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Scenarios for Climate Change Mitigation from the Energy Sector in Indonesia: The Role of Fiscal Instruments[1,2]

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Abstract

As mandated by the recent Copenhagen Accord, Indonesia submitted a nationally appropriate mitigation actions plan to reduce greenhouse gasses emission by 26% by 2020. However, for now, specific strategies especially appropriate instruments to achieve those targets are yet under early planning stage. This study is an attempt to contribute to the policy design on how Indonesia can achieve that target in particular for the energy sector by looking directly at specific instruments available and under the discretion of Indonesian government particularly the Ministry of Finance. For this purpose, we constructed AGEFIS-E[3] model, a computable general equilibrium (CGE) model with a focus on energy sector and fiscal instruments. As the departure from the previous literature on CGE modeling in Indonesia, this model incorporates explicitly the renewable energy such as geothermal and hydropower. It was used to exercise various scenarios of finding an effective mix of instruments to reduce emissions from the energy sector. We find that a scenario of engineering the energy relative prices through pricing-instruments is an effective way to achieve a given target of reducing emissions from the energy sectors. More specifically, we conclude that removing energy subsidy (fuel and electricity) can contribute to significant reduction in carbon emissions. Adding a carbon tax to the policy mix will complement to find the best scenario to achieve a certain target of emissions reduction. A target of 14% reduction of emissions from the energy sector, for example, can be achieved by removing energy subsidy complemented by a carbon tax of only around US$3/ton CO_2. Half of the reduction is attributed to the removing energy subsidy alone, suggesting evidence that the emissions reduction potential of energy pricing reform has been overlooked in the policy agenda.

Keywords: climate change, computable general equilibrium model, fiscal instruments, energy, Indonesia

JEL Code: D30, D58, Q40, Q48, Q54, Q56, Q58

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[3] AGEFIS-E stands for Applied General Equilibrium model for FIScal policy analysis – Energy an extended version of an earlier AGEFIS model developed under the collaboration between Padjadjaran University and the Ministry of Finance.

1. Introduction

Following the Copenhagen Accord in 2009 on climate change, Indonesia has submitted a national appropriate mitigation actions plan to reduce emission by 26% before 2020. Yet, to date, no specific policy instrument has been specified. This paper attempts a contribution to the economic policy design, in particular the fiscal policy under the jurisdiction of the Ministry of Finance, for Indonesia to attain that emission reduction target.

Climate change no longer remains as environmental issues. It has been well accepted as development issues since UNFCCC COPXIII in Bali, 2007. Macroeconomic management, fiscal policy instrumentation, and financial market as well as capital market regulations are responsible for shaping incentives and preferences of economic agents. Due to the transmission mechanism from the relative prices to whole economy, fiscal policy affects consumption behavior towards green products, investment on green technology, and certainly central government green budgeting.

Worldwide best practices on climate change fiscal policy have evolved around either Pigouvian carbon tax or Coasian carbon market. Though carbon market is not a fiscal instrument, regulation on its trade remains under fiscal jurisdiction just like the financial and capital market.

A report produced by the World Bank in 2007 ranked Indonesia as one of the greatest CO2 emitting nations. Second to the land-use-land-use-change-and-forestry (LULUCF), energy sector has been responsible for that emission statistics. Moreover, taking into account the recent growth rate on energy's CO2 emission, it would supersede its rival as the nation's greatest emitter in the near future.

Unlike renewable energy, carbon molecule is found in any fossil fuel like coal, oil, and natural gas. These fossil fuels release CO2 into atmosphere after combustion. A carbon tax raises their price relative to other fuels in proportion to their carbon content in attempt to reduce carbon emission from consuming fossil fuels. Carbon tax applies to fossil fuel input of economic activities in the unit of tonne CO2 (tCO2) or tonne C (tC). Integovgernmental Panel on Climate Change (IPCC) recorded cost of carbon emission in the unit of USD per tonne CO2 or USD per tonne C.

In 2007, IPCC reported an estimate for social externality cost of carbon emission using 2005 base year in an average of USD43/tC with a standard deviation of USD83/tC. The huge variance was due to unsettled scientific methodology along with variation in discounting the economic impact from extreme projection. The same report also published annual growth rate of social carbon emission in range of 2-4 percent.

The importance of obtaining estimate for social externality cost of carbon emission for the Ministry of Finance is to formulate optimal mitigation compensating and equating valuation to the central government's budget. This serves as reference in setting tariff on carbon tax as well as spending on central government expenditures, subsidy and transfers to regions. It just gets more interesting taking into account the fact that the Indonesia provides subsidy to peg the 'premium' fuel price at Rp4500/liter.

