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Abstract

Escalating oil prices and the need to control carbon emissions sound the alarm for Indonesia to reduce or be more efficient in its energy use. To create an incentive for society to be more energy efficient, they need to understand the full consequences of adopting more efficient energy use strategies toward their incomes. This paper aims to analyse the impact on the economy of energy policies aiming to reduce and to improve the efficiency of energy use, particularly on the income of various household groups. This paper will, first, construct a Social Accounting Matrix for Indonesia with detailed energy sectors and, second, utilise various multiplier analyses to observe and understand the impact of these energy policies.

Keywords: Energy economics, government policy, technological change, social accounting matrix

JEL Categories: Q43, Q48, E64, O21

1. Introduction

Oil has played an important role as Indonesia's main energy source. In the last 10 years, approximately 65.5 percent of Indonesia's total energy consumption has come from crude oil (Center of Data and Information – Ministry of Energy and Mineral Resources, 2005). Furthermore, crude oil has long been an important source of government revenue. Nowadays, however, more and more people are questioning whether Indonesia can continue to depend on oil as its main source of energy and as one of its main sources of revenue. Figure 1 shows that Indonesian oil production has been declining in the last several years, domestic demand for oil has increased significantly in spite of the increase in price. That Indonesia depends too much on oil is one of the energy related concerns.

The second energy related concern is the government energy subsidy. The government has always controlled the price of domestic oil products —fuel oils— such as gasoline, automotive diesel oil and kerosene, so as to be lower than the world price, by providing a subsidy to Pertamina, the only oil processor and distributor of fuel oils in the country. The government also controls the price of electricity at a lower than production cost by subsidising the national electricity company.

In recent years, the increasing demand for fuel oils has forced Indonesia to increase the amount of crude oil imported, while the world price of crude oil has increased. Demand for electricity has also increased. Hence, overall, the government spends a significant amount of its budget on energy subsidies (Table 1).

The third concern is energy intensity, which has not improved. Energy Information Administration (EIA) reported that, in the last two decades, energy intensity in several East Asian countries, particularly China, has improved significantly, and developed countries around the world have been able to keep their level low, while Indonesia's has worsened at a rate of 1.94 percent annually[1]. This situation indicates, though not precisely, that there has been an increasing trend towards inefficiency in primary energy use in Indonesia. Hence, there has been growing pressure on Indonesia to improve its efficiency in using primary energy.

The fourth concern is negative externalities to the environment, both at local and global levels. At the local level, environmental problems related to energy use are generally human health problems caused by emissions from vehicles and industrial activities. At the global level, the main concerns are global climate change and global warming due to increasing emissions of greenhouse gases. The energy sector, through its production and exploitation activities, is considered to be the main contributor of greenhouse gases. EIA reported that the CO_2 emission intensity of Indonesia has been worsening at a rate of 4.1% annually during the 1990s and early 2000s.

With the above mentioned problems in mind, the Indonesian government must develop various programs to promote better and more efficient use of energy. Eliminating the fuel oil subsidy; i.e. increasing the price of fuel oil, is the most common measure suggested as a way to encourage households and industries to be more efficient in using energy (or to save energy). Instead, the Indonesian government seems to be more in favour of restricting energy use by, for example, requiring all hotels, restaurants, night clubs and other business activities to close down by 1am. The main argument is that, first, reducing the subsidy is expected to affect the poor more than the rich (Iksan et al., 2005;

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[1] http://www.eia.doe.gov

Sugema et al., 2005; World Bank, 2006). Second, innovations improving the efficiency of energy use might end up using more energy (Khazzoom, 1980; Lovins, 1988; Brookes, 1990; Binswanger, 2001). This phenomenon, commonly known as the rebound effect, occurs since the money saved by using less energy will eventually be used to buy other goods and services (which in turn need energy to be produced). Furthermore, lower use of energy pulls the energy price down. A lower energy price results in higher income, which is followed by a rise in demand for goods and services. Producers anticipate the rise in demand by raising their level of production (which results in higher use of energy).

On the other hand, limiting the operating time of hotels, restaurants, night clubs, street lights etc. will most likely not affect the poor and will avoid the rebound effect phenomenon. This paper aims to contribute to these debates between the need to improve energy efficiency and to limit its use. This paper develops a simple economy-wide model to analyse the impact of an improvement in efficiency of energy use, the cutting of the fuel oil subsidy, and the restrictions of energy use for households and industries on the Indonesian economy, particularly on the income of various household groups. Whether or not a rebound effect phenomenon is happening will also be observed. This paper is expected to be useful as a comparative study for other developing countries which intend to control their energy use.

2. Literature Reviews

There are many previous empirical studies on the economy-wide impact of energy policy on the economy. Generally, these empirical studies can be classified into five main categories: (i) decomposition approach, (ii) linear programming, (iii) Input-Output (I-O) Model, (iv) macroeconomic model, and

(v) general equilibrium model.

The decomposition technique decomposes sectoral output production into various inputs, energy and technology, then analyses the contribution of energy efficiency on the output changes. Examples of works in this category include those by Newell et al. (1999) and by Koop (2001). The linear programming approach typically minimises the cost of producing outputs to meet certain levels of demand under a certain energy policy regime (Pacudan and Guzman, 2002).

The I-O model implements an I-O multiplier matrix to predict the direct and indirect impacts of improvement in efficiency of energy use on the industrial outputs, and then uses the output changes to predict the impact on macroeconomic indicators and demographic variables. Examples of works in this category are those by Ghebremedhin and Schreiner (1983) and Yanai and Hewings (2004). Meanwhile, the macroeconomic model is a set of macroeconomic equations representing an economy that are used to predict the impact of abolishing economic distortion, such as tax, to induce a more efficient use of energy (Khanna and Zilberman, 2001).

Works in the four categories mentioned above typically are not able to determine the impact of an energy policy on household incomes, particularly poor households. A general equilibrium model with multi household groups, such as those of Iksan et al. (2005), Sugema et al. (2005), Clements et al. (2007), does. However, most of these general equilibrium models did not conduct a simulation of energy efficiency improvement. Most of them simulate the impact of energy prices on household incomes.

This paper uses a simple version of a general equilibrium model, namely the social accounting matrix framework, to predict the impact of an improvement of energy efficiency on household incomes for various different groups. The two particular methods implemented are: (i) an accounting multiplier matrix with backward linkage to analyse the impacts of improvement in efficiency of energy use (or energy-saving), both with and without subsidies; and (ii) a constrained fixed price multiplier to analyse the impact of restrictions in energy use. All methodologies used in this study are based on the national data system, i.e. the Social Accounting Matrix (SAM) Indonesia 2000.

3. Methodology

SAM is a traditional double accounting economic matrix in the form of a partition matrix that records all economic transactions between agents, especially between sectors in production blocks, sectors within institution blocks (including households), and sectors within production factors, in the economy (Pyatt and Round, 1979; Sadoulet and de Janvry, 1995; Hartono and Resosudarmo, 1998). It is a solid database system, since it summarises all transaction activities in an economy within a certain period of time, thus giving a general picture of the socio-economic structure in an economy and illustrating the income distribution situation.

SAM is also an important analysing tool, because: (1) its multiplier coefficients are able to properly describe economic policy impacts on a household's income, hence illustrating the economic policy impact on income distribution; and (2) the application is relatively simple; thus it can easily be applied to various countries.

