared to the other sectors, the two aforementioned sectors that will be most affected by energy subsidy removal consumes more energy (energy-intensive), with the energy cost representing a high proportion of the price. Figure 4-1 illustrates the rates of increase in the relative prices in the economic sectors as a result of energy subsidy removal.

The aforementioned results are consistent with the finding of Jiang and Tan (2013) and Ogarenko and Hubacek (2013) that the energy-intensive sectors will be affected the most by energy subsidy reform. Regarding the impact of fuel subsidy removal on the generation of increases in the general prices in Indonesia, Fathurrahman (2014), using Social Accounting Matrix (SAM), also found that fuel subsidy removal will have the biggest effect on the oil refinery sector. While Setyawan (2014) found that a fuel price increase could lead to the biggest increase in the electricity sector price, followed by road transport. He stated that a 10% increase in fuel would cause an 18.67% price rise in the electricity sector. Setyawan used the 2005 IO data from the Statistical Bureau Agency.

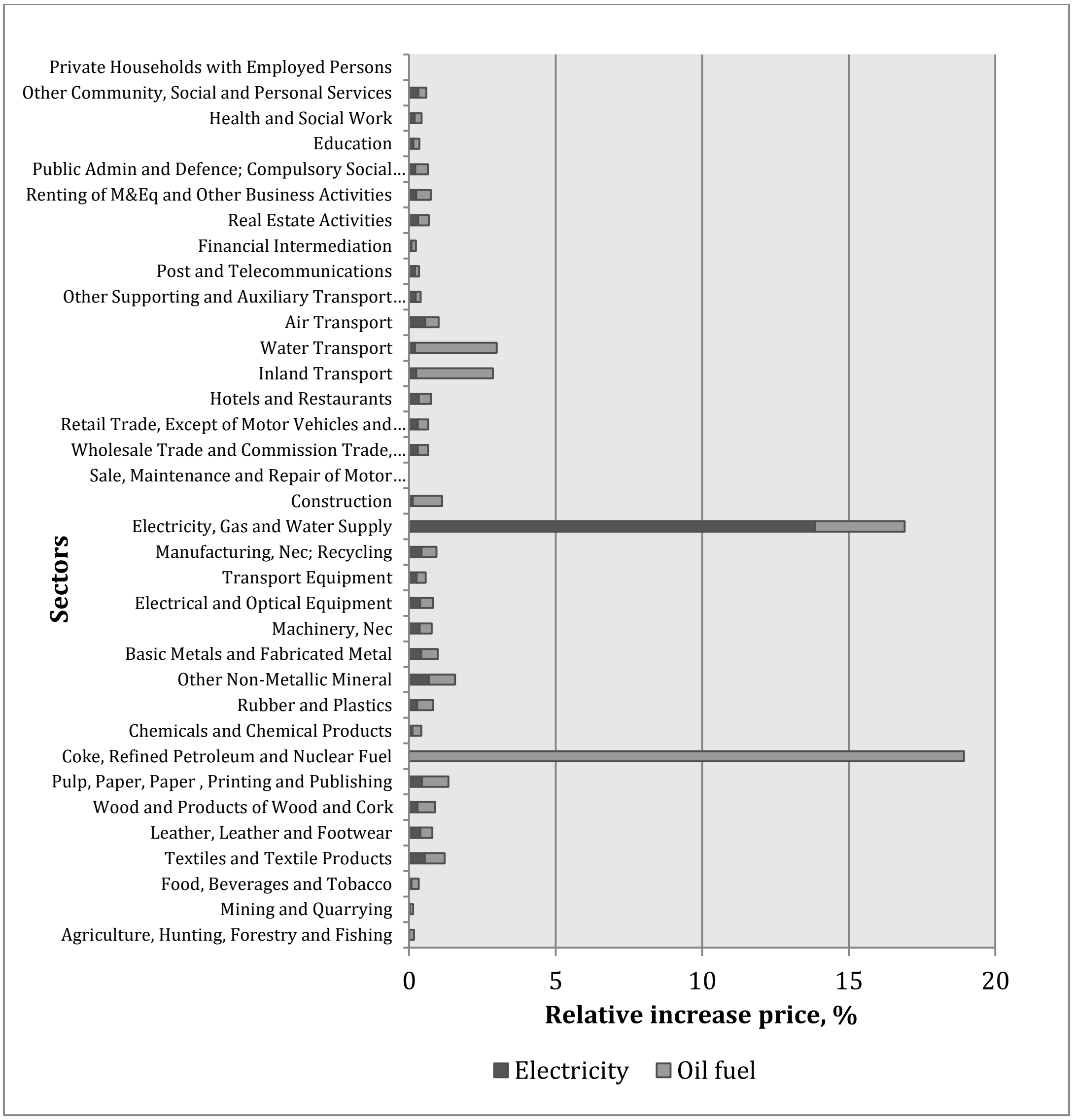

Figure 4-1. Increase of relative price

Table 4-2 indicates the top six sectors that will be most affected by energy subsidy removal.

Table 4-2. Top 6 sectors most affected

Sector affected by Oil fuel	Impact	Sector Electricity	Impact
Coke, Refined petroleum	18.9	Electricity, gas and water	13.8
Electricity, gas and water	3.1	Other non-metallic mineral	0.7
Water transportation	2.8	Air transport	0.6
Inland transportation	2.6	Textile and textile products	0.5
Construction	0.9	Pulp, paper, printing and publication	0.4
Other non metallic mineral	0.9	Manufacturing	0.4

Thus, energy subsidy removal will cause the prices of several products and services to increase. This, in turn, is likely to drive the consumers to reduce their consumption so as to minimize their losses, or to switch to cheaper goods or those that whose production is less energy-intensive. Nevertheless, in the short term, it is assumed that the demand sensitivity is likely to be inelastic in most sectors. Compared with other sectors, most energy-related products such as fuel and electricity have lower price elasticity because even though their prices change, people will likely stick to them as there are not many alternative products that they can substitute for such products. Consequently, the price increase in the different economic sectors caused by energy subsidy removal can reduce the total final demand by around US$2.9 billion (0.82%), with the highest decline coming from the refined petroleum sector, followed by electricity. Figure 4-2 shows the decline in demand for all the sectors as a result of energy subsidy removal. If it is assumed that investment and net exports will not change in the short run, energy subsidy removal can result in a GDP decline of about 0.53% with respect to the 2009 level. This, however, is the price that will have to be paid to correct the market distortion that has been going on for decades and that has resulted in inefficient energy pricing and energy use.

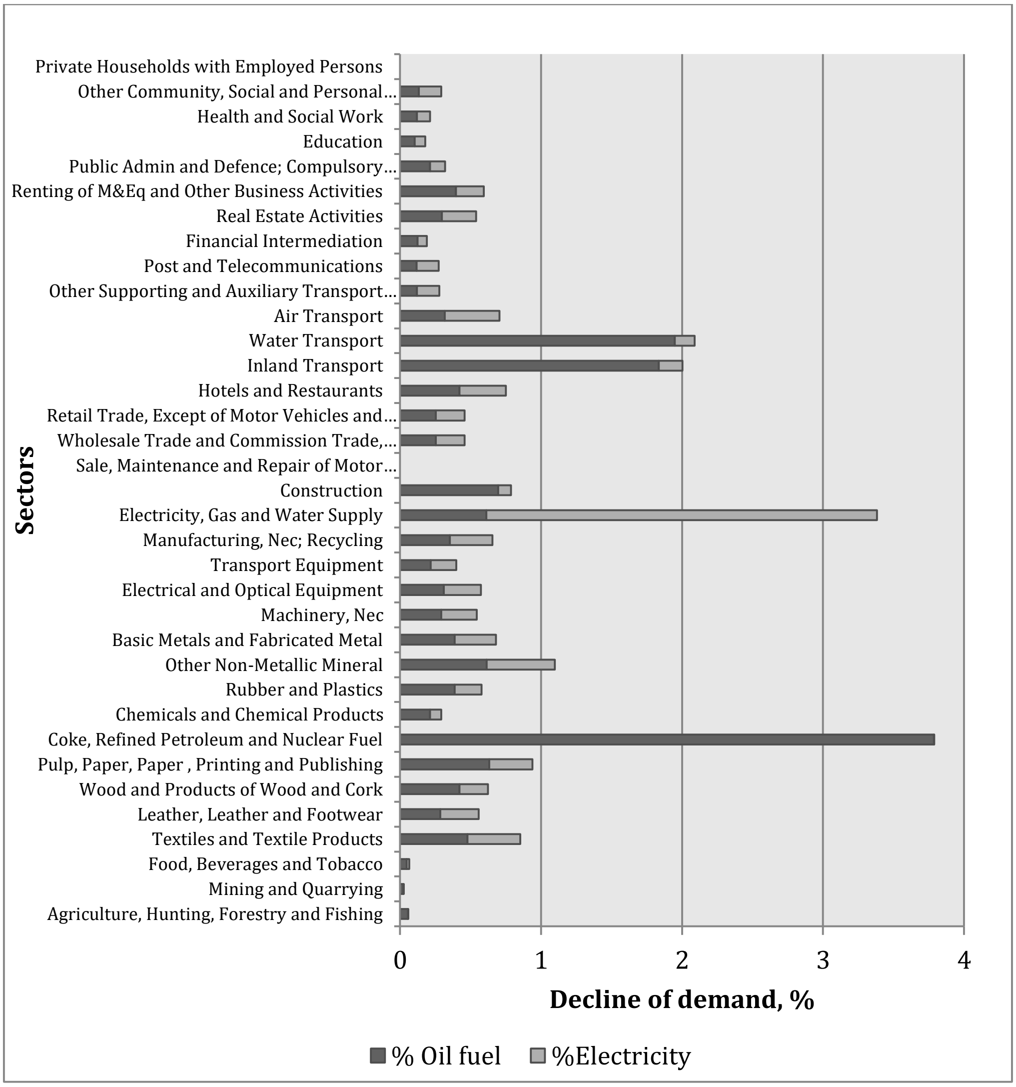

Figure 4-2. Decline in demand

Going further, a reduction in the final demand will lead to a decline in the output of the different economic sectors. Using the demand-driven IO model, the total output is estimated to decline by US$6 billion or 0.56% overall compared with the total output in 2009. Figure 4-3 illustrates the breakdown of the percentage decline in gross output for all sectors. The figure shows that the energy-intensive sectors such as the electricity, refining, and transportation sectors will be the most affected by energy subsidy removal in terms of output. This is on account of the big decrease in product demand mainly triggered by the high price increase in such sectors.