In the quest to opt for optimal fiscal policy, strategy, and instrument formulations, this papers utilizes Applied General Equilibrium Fiscal Model or AGEFIS (Yusuf, et.al., 2008) to simulate numerous options on energy sourcing to attain 14% emission reduction of CO2 from energy sector in 2020.

This modeling exercise has produced (a) an Energy Social Accounting Matrix (SAM) extending the 2005 SAM from bureau of statistics to include detail on energy sourcing and usage; (b) price induced substitution among different sources of energy including between renewable and fossil fuels; (c) price-induced substitution between aggregate energy with other other primary factor of production; (d) multi-households to study poverty; (e) inclusion of CO2 emission module; and (f) inclusion of a of carbon-tax mechanism.

To this end, an introduction to engineering the energy relative prices through pricing-instruments is the focus of this paper. A summarized part of methodology on Applied General Equilibrium for Fiscal Policy Analysis – Energy is written in section two. Simulating an effective way to achieve a given target of reducing emissions from the energy sectors is the content of section three. The paper ends with conclusion in section four.

2. Methodology: Applied General Equilibrium for Fiscal Policy Analysis – Energy (AGEFIS-E)

AGEFIS (Applied General Equilibrium model for FIScal Policy Analysis) is a Computable General Equilibrium (CGE) model designed specifically, but not limited, to analyze various aspects of fiscal policies in Indonesia. AGEFIS was built under the capacity building activity carried out by the CGE Modeling Unit (CCMU), Center for Economics and Development Studies (CEDS), Faculty of Economics, Padjadjaran University, for Fiscal Policy Agency, The Ministry of Finance, Republic of Indonesia. It was developed to anticipate the need of the Ministry of Finance to analyze the impact of various fiscal policies on the economy, as well as the impact of various economic shocks to the fiscal position of the budget of the Indonesian government.

AGEFIS-E (E stands for energy) is a modification to the first AGEFIS model to further analyze various policies related to mitigation of climate change from the energy sector. The model was intended to be used to exercise various scenarios of finding an effective mix of instruments to reduce emissions from the energy sector. AGEFIS is basically a SAM-based CGE model solved by Gempack. Detail structure of the first AGEFIS model can be found in Yusuf et al (2008). Here we will only describe the extension of AGEFIS[4].

In summary, the modification to the first version of AGEFIS is the following: (i) a more detailed sector disaggregation especially with regard to various energy sector with both fossil or carbon-emitting and renewable energy explicitly; (ii) the production structure allows for substitution between energy types and between the energy with other inputs (in this case primary inputs) and with explicit renewable energy sector in this case geothermal and hydropower (iii) disaggregated households that are designated for distribution analysis where we divide households into urban poor, urban non poor, rural poor, and rural non poor; (iv) incorporate carbon emissions and carbon taxation into the model explicitly.

In a nutshell, the structure of the AGEFIS-E model can be explained as follows. The production structure of AGEFIS-E consists of 33 production sectors based on a nested Leontief production function for intermediate inputs and value added. Value-added production function has the specification of the Constant Elasticity of Substitution (CES), where primary production factors consist of capital and several categories of labor. AGEFIS-E extends the production structure that allows for substitution of energy (see Figure 1). The choice of domestic and import consumption was based on the optimization of the composition of imports and domestic goods with the Armington specification. Households maximize the Cobb-Douglas utility function with a budget constraint and receive income

[4] Readers who are more interested in the detail structure of the model are encourage to refer to Yusuf et al (2008).

from the ownership of factors of production as well as transfers from other institutions (government, corporations, and rest of the world). The government receives revenue from indirect taxes, direct taxes, the ownership of factors, and transfers from other institutions such as rest of the world. Government spend its budget for consumption, commodity subsidies, and transfers to other institutions such as households. Finally, the model has a closure that is flexible, which are: (i) long-term closure which is marked by full employment of factors, and capital and labor are free to move between sectors, (ii) short-term closure which is marked with capital sector-immobility, and aggregate employment are subject to change (possibility of unemployment), (iii) short-term closure of full employment conditions, characterized by capital immobility but labor is always in full employment, and (iv) various closure of the fiscal side