The basic framework of a SAM is a 4x4 partition matrix as shown in Figure 2. The accounts in a SAM are grouped into endogenous and exogenous accounts. The main endogenous accounts are divided into three blocks: production factor, institutional, and production activity blocks. The row shows income, while the column shows expenditure. Sub matrix $\boldsymbol{T}_{ij}$ (or $\boldsymbol{Z}_i$) shows the income of the account in row i from the account of column j. Vector $\boldsymbol{y}_i$ (or $\boldsymbol{z}$) shows the total incomes of all accounts, and vector $\boldsymbol{y}'_j$ (or $\boldsymbol{z}'$) shows the total expenditure account of all accounts. In addition, SAM requires that the vector $\boldsymbol{y}_i$ is the same as vector $\boldsymbol{y}'_j$, or in other words $\boldsymbol{y}'_j$ is a transpose of $\boldsymbol{y}_i$, for every $i = j$. The relations in Figure 2 can be written as (Defourny and Thorbecke, 1984):

$$\boldsymbol{y} = \boldsymbol{A}\,\boldsymbol{y} + \boldsymbol{x} \qquad [1]$$

where: $\boldsymbol{y}$ = vector of total income

$\boldsymbol{x}$ = vector whose members are $x_m = \Sigma_n z_{mn}$ *where* $z_{mn} \in \boldsymbol{Z_i}$

$\boldsymbol{A}$ = matrix whose members are $a_{mn} = t_{mn}/y_n$ where $t_{mn} \in T_{ij}$ and $y_n \in \boldsymbol{y}'_j$

3.1. Accounting Multiplier Matrix to Simulate an Improvement in Energy Efficiency

An accounting multiplier matrix in a SAM framework is very important since it captures overall impacts of changes in a particular sector on other sectors within the economy, and is thus also used to explain the impacts of changes in exogenous accounts on endogenous accounts. The accounting multiplier matrix, which is a standard inversion of the $(\mathrm{I}-\boldsymbol{A})$ matrix, can be derived from the basic SAM framework and written as (Defourny and Thorbecke, 1984):

$$\boldsymbol{y} = \boldsymbol{A}\,\boldsymbol{y} + \boldsymbol{x} \Leftrightarrow \boldsymbol{y} = (\boldsymbol{I} - \boldsymbol{A})^{-1}\,\boldsymbol{x} \Leftrightarrow \boldsymbol{y} = \boldsymbol{M}_a\,\boldsymbol{x} \qquad [2]$$

The $\boldsymbol{M}_a = (\boldsymbol{I} - \boldsymbol{A})^{-1}$ is known as a multiplier matrix account, which shows global impacts of changes in a particular economic sector on other sectors.

To analyse the impact of the improvement in efficiency of energy consumption on income among household groups, it is necessary to modify equation [2]. This can be done by changing all $a_{ej} \in \boldsymbol{A}$ to become $a_{ej}^{*} \in \boldsymbol{A}^{*}$, where $a_{ej}^{*} < a_{ej}$ and e is the index of energy sectors. The benefits of this energy efficiency improvement then distribute to production factors (labour and capital); representing an adoption of better tehcnology.

We observe the impact of improvement in the efficiency of energy use on the performance of the economy and society's welfare by looking at:

$$\nabla \boldsymbol{y} = \boldsymbol{y}^{*} - \boldsymbol{y} \qquad [3]$$

where $\boldsymbol{y}^{*} = (\boldsymbol{I} - \boldsymbol{A}^{*})^{-1}\, \boldsymbol{x}$.

3.2. Constrained Fixed Price Multiplier to Simulate a Restriction on Energy Use

The Constrained Fixed Price Multiplier method is used to discover the impact of changes in outputs of constrained endogenous accounts on non-constrained endogenous accounts. To illustrate this, we modify the SAM framework in Figure 2 by differentiating the endogenous account into constrained and non-constrained endogenous accounts, as depicted in Figure 3 (Lewis and Thorbecke, 1992; Resosudarmo and Thorbecke, 1996).

Mathematically, Figure 3 can be formulated as:

$$\left[\frac{y_{NC}}{y_C}\right] = \left[\frac{n_{NC}}{n_C}\right] + \left[\frac{x_{NC}}{x_C}\right] = \left[\begin{array}{c|c} \dfrac{A_{NC}}{R} & \dfrac{Q}{A_C} \end{array}\right]\left[\frac{y_{NC}}{y_C}\right] + \left[\frac{x_{NC}}{x_C}\right] \qquad [4]$$

By elabourating equation [4] into 2 equations and rearranging those equations (Resosudarmo and Thorbecke, 1996), we arrive at:

$$\left[\frac{y_{NC}}{x_C}\right] = \left[\begin{array}{c|c} \dfrac{(I - A_{NC})}{R} & \dfrac{0}{I} \end{array}\right]^{-1}\left[\begin{array}{c|c} \dfrac{I}{0} & \dfrac{Q}{(I - A_C)} \end{array}\right]\left[\frac{x_{NC}}{y_C}\right] \qquad [5]$$

$\left[\begin{array}{c|c} \dfrac{(I - A_{NC})}{R} & \dfrac{0}{I} \end{array}\right]^{-1}\left[\begin{array}{c|c} \dfrac{I}{0} & \dfrac{Q}{(I - A_C)} \end{array}\right]$ is the constrained fixed price multiplier matrix. This matrix reflects the impact of changes in exogenous sectors (x_{NC}) and constrained endogenous sectors (y_C) on non-constrained endogenous sectors (y_{NC}) and exogenous accounts (x_C).

Suppose the government forces some sectors to reduce their energy consumption by controlling the amount of their outputs. We simulate this by changing $\boldsymbol{y}_c \in \boldsymbol{y}_C$ into $\boldsymbol{y}_c^* \in \boldsymbol{y}_C^*$ where $\boldsymbol{y}_c^* < \boldsymbol{y}_c$. We observe the impact of this reduction in energy consumption policy by looking at

$$\nabla \boldsymbol{y}_{NC} = \boldsymbol{y}^*_{NC} - \boldsymbol{y}_{NC} \qquad [6]$$

where $\begin{bmatrix} \dfrac{y^*_{NC}}{x^*_C} \end{bmatrix} = \begin{bmatrix} \dfrac{(I - A_{NC})}{R} \left| \dfrac{0}{I} \right. \end{bmatrix}^{-1} \begin{bmatrix} \dfrac{I}{0} \left| \dfrac{Q}{(I - A_C)} \right. \end{bmatrix} \begin{bmatrix} \dfrac{x_{NC}}{y^*_C} \end{bmatrix}$.

4. Sources of Data

The Indonesian Energy SAM data used in this study are based on the Indonesian SAM data 2000 and provide comprehensive data of energy sectors. The 33 production sectors can be seen in Table 2. The energy sector discussed in this study only covers: (1) fuel oil sectors (BBM), comprising: gasoline, automotive diesel oil, industrial diesel oil and kerosene; (2) the gas fuel sector (BBG), i.e. refinery gas and urban gas, where BBG referred to here is from refinery or oil production and is not a liquid natural gas; and (3) the electricity sector.

The Indonesian Energy SAM data 2000 in this study comprises formal and informal labour both in rural and urban areas. Each labour group consists of agricultural, manual, clerical and professional workers. Capital is disaggregated into land, housing, rural assets, urban assets, domestic capital, government assets and foreign capital. Household groups are:

- Agricultural Employee: Agricultural workers who do not own land.
- Small Farmer: Agricultural land owners with land between 0.0 and 0.5 ha.
- Medium Farmer: Agricultural land owners with land between 0.5 and 1.0 ha.
- Large Farmer: Agricultural land owners with land larger than 1.0 ha.