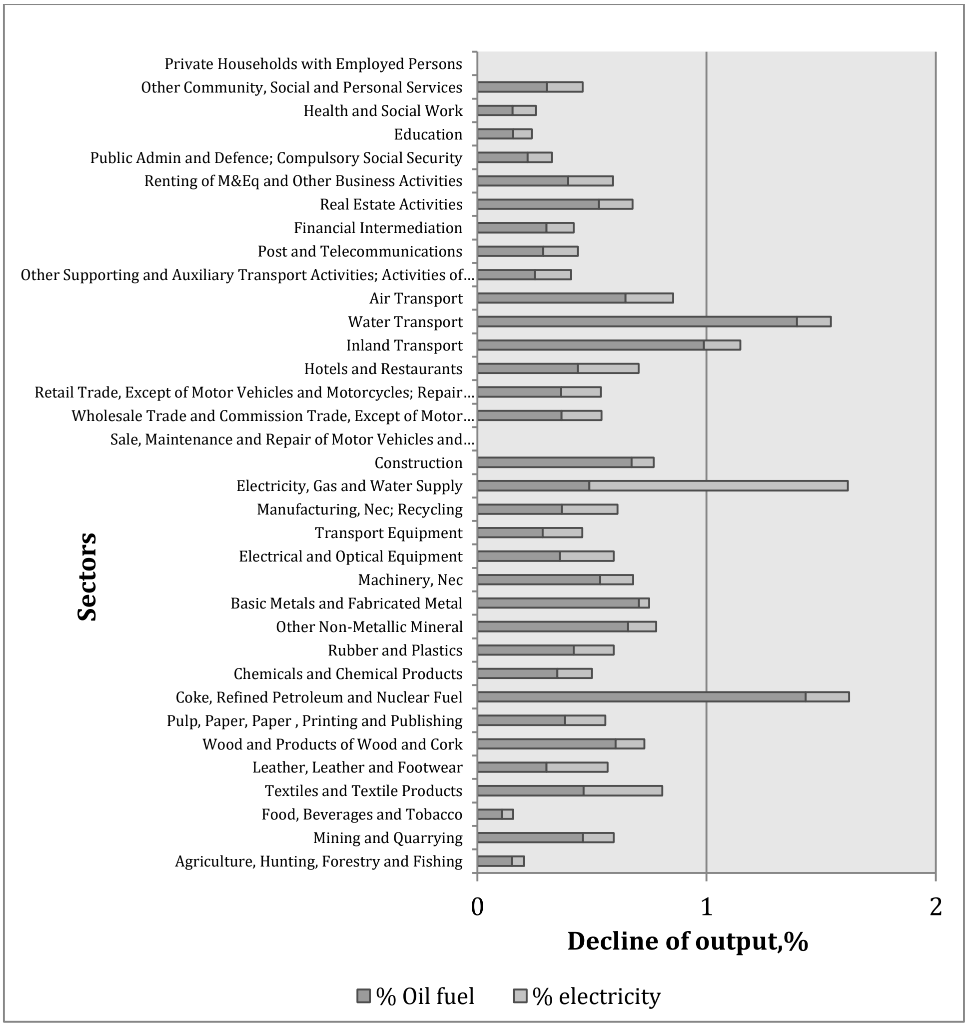

Figure 4-3. Decline in output

A decline in output will result in reduced production by producer companies. Companies may take several measures to minimize their losses, such as boosting their efficiency and reducing their labor to reduce their excess output. In short, employment will be negatively affected by such policy in the short run. Figure 4-4 shows the effect of output drop on employment. From the estimation, the biggest reduction in labor will be seen in the construction sector, followed by the agriculture sector. The magnitude of the effect on employment will be mainly determined by the labor intensity and the percentage of decline in output. Even if the drop in output is small, if the labor intensity is high, the impact will be great compared with other sectors. In 2009, labor force in the agriculture, hunting, forestry, and fishing sectors amounted to almost 81.3 million people or 43% of the country's total labor force. This situation is understandable because Indonesia is an agro-based developing country located along the equator. In comparison, a relatively-low-labor-intensity sector such as the oil refinery sector (with only 47,000 workers) will experience a lesser effect. It is estimated that the employment in such sector will be reduced by 849,000 jobs as a result of the removal of energy subsidy. The government should compensate for such effect of energy subsidy reform through job creation.

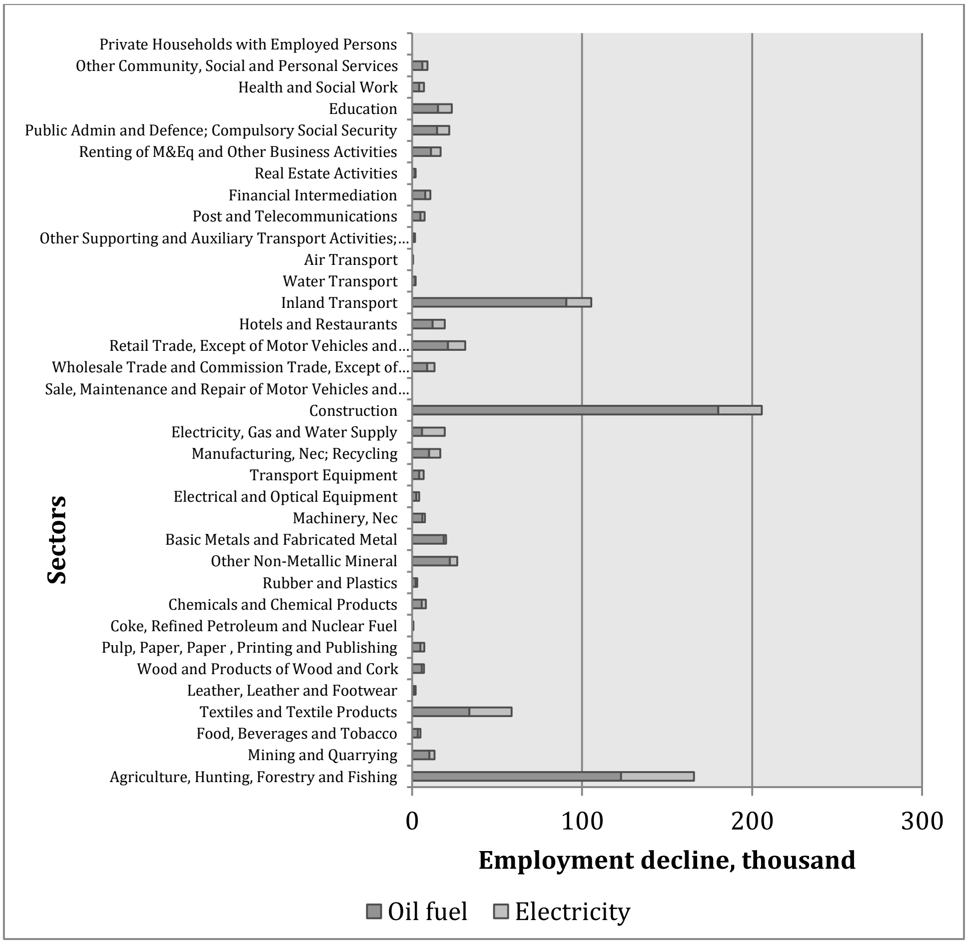

Figure 4-4. Decline in employment

4.3 Income Effects for Different Income Groups

Energy subsidy removal will also affect the households' purchasing power. The consumer price index was used to quantify the change in the standard goods and services required by households as a consequence of the price increases caused by energy subsidy removal. Consumer price index measurement could be suitable for use in estimating the welfare effects of energy subsidy reform. From the estimation results, it was found that removing the energy subsidies will reduce the households' real income and purchasing ability by about 10.1% for the urban higher-income group (category 8) and by 5.5 % for the urban lower-income group (category 1). Figure 4-5 illustrates the increases in CPI or in the percentage of additional income required by the rural and urban households to be able to purchase the same goods and services that they have been purchasing. The rural households will be comparatively less affected than the urban households.