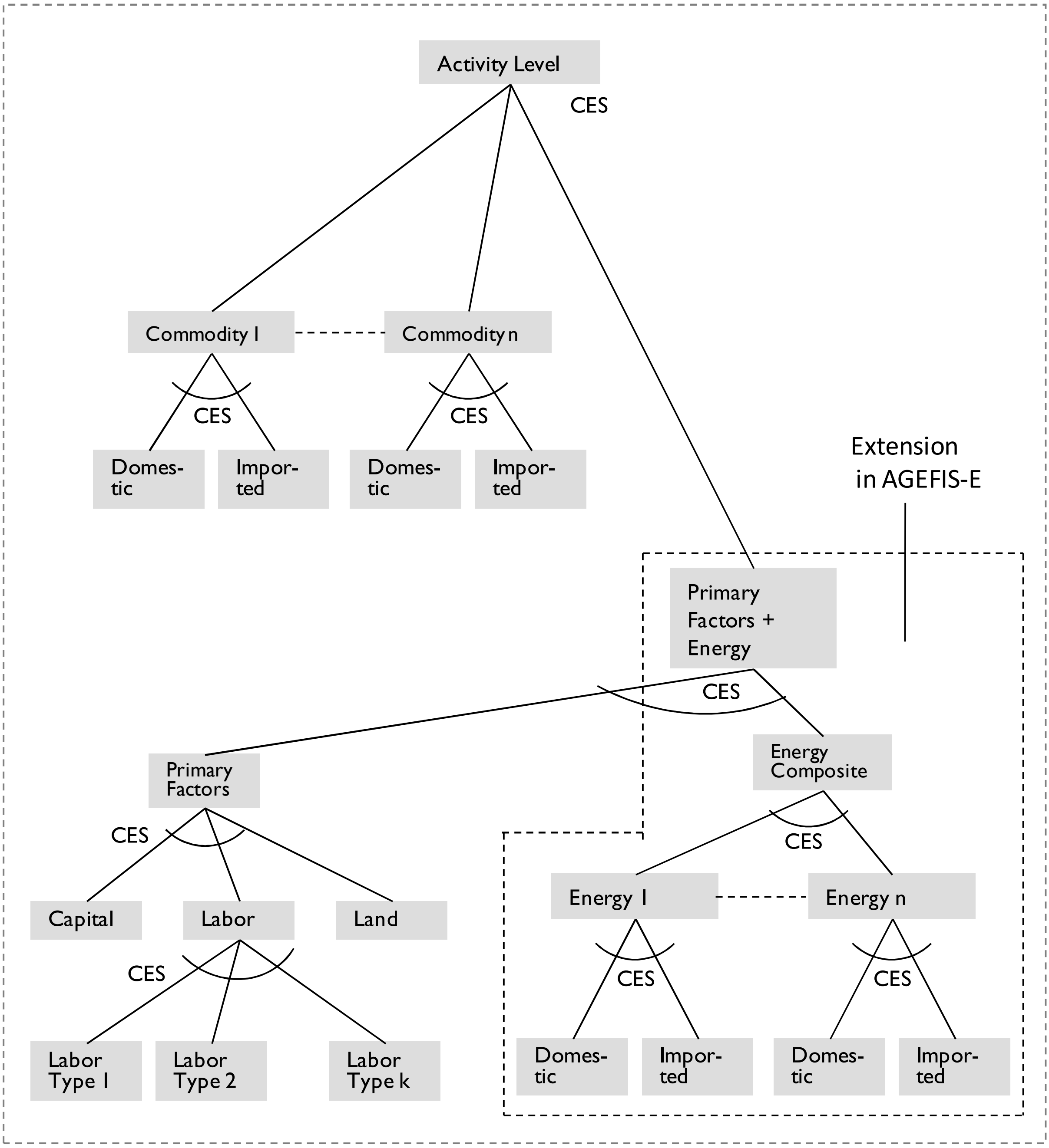

Figure 1. Extension to the production structure of AGEFIS

The equations in AGEFIS-E typically consist of:

1. Domestic-import sourcing. Equations that describe the composition of demand by source, namely domestic-import, with the Armington specification.
2. Purchaser's price. The equation that links between producer prices or international prices with the purchase price.
3. Demand for Commodities. Equations associated with the demand for goods and services by various users.
4. Production sector. Equations associated with the production of goods and services.
5. Market clearing conditions. Equations associated with the market clearing conditions, where the supply equal to demand, both for commodities and factors of production.
6. Factor income. Equations that describe the various sources of income from production factors.
7. Institutions. Equations associated with the receipt and expenditures of institutions (households, governments, companies, and rest of the world)

Database of AGEFIS-E was built based on Social Accounting Matrix 2005 which was further extended specifically for the model with the assistance from Indonesian Statistics Agency.