- Rural Non-labour: Non-agricultural households, consisting of non-labour force and unclassified households in rural areas.
- Rural Low Income: Non-agricultural households, consisting of small retail store owners, small entrepreneurs, small personal service providers, and clerical and manual workers in rural areas.
- Rural High Income: Non-agricultural households, consisting of managers, technicians, professionals, military officers, teachers, big entrepreneurs, big retail store owners, big personal service providers, and skilled clerical workers in rural areas.
- Urban Non-labour: Non-agricultural households, consisting of non-labour force and unclassified households in urban areas.
- Urban Low Income: Non-agricultural households, consisting of small retail store owners, small entrepreneurs, small personal service providers, and clerical and manual workers in urban areas.
- Urban High: Non-agricultural households, consisting of managers, technicians, professionals, military officers, teachers, big entrepreneurs, big retail store owners, big personal service providers, and skilled clerical workers in urban areas.

Other accounts in this SAM are corporate, government, capital account, indirect tax, subsidies and foreign transaction accounts.

5. Scenarios

The scenarios simulated are categorised into two groups. Group A consists of 6 scenarios simulating the impact of improvement in the efficiency of energy use,[2] and Group B consists of 4 scenarios simulating the impact of energy restriction policies. The scenarios are as follows.

Scenario A1: This scenario simulates a situation in which all industrial sectors are able to improve the efficiency of their energy consumption by 10 %.

Scenario A2: This scenario simulates a situation in which all household groups are able to improve the efficiency of their energy consumption by 10 %.

Scenario A3: This scenario combines Scenarios A1 and A2; i.e. a situation in which all industrial sectors and all household groups are able to improve the efficiency of their energy consumption by 10%, respectively.

Scenario A4: This scenario simulates a condition in which the government reduces its total energy subsidy by 20% and distributes 50% of this fund to poor households. All industrial sectors, in this scenario, are able to improve the efficiency of their energy consumption by 10%.

Scenario A5: This scenario simulates a condition in which the government reduces its total energy subsidy by 20% and distributes 50% of this fund to poor households. All household groups are able to improve the efficiency of their energy consumption by 10%.

Scenario A6: This scenario combines Scenarios A4 and A5.

Since mid 2006, the government has required owners of restaurants, pubs and coffee shops to close by 1am. No public buses operate and most street lights are turned off by 1am. In fact, apart from police stations, most electric

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[2] The rates of improvement in efficiency of energy use in the all scenarios are based on focus group discussions with several engineers at University of Indonesia. They argued that efficiency of energy use in Indonesia has been very low due to low domestic energy prices.

appliances in public offices should be shut down by 1am. Hotels are also required to reduce their electricity use significantly by 1am. Hence, the scenarios in group B assume that activities within the relevant sector are restricted (declined by 2.5%) so that fuel oil (gasoline, automotive diesel oil and kerosene) and electricity consumptions in those sectors are expected to decline. **Scenario B1** concerns the restriction on restaurant sector; **Scenario B2** concerns the restriction on hotel sector; **Scenario B3** concerns the restriction on public service sector and **Scenario B4** concerns the restriction on restaurant, hotel, and public service sectors.

6. Results and Discussion

In this part, we elaborate and analyse the results from the application of the two methods. There are three main issues to discuss: (i) the improvement in efficiency of energy use **without** subsidy cuts; (ii) the improvement in efficiency of energy use **with** subsidy cuts; (iii) the restrictions in energy usage.

Tables 3A, 3B, and 3C display the changes in income of various household groups due to the improvement in efficiency of each type of energy use without subsidy cuts. In general, **Scenarios A1**, **A2** and **A3** produce the following results. First, returns of capital and labour increase due to ‘saving’ from a more efficient use of energy. The increasing return to labour and capital is translated to higher income for households. Furthermore, higher household income increases demand for commodities and services and ultimately further increases returns to labour and capital.

Second, the concern is whether energy demand ultimately increases due to more efficient use of energy. If the total consumption of energy decreases, the income of households, which own capital and labour in energy sectors, will be negatively affected. On the other hand, decreasing the total consumption of energy might mean decreasing government fuel subsidies. Government then has more funding for other goods and services. Higher government consumption might lead to higher production and ultimately positively affect household income. If the total consumption of energy increases, i.e. if the rebound effect phenomenon occurs, the situation will be reversed.

The estimates from **Scenario A1** show that all households enjoy an improvement in their level of income if all industry sectors use one of the following types of energy more efficiently: gasoline, automotive diesel oil, refinery gas, electricity, or urban gas. When all industry sectors use industrial diesel oil more efficiently, the income of the large farmer (LarFarm), rural low-income (RurLow), and urban low-income (UrbLow) are negatively affected, but of other households not. In the case of more efficient use of kerosene by all industry sectors, almost all household groups suffer from income decline.

It is important to note the cases of more efficient use of automotive diesel oil and of electricity by industy sectors. Here household incomes in general increase the most. With higher efficiency in automotive diesel oil use by all industry sectors, urban workers receive higher income benefits than workers in rural areas. The same occurs in the case of more efficient electricity use. Hence urban households in general benefit more than rural households in these two cases.

In general, the rise in payments to factor owners due to higher efficiency and higher government expenditure (thanks to a lower fuel subsidy) can counterbalance the negative impact of the decline in outputs of the gasoline, automotive diesel oil, refinery gas, electricity, and urban gas sectors.

Nonetheless, this is not the case when all industry sectors are efficient in using kerosene, where almost all households' income falls.

The estimates from **Scenario A2** show that the income of all households increases when they use one of the following types of energy efficiently: refinery gas, electricity, urban gas, and, in particular, electricity (which will raise household income the most). Nonetheless, there are some groups of households whose income falls when all households use gasoline and automotive diesel oil more efficiently. Furthermore, all households' income falls when they all use kerosene more efficiently. The results also show that urban low-income (UrbLow) households receive the greatest negative impact when all households use kerosene efficiently. Conversely, small farmer (SmlFarm) households receive the greatest positive impact when all households use electricity efficiently.

Scenario A3 shows that the income of all households increases when all industry sectors and all households use one of the following types of energy more efficiently: gasoline, automotive diesel oil, refinery gas, electricity, or urban gas. However, there are household groups whose income falls when all industry sectors and all households use kerosene more efficiently. The results also show that urban high-income (UrbHigh) households receive the greatest positive impact when all industry sectors and all households use electricity more efficiently. Meanwhile, large farmer (LarFarm), rural low-income (RurLow), and urban low-income (UrbLow) households suffer the most when all industry sectors and all households use kerosene more efficiently, as income for these three groups falls.

Tables 4A, 4B, and 4C provide information on the total output of each energy sector under **Scenarios A1**, **A2** and **A3**. It can be seen that as the use of a certain type of energy becomes more efficient, the output of that energy declines. This is an indication that **Scenarios A1**, **A2** and **A3** do not induce a rebound effect; i.e. an increase of a certain type of energy use due to its more efficient use.[3]

Tables 5A, 5B, and 5C display the income changes of various household groups resulting from the higher efficiency of energy use with a subsidy cut. What happen in **Scenarios A4**, **A5** and **A6** is almost the same as in **Scenarios A1**, **A2** and **A3**, except that the subsidy cut ensures that the government will be able to spend more on goods and services and so create a positive impact on household income, thus enabling the government to provide a direct transfer to poor households.