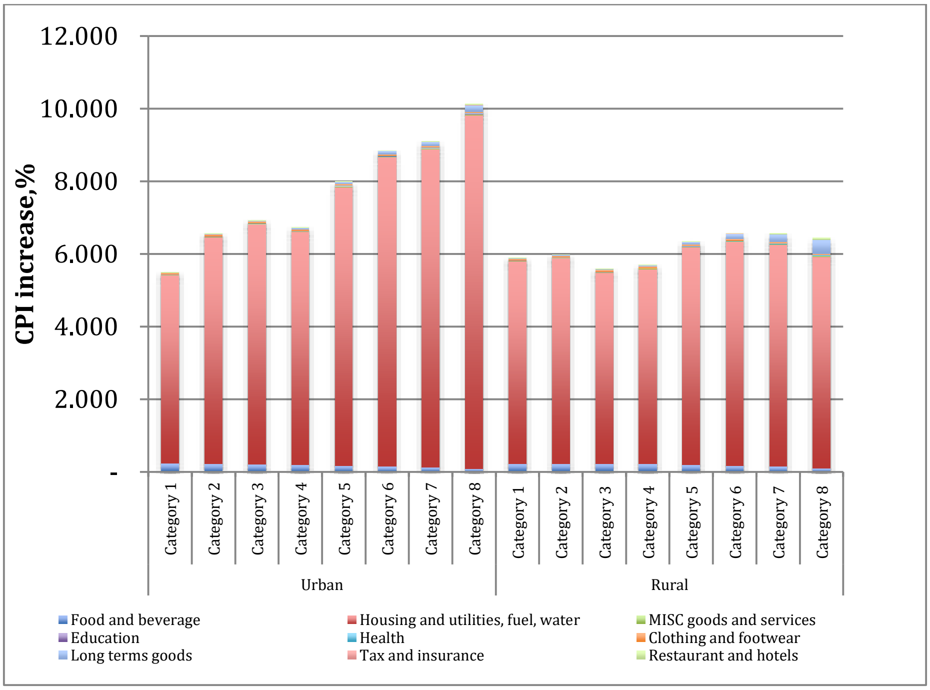

Figure 4-5. CPI increase in different household groups

The results also show that the housing utilities (electricity, gas, and water) and fuel are responsible for the increase in CPI. The increase in CPI to be caused by such expenditures constitutes almost 95% of the CPI in all the income groups in the urban areas. In such areas, the higher-income group spends more money on housing, utilities, and fuel compared with the lower-income group. In contrast, in the rural areas, the lower-income group spends more on housing, utilities, and fuel compared with the higher-income group. Food and beverages account for the second largest expenditure that plays a role in increasing the CPI.

Based on the CPI estimation result reflecting a 6.9% average CPI rise in the households from energy subsidy removal, the policymakers should also take into consideration the actual inflation rate (which reached 5% in 2009, according to the Bank of Indonesia) if energy subsidy removal will be implemented. Most of the relevant studies found that immediate energy subsidy removal would not be tolerable for the society considering the further effect of the existing inflation. Energy subsidy removal should be well planned, should be implemented in steps, and should be followed by proper social support programs.

It should be noted that in the aforementioned estimation, similar to the constant technical coefficient, the household consumption patterns were assumed to remain the same in response to increases in the relative prices of goods and services (Perman et al., 2003). This assumption is still applicable for a short period in this study.

4.4 Effects on Energy Consumption

A drop in output will lead to a reduction in energy consumption; the producers will reduce their energy consumption due to the decline in their production capacity. The estimation results show that energy subsidy removal will lead to a 92.4 Peta Joule (PJ) total reduction (1.2%) compared to the total energy consumption in 2009. The total energy consumption reduction will be largely on account of the oil fuel subsidy reduction (58.2 PJ) while a 34.2 PJ reduction will be on account of the electricity subsidy removal from all sectors. Figure 4-6 shows the energy reduction in all sectors as a result of energy subsidy removal. The electricity, gas, and water sector will see the highest total energy consumption reduction (almost 36 PJ) if the energy subsidy will be removed while the coke and refined petroleum sector can save 35 PJ overall. A higher impact will be felt by these sectors due to their relatively high energy requirements (energy-intensive) per unit of output, and also due to the decline in their total production. The impact on the potential energy consumption reduction of the electricity and oil refinery sectors will be an almost 77% total energy reduction.

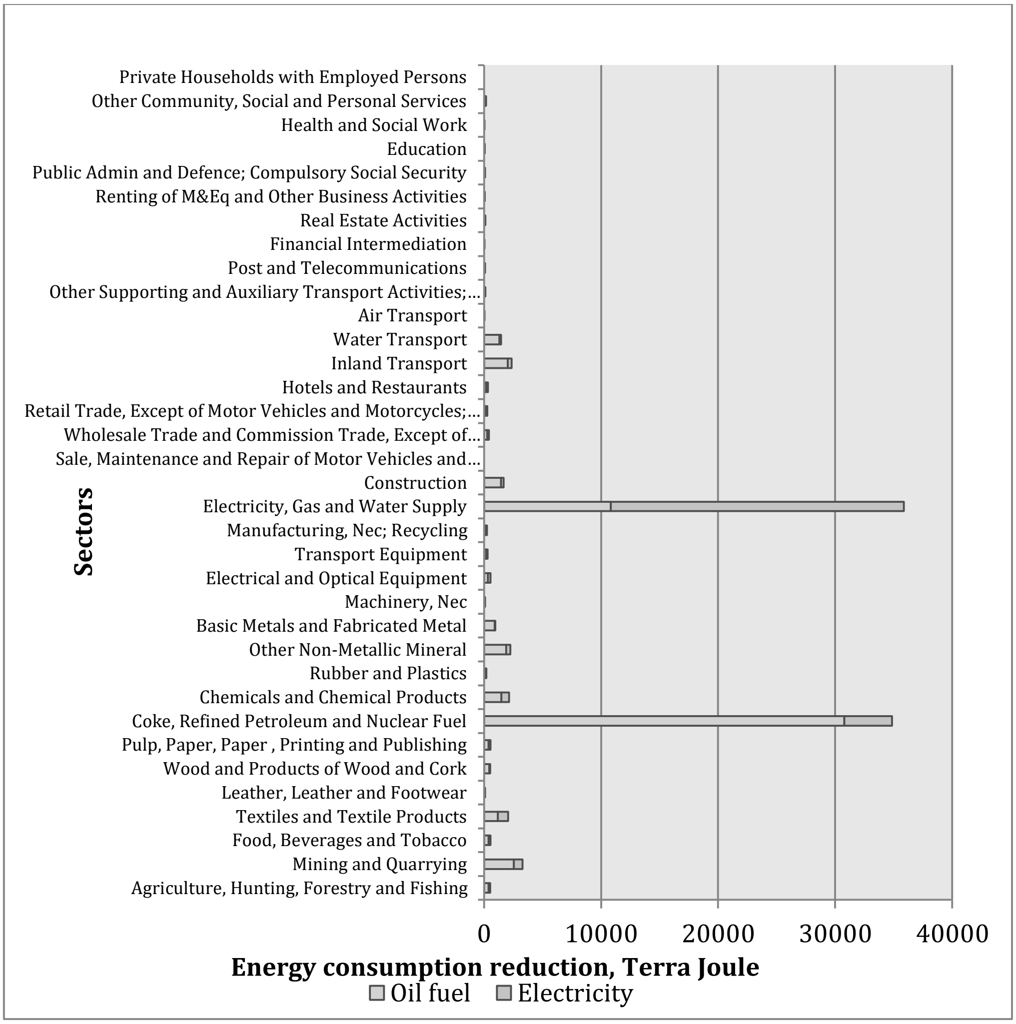

Figure 4-6. Decline in energy consumption

It should be noted that in the aforementioned estimation, the energy reduction is not from technological change but is from the demand-induced decline in total output. In the short term, technological changes such as efficiency improvement are not feasible. In the longer term, however, the price signals can induce energy efficiency improvements and the development of less-energy-intensive industries.

4.5 Effects on GHG Emissions

Due to the output drop owing to the decline in demand, it can be expected from the estimation that the emission will also be reduced. Energy subsidy removal will result in an emission reduction of about 3.3 million tons of CO_2 or a 1% reduction of the total CO_2 emission in 2009. Figure 4-7 illustrates each sector's share in the total CO_2 emission reduction. The most significant emission reduction will come from the electricity, gas, and water supply sector, with a 2.4 million ton CO_2 reduction. This CO_2 emission reduction is determined by the carbon emission coefficient factor as well as the decline in output. In Indonesia, electricity power is mostly generated from coal, which has a higher carbon emission coefficient than gas or renewable energy. In 2009, the electricity generated from coal was still dominant, reaching 43.14 TWh or 65% of the total electricity generated in 2009 (MEMR, 2010). Figure 4-8 shows the share of each fuel type in the electricity generation in Indonesia in 2009.