3. Simulation Scenarios, Results and Discussion

Several criteria are used in search for various alternative scenarios for reducing carbon dioxide emissions from the energy sectors. Among the most important criterion is the urgency of the scenario in the context of the relevant and current situation and policy setting. With this consideration in mind, we argue that the elimination of energy subsidies is the first scenario we considered urgent, hence will be the starting point in proposing the other complementary sets of alternative scenarios.

Another criterion is the degree to which the scenario can effectively encourages the reduction of energy intensity –the ratio of energy use to GDP. The third criterion is the extent to which the scenario can encourage a better energy mix that supports the most effective greenhouse gas emissions reduction.

The last important criterion is that these alternatives scenarios can be translated into workable fiscal instruments. We also acknowledge the technical constrains that the selection of alternative instruments is limited by the ability of the model in accommodating the various options of fiscal instruments.

Based on the above criterion we will argue and demonstrate the scenario of engineering energy pricing in the form of eliminating current energy subsidy (fuel and electricity subsidies) complemented by a carbon tax is an effective mixed set of fiscal instruments to achieve a given target of reducing emissions from the energy sectors.

3.1. The Elimination of fuel and electricity subsidies

The issue of potential negative effects of energy subsidies is not new and widely discussed in the literature. Energy subsidy which is still implemented in many part of the world are considered no longer relevant (The Economist, 2009). The subsidy has been considered to be inaccurately targeted, as most of the subsidy is enjoyed by the middle and upper-income households especially those residing in urban areas. Furthermore, as Indonesia has become a net importer of oil since 2004, the fuel subsidy might increase dependence on foreign supplies of energy. This is risky and a threat to our energy security. Energy subsidies discourage the energy saving and become a disincentive for the development of new and renewable energy.

From the environment point of view, fossil fuel subsidies would only exacerbate the environmental conditions and temperature of the earth. Subsidizing fossil fuels is identical with supporting the addition of greenhouse gas emissions that cause global warming.

The International Energy Agency, in the Economist (2009), argues that eliminating fossil fuel subsidies could reduce global greenhouse gas emissions by 10%. Therefore, the elimination of energy subsidies should be the main concern of policy makers, particularly in the finance department, in an effort to mitigate climate change utilizing fiscal instruments.

The table below outlines the results of our simulations removing all form of energy subsidy namely the elimination of fuel subsidies and electricity subsidies. We use both short run and long run closure in the model[5].

Table 1: Simulated impact of removing energy subsidies (% relative to the baseline)

	Long run			**Short run adjustment**		
	Fuel	**electricity**	**Fuel and Electricity**	**Fuel**	**Electricity**	**Fuel and Electricity**
CO2 emissions	**-5.79**	**-0.92**	**-6.66**	**-1.71**	**-1.24**	**-2.92**
Hydroelectric	0.00	0.00	0.00	0.00	0.00	0.00
Geothermal	0.00	0.00	0.00	0.00	0.00	0.00
Coal	4.07	-1.89	2.30	-0.50	-2.68	-3.13
Natural Gas	0.33	-0.18	0.14	5.35	-0.20	5.12
Fuel	-12.27	-0.49	-12.73	-3.48	-0.59	-4.04
GDP	**0.44**	**0.00**	**0.43**	**-0.44**	**-0.06**	**-0.50**
Energy Consumption	**-13.55**	**-0.54**	**-14.12**	**-3.18**	**-0.61**	**-3.79**
Energy Intensity	**-13.99**	**-0.54**	**-14.55**	**-2.75**	**-0.55**	**-3.29**
Energy mix						
Hydroelectric	0.41	-0.18	-0.05	0.05	-0.13	-0.09
Geothermal	0.51	-0.08	0.44	0.09	0.02	0.10
Coal	3.53	-0.20	3.45	0.45	-0.36	0.09
Natural Gas	-3.06	0.16	-2.91	0.00	0.19	0.18
Fuel	-1.38	0.29	-0.93	-0.57	0.28	-0.29
Total	0.00	0.00	0.00	0.00	0.00	0.00
Household Consumption	**-1.22**	**-0.30**	**-1.53**	**-1.46**	**-0.28**	**-1.74**
HH - Rural Poor	-1.91	-0.25	-2.18	-1.39	-0.21	-1.60
HH - Rural Non-Poor	-0.55	-0.31	-0.87	-1.27	-0.30	-1.57
HH - Urban Poor	-2.19	-0.22	-2.42	-1.82	-0.22	-2.03
HH - Urban Non-Poor	-1.57	-0.29	-1.87	-1.57	-0.27	-1.84
Employment	**0.00**	**0.00**	**0.00**	**-0.97**	**-0.11**	**-1.08**

Source: Author's calculation

[5] Long run closure is the assumption that all factors of production including labor are employed, while short-run closure accommodate possible short-run adjustment where nominal wage rigidity open the possibility of lost employment.