The estimates in **Scenario A4** show that the income of all households rises if all industry sectors use one of the following types of energy efficiently: gasoline, automotive diesel oil, industrial diesel oil, refinery gas, or electricity, where the improvement in efficiency occurs with a subsidy cut. With this cut, a greater increase in income will take place if all industry sectors use automotive diesel oil efficiently. In the case of kerosene, however, large farmer (LarFarm) households are negatively affected.

This scenario also shows that, with the subsidy cut, small farmer (SmlFarm) households enjoy the highest increase in income when all industry sectors use automotive diesel oil efficiently, while urban non-labour (UrbNlab) households receive the lowest increase in income when all industry sectors use kerosene efficiently. Small farmer (SmlFarm) households enjoy a considerable increase in their income since they receive subsidy-compensation funds. Generally, the increase in payments to factor owners can counterbalance the

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[3] Note that in our analysis, exports and imports are fixed.

negative impact of falling outputs in the gasoline, automotive diesel oil, industrial diesel oil, refinery gas, and electricity sectors (except, still, for kerosene).

Meanwhile, with the subsidy cut, the estimates in **Scenario A5** show that the income of all households rises if they use one of the following types of energy more efficiently: gasoline, automotive diesel oil, refinery gas, or electricity. Nevertheless, again, there are some households whose income declines when all use kerosene efficiently.

It also shows that, with the subsidy cut, small farmer (SmlFarm) households receive the highest increase in income when they all use automotive diesel oil efficiently. Conversely, large farmer (LarFarm) and urban non-labour (UrbNlab) households suffer from a negative impact when all use kerosene efficiently. It is interesting that small farmer (SmlFarm) household income rises since they receive compensation funds for the poor. The increase in payments to labour can counterbalance the negative impact of falling outputs in the gasoline, automotive diesel oil, refinery gas, and electricity sectors (except for kerosene).

Scenario A6 shows that, with the subsidy cut, all households' income rises if all industry sectors and all households use one of the following types of energy more efficiently: gasoline, automotive diesel oil, refinery gas, electricity, or kerosene. Please note that, only under this scenario, the kerosene policy 'works' for all household groups. Furthermore, under this scenario, a relatively higher increase in income of all households takes place when all industry sectors and all households use automotive diesel oil more efficiently.

Tables 6A, 6B, and 6C present the total energy outputs under **Scenarios A4**, **A5** and **A6**. The table shows that **Scenarios A4**, **A5** and **A6** do not cause a rebound effect.

Table 7 exhibits that with restrictions of energy use in the restaurant, hotel, or public service, or simultaneously in all three sectors, all households' income falls. Under all scenarios in this group, it is expected that all household groups will be negatively affected; and indeed Table 7 shows that this is the case.

The least negative impact on households is when restrictions are imposed on the hotel sector, while the most is when they are imposed on the public service sector. In general, the restriction of energy use in the hotel sector curbs the income of urban workers more than rural workers. A similar result occurs when the restriction is imposed on the restaurant and public service sectors. Hence, urban households suffer more than rural households in these scenarios.

Specifically, simultaneous restrictions of energy use in the three sectors harms urban high-income (UrbHigh) households the most, and small farmer (SmlFarm) households the least. Meanwhile, medium farmer (MedFarm) households receive the least negative impact when restrictions are also imposed on the hotel sector.

7. Conclusion

This paper, using an Indonesia Energy SAM, has elaborated the calculation methods for energy efficiency and energy restrictions, and analysed energy issues related to efficiency and restrictions in energy use, and their impacts on the Indonesian economy. There are some constraints concerning this study: (i) the method is relatively simple and does not address the price issue, while price is an important variable in energy issues in Indonesia, especially for fuel oil; (ii) the general equilibrium of the SAM in this model is static in nature, hence less reliable for forecasting long-run trends; (iii) the SAM assumes fixed Leontief Technology, which implies that technologies are constant from the base year of the model until a particular period (usually five years);

Nonetheless, it is worth noting that only a few scholars and researchers have used the Energy SAM Table to discuss energy issues in Indonesia and by carefully taking into account all weaknesses concerning the methods implemented, some of the important conclusions that can be drawn from this study are as follows. First, a policy improving the efficiency of energy use is relatively better than a policy restricting the use of energy. In general, an improvement in energy efficiency increases the income of most household groups, while energy restriction decreases their incomes. Furthermore, the simulations show that an improvement in energy efficiency most likely will not cause a rebound effect or an increase in energy use.

Second, a combination between reduction energy subsidy policy and policy improving the efficiency of energy use, in general, produces the best outcome. In the case where greater energy efficiency is reached without any reduction in government subsidy, household incomes will increase the most when all industry sectors and all households use electricity more efficiently. In the case where more efficient of energy use is achieve with a reduction of energy subsidy, household incomes will increase the most when all industry sectors and all households use automotive diesel oil more efficiently.

Third, an improvement in energy efficiency should be emphasised more in industrial sectors than in households, as the former will increase household income by a greater amount than the increase created by the improvement in household energy efficiency. In general, the improvement in efficiency in industrial sectors should focus on the use of automotive diesel oil and electricity. Furthermore, specific recommendations on the industrial sectors that are suggested to trial more efficiency in energy consumption in order to result in a positive effect on household income are: (i) The Pulp and Paper Industry, Construction and Land Transportation for automotive diesel oil; and (ii) The Trade, Pulp and Paper Industry and Textile Industry for electricity.

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Table 1. Fuel and Electricity Subsidies, 1994–2004 (Billion Rupiah)

Fiscal Year	Fuel Subsidy	% of Fuel Subsidy to State Budget	Electricity Subsidy	% of Electricity Subsidy to State Budget
1994/1995[p]	686.8	1.10	0.0	0.00
1995/1996[p]	0.0	0.00	0.0	0.00
1996/1997[p]	1,416.1	1.72	0.0	0.00
1997/1998[p]	9,814.3	8.98	0.0	0.00
1998/1999[p]	28,606.6	16.57	1,929.9	1.12
1999/2000[1)p]	40,923.4	17.65	4,551.6	1.96
2000[2)p]	51,135.2	23.09	3,928.0	1.77
2001[p]	68,380.8	20.02	4,618.1	1.35
2002[p]	31,161.7	9.67	4,102.7	1.27
2003[p]	30,037.9	7.98	3,759.3	1.00
2004[3)]	69,024.5	15.82	3,309.5	0.76

Source: Fiscal Policy Office – Ministry of Finance.

Notes:

p states budget calculation.
1) real budget until March 31, 2000.
2) phase April 1–December 31, 2000 (9 months).
3) estimates for the 2004 phase.