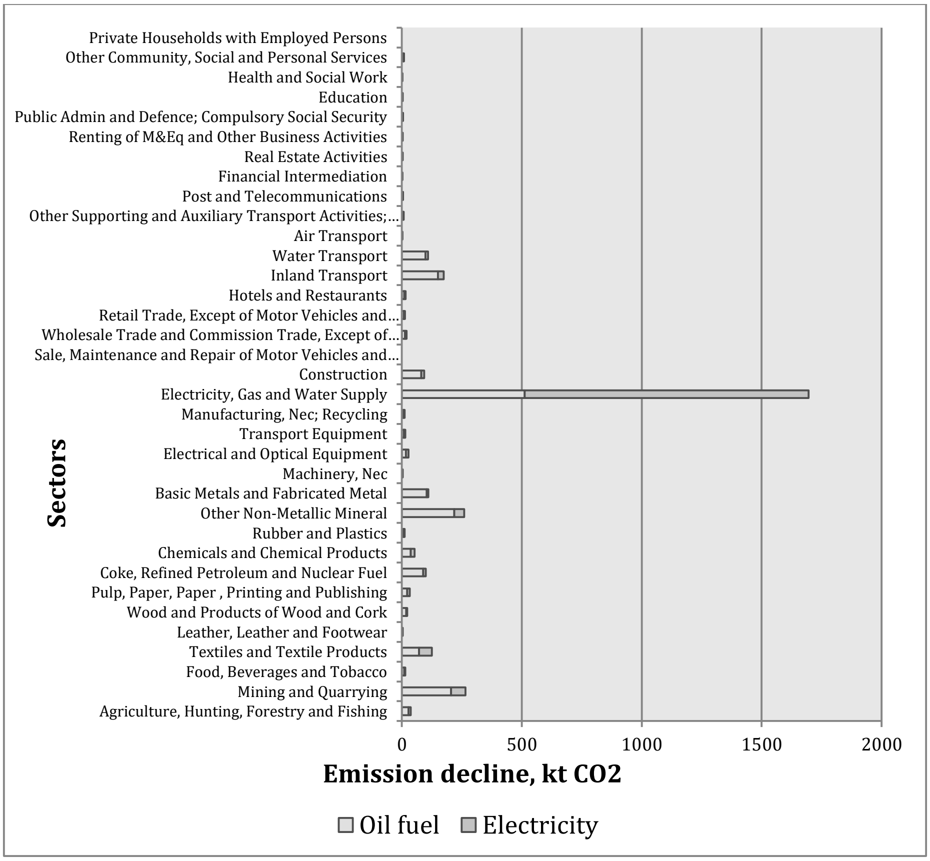

Figure 4-7. Decline in emission

It should be noted that in this estimation analysis, fuel substitution could not be applied in electricity generation. Thus, the high price of electricity for certain electricity generation sources such as gas, nuclear, and renewable energy can induce the utilization of cheaper electricity generation sources such as coal, which in the long term will result in greater CO_2 emissions. In the case of Indonesia, coal was not included by the government in the energy subsidy scheme; as such, if the electricity subsidy will be removed, as coal-fired electricity generation will still be cheaper than electricity generation using gas or renewable energy, the electricity producer will most likely still use coal as a power generation fuel, and in the longer term, this will increase the country's CO_2 emission. In this light, the energy subsidy removal should also consider the other fuels to prevent undesirable results. An additional policy may be needed to prevent substitution, such as a carbon tax charge.

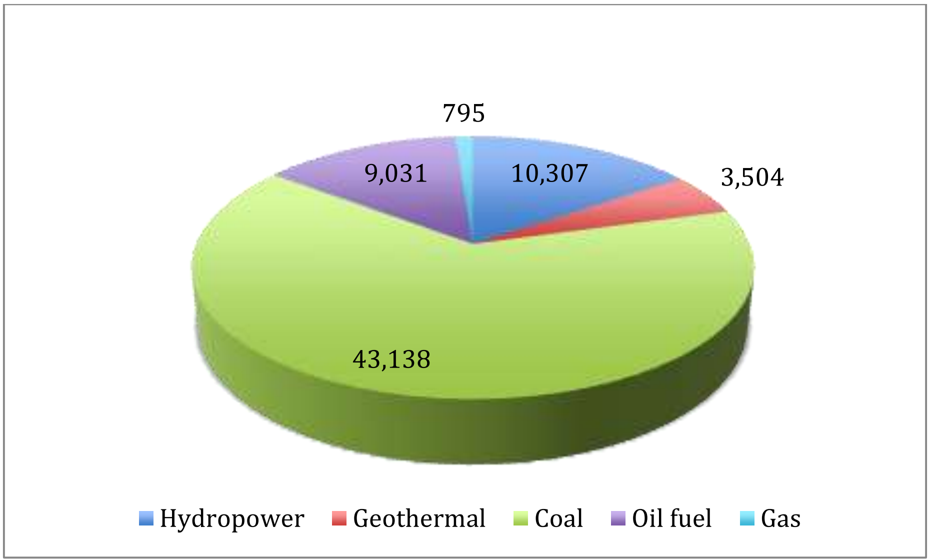

Figure 4-8. Share of electricity power generation by fuel type in 2009, GWh

(Source: Based on 2010 Handbook of Energy and Economic Statistics of Indonesia)

Chapter 5. Conclusion and Policy Recommendation

5.1 Conclusion

The objective of this study was to estimate the effects of energy subsidy removal on the different economic sectors' prices, which will then impact the country's socioeconomic, energy consumption, and carbon emission issues. To achieve this objective, this study adopted the input-output framework based on the demand-driven model to estimate the effects of energy pricing policy reform on the economic, energy, and environmental issues.

The key findings of this study can be summarized as follows:

- Energy subsidy removal will potentially result in a small decline (0.53%) in the GDP in the short term compared with Indonesia's energy subsidy, estimated at US$9.1 billion (1.6% of the total GDP) in 2009. This is the price that will have to be paid to correct the market distortion that has been going on for decades and that has resulted in inefficient energy pricing and energy use.
- Energy subsidy reform will have the largest impact on the energy-intensive industries in terms of generating a price increase, which in turn will potentially have a negative effect on employment due to the response of decreasing the output.

- Energy subsidy removal is likely to have a greater CPI increase impact on the urban higher-income group, which spends a larger share of their income on fuel and electricity use.
- Energy subsidy removal has the advantages of the potential reduction of the total energy consumption and of the CO_2 emission, which will drop by about 1.2 and 1%, respectively, and which can potentially trigger technological improvements in energy efficiency over the long term.

5.2 Policy Recommendation

Energy subsidy removal may induce an increase in CPI and may worsen the inflation, which will have a negative impact on the economy. Meanwhile, the absence of energy pricing reform agenda will burden the economy and will affect energy savings, carbon emission reduction, and the pursuit of sustainable development. Thus, the policymakers should carefully design a more appropriate pricing mechanism to minimize the negative impact of energy subsidy removal. Although the impact of energy subsidy removal is limited, gradual energy subsidy removal is more advisable and may start with the energy source that has a low consumption and whose removal is thus projected to wield a small impact (Jiang & Tan, 2013). The reform should be elaborately planned to mitigate its negative effects. Instant energy subsidy removal is herein considered a theoretical exercise to estimate the potential losses. Direct energy subsidy, which is mostly enjoyed by the higher-income group, can be mitigated by more targeted social policies, especially targeting the provision of support to the lower-income group. Some complementary measures should be implemented to alleviate the negative impact of energy subsidy removal, such as direct cash transfer to the poor and indirect transfer (including fee waivers) to help households maintain their access to essential services such as health, education, and transportation (Saboohi, 2001).

In addition, end-user subsidy reform in the electricity sectors is not sufficient to correct all price distortions. The government should manage the coal market to stimulate technological change towards a less-carbon-intensive industry (Ogarenko & Hubacek, 2013).

5.3 Limitations and Further Study

It is important to note that the limitations in this study need to be pointed out and the results obtained have to be carefully treated based on the data associated with this research and the limitations of the methods used.

- The input-output models contain some simplistic assumptions, which should be considered carefully while interpreting the results. The most important of these are the technical coefficients and the coefficients of physical factors; that is, the GHG emissions and energy inputs do not change as a result of energy-subsidy-induced price changes. The price elasticities of demand were incorporated in the study design to allow for the adjustment of the quantities of goods consumed to the price changes. Ho et al. (2008) argued that this approach could be intrinsically inconsistent because the response of the final consumers to higher prices is taken into account while the producers are not able to switch to less-energy-intensive inputs. Therefore, an assumption is made that all the additional costs on the part of the producers are passed on to the final consumers.

- The degree of accuracy of the obtained results depends on the quality of the data that were used in the model. National income accounts always have a “residual error,” which is the difference between the GDP estimates according to two of three possible conventions (Perman et al., 2003).
- Price changes will also affect investment decisions and labor inputs, which are not taken into account (Ho et al., 2008). Nevertheless, the assumptions of the approach are consistent with the short-term time framework that was adopted in the analysis.
- The subsidized rate of oil fuel is the weighted average of gasoline, diesel oil, LPG, and kerosene.

This hypothetical study estimated the effect of energy subsidy removal in terms of generating a price increase in other economic sectors as well as its possible impact on the socioeconomic and environmental issues in the country. While this study has given profound insights on these matters, further studies may elaborate the study results by considering the government plan to reallocate the energy subsidy budget so as to minimize the pay-off of energy subsidy removal (especially poverty) as well as to generate a more productive economy to achieve economic growth.

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Appendix

Appendix 1-a: National Input-Output Table for 2009 in current price (Industry by industry)