As shown in the table above, the potential emission reductions from the elimination of energy subsidies, in this case the fuel subsidies and electricity subsidies are quite large. The potential reduction of these emissions amounted to 6.66% relative to baseline, where the largest contribution is from the removal of fuel subsidies (5.79%) while the remaining of 0.92% comes from the elimination of electricity subsidies. The majority of these emissions reductions come from the reduction of energy consumption or energy intensity. For example, energy intensity decreased by 14.12% as a result of the elimination of energy subsidies.

There are some changes in the energy mix. However, whether the change in the energy mix is compatible with emissions reductions is unclear. Fuel composition in the energy mix declines from 53% to 51.76%, but there is a fairly large increase in the composition of coal. As now coal is seen relatively cheaper to fuel, the portion of the coal in the energy mix which was initially amounted to 22.7% changed after the reduction in fuel subsidies to 26.2%. Although the share of fuel has declined and the share of renewable (hydroelectric and geothermal) energy has slightly risen in the energy mix, the elimination of fuel subsidy has changed the energy mix into a kind that is not 'friendly' to the spirit of emissions reduction because of the increase in the consumption of high-carbon content coal.

Table 2: Simulated impact of removing energy subsidies on the changes in Government Budget (Billion Rupiah)

Long-run closure

Government Budget item	**Fuel**		**Electricity**		**Fuel + Electricity**	
	Income	**Expenditure**	**Income**	**Expenditure**	**Income**	**Expenditure**
Indirect Tax	-683.34	0.00	-88.34	0.00	-770.79	0.00
Carbon tax	0.00	0.00	0.00	0.00	0.00	0.00
Import Tariff	-687.90	0.00	-128.73	0.00	-826.97	0.00
Household Income Tax	-1,492.67	0.00	-174.20	0.00	-1,676.44	0.00
Corporate Income Tax	-12,085.22	0.00	-650.83	0.00	-12,750.48	0.00
Government Transfers	-2,770.89	-2,770.89	-192.95	-192.95	-2,970.05	-2,970.05
Transfer to overseas	-11.67	-142.12	0.31	3.74	-11.41	-139.01
Consumption	0.00	-1,876.39	0.00	24.97	0.00	-1,851.34
Subsidy	0.00	-53,295.85	0.00	-6,925.59	0.00	-60,477.41
Transfers to Households	0.00	-1,382.37	12.00	36.37	0.00	-1,352.18
Surplus / Deficit Budget	0.00	41,735.94	0.00	5,818.71	0.00	47,783.85
TOTAL	-17,731.68	-17,731.68	-1,234.75	-1,234.75	-19,006.14	-19,006.14

Short-run closure

Government Budget item	**Fuel**		**Electricity**		**Fuel + Electricity**	
	Income	**Expenditure**	**Income**	**Expenditure**	**Income**	**Expenditure**
Indirect Tax	-1,346.22	0.00	-141.52	0.00	-1,484.62	0.00
Carbon tax	0.00	0.00	0.00	0.00	0.00	0.00
Import Tariff	-667.89	0.00	-130.52	0.00	-797.57	0.00
Household Income Tax	-1,303.07	0.00	-154.14	0.00	-1,455.12	0.00
Corporate Income Tax	-12,130.27	0.00	-1,022.93	0.00	-13,124.78	0.00
Government Transfers	-2,862.15	-2,862.15	-268.31	-268.31	-3,124.07	-3,124.07
Transfer to overseas	-6.05	-73.69	0.44	5.37	-5.61	-68.28
Revenue Production Factors	0.00	0.00	0.00	0.00	0.00	0.00
Consumption	0.00	-508.29	0.00	129.20	0.00	-378.57

Subsidy	0.00	-53,540.18	0.00	-6,980.68	0.00	-60,369.24
Transfers to Households	0.00	-716.75	0.00	52.20	0.00	-664.18
Surplus / Deficit Budget	0.00	39,385.41	0.00	5,345.25	0.00	44,612.58
TOTAL	-18,315.65	-18,315.65	-1,716.98	-1,716.98	-19,991.76	-19,991.76

Source: Author's calculation

In the long-run, scenario of removing energy subsidies increases GDP slightly by 0.43% relative to baseline due to the reallocation of economic resources. However, this elimination tends to reduce the total welfare. The household consumption declined by 1.53% relative to baseline. This reduction is largely due to the removal of fuel subsidies (1.22%). The impact is biased against poor households in urban and rural. More specifically, the bias to the poor households is largely due their dependence on consumption of kerosene. On the other hand, there is no such bias from the elimination of electricity subsidy. The greater impact is the non-poor households.