Table 2. Production Sector Classification

Sector Classification	Sector Classification
Food Crops	Kerosene
Estate Crops	Fuel Oil
Livestock	Other Chemical Industry
Forestry and Hunting	Electricity
Fishery	Urban Gas
Coal Mining	Clean Water
Crude Oil	Construction
Natural Gas	Trade and Storage
Other Mining	Restaurant
Food Processing	Hotel
Textile and Leather	Land Transportation
Wood Processing	Air-Water Transportation and Communication
Paper and Metal Product	Bank and Insurance
Gasoline	Real Estate
Automotive Diesel Oil	Public Services
Industrial Diesel Oil	Personal Services
Refinery Gas	

Table 3A. Income Changes of Various Household Groups Based on the Improvement in Efficiency of Energy Use without Subsidy Cuts under Scenario A1

(Billion Rupiah, %)

Household Group	Improve Efficiency in the Use of						
	Gasoline	Automotive Diesel Oil	Industrial Diesel Oil	Refinery Gas	Kerosene	Electricity	Urban Gas
AGMPL	25.0 *0.03%*	33.7 *0.05%*	4.2 *0.01%*	6.3 *0.01%*	-11.6 *-0.02%*	41.1 *0.06%*	1.5 **
SMLFARM	44.5 *0.04%*	56.5 *0.06%*	6.5 *0.01%*	11.0 *0.01%*	-22.4 *-0.02%*	71.9 *0.07%*	2.5 **
MEDFARM	24.1 *0.05%*	34.6 *0.07%*	4.5 *0.01%*	5.9 *0.01%*	-8.9 *-0.02%*	35.0 *0.07%*	1.2 **
LARFARM	11.8 *0.02%*	1.3 **	-4.8 *-0.01%*	3.9 *0.01%*	-29.1 *-0.05%*	23.7 *0.04%*	1.0 **
RURLOW	40.6 *0.04%*	19.9 *0.02%*	-0.1 **	12.4 *0.01%*	-58.8 *-0.05%*	98.0 *0.09%*	3.6 **
RURNLAB	23.6 *0.05%*	28.7 *0.06%*	4.1 *0.01%*	5.2 *0.01%*	-13.0 *-0.03%*	31.0 *0.06%*	1.1 **
RURHIGH	59.8 *0.06%*	93.6 *0.09%*	15.7 *0.02%*	13.4 *0.01%*	1.2 **	86.6 *0.08%*	2.8 **
URBLOW	75.5 *0.04%*	40.1 *0.02%*	-3.4 **	19.9 *0.01%*	-73.6 *-0.04%*	159.1 *0.09%*	6.4 **
URBNLAB	32.0 *0.04%*	31.2 *0.04%*	1.8 **	9.1 *0.01%*	-18.2 *-0.03%*	74.8 *0.10%*	2.7 **
URBHIGH	114.4 *0.06%*	178.1 *0.10%*	27.7 *0.01%*	29.3 *0.02%*	10.1 *0.01%*	225.5 *0.12%*	7.3 **

Notes:

** is a very small percentage number; smaller than 0.01%

Table 3B. Income Changes of Various Household Groups Based on the Improvement in Efficiency of Energy Use without Subsidy Cuts under Scenario A2

(Billion Rupiah, %)

Household Group	Improve Efficiency in the Use of						
	Gasoline	**Automotive Diesel Oil**	**Industrial Diesel Oil**	**Refinery Gas**	**Kerosene**	**Electricity**	**Urban Gas**
AGMPL	11.2 *0.02%*	2.0 **	–	3.0 **	-2.7 **	25.7 *0.04%*	0.3 **
SMLFARM	22.5 *0.02%*	4.3 **	–	5.8 *0.01%*	-3.1 **	51.7 *0.05%*	0.6 **
MEDFARM	11.8 *0.02%*	2.3 **	–	3.0 *0.01%*	-1.6 **	25.6 *0.05%*	0.3 **
LARFARM	7.2 *0.01%*	0.3 **	–	2.2 **	-7.1 *-0.01%*	19.6 *0.04%*	0.2 **
RURLOW	-1.2 **	-4.4 **	–	1.2 **	-22.9 *-0.02%*	18.2 *0.02%*	0.3 **
RURNLAB	5.4 *0.01%*	0.3 **	–	1.7 **	-5.3 *-0.01%*	15.3 *0.03%*	0.2 **
RURHIGH	19.2 *0.02%*	4.1 **	–	4.8 *0.01%*	-2.0 **	34.5 *0.03%*	0.4 **
URBLOW	-9.5 *-0.01%*	-10.3 *-0.01%*	–	0.6 **	-45.8 *-0.03%*	13.4 *0.01%*	0.3 **
URBNLAB	2.6 **	-1.5 **	–	1.5 **	-11.9 *-0.02%*	13.3 *0.02%*	0.2 **
URBHIGH	26.6 *0.01%*	4.6 **	–	7.2 **	-9.2 *-0.01%*	51.9 *0.03%*	0.6 **

Notes:

– we assume that households do not consume industrial diesel oil, therefore calculation was not performed

** is a very small percentage number; smaller than 0.01%

Table 3C. Income Changes of Various Household Groups Based on the Improvement in Efficiency of Energy Use without Subsidy Cuts under Scenario A3

(Billion Rupiah, %)

Household Group	Improve Efficiency in the Use of						
	Gasoline	**Automotive Diesel Oil**	**Industrial Diesel Oil**	**Refinery Gas**	**Kerosene**	**Electricity**	**Urban Gas**
AGMPL	37.5 *0.05%*	37.1 *0.05%*	–	9.3 *0.01%*	-9.3 *-0.01%*	67.4 *0.09%*	1.8 **
SMLFARM	69.2 *0.07%*	63.2 *0.06%*	–	16.8 *0.02%*	-17.0 *-0.02%*	124.6 *0.12%*	3.2 **
MEDFARM	37.1 *0.07%*	38.3 *0.07%*	–	8.9 *0.02%*	-5.7 *-0.01%*	61.2 *0.12%*	1.6 **
LARFARM	20.5 *0.04%*	3.2 *0.01%*	–	6.1 *0.01%*	-30.6 *-0.06%*	44.1 *0.08%*	1.2 **
RURLOW	42.1 *0.04%*	18.5 *0.02%*	–	13.6 *0.01%*	-71.3 *-0.06%*	117.5 *0.10%*	3.9 **
RURNLAB	30.2 *0.06%*	30.4 *0.06%*	–	6.8 *0.01%*	-13.6 *-0.03%*	46.9 *0.09%*	1.3 **
RURHIGH	81.6 *0.08%*	100.6 *0.10%*	–	18.3 *0.02%*	9.4 *0.01%*	122.5 *0.12%*	3.3 **
URBLOW	70.7 *0.04%*	35.3 *0.02%*	–	20.6 *0.01%*	-100.5 *-0.06%*	174.9 *0.10%*	6.7 **
URBNLAB	36.5 *0.05%*	31.8 *0.04%*	–	10.6 *0.01%*	-22.9 *-0.03%*	89.0 *0.12%*	2.9 **
URBHIGH	145.7 *0.08%*	188.0 *0.10%*	–	36.6 *0.02%*	19.5 *0.01%*	279.8 *0.15%*	8.0 **

Notes:

– we assume that households do not consume industrial diesel oil, therefore calculation was not performed

** is a very small percentage number; smaller than 0.01%

Table 4A. Output Changes of Various Types of Energy Based on the Improvement in Efficiency of Energy Use without Subsidy Cuts under Scenario A1

(Billion Rupiah, %)

Output	Improve Efficiency in the Use of						
	Gasoline	Automotive Diesel Oil	Industrial Diesel Oil	Refinery Gas	Kerosene	Electricity	Urban Gas
Gasoline	-1524.1 *-5.32%*	-37.2 *-0.13%*	-10.3 *-0.04%*	-2.3 *-0.01%*	-25.2 *-0.09%*	-1.7 *-0.01%*	* **
Automotive Diesel Oil	-44.6 *-0.16%*	-2751.9 *-9.68%*	-16.2 *-0.06%*	-5.4 *-0.02%*	-65.8 *-0.23%*	-18.0 *-0.06%*	-0.4 **
Industrial Diesel Oil	-7.9 *-0.13%*	-17.8 *-0.29%*	-608.0 *-10.02%*	-1.2 *-0.02%*	-10.8 *-0.18%*	-3.2 *-0.05%*	-0.1 **
Refinery Gas	-2.4 **	-5.5 *-0.01%*	-1.6 **	-324.8 *-0.57%*	-4.2 *-0.01%*	0.2 **	* **
Kerosene	-11.0 *-0.09%*	-25.0 *-0.20%*	-6.8 *-0.05%*	-1.4 *-0.01%*	-1025.5 *-8.07%*	-2.9 *-0.02%*	-0.1 **
Fuel Oil	-10.3 *-0.16%*	-26.0 *-0.41%*	-7.4 *-0.12%*	-2.3 *-0.04%*	-17.4 *-0.27%*	-4.1 *-0.06%*	-0.1 **
Electricity	-12.0 *-0.04%*	-31.1 *-0.11%*	-9.3 *-0.03%*	-2.1 *-0.01%*	-25.3 *-0.09%*	-2054.8 *-7.39%*	-4.0 *-0.01%*
Urban Gas	-0.3 *-0.03%*	-0.5 *-0.06%*	-0.1 *-0.02%*	-0.1 *-0.01%*	-0.4 *-0.05%*	-3.5 *-0.45%*	-64.3 *-8.10%*

