Indonesia's Commitment to Reducing GHG and Its Impact on the Indonesian Economy: CGE Approach

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Abstract

To achieve the carbon emission target in Indonesia in 2030, what trade offs will be carried out if viewed from an economic perspective such as GDP, energy consumption? This study employs the CGE model to see the impact of imposing carbon tax on GDP and GHG emissions in Indonesia. Five scenarios have been applied to gauge the linkage between those factors. The main finding in this study is that carbon tax can reduce emissions in large numbers in Indonesia thus that carbon tax can be used as an effective emission control instrument. However, what needs to be concerned is the impact of carbon tax on decreasing GDP. It is different from Singapore where the impact of carbon tax almost does not affect GDP, in Indonesia even though the tax is applied in small amounts but has a significant effect on changes in GDP.

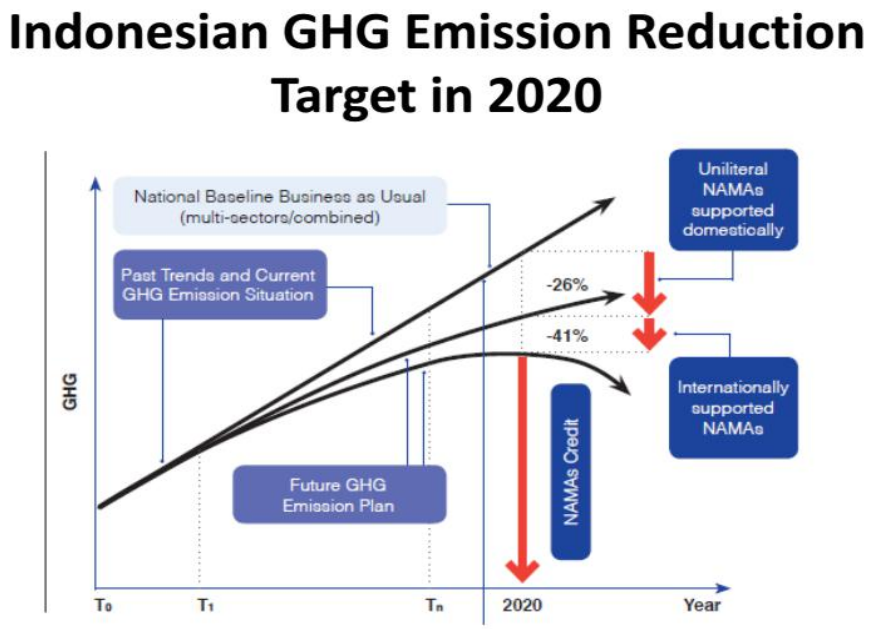
Keywords: carbon emission, GHG, carbon tax, CGE

1. Introduction

Indonesia is a member of the G20 group of countries with the largest economic growth rates in the world. As one of the countries with large economic growth and the fourth largest population after India, Indonesia has also become the top five emitters in the world. Whereas if viewed from the side of emissions generated from land use and the forestry sector, Indonesia is the first largest emitter in the world.

With the worsening of environmental conditions due to excessive degradation and climate uncertainty at the global level, the 2012 Paris agreement was agreed on which states commitments to reduce greenhouse gas emissions or commonly referred to as Green House Gases. This commitment is then realized by the countries involved in making climate policies in their respective countries.

Indonesia realizes the Paris agreement by submitting a draft of Indonesia 's Intended Nationally Determined Contribution (INDC), which in broad outline is Indonesia's commitment to reduce CO2 by 29 percent by 2030.



Source: Guideline for Implementing Green House Gas Emission Reduction Action Plan

In other countries that are members of the G20 as well as countries that are not members of the G20, they have started to be concerned with the issue of GHG long before Indonesia is involved in the collaboration, the majority of these countries apply carbon tax which is the tax rate for carbon in order to reduce CO2 emissions so that stock pollution in the environment can be reduced. In many countries with rapid economic growth, they apply carbon tax tariffs to reduce CO2 emissions.

In Indonesia, the existence of a carbon tax starting as a study material is even an alternative consideration for achieving the agreed carbon emissions target. However, there are consequences that must be avoided from the reduction of CO2 emissions, namely participating in the decline in economic growth. This is

supported by research in countries such as China, South Africa and Singapore which will also realize carbon tax in the Southeast Asia region.