The simulation with short-run closure was conducted to see the short-run adjustment (short-term) from the elimination of energy subsidies. The total potential emissions reduction in the short-run is only 2.92%, smaller when compared with long-term closure of 6.66%. Here, GDP falls by 0.5% which is mainly due to the reduction in employment of around 1.08% relative to the baseline. In the short-run, capital cannot move across sectors hence the economy cannot responses optimally to the changes in relative price of energy which in turn impede the reduction of energy consumption reduction.

From the standpoint of the government budget, fuel and electricity subsidies add to the budget surplus by 47.8 trillion rupiah. The government expenditure on subsidies declines by 60.5 trillion rupiahs. However, there is a reduction in government revenue caused by a decrease in corporate income tax amounted to 12.7 trillion. The reduction in government revenue is caused by a drop in corporate profits as a result of the contraction that occurred in the energy-intensive and capital intensive sectors.

3.2. Carbon Tax Scenarios

The carbon tax scenario is to assign the sales tax on fossil fuels consumption i.e. coal, petroleum and natural gas based on the carbon content of each respective fuel. This scenario is chosen for the following reasons.

Carbon tax is considered the most effective way to change the energy mix toward a greener energy-blend. Engineering or technical perspective usually argues of promoting directly a better energy mix but without detail on how to achieve that. In a market economy, this needs to be achieved by engineering relative prices of energy and in particular a carbon taxing. We can have a target of energy mix, but in a market mechanism, energy mix is endogenous and not a policy variable or instruments. Carbon tax, on the other hand is a policy variable and instrument.

Other alternative instrument is to provide a subsidy for renewable energy, in this case the hydro power and geothermal. This scenario can be done by giving a price subsidy to the sector, effectively changing relative price of energy which is better for the emissions reduction target. This scenario could have been done but its impact, in principle, is similar to the imposition of carbon taxes. In addition, because the current share of renewable energy is very small, such a price subsidy may not have a significant impact on the emissions reduction.

The carbon tax scenario was conducted in order to achieve the remaining 14 percent[6] emission reduction targets right after the removal of fuel and electricity subsidies. The simulation suggests that the carbon tax this can be done by imposing a carbon tax of only US$ 2.8 per ton of CO2 (see table 3.3). Emission reductions amounted 7.36%, which is sufficient to meet the emissions reduction target of 14%. The largest emission reduction is from coal (18.8%).

In contrast to fuel subsidy removal scenario, where most of the emissions reduction was caused by a reduction in energy intensity or overall energy consumption, in the carbon tax, emissions reduction is caused more by changes in the energy mix. From the overall reduction of 7.6 percent, only 2.7% is attributed the reduction in energy consumption (See its illustration in Figure 2). The rest is caused by the change in the energy composition. The share of coal in the energy mix has declined from 22.7% to 19.5%, along with the increase in the share of renewable energy, although with a lot less amount. The carbon tax scenario also tends to be biased against urban non-poor household groups.