US$)		Agriculture, Hunting, Forestry and Fishing	Mining and Quarrying	Food, Beverages and Tobacco	Textiles and Textile Products	Leather, Leather and Footwear	Wood and Products of Wood and Cork	Pulp, Paper, Paper , Printing and Publishing	Coke, Refined Petroleum and Nuclear Fuel	Chemicals and Chemical Products	Rubber and Plastics	Other Non-Metallic Mineral	Basic Metals and Fabricated Metal	Machinery, Nec	Electrical and Optical Equipment	Transport Equipment	Manufacturin g, Nec; Recycling	Electricity, Gas and Water Supply	Construction	Sale, Maintenance and Repair of Motor Vehicles and Motorcycles; Retail Sale of Fuel	Wholesale Trade and Commission Trade, Except of Motor Vehicles and Motorcycles
		IDN	IDN	IDN	IDN	IDN	IDN	IDN	IDN	IDN	IDN	IDN	IDN	IDN	IDN	IDN	IDN	IDN	IDN	IDN	IDN
Agriculture, Hunting, Forestry and Fishing	IDN	6,689	8	39,463	759	8	2,315	257	0	714	12	12	0	0	21	8	755	0	3,656	0	2,980
Mining and Quarrying	IDN	0	8,347	116	45	0	11	48	7,229	13,044	641	2,112	2,968	4	15	12	19	2,955	11,522	0	1
Food, Beverages and Tobacco	IDN	4,753	0	16,435	95	356	70	48	0	297	0	0	0	0	7	0	7	0	0	0	4,242
Textiles and Textile Products	IDN	61	2	20	5,235	98	10	20	0	41	114	3	6	16	21	29	56	1	112	0	332
Leather, Leather and Footwear	IDN	0	8	0	129	500	1	1	0	3	13	1	2	3	24	20	13	1	1	0	3
Wood and Products of Wood and Cork	IDN	1	3	1	7	5	2,801	12	0	11	4	6	25	8	133	80	1,579	0	10,931	0	0
Pulp, Paper, Paper , Printing and Publishing	IDN	27	15	644	49	25	24	3,704	0	91	26	46	5	13	194	23	20	23	302	0	525
Coke, Refined Petroleum and Nuclear Fuel	IDN	271	145	227	229	11	161	226	55	143	98	178	83	5	94	74	38	1,274	3,607	0	270
Chemicals and Chemical Products	IDN	3,623	378	534	1,826	129	680	1,056	9	4,344	2,827	308	472	89	2,072	189	251	185	1,593	0	177
Rubber and Plastics	IDN	19	1	106	25	99	10	20	0	27	749	1	6	16	390	229	31	0	990	0	115
Other Non-Metallic Mineral	IDN	0	0	19	0	0	17	0	0	24	4	113	8	3	107	41	14	1	7,603	0	11
Basic Metals and Fabricated Metal	IDN	2	0	8	3	1	2	1	2	1	7	6	9	26	52	56	7	0	2,274	0	0
Machinery, Nec	IDN	33	85	13	26	2	26	12	1	11	10	9	3	477	84	17	5	10	430	0	1
Electrical and Optical Equipment	IDN	1	53	2	2	0	40	9	1	5	11	9	16	236	5,917	1,014	15	172	1,514	0	61
Transport Equipment	IDN	30	0	0	0	0	0	0	0	0	0	0	1	0	0	12,761	1	0	0	0	0
Manufacturing, Nec; Recycling	IDN	108	9	56	11	4	43	19	0	6	14	11	5	48	51	6	280	4	450	0	102
Electricity, Gas and Water Supply	IDN	58	40	314	685	53	234	333	3	217	129	431	207	48	433	327	169	2,400	85	0	881
Construction	IDN	1,211	798	49	70	20	16	6	4	61	44	69	30	21	86	58	2	208	284	0	1,056
Sale, Maintenance and Repair of Motor Vehicles and Motorcycles	IDN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wholesale Trade and Commission Trade, Except of Motor Vehicl	IDN	1,256	246	3,878	796	190	513	706	22	562	602	227	281	717	1,517	1,362	307	495	9,164	0	1,021
Retail Trade, Except of Motor Vehicles and Motorcycles; Repair o	IDN	848	166	2,618	537	128	346	477	15	379	406	153	190	484	1,024	919	207	334	6,188	0	690
Hotels and Restaurants	IDN	90	141	398	238	31	63	134	23	174	58	111	62	94	179	339	32	51	1,777	0	927
Inland Transport	IDN	628	304	1,497	471	88	629	483	10	311	267	203	140	257	1,000	523	213	150	2,787	0	1,114
Water Transport	IDN	22	38	56	14	2	19	9	1	15	8	8	6	8	31	20	6	7	137	0	123
Air Transport	IDN	40	11	148	51	8	104	28	1	27	28	22	17	22	109	44	20	12	197	0	48
Other Supporting and Auxiliary Transport Activities; Activities of T	IDN	2	11	24	10	3	2	11	0	25	6	10	4	3	26	11	7	2	125	0	116
Post and Telecommunications	IDN	915	137	1,306	330	54	376	329	22	260	196	126	77	63	261	386	163	139	1,719	0	1,492
Financial Intermediation	IDN	181	192	127	159	24	13	64	6	126	40	23	32	32	109	199	10	45	850	0	2,711
Real Estate Activities	IDN	394	396	598	234	36	223	111	17	194	85	109	120	48	1,581	700	193	418	8,723	0	1,485
Renting of M&Eq and Other Business Activities	IDN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Public Admin and Defence; Compulsory Social Security	IDN	0	0	4	3	1	0	35	0	12	1	9	0	4	3	2	1	3	0	0	0
Education	IDN	5	27	65	42	6	1	108	0	162	10	16	74	4	21	110	7	20	1,006	0	58
Health and Social Work	IDN	15	0	13	12	0	2	11	0	11	3	5	0	0	1	9	4	0	1	0	9
Other Community, Social and Personal Services	IDN	505	473	998	107	72	221	166	19	428	99	79	100	57	527	167	95	20	642	0	876
Private Households with Employed Persons	IDN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Agriculture, Hunting, Forestry and Fishing	Imports	296	0	2,372	50	1	7	4	0	44	1	0	0	0	1	0	11	0	11	0	172
Mining and Quarrying	Imports	6	1,257	13	8	0	3	10	1,459	2,227	131	124	188	9	18	23	9	393	382	0	3
Food, Beverages and Tobacco	Imports	477	2	1,496	19	36	10	10	0	47	12	1	2	1	11	2	2	1	13	0	379
Textiles and Textile Products	Imports	50	2	16	3,658	76	9	17	0	35	84	3	5	13	19	23	42	0	91	0	140
Leather, Leather and Footwear	Imports	1	2	0	49	129	0	1	0	1	4	0	1	1	7	6	4	0	2	0	2
Wood and Products of Wood and Cork	Imports	1	0	1	1	0	37	2	0	1	1	0	1	1	4	2	22	0	159	0	1
Pulp, Paper, Paper , Printing and Publishing	Imports	9	4	141	12	6	7	877	1	23	9	11	2	2	54	7	5	4	52	0	84
Coke, Refined Petroleum and Nuclear Fuel	Imports	167	80	123	133	7	89	128	30	110	73	94	47	4	65	40	22	661	1,885	0	142
Chemicals and Chemical Products	Imports	1,484	156	226	757	53	280	438	4	1,766	1,156	127	192	42	847	82	105	87	707	0	79
Rubber and Plastics	Imports	14	3	47	23	40	6	21	0	17	309	2	4	15	168	100	15	4	438	0	50
Other Non-Metallic Mineral	Imports	2	1	2	2	0	2	1	0	5	2	8	2	2	12	5	2	1	536	0	1
Basic Metals and Fabricated Metal	Imports	17	13	19	22	3	12	10	3	15	21	18	394	201	381	637	213	6	6,962	0	4
Machinery, Nec	Imports	132	327	51	102	8	104	49	5	44	42	35	14	1,846	393	93	26	40	1,740	0	7
Electrical and Optical Equipment	Imports	14	42	7	12	1	32	9	1	11	15	6	10	222	4,364	494	18	62	911	0	32
Transport Equipment	Imports	36	6	2	3	1	3	2	0	2	3	1	3	32	29	1,848	4	1	82	0	2
Manufacturing, Nec; Recycling	Imports	56	6	30	9	3	23	13	0	7	10	6	4	30	55	17	136	3	255	0	50
Electricity, Gas and Water Supply	Imports	1	10	2	1	0	1	1	10	16	1	1	1	4	4	2	1	4	16	0	2
Construction	Imports	1	1	1	1	0	1	0	0	1	0	0	0	4	5	2	0	0	19	0	1
Sale, Maintenance and Repair of Motor Vehicles and Motorcycles	Imports	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1	0	0	3	0	0
Wholesale Trade and Commission Trade, Except of Motor Vehicl	Imports	22	61	58	12	3	7	12	71	114	16	7	8	12	23	16	4	24	112	0	16
Retail Trade, Except of Motor Vehicles and Motorcycles; Repair o	Imports	7	2	14	4	1	2	5	0	4	3	1	1	5	8	4	1	2	32	0	5
Hotels and Restaurants	Imports	5	12	27	19	2	4	10	2	14	3	9	5	6	11	27	2	3	137	0	84
Inland Transport	Imports	64	92	152	47	9	64	49	78	143	33	25	18	26	99	55	21	34	281	0	114
Water Transport	Imports	21	35	52	13	2	17	19	1	14	8	7	6	8	28	18	6	7	126	0	115
Air Transport	Imports	18	5	67	23	4	47	13	0	12	13	10	8	10	48	20	9	5	88	0	22
Other Supporting and Auxiliary Transport Activities; Activities of T	Imports	3	7	17	7	2	4	7	0	15	4	6	3	2	17	8	4	2	76	0	66
Post and Telecommunications	Imports	22	3	31	8	1	9	8	0	6	5	3	2	2	12	9	4	3	43	0	37
Financial Intermediation	Imports	10	10	7	8	1	1	3	0	7	2	1	2	2	8	11	1	3	55	0	143
Real Estate Activities	Imports	74	75	113	44	7	42	21	3	36	16	20	22	9	297	132	36	79	1,640	0	280
Renting of M&Eq and Other Business Activities	Imports	3	1	8	1	0	1	2	0	3	1	0	1	2	3	2	0	0	16	0	7
Public Admin and Defence; Compulsory Social Security	Imports	5	4	10	2	1	2	9	0	6	1	3	1	1	7	3	1	1	17	0	9
Education	Imports	0	2	4	2	0	0	6	0	9	1	1	4	1	1	6	0	1	59	0	4
Health and Social Work	Imports	1	0	1	1	0	0	1	0	1	0	0	0	0	1	1	0	0	2	0	1
Other Community, Social and Personal Services	Imports	39	36	78	8	5	17	13	2	33	8	6	8	5	41	13	7	2	52	0	68
Private Households with Employed Persons	Imports	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total intermediate consumption	TOT	24,846	14,292	74,925	17,263	2,357	9,811	10,206	9,110	26,513	8,503	4,954	5,908	5,326	23,132	23,443	5,260	10,366	95,673	0	23,549
taxes less subsidies on products		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cif/ fob adjustments on exports		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Direct purchases abroad by residents		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Purchases on the domestic territory by non-residents		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Value added at basic prices		83,128	65,194	40,741	9,681	1,602	7,762	5,919	12,799	11,407	4,347	4,212	2,589	2,017	12,928	16,168	3,365	4,535	53,754	0	34,359
International Transport Margins		169	114	323	260	27	42	109	73	231	107	28	50	208	473	268	39	80	883	0	74
Output at basic prices		108,142	79,599	115,989	27,204	3,986	17,614	16,234	21,982	38,151	12,958	9,193	8,547	7,552	36,533	39,879	8,664	14,981	150,310	0	57,982