Notes:

* is a verry small number; smaller than 0.1

** is a very small percentage number; smaller than 0.01%

Table 4B. Output Changes of Various Types of Energy Based on the Improvement in Efficiency of Energy Use without Subsidy Cuts under Scenario A2
(Billion Rupiah, %)

Output	Improve Efficiency in the Use of						
	Gasoline	**Automotive Diesel Oil**	**Industrial Diesel Oil**	**Refinery Gas**	**Kerosene**	**Electricity**	**Urban Gas**
Gasoline	-496.3 *-1.73%*	-0.4 **	–	0.9 **	-3.8 *-0.01%*	10.0 *0.03%*	0.1 **
Automotive Diesel Oil	-8.5 *-0.03%*	-154.6 *-0.54%*	–	-0.3 **	-14.7 *-0.05%*	2.9 *0.01%*	0.1 **
Industrial Diesel Oil	-1.5 *-0.02%*	-0.7 *-0.01%*	–	-0.1 **	-2.3 *-0.04%*	0.6 *0.01%*	* **
Refinery Gas	0.7 **	0.1 **	–	-115.9 *-0.20%*	-0.6 **	2.5 **	* **
Kerosene	* **	-0.5 **	–	0.4 **	-253.1 *-1.99%*	4.7 *0.04%*	0.1 **
Fuel Oil	-2.4 *-0.04%*	-1.3 *-0.02%*	–	-0.6 *-0.01%*	-4.1 *-0.06%*	* **	* **
Electricity	5.6 *0.02%*	0.8 **	–	1.8 *0.01%*	-2.8 *-0.01%*	-835.9 *-3.00%*	-0.4 **
Urban Gas	0.2 *0.02%*	* **	–	* *0.01%*	* **	-1.1 *-0.14%*	-10.0 *-1.26%*

Notes:

– we assume that households do not consume industrial diesel oil, therefore calculation was not performed

* is a verry small number; smaller than 0.1

** is a very small percentage number; smaller than 0.01%

Table 4C. Output Changes of Various Types of Energy Based on the Improvement in Efficiency of Energy Use without Subsidy Cuts under Scenario A3

(Billion Rupiah, %)

Output	**Improve Efficiency in the Use of**						
	Gasoline	**Automotive Diesel Oil**	**Industrial Diesel Oil**	**Refinery Gas**	**Kerosene**	**Electricity**	**Urban Gas**
Gasoline	-2018.3 *-7.05%*	-36.9 *-0.13%*	–	-1.4 **	-26.7 *-0.09%*	8.6 *0.03%*	0.1 **
Automotive Diesel Oil	-52.1 *-0.18%*	-2904.9 *-10.22%*	–	-5.8 *-0.02%*	-76.3 *-0.27%*	-14.7 *-0.05%*	-0.3 **
Industrial Diesel Oil	-9.2 *-0.15%*	-18.4 *-0.30%*	–	-1.4 *-0.02%*	-12.4 *-0.20%*	-2.5 *-0.04%*	-0.1 **
Refinery Gas	-1.5 **	-5.3 *-0.01%*	–	-440.7 *-0.78%*	-4.3 *-0.01%*	2.7 **	* **
Kerosene	-10.6 *-0.08%*	-25.1 *-0.20%*	–	-1.0 *-0.01%*	-1276.9 *-10.05%*	2.0 *0.02%*	* **
Fuel Oil	-12.5 *-0.20%*	-27.1 *-0.42%*	–	-2.9 *-0.04%*	-20.7 *-0.32%*	-4.0 *-0.06%*	-0.1 **
Electricity	-5.7 *-0.02%*	-29.4 *-0.11%*	–	-0.2 **	-25.1 *-0.09%*	-2884.3 *-10.37%*	-4.5 *-0.02%*
Urban Gas	-0.1 *-0.01%*	-0.4 *-0.05%*	–	* **	-0.3 *-0.04%*	-4.6 *-0.58%*	-74.3 *-9.36%*

Notes:

– we assume that households do not consume industrial diesel oil, therefore calculation was not performed

* is a verry small number; smaller than 0.1

** is a very small percentage number; smaller than 0.01%

Table 5A. Income Changes of Various Household Groups Based on the Improvement in Efficiency of Energy Use with the Subsidy Cuts under Scenario A4

(Billion Rupiah, %)

Household Group	Improve Efficiency in the Use of					
	Gasoline	Automotive Diesel Oil	Industrial Diesel Oil	Refinery Gas	Kerosene	Electricity
AGMPL	305.4 *0.43%*	479.1 *0.67%*	123.5 *0.17%*	345.8 *0.48%*	307.3 *0.43%*	129.1 *0.18%*
SMLFARM	492.5 *0.48%*	768.1 *0.75%*	197.1 *0.19%*	553.4 *0.54%*	485.8 *0.48%*	214.1 *0.21%*
MEDFARM	74.1 *0.14%*	114.8 *0.22%*	25.1 *0.05%*	66.9 *0.13%*	36.2 *0.07%*	54.6 *0.11%*
LARFARM	47.0 *0.09%*	58.3 *0.11%*	9.4 *0.02%*	47.2 *0.09%*	-4.4 *-0.01%*	38.7 *0.07%*
RURLOW	327.2 *0.29%*	475.9 *0.42%*	121.0 *0.11%*	359.7 *0.32%*	251.3 *0.22%*	192.6 *0.17%*
RURNLAB	62.1 *0.12%*	90.6 *0.18%*	19.8 *0.04%*	52.3 *0.10%*	18.4 *0.04%*	47.0 *0.09%*
RURHIGH	165.6 *0.16%*	263.4 *0.25%*	59.3 *0.06%*	142.2 *0.14%*	96.5 *0.09%*	125.5 *0.12%*
URBLOW	307.4 *0.17%*	411.2 *0.23%*	93.0 *0.05%*	302.6 *0.17%*	146.2 *0.08%*	241.0 *0.13%*
URBNLAB	68.5 *0.09%*	90.3 *0.12%*	16.2 *0.02%*	53.8 *0.07%*	3.3 **	91.4 *0.13%*
URBHIGH	280.0 *0.15%*	444.4 *0.24%*	95.4 *0.05%*	230.7 *0.12%*	150.8 *0.08%*	289.7 *0.16%*

Notes:

** is a very small percentage number; smaller than 0.01%

Table 5B. Income Changes of Various Household Groups Based on the Improvement in Efficiency of Energy Use with the Subsidy Cuts under Scenario A5

(Billion Rupiah, %)