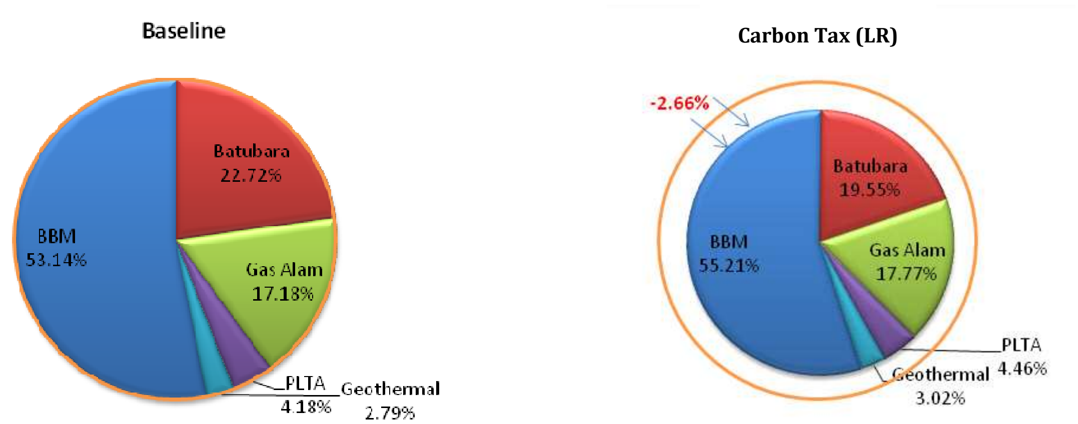

Figure 2: Illustrative impact of carbon tax on energy intensity and energy mix

The carbon tax scenario is found to remedy the tendency of fuel subsidy removal scenario to switch the fuel use to coal consumption. The carbon tax is thus highly complementary to the fuel subsidy elimination scenario.

[6] The 14% emissions reduction is based on some discussions in the Ministry of Finance.

Table 3: Simulated impact of carbon tax and mixed policies (% relative to baseline)

	Long run			Short run adjustment		
	Carbon Tax	**Fuel + Electricity + Carbon Tax**	**Fuel + Electricity + Carbon Tax + Recycling**	**Carbon Tax**	**Fuel + Electric + Carbon Tax**	**Fuel + Electric + Carbon Tax + Recycling**
CO2 emissions	**-7.36**	**-14.00**	**-14.00**	**-6.94**	**-9.63**	**-8.65**
Hydroelectric	0:00	0:00	0:00	0:00	0:00	0:00
Geothermal	0:00	0:00	0:00	0:00	0:00	0:00
Coal	-18.83	-17.17	-19.46	-18.31	-20.86	-21.64
Natural Gas	-0.37	-0.41	-0.29	0:08	5:18	5.71
Fuel	-1.99	-14.31	-13.04	-1.63	-5.59	-3.56
GDP	**0:02**	**0:44**	**0:48**	**-0.04**	**-0.54**	**0:13**
Energy consumption	**-2.66**	**-16.36**	**-15.51**	**-2.02**	**-5.77**	**-4.11**
Energy intensity	**-2.68**	**-16.80**	**-16.00**	**-1.98**	**-5.23**	**-4.24**
Energy mix						
Hydroelectric	0:29	0:56	0.63	0:24	0:16	0:19
Geothermal	0:23	0.71	0.73	0:15	0:26	0:24
Coal	-3.17	-0.18	-0.84	-3.18	-3.09	-3.49
Natural Gas	0:58	-2.49	-2.63	0.87	1:03	0.86
Fuel	2:07	1:40	2:11	1.91	1.64	2:20
Total	0:00	0:00	0:00	0:00	0:00	0:00
Household Consumption	**-0.24**	**-1.74**	**0.62**	**-0.25**	**-1.99**	**0.40**
HH Rural Poor	-0.19	-2.35	0:00	-0.17	-1.77	0:00
HH Rural Non-Poor	-0.19	-1.05	1:55	-0.24	-1.81	0.92
HH Urban Poor	-0.20	-2.59	0:00	-0.16	-2.19	0:00
HH Urban Non-Poor	-0.27	-2.11	12:11 a.m.	-0.26	-2.10	12:11 a.m.
Job opportunities	**0:00**	**0:00**	**0:00**	**-0.07**	**-1.16**	**0:06**
Carbon Tax (U.S. $)	**2.80**	**2.80**	**3:30**	**2.80**	**2.80**	**3:30**
Energy Tax						
Hydroelectric	0:00	0:00	0:00	0:00	0:00	0:00
Geothermal	0:00	0:00	0:00	0:00	0:00	0:00
Coal	23.73	23.85	28.64	23.80	23.70	28.65
Natural Gas	1.82	2:57	3:08	1.83	2:52	3:02
Fuel	2:01	1.77	2:12	2:02	1.97	2:37

Table 4: Changes in Government Budget (Billion Rupiah)