Appendix 1-b: National Input-Output Table for 2009 in current price (Industry by industry)

US$)		Retail Trade, Except of Motor Vehicles and Motorcycles; Repair of Household Goods	Hotels and Restaurants	Inland Transport	Water Transport	Air Transport	Other Supporting and Auxiliary Transport Activities; Activities of Travel Agencies	Post and Telecommunications	Financial Intermediation	Real Estate Activities	Renting of M&Eq and Other Business Activities	Public Admin and Defence; Compulsory Social Security	Education	Health and Social Work	Other Community, Social and Personal Services	Private Households with Employed Persons	Final consumption expenditure by households	Final consumption expenditure by non-profit organisations serving households (NPISH)	Final consumption expenditure by government	Gross fixed capital formation	Changes in inventories and valuables	Exports	Total output
		IDN	IDN	IDN	IDN	IDN	IDN	IDN	IDN	IDN	IDN	IDN	IDN	IDN	IDN	IDN	IDN	IDN	IDN	IDN	IDN	IDN	IDN
Agriculture, Hunting, Forestry and Fishing	IDN	2,000	2,248	12	0	0	0	0	0	29	1	139	3,145	299	251	0	40,798	0	0	211	-1,504	2,856	108,142
Mining and Quarrying	IDN	1	33	0	0	0	0	0	0	0	0	361	0	0	147	0	2	0	0	299	-731	30,397	79,599
Food, Beverages and Tobacco	IDN	2,847	4,001	210	33	5	0	18	38	21	0	0	2,372	594	578	0	64,199	0	0	0	-2,400	17,162	115,989
Textiles and Textile Products	IDN	223	115	42	3	12	1	4	9	58	22	78	48	24	179	0	11,777	0	0	33	-739	9,139	27,204
Leather, Leather and Footwear	IDN	2	2	6	1	0	2	0	6	0	16	32	0	0	66	0	1,540	0	0	0	-176	1,764	3,986
Wood and Products of Wood and Cork	IDN	0	0	0	0	0	0	0	0	0	0	35	0	0	25	0	0	0	0	0	-18	1,964	17,614
Pulp, Paper, Paper , Printing and Publishing	IDN	353	73	56	19	10	25	201	62	226	174	3,701	19	8	540	0	1,406	0	0	0	-208	3,811	16,234
Coke, Refined Petroleum and Nuclear Fuel	IDN	181	205	2,204	543	14	3	24	15	104	77	147	16	8	57	0	1,613	0	0	0	-294	9,875	21,982
Chemicals and Chemical Products	IDN	119	139	69	6	4	1	24	10	247	112	1,122	1,812	52	562	0	8,315	0	0	0	-706	5,524	38,151
Rubber and Plastics	IDN	77	2	170	43	8	0	27	4	19	8	22	25	3	903	0	2,807	0	0	14	-213	6,206	12,958
Other Non-Metallic Mineral	IDN	7	9	1	0	0	0	0	1	6	6	9	2	0	19	0	416	0	0	5	-114	862	9,193
Basic Metals and Fabricated Metal	IDN	0	1	0	0	0	0	13	0	9	0	3	0	0	19	0	3	0	0	20	-359	6,378	8,547
Machinery, Nec	IDN	1	2	7	0	1	0	4	1	191	10	1	0	0	48	0	155	0	0	989	-401	5,287	7,552
Electrical and Optical Equipment	IDN	41	20	269	17	19	25	62	5	48	58	180	72	3	681	0	15,002	0	0	2,968	-1,526	9,508	36,533
Transport Equipment	IDN	0	99	229	271	1	0	0	0	0	25	0	0	0	5,824	0	14,293	0	0	2,993	-44	3,395	39,879
Manufacturing, Nec; Recycling	IDN	68	32	11	1	3	1	12	8	25	63	518	6	5	107	0	2,866	0	0	868	-86	2,927	8,664
Electricity, Gas and Water Supply	IDN	592	525	151	37	125	57	170	50	359	137	293	95	38	592	0	4,715	0	0	0	0	0	14,981
Construction	IDN	709	632	165	9	516	106	240	1,737	251	907	1,019	124	31	380	0	0	0	0	139,391	0	0	150,310
Sale, Maintenance and Repair of Motor Vehicles and Motorcycles	IDN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wholesale Trade and Commission Trade, Except of Motor Vehicl	IDN	686	762	991	495	21	11	98	49	546	408	668	554	93	1,119	0	25,443	0	0	2,428	-873	623	57,982
Retail Trade, Except of Motor Vehicles and Motorcycles; Repair o	IDN	463	515	669	335	14	7	66	33	368	276	451	374	63	756	0	16,961	0	0	1,630	-586	418	38,923
Hotels and Restaurants	IDN	622	242	320	155	80	23	180	204	547	793	491	81	23	432	0	16,228	0	0	87	-31	2,182	27,580
Inland Transport	IDN	748	199	511	94	44	17	82	80	275	226	415	163	28	451	0	9,516	0	0	702	-253	2,187	26,559
Water Transport	IDN	83	21	55	117	13	4	30	23	211	121	47	9	3	28	0	4,119	0	0	33	-12	929	6,365
Air Transport	IDN	32	41	618	345	110	3	3	9	27	29	28	15	3	31	0	1,152	0	0	82	-30	686	4,121
Other Supporting and Auxiliary Transport Activities; Activities of Tr	IDN	78	30	56	9	30	38	59	19	68	11	23	17	1	59	0	1,700	0	0	0	0	1,208	3,804
Post and Telecommunications	IDN	1,001	97	204	61	19	51	5,055	552	570	248	520	58	45	310	0	8,053	0	0	0	0	362	25,557
Financial Intermediation	IDN	1,820	107	671	176	69	62	702	590	1,394	44	203	99	15	1,160	0	10,376	0	0	0	0	172	22,604
Real Estate Activities	IDN	997	517	806	333	271	181	825	662	975	215	523	350	40	1,191	0	165	0	0	259	0	1,589	25,565
Renting of M&Eq and Other Business Activities	IDN	0	5	1	1	0	0	17	13	23	0	4	2	0	5	0	179	0	11,955	0	0	426	12,635
Public Admin and Defence; Compulsory Social Security	IDN	0	94	7	6	3	4	94	29	147	26	719	37	16	43	0	981	0	31,177	0	0	450	33,912
Education	IDN	39	87	15	7	20	7	21	31	331	20	88	89	9	101	0	12,655	0	5,740	0	0	375	21,375
Health and Social Work	IDN	6	19	31	2	11	3	30	20	42	6	105	9	86	100	0	256	0	2,923	0	0	13	3,758
Other Community, Social and Personal Services	IDN	588	207	4,861	87	138	87	270	221	2,194	647	912	245	67	1,612	0	24,588	0	0	2,233	0	1,913	46,521
Private Households with Employed Persons	IDN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Agriculture, Hunting, Forestry and Fishing	Imports	116	134	1	0	0	0	0	0	0	0	10	193	19	14	0	834	0	0	0	0	0	0
Mining and Quarrying	Imports	2	2	18	5	0	0	0	0	3	1	17	2	0	9	0	24	0	0	11	0	0	0
Food, Beverages and Tobacco	Imports	255	380	21	3	1	0	2	4	4	1	6	238	58	59	0	2,533	0	0	3	0	0	0
Textiles and Textile Products	Imports	94	34	11	1	0	0	2	1	43	7	54	35	3	86	0	437	0	0	6	0	0	0
Leather, Leather and Footwear	Imports	1	1	2	0	0	0	0	2	0	4	9	0	0	18	0	232	0	0	1	0	0	0
Wood and Products of Wood and Cork	Imports	0	0	0	0	0	0	0	0	1	0	3	0	0	2	0	15	0	0	5	0	0	0
Pulp, Paper, Paper , Printing and Publishing	Imports	56	5	13	2	1	1	27	10	41	26	406	5	2	60	0	202	0	0	6	0	0	0
Coke, Refined Petroleum and Nuclear Fuel	Imports	95	108	1,144	282	7	2	13	8	56	41	87	22	5	35	0	860	0	0	1	0	0	0
Chemicals and Chemical Products	Imports	53	61	52	8	2	0	11	5	105	47	466	740	22	236	0	985	0	0	19	0	0	0
Rubber and Plastics	Imports	34	2	76	19	3	0	12	2	13	5	19	13	1	372	0	330	0	0	32	0	0	0
Other Non-Metallic Mineral	Imports	1	1	1	0	0	0	0	0	1	1	2	1	0	3	0	28	0	0	6	0	0	0
Basic Metals and Fabricated Metal	Imports	3	3	9	3	1	0	22	1	36	3	16	4	0	64	0	93	0	0	279	0	0	0
Machinery, Nec	Imports	5	9	33	3	6	2	15	6	745	42	20	4	0	204	0	749	0	0	3,868	0	0	0
Electrical and Optical Equipment	Imports	21	17	102	11	17	24	53	5	78	31	126	89	2	669	0	1,858	0	0	5,296	0	0	0
Transport Equipment	Imports	1	107	250	292	2	0	1	0	13	29	6	1	0	681	0	570	0	0	2,659	0	0	0
Manufacturing, Nec; Recycling	Imports	34	16	9	2	2	1	6	4	16	32	257	8	3	58	0	1,504	0	1	384	0	0	0
Electricity, Gas and Water Supply	Imports	1	1	8	1	0	0	1	1	4	1	2	1	0	3	0	12	0	0	10	0	0	0
Construction	Imports	1	1	2	0	0	0	1	1	4	0	1	1	0	2	0	11	0	0	11	0	0	0
Sale, Maintenance and Repair of Motor Vehicles and Motorcycles	Imports	0	0	1	0	0	0	1	1	1	0	0	0	0	1	0	10	0	0	1	0	0	0
Wholesale Trade and Commission Trade, Except of Motor Vehicl	Imports	11	13	14	6	0	0	4	3	12	5	11	11	2	16	0	125	0	0	15	0	0	0
Retail Trade, Except of Motor Vehicles and Motorcycles; Repair o	Imports	3	3	4	1	0	0	1	1	4	2	5	3	0	5	0	133	0	0	10	0	0	0
Hotels and Restaurants	Imports	56	21	26	13	7	2	17	19	50	73	44	6	2	37	0	307	0	0	0	0	0	0
Inland Transport	Imports	77	22	55	12	5	2	10	9	30	23	42	17	3	46	0	334	0	0	4	0	0	0
Water Transport	Imports	77	20	52	109	12	4	28	22	195	112	44	8	2	26	0	338	0	0	0	0	0	0
Air Transport	Imports	14	18	280	156	49	1	2	4	13	13	12	7	1	14	0	469	0	0	1	0	0	0
Other Supporting and Auxiliary Transport Activities; Activities of Tr	Imports	44	18	41	11	18	20	33	11	40	8	14	10	1	33	0	86	0	1	1	0	0	0
Post and Telecommunications	Imports	25	3	6	2	1	2	121	14	15	6	13	2	1	9	0	84	0	0	1	0	0	0
Financial Intermediation	Imports	96	7	36	10	4	3	40	33	77	3	12	6	1	62	0	127	0	0	0	0	0	0
Real Estate Activities	Imports	188	100	152	63	51	34	163	131	194	41	100	67	8	226	0	1,793	0	0	0	0	0	0
Renting of M&Eq and Other Business Activities	Imports	4	14	6	3	1	1	40	32	59	1	13	7	1	14	0	23	0	2	5	0	0	0
Public Admin and Defence; Compulsory Social Security	Imports	6	22	37	2	2	2	23	9	47	10	155	10	4	22	0	58	0	212	1	0	0	0
Education	Imports	2	5	1	0	1	0	1	2	20	1	6	5	1	6	0	58	0	26	1	0	0	0
Health and Social Work	Imports	1	1	2	0	1	0	2	1	2	0	6	1	4	5	0	5	0	32	0	0	0	0
Other Community, Social and Personal Services	Imports	46	16	376	7	11	7	21	17	169	50	71	19	5	124	0	424	0	0	3	0	0	0
Private Households with Employed Persons	Imports	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total intermediate consumption	TOT	15,808	12,247	16,258	4,236	1,769	832	9,004	4,840	11,401	5,305	14,910	11,377	1,709	21,597	0	317,930	0	52,069	167,891	-11,302	0	0
taxes less subsidies on products		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cif/ fob adjustments on exports		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Direct purchases abroad by residents		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Purchases on the domestic territory by non-residents		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Value added at basic prices		23,065	15,277	10,184	2,088	2,349	2,970	16,542	17,761	14,069	7,311	18,900	9,915	2,042	24,722	0	0	0	0	0	0	0	0
International Transport Margins		50	56	117	40	3	2	11	3	94	19	103	84	7	202	0	811	0	0	1,064	0	0	0
Output at basic prices		38,923	27,580	26,559	6,365	4,121	3,804	25,557	22,604	25,565	12,635	33,912	21,375	3,758	46,521	0	0	0	0	0	0	0	0