Household Group	Improve Efficiency in the Use of					
	Gasoline	Automotive Diesel Oil	Industrial Diesel Oil	Refinery Gas	Kerosene	Electricity
AGMPL	285.8 *0.40%*	417.1 *0.58%*	–	341.9 *0.48%*	293.8 *0.41%*	112.4 *0.16%*
SMLFARM	460.7 *0.45%*	664.9 *0.65%*	–	547.2 *0.54%*	467.2 *0.46%*	191.8 *0.19%*
MEDFARM	56.3 *0.11%*	53.7 *0.10%*	–	63.4 *0.12%*	22.3 *0.04%*	44.0 *0.09%*
LARFARM	35.8 *0.07%*	22.6 *0.04%*	–	44.9 *0.08%*	-8.1 *-0.01%*	33.0 *0.06%*
RURLOW	273.3 *0.24%*	388.9 *0.34%*	–	347.3 *0.31%*	240.7 *0.21%*	110.1 *0.10%*
RURNLAB	38.3 *0.07%*	33.3 *0.07%*	–	48.2 *0.09%*	4.7 *0.01%*	30.1 *0.06%*
RURHIGH	113.2 *0.11%*	112.5 *0.11%*	–	132.4 *0.13%*	47.9 *0.05%*	70.6 *0.07%*
URBLOW	200.5 *0.11%*	247.2 *0.14%*	–	281.0 *0.16%*	89.7 *0.05%*	90.1 *0.05%*
URBNLAB	30.6 *0.04%*	13.9 *0.02%*	–	45.3 *0.06%*	-22.8 *-0.03%*	27.9 *0.04%*
URBHIGH	170.5 *0.09%*	158.1 *0.08%*	–	206.4 *0.11%*	48.1 *0.03%*	111.2 *0.06%*

Notes:

– we assume that households do not consume industrial diesel oil, therefore calculation was not performed

Table 5C. Income Changes of Various Household Groups Based on the Improvement in Efficiency of Energy Use with the Subsidy Cuts under Scenario A6
(Billion Rupiah, %)

Household Group	**Improve Efficiency in the Use of**					
	Gasoline	**Automotive Diesel Oil**	**Industrial Diesel Oil**	**Refinery Gas**	**Kerosene**	**Electricity**
AGMPL	320.6 *0.45%*	484.1 *0.68%*	–	349.1 *0.49%*	316.1 *0.44%*	156.0 *0.22%*
SMLFARM	521.8 *0.51%*	777.6 *0.76%*	–	559.8 *0.55%*	502.1 *0.49%*	267.9 *0.26%*
MEDFARM	89.7 *0.17%*	120.0 *0.23%*	–	70.2 *0.14%*	45.6 *0.09%*	81.4 *0.16%*
LARFARM	58.9 *0.11%*	62.1 *0.11%*	–	49.8 *0.09%*	1.6 **	59.9 *0.11%*
RURLOW	334.2 *0.29%*	477.8 *0.42%*	–	361.6 *0.32%*	252.2 *0.22%*	213.7 *0.19%*
RURNLAB	71.3 *0.14%*	93.8 *0.18%*	–	54.2 *0.11%*	24.1 *0.05%*	63.6 *0.12%*
RURHIGH	192.9 *0.19%*	273.7 *0.26%*	–	147.7 *0.14%*	117.8 *0.11%*	162.7 *0.16%*
URBLOW	312.8 *0.17%*	412.4 *0.23%*	–	304.5 *0.17%*	143.7 *0.08%*	259.8 *0.14%*
URBNLAB	76.8 *0.11%*	93.2 *0.13%*	–	55.8 *0.08%*	8.1 *0.01%*	106.6 *0.15%*
URBHIGH	321.4 *0.17%*	460.4 *0.25%*	–	239.2 *0.13%*	184.5 *0.10%*	346.4 *0.19%*

Notes:

– we assume that households do not consume industrial diesel oil, therefore calculation was not performed

** is a very small percentage number; smaller than 0.01%

Table 6A. Output Changes of Various Types of Energy Based on the Improvement in Efficiency of Energy Use with the Subsidy Cuts under Scenario A4

(Billion Rupiah, %)

Output	Improve Efficiency in the Use of					
	Gasoline	Automotive Diesel Oil	Industrial Diesel Oil	Refinery Gas	Kerosene	Electricity
Gasoline	-1546.3 *-5.40%*	-25.6 *-0.09%*	-7.5 *-0.03%*	8.4 *0.03%*	-22.9 *-0.08%*	4.9 *0.02%*
Automotive Diesel Oil	-58.3 *-0.21%*	-2786.1 *-9.80%*	-15.4 *-0.05%*	-5.4 *-0.02%*	-96.2 *-0.34%*	-13.1 *-0.05%*
Industrial Diesel Oil	-10.8 *-0.18%*	-21.7 *-0.36%*	-609.1 *-10.04%*	-3.4 *-0.06%*	-15.3 *-0.25%*	-2.5 *-0.04%*
Refinery Gas	0.7 **	-0.8 **	-0.5 **	-326.2 *-0.58%*	-2.7 **	2.1 **
Kerosene	-8.6 *-0.07%*	-19.7 *-0.16%*	-5.4 *-0.04%*	4.6 *0.04%*	-1025.8 *-8.07%*	0.4 **
Fuel Oil	-15.7 *-0.25%*	-35.8 *-0.56%*	-10.4 *-0.16%*	-11.7 *-0.18%*	-28.7 *-0.45%*	-3.8 *-0.06%*
Electricity	5.9 *0.02%*	-2.3 *-0.01%*	-2.2 *-0.01%*	19.5 *0.07%*	-13.4 *-0.05%*	-2082.4 *-7.49%*
Urban Gas	0.5 *0.06%*	0.7 *0.08%*	0.2 *0.02%*	0.8 *0.10%*	0.2 *0.03%*	-4.1 *-0.52%*

Notes:

** is a very small percentage number; smaller than 0.01%

Table 6B. Output Changes of Various Types of Energy Based on the Improvement in Efficiency of Energy Use with the Subsidy Cuts under Scenario A5

(Billion Rupiah, %)

Output	Improve Efficiency in the Use of					
	Gasoline	Automotive Diesel Oil	Industrial Diesel Oil	Refinery Gas	Kerosene	Electricity
Gasoline	-527.0 *-1.84%*	-3.3 *-0.01%*	–	11.3 *0.04%*	-12.0 *-0.04%*	16.1 *0.06%*
Automotive Diesel Oil	-27.1 *-0.10%*	-219.5 *-0.77%*	–	-0.7 **	-63.8 *-0.22%*	7.0 *0.02%*
Industrial Diesel Oil	-5.1 *-0.08%*	-8.8 *-0.14%*	–	-2.4 *-0.04%*	-9.9 *-0.16%*	1.1 *0.02%*
Refinery Gas	3.1 *0.01%*	1.4 **	–	-117.8 *-0.21%*	-1.6 **	4.3 *0.01%*
Kerosene	0.6 **	-3.8 *-0.03%*	–	6.1 *0.05%*	-260.5 *-2.05%*	7.7 *0.06%*
Fuel Oil	-8.8 *-0.14%*	-16.1 *-0.25%*	–	-10.1 *-0.16%*	-19.4 *-0.30%*	0.1 **
Electricity	19.9 *0.07%*	11.3 *0.04%*	–	23.0 *0.08%*	-4.4 *-0.02%*	-870.5 *-3.13%*
Urban Gas	0.8 *0.10%*	0.7 *0.09%*	–	0.9 *0.11%*	0.2 *0.02%*	-1.7 *-0.22%*

Notes:

– we assume that households do not consume industrial diesel oil, therefore calculation was not performed

** is a very small percentage number; smaller than 0.01%

Table 6C. Output Changes of Various Types of Energy Based on the Improvement in Efficiency of Energy Use with the Subsidy Cuts under Scenario A6

(Billion Rupiah, %)

Output	Improve Efficiency in the Use of					
	Gasoline	Automotive Diesel Oil	Industrial Diesel Oil	Refinery Gas	Kerosene	Electricity
Gasoline	-2039.4 *-7.12%*	-24.5 *-0.09%*	–	9.5 *0.03%*	-21.3 *-0.07%*	15.4 *0.05%*
Automotive Diesel Oil	-63.6 *-0.22%*	-2938.2 *-10.33%*	–	-5.5 *-0.02%*	-101.3 *-0.36%*	-9.4 *-0.03%*
Industrial Diesel Oil	-11.6 *-0.19%*	-22.0 *-0.36%*	–	-3.5 *-0.06%*	-16.1 *-0.26%*	-1.8 *-0.03%*
Refinery Gas	1.8 **	-0.4 **	–	-442.2 *-0.78%*	-2.0 **	4.7 *0.01%*
Kerosene	-7.5 *-0.06%*	-19.4 *-0.15%*	–	5.0 *0.04%*	-1276.2 *-10.04%*	4.6 *0.04%*
Fuel Oil	-17.5 *-0.27%*	-36.6 *-0.57%*	–	-12.2 *-0.19%*	-30.8 *-0.48%*	-3.7 *-0.06%*
Electricity	13.8 *0.05%*	0.3 **	–	21.5 *0.08%*	-9.3 *-0.03%*	-2904.0 *-10.44%*
Urban Gas	0.7 *0.09%*	0.8 *0.09%*	–	0.9 *0.11%*	0.4 *0.05%*	-5.1 *-0.64%*

Notes:

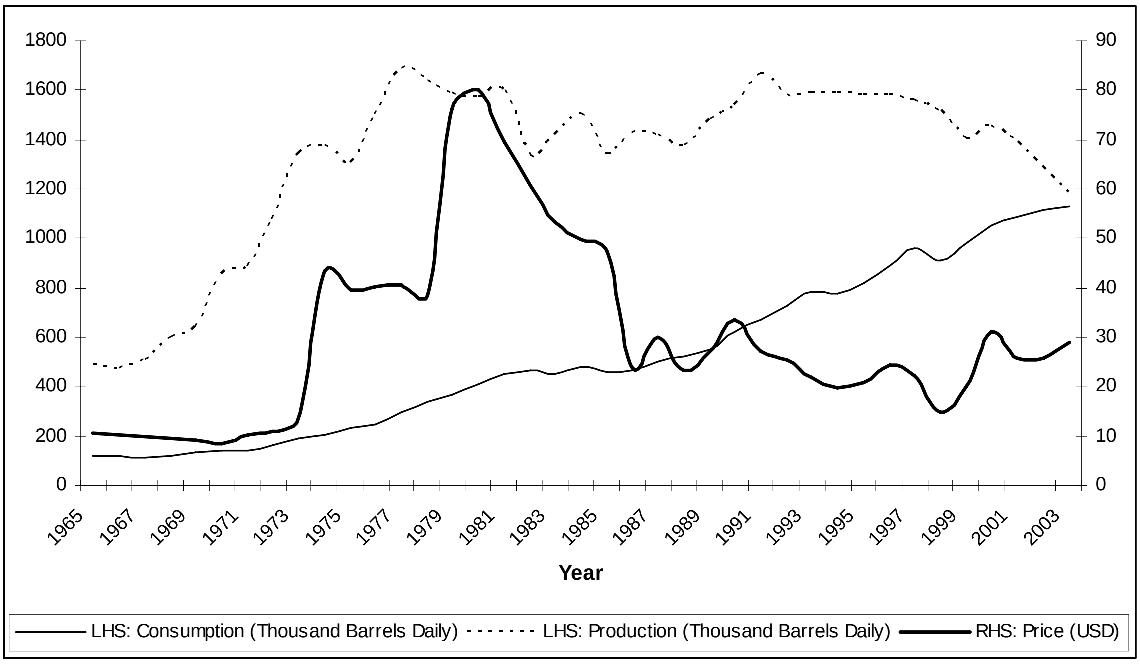
– we assume that households do not consume industrial diesel oil, therefore calculation was not performed

** is a very small percentage number; smaller than 0.01%

Table 7. Income Changes of Various Household groups Based on the Restriction of Energy Use

(Billion Rupiah, %)

Household Group	Scenario B1 (restaurant)	Scenario B2 (hotel)	Scenario B3 (public service)	Scenario B4 (combined)
AGMPL	-20.9 *-0.03%*	-4.6 *-0.01%*	-72.1 *-0.10%*	-97.5 *-0.14%*
SMLFARM	-29.0 *-0.03%*	-6.1 *-0.01%*	-81.6 *-0.08%*	-116.7 *-0.11%*
MEDFARM	-11.4 *-0.02%*	-3.3 *-0.01%*	-78.1 *-0.15%*	-92.9 *-0.18%*
LARFARM	-16.6 *-0.03%*	-6.5 *-0.01%*	-76.6 *-0.14%*	-99.7 *-0.18%*
RURLOW	-58.1 *-0.05%*	-10.0 *-0.01%*	-127.5 *-0.11%*	-195.5 *-0.17%*
RURNLAB	-13.3 *-0.03%*	-4.3 *-0.01%*	-105.5 *-0.21%*	-123.1 *-0.24%*
RURHIGH	-55.4 *-0.05%*	-13.3 *-0.01%*	-380.3 *-0.37%*	-449.0 *-0.43%*
URBLOW	-123.2 *-0.07%*	-28.1 *-0.02%*	-270.7 *-0.15%*	-422.0 *-0.23%*
URBNLAB	-63.3 *-0.09%*	-12.1 *-0.02%*	-158.7 *-0.22%*	-234.0 *-0.32%*
URBHIGH	-187.3 *-0.10%*	-36.2 *-0.02%*	-716.6 *-0.38%*	-940.2 *-0.50%*



Source: Center of Data and Information – Ministry of Energy and Mineral Resources (2005)

Figure 1. International Crude Oil Price and Indonesian Crude Oil Consumption

			EXPENDITURE				
			Endogenous Accounts			*Exogenous Account*	TOTAL
			Production Factors	Institutions	Production Activities		
RECEIPTS	*Endogenous Accounts*	Production Factors	***0***	***0***	T_{13}	Z_1	y_1
		Institutions	T_{21}	T_{22}	***0***	Z_2	y_2
		Production Activities	***0***	T_{32}	T_{33}	Z_3	y_3
	Exogenous Account		T_{41}	T_{42}	T_{43}	Z_4	z
	TOTAL		y'_1	y'_2	y'_3	z'	

Figure 2. SAM Framework

				Endogenous			Exogenous		TOTAL
				Non-constrained	Constrained	**Sum**	Transaction	**Sum**	
Endogenous	Non-constrained	1	Factor	T_{NC}	T_Q	n_{NC}	X_{NC}	x_{NC}	y_{NC}
		2a	Institution						
	Constrained	3	Sector	T_R	T_C	n_C	X_C	x_C	y_C
Exogenous		2b	Government	L_{NC}	L_C	L	U	u	y_E
		4	Other						
TOTAL				y_{NC}'	y_C'		y_E'		

Figure 3. The SAM with Constrained and Non-constrained Accounts