Long run

Government Budget	**Carbon Tax**		**Petrol & Electricity + Carbon Tax**		**Petrol & Electricity + Tax & Recycling Carbon**	
	Income	**Expenditure**	**Income**	**Expenditure**	**Income**	**Expenditure**
Indirect Tax	-212.82	0:00	-962.57	0:00	-62,625.41	0:00
Carbon tax	8,095.81	0:00	7,452.88	0:00	9,022.75	0:00
Import Tariff	-197.62	0:00	-1,002.94	0:00	2.68	0:00
Household Income Tax	-153.27	0:00	-1,811.83	0:00	10:13	0:00
Corporate Income Tax	-1,080.67	0:00	-13,678.59	0:00	-7,603.69	0:00
Government Transfers	1,203.96	1,203.96	-1,866.06	-1,866.06	-11,424.14	-11,424.14
Transfer of Foreign Affairs	0:08	0.96	-11.30	-137.62	-4.95	-60.27
Revenue Production Factors	0:00	0:00	0:00	0:00	0:00	0:00
Consumption	0:00	-86.94	0:00	-1,914.38	0:00	-891.71
Subsidy	0:00	-712.45	0:00	-60,194.09	0:00	-60,049.19
Transfers to Households	0:00	9:36	0:00	-1,338.66	0:00	-197.31
Surplus / Deficit Budget	0:00	7,240.59	0:00	53,570.40	0:00	0:00
TOTAL	7,655.48	7,655.48	-11,880.40	-11,880.40	-72,622.62	-72,622.62

Short run adjustment

Government Budget	**Carbon Tax**		**Petrol & Electric + Carbon Tax**		**Petrol & Electric + Tax & Recycling Carbon**	
	Income	**Expenditure**	**Income**	**Expenditure**	**Income**	**Expenditure**
Indirect Tax	-162.05	0:00	-1,645.57	0:00	-66,251.24	0:00
Carbon tax	8,137.22	0:00	7,874.25	0:00	9,623.38	0:00
Import Tariff	-170.66	0:00	-966.53	0:00	19:49	0:00
Household Income Tax	-117.12	0:00	-1,573.31	0:00	177.15	0:00
Corporate Income Tax	-828.21	0:00	-13,921.24	0:00	-3,981.37	0:00
Government Transfers	1,280.23	1,280.23	-1,909.20	-1,909.20	-11,289.16	-11,289.16
Transfer of Foreign Affairs	0.79	9:58	-4.86	-59.22	0:05	0.60
Revenue Production Factors	0:00	0:00	0:00	0:00	0:00	0:00
Consumption	0:00	84.14	0:00	-290.30	0:00	-488.68
Subsidy	0:00	-213.76	0:00	-60,264.14	0:00	-60,094.13
Transfers to Households	0:00	93.18	0:00	-576.07	0:00	169.71
Surplus / Deficit Budget	0:00	6,886.83	0:00	50,952.47	0:00	0:00
TOTAL	8,140.19	8,140.20	-12,146.46	-12,146.46	-71,701.66	-71,701.67

We also run two other scenarios: (1) combining both energy subsidy removal and carbon tax (2) combining both energy subsidy removals with revenue recycling i.e., reducing the rate of indirect tax to production and transfers to poor households to keep their welfare unchanged. As can be seen from the table, with this combined instruments the policies of reducing carbon emissions can be implemented without hurting the poor and minimizing the potential of employment loss while maintaining the budget relatively unchanged.

4. Concluding Remarks

This paper attempts to contribute to the policy design in achieving emission reduction target from the energy sector by looking directly at fiscal instruments under the discretion of Indonesian the Ministry of Finance. For this purpose, we simulated a scenario of engineering the energy relative prices through pricing-instruments as an effective way to achieve a given target of reducing emissions from the energy sectors using AGEFIS-E model.

Simulation with AGEFIS-E suggested potential reduction of these emissions from abolishing fuel subsidy amounted to 6.66% relative to baseline. Nevertheless, as fuel composition in the energy mix declines (from 53% to 51.76%), there is a fairly large increase in the composition of coal. As coal became cheaper to fuel, the portion of the coal in the energy mix (which was initially amounted to 22.7%) raised after the reduction in fuel subsidies (to 26.2%). This calls for an introduction of carbon tax to avert the perverse incentive in switching from oils to coals amounted to 23.7% on coal against 1.8% of natural gas and fuel oil 2%. This is equivalent to the imposition of carbon tax of US$ 2.8 per tonne of CO2. Emission reductions amounted 7.36%, which is sufficient to meet the emissions reduction target of 14%.

To conclude, our analysis suggests that removing energy subsidy (fuel and electricity) can contribute to significant reduction in carbon emissions while adding a carbon tax to the policy mix will complement to find the best scenario to achieve a certain target of emissions reduction. In the current policy setting, where energy subsidy is still a significant component of central government budget, it suggests that this potentials of emissions reduction from the subsidy removal is still overlooked

References

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