Appendix 2: Change in Relative Price

Sector	Increase in Relative Price (%)		
	Oil fuel	Electricity	Total
Agriculture, Hunting, Forestry and Fishing	0.159	0.010	0.168
Mining and Quarrying	0.107	0.027	0.134
Food, Beverages and Tobacco	0.240	0.086	0.326
Textiles and Textile Products	0.683	0.534	1.218
Leather, Leather and Footwear	0.409	0.388	0.797
Wood and Products of Wood and Cork	0.601	0.290	0.890
Pulp, Paper, Paper , Printing and Publishing	0.903	0.439	1.342
Coke, Refined Petroleum and Nuclear Fuel	18.928	0.001	18.930
Chemicals and Chemical Products	0.304	0.113	0.416
Rubber and Plastics	0.552	0.273	0.825
Other Non-Metallic Mineral	0.879	0.689	1.568
Basic Metals and Fabricated Metal	0.555	0.417	0.972
Machinery, Nec	0.418	0.358	0.776
Electrical and Optical Equipment	0.444	0.375	0.819
Transport Equipment	0.312	0.258	0.570
Manufacturing, Nec; Recycling	0.504	0.431	0.935
Electricity, Gas and Water Supply	3.064	13.846	16.910
Construction	0.996	0.129	1.125
Sale, Maintenance and Repair of Motor Vehicles and Motorcycles; Retail Sale of Fuel	-	-	-
Wholesale Trade and Commission Trade, Except of Motor Vehicles and Motorcycles	0.361	0.293	0.654
Retail Trade, Except of Motor Vehicles and Motorcycles; Repair of Household Goods	0.361	0.293	0.654
Hotels and Restaurants	0.423	0.328	0.751
Inland Transport	2.620	0.243	2.863
Water Transport	2.784	0.202	2.986
Air Transport	0.452	0.556	1.008
Other Supporting and Auxiliary Transport Activities; Activities of Travel Agencies	0.172	0.226	0.398
Post and Telecommunications	0.147	0.197	0.344
Financial Intermediation	0.155	0.083	0.238
Real Estate Activities	0.371	0.304	0.675
Renting of M&Eq and Other Business Activities	0.495	0.247	0.742
Public Admin and Defence; Compulsory Social Security	0.426	0.211	0.638
Education	0.209	0.147	0.356
Health and Social Work	0.238	0.186	0.425
Other Community, Social and Personal Services	0.267	0.319	0.586
Private Households with Employed Persons	-	-	-

Appendix 3: Decline in Demand

Sector	Decline in demand (million US$)	
	Oil fuel	Electricity
Agriculture, Hunting, Forestry and Fishing	21.633	1.302
Mining and Quarrying	5.061	-1.268
Food, Beverages and Tobacco	36.211	13.017
Textiles and Textile Products	74.420	58.178
Leather, Leather and Footwear	8.246	7.827
Wood and Products of Wood and Cork	7.172	3.455
Pulp, Paper, Paper , Printing and Publishing	19.275	9.371
Coke, Refined Petroleum and Nuclear Fuel	203.980	0.016
Chemicals and Chemical Products	5.823	2.160
Rubber and Plastics	26.937	13.302
Other Non-Metallic Mineral	3.502	2.747
Basic Metals and Fabricated Metal	-11.953	-8.984
Machinery, Nec	-0.358	-0.306
Electrical and Optical Equipment	57.278	48.425
Transport Equipment	37.539	31.046
Manufacturing, Nec; Recycling	19.118	16.320
Electricity, Gas and Water Supply	28.268	127.733
Construction	971.418	126.064
Sale, Maintenance and Repair of Motor Vehicles and Motorcycles; Retail Sale of Fuel	0.000	0.000
Wholesale Trade and Commission Trade, Except of Motor Vehicles and Motorcycles	68.067	55.216
Retail Trade, Except of Motor Vehicles and Motorcycles; Repair of Household Goods	46.250	37.518
Hotels and Restaurants	74.846	58.142
Inland Transport	190.639	17.657
Water Transport	75.381	5.477
Air Transport	2.812	3.452
Other Supporting and Auxiliary Transport Activities; Activities of Travel Agencies	2.841	3.733
Post and Telecommunications	9.407	12.569
Financial Intermediation	12.279	6.573
Real Estate Activities	-7.267	-5.956
Renting of M&Eq and Other Business Activities	48.720	24.340
Public Admin and Defence; Compulsory Social Security	68.582	33.994
Education	19.421	13.687
Health and Social Work	3.760	2.943
Other Community, Social and Personal Services	36.561	43.619
Private Households with Employed Persons	0.000	0.000

Appendix 4: Decline in Total Output

Sector	Decline in Total Output (US$ million)	
	Oil fuel	**Electricity**
Agriculture, Hunting, Forestry and Fishing	163.355	57.299
Mining and Quarrying	366.531	107.101
Food, Beverages and Tobacco	125.022	56.223
Textiles and Textile Products	126.259	93.174
Leather, Leather and Footwear	12.033	10.612
Wood and Products of Wood and Cork	106.194	22.224
Pulp, Paper, Paper , Printing and Publishing	62.121	28.637
Coke, Refined Petroleum and Nuclear Fuel	314.749	41.649
Chemicals and Chemical Products	133.301	57.221
Rubber and Plastics	54.452	22.579
Other Non-Metallic Mineral	60.394	11.368
Basic Metals and Fabricated Metal	60.260	3.801
Machinery, Nec	40.541	10.756
Electrical and Optical Equipment	131.828	85.479
Transport Equipment	113.931	69.000
Manufacturing, Nec; Recycling	32.009	20.958
Electricity, Gas and Water Supply	73.208	168.990
Construction	1011.471	144.099
Sale, Maintenance and Repair of Motor Vehicles and Motorcycles; Retail Sale of Fuel	0.000	0.000
Wholesale Trade and Commission Trade, Except of Motor Vehicles and Motorcycles	213.073	101.007
Retail Trade, Except of Motor Vehicles and Motorcycles; Repair of Household Goods	142.217	67.809
Hotels and Restaurants	120.796	73.469
Inland Transport	262.363	42.461
Water Transport	88.784	9.358
Air Transport	26.647	8.562
Other Supporting and Auxiliary Transport Activities; Activities of Travel Agencies	9.590	6.003
Post and Telecommunications	73.381	38.684
Financial Intermediation	68.121	26.850
Real Estate Activities	135.707	37.506
Renting of M&Eq and Other Business Activities	50.034	24.811
Public Admin and Defence; Compulsory Social Security	74.219	36.382
Education	33.350	17.500
Health and Social Work	5.796	3.791
Other Community, Social and Personal Services	141.309	72.193
Private Households with Employed Persons	0.000	0.000

Appendix 5: Decline in Energy Consumption

Sector	Decline in Energy Consumption (Terra Joule)	
	Oil fuel	**Electricity**
Agriculture, Hunting, Forestry and Fishing	386.290	135.496
Mining and Quarrying	2552.405	745.815
Food, Beverages and Tobacco	391.918	176.246
Textiles and Textile Products	1178.664	869.801
Leather, Leather and Footwear	43.275	38.166
Wood and Products of Wood and Cork	436.795	91.413
Pulp, Paper, Paper , Printing and Publishing	390.819	180.161
Coke, Refined Petroleum and Nuclear Fuel	30785.260	4073.693
Chemicals and Chemical Products	1492.862	640.834
Rubber and Plastics	151.326	62.750
Other Non-Metallic Mineral	1894.030	356.515
Basic Metals and Fabricated Metal	916.356	57.800
Machinery, Nec	56.562	15.006
Electrical and Optical Equipment	346.305	224.548
Transport Equipment	196.998	119.308
Manufacturing, Nec; Recycling	156.389	102.398
Electricity, Gas and Water Supply	10842.037	25027.229
Construction	1461.316	208.186
Sale, Maintenance and Repair of Motor Vehicles and Motorcycles; Retail Sale of Fuel	0.000	0.000
Wholesale Trade and Commission Trade, Except of Motor Vehicles and Motorcycles	279.975	132.722
Retail Trade, Except of Motor Vehicles and Motorcycles; Repair of Household Goods	186.871	89.100
Hotels and Restaurants	216.071	131.416
Inland Transport	2028.540	328.298
Water Transport	1315.789	138.680
Air Transport	19.372	6.224
Other Supporting and Auxiliary Transport Activities; Activities of Travel Agencies	69.381	43.433
Post and Telecommunications	58.782	30.988
Financial Intermediation	14.425	5.686
Real Estate Activities	95.265	26.329
Renting of M&Eq and Other Business Activities	40.831	20.248
Public Admin and Defence; Compulsory Social Security	59.189	29.014
Education	34.505	18.105
Health and Social Work	8.588	5.617
Other Community, Social and Personal Services	121.291	61.966
Private Households with Employed Persons	0.000	0.000

Appendix 6: Decline in CO_2 Emission

Sector	Decline in CO_2 Emission (Kilo ton CO_2)	
	Oil fuel	Electricity
Agriculture, Hunting, Forestry and Fishing	27.805	9.753
Mining and Quarrying	205.560	60.065
Food, Beverages and Tobacco	10.023	4.507
Textiles and Textile Products	71.905	53.062
Leather, Leather and Footwear	2.245	1.980
Wood and Products of Wood and Cork	17.939	3.754
Pulp, Paper, Paper , Printing and Publishing	22.812	10.516
Coke, Refined Petroleum and Nuclear Fuel	88.441	11.703
Chemicals and Chemical Products	36.683	15.747
Rubber and Plastics	8.096	3.357
Other Non-Metallic Mineral	218.285	41.088
Basic Metals and Fabricated Metal	104.245	6.575
Machinery, Nec	2.771	0.735
Electrical and Optical Equipment	16.689	10.822
Transport Equipment	9.101	5.512
Manufacturing, Nec; Recycling	6.768	4.431
Electricity, Gas and Water Supply	512.427	1182.862
Construction	81.664	11.634
Sale, Maintenance and Repair of Motor Vehicles and Motorcycles; Retail Sale of Fuel	0.000	0.000
Wholesale Trade and Commission Trade, Except of Motor Vehicles and Motorcycles	12.944	6.136
Retail Trade, Except of Motor Vehicles and Motorcycles; Repair of Household Goods	8.674	4.136
Hotels and Restaurants	9.988	6.075
Inland Transport	150.102	24.292
Water Transport	98.125	10.342
Air Transport	1.389	0.446
Other Supporting and Auxiliary Transport Activities; Activities of Travel Agencies	4.817	3.016
Post and Telecommunications	3.248	1.712
Financial Intermediation	0.735	0.290
Real Estate Activities	2.832	0.783
Renting of M&Eq and Other Business Activities	1.849	0.917
Public Admin and Defence; Compulsory Social Security	3.095	1.517
Education	1.985	1.042
Health and Social Work	0.587	0.384
Other Community, Social and Personal Services	5.857	2.992
Private Households with Employed Persons	0.000	0.000

Appendix 6: Decline in Employment

Sector	Decline in Employment (thousand person)	
	Oil fuel	Electricity
Agriculture, Hunting, Forestry and Fishing	122.803	43.075
Mining and Quarrying	10.259	2.998
Food, Beverages and Tobacco	3.366	1.514
Textiles and Textile Products	33.700	24.869
Leather, Leather and Footwear	1.099	0.969
Wood and Products of Wood and Cork	5.734	1.200
Pulp, Paper, Paper , Printing and Publishing	4.974	2.293
Coke, Refined Petroleum and Nuclear Fuel	0.673	0.089
Chemicals and Chemical Products	5.709	2.451
Rubber and Plastics	2.105	0.873
Other Non-Metallic Mineral	22.329	4.203
Basic Metals and Fabricated Metal	18.754	1.183
Machinery, Nec	6.007	1.594
Electrical and Optical Equipment	2.526	1.638
Transport Equipment	4.205	2.547
Manufacturing, Nec; Recycling	10.015	6.558
Electricity, Gas and Water Supply	5.801	13.390
Construction	180.000	25.644
Sale, Maintenance and Repair of Motor Vehicles and Motorcycles; Retail Sale of Fuel	0.000	0.000
Wholesale Trade and Commission Trade, Except of Motor Vehicles and Motorcycles	8.967	4.251
Retail Trade, Except of Motor Vehicles and Motorcycles; Repair of Household Goods	21.155	10.087
Hotels and Restaurants	11.996	7.296
Inland Transport	90.783	14.692
Water Transport	1.967	0.207
Air Transport	0.382	0.123
Other Supporting and Auxiliary Transport Activities; Activities of Travel Agencies	1.046	0.655
Post and Telecommunications	4.844	2.553
Financial Intermediation	7.757	3.057
Real Estate Activities	1.662	0.459
Renting of M&Eq and Other Business Activities	11.211	5.559
Public Admin and Defence; Compulsory Social Security	14.652	7.183
Education	15.315	8.036
Health and Social Work	4.181	2.734
Other Community, Social and Personal Services	6.005	3.068
Private Households with Employed Persons	0.000	0.000

Appendix 7: Increase in CPI

	Urban								Rural							
	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Group 7	Group 8	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Group 7	Group 8
Food and beverage	0.235	0.213	0.205	0.203	0.174	0.150	0.131	0.089	0.227	0.220	0.225	0.217	0.193	0.170	0.149	0.098
Housing and utilities, fuel, electricity, water	5.182	6.250	6.610	6.409	7.671	8.510	8.752	9.733	5.575	5.660	5.265	5.369	5.991	6.161	6.102	5.832
MISC goods and services	0.009	0.011	0.013	0.014	0.018	0.021	0.023	0.027	0.009	0.010	0.011	0.012	0.015	0.017	0.017	0.020
Education	0.010	0.011	0.011	0.009	0.012	0.014	0.017	0.018	0.010	0.010	0.008	0.008	0.008	0.008	0.008	0.006
Health	0.006	0.009	0.009	0.009	0.011	0.013	0.015	0.019	0.007	0.007	0.007	0.008	0.010	0.013	0.014	0.015
Clothing and footwear	0.037	0.048	0.046	0.040	0.040	0.040	0.039	0.037	0.043	0.047	0.043	0.043	0.045	0.043	0.041	0.033
Long terms goods	0.006	0.014	0.019	0.035	0.059	0.087	0.112	0.178	0.014	0.018	0.022	0.034	0.070	0.145	0.214	0.386
Tax and insurance	0.000	0.001	0.001	0.002	0.002	0.003	0.004	0.007	0.001	0.001	0.001	0.001	0.002	0.003	0.003	0.004
Restaurant and hotels	0.004	0.003	0.003	0.006	0.006	0.007	0.012	0.024	0.002	0.004	0.004	0.005	0.008	0.013	0.024	0.057
Total	5.489	6.561	6.918	6.727	7.993	8.845	9.103	10.13	5.888	5.978	5.587	5.698	6.344	6.572	6.572	6.451