To achieve the carbon emission target in Indonesia in 2030, what trade offs will be carried out if viewed from an economic perspective such as GDP, energy consumption? This paper will try to answer these questions with the CGE approach. The next section (II) of the paper will discuss the literature review, section III discusses the CGE and GTAP models, section IV regarding the results and discussion, and conclusions will be displayed in the final section.

2. Literature Review

The research conducted by Liu, Huang, Huang, Baetz, & Pittendrigh (2018) uses the Computable General Equilibrium model to see the impact of applying carbon tax on the socio-economic system in the province of Canada and supports the implementation of carbon tax to reduce GHG in the region. The analysis is carried out by applying five different carbon taxes to see the relationship between carbon tax, reduction of emission of GHG, and its impact on economic growth. Several other macroeconomic variables were added and observed responses from more specific sectors to better understand their relevance to economic conditions.

The results show that GDP and carbon tax are negatively related. It means that along with the carbon tax, economic growth will decline. The GDP component is then broken down to nominal GDP and real GDP. In addition, the GDP component is also the sum of consumption, investment, government expenditure so that it can be seen which expenditures will be affected by carbon tax.

The findings show that the carbon tax will reduce GHG emissions but will cause a contraction for the economy, which means that the higher the carbon tax is applied, the economy will experience a significant decline as indicated by a decrease in GDP. In an economy based on natural resources (resource based) whose cases are similar to Indonesia, this study concludes that the existence of carbon tax will simply result in a decision to contract economy activity rather than making adjustments.

Products such as coal and petroleum are the biggest contributors to GHG emissions reductions which indicate that only clean technology in these two sectors will be a crucial issue in achieving economic growth and reducing GHG emissions simultaneously in the future. This is what also needs to be considered in Indonesia as one of the producing countries and consuming the biggest fuel.

By looking at the industrial sector that is growing rapidly and requires raw materials from the side of coal and petroleum, there needs to be a policy in the future to better utilize environmentally friendly technology so that achieving clean environmental targets with reduced GHG emissions can be achieved. In addition, based on research from WRI that Indonesia is a country with high energy use, especially in terms of transportation, it is also necessary to make policies from this aspect. Policies can be adopted by applying and ensuring the use of bicycles or promoting the use of private vehicles or by converting fuel tanks to use gas. This needs to be considered very carefully so that Indonesia can be released from large energy dependencies. And also need to be considered how the impact tie the economy side.

Research conducted by Lin & Jia (2018) states that carbon tax is a policy tool that can be used to reduce global emissions. This paper applies 9 scenarios taking into account the different levels of carbon tax and different industrial sectors that are taxed. The research objective is to analyze the impact of carbon tax system (CTS) on energy, environment and economy.

The result is a negative effect of the carbon tax system (CTS) on GDP which represents the economic condition with a maximum scenario not exceeding 0.5%. If carbon tax is applied to the energy intensive sector, the impact of reducing carbon is still relatively small even though high taxes have been applied.

The carbon tax rate follows the law "law of increasing marginal emission reduction" which means that the higher the carbon tax rate is set, the greater the CO2 emissions can be reduced. In conclusion, in this paper, the focus of carbon tax needs to be directed at energy companies. In this way energy market efficiency can be done to achieve energy conservation in the future and reduce CO2 emissions. This paper advises China to adopt a carbon tax system (CTS) simultaneously with high taxes in the energy sector and the sector that uses energy intensively. Because this will reduce emissions and only have a small impact on GDP.

3. Simulation and GTAP-E Model

4.1. Scenario

This study follows the scenario in Lirong Liu's research (2018) which applies 5 carbon tax scenarios using Canadian dollars. While in this study, carbon tax is expressed in US dollars, which is US$ 10/tonne, US$ 20/tonne US$ 30/tonne, US

$ 40/tonne, US$ 50/tonne assuming the rupiah exchange rate against the dollar is Rp14,000/US. Based on Lirong Liu (2018), this research uses the Computable General Equlibrium (CGE) approach which assumes that there is a balance between market factors (input) and commodity markets (output).

The variable to be observed is GDP which represents the level of economic growth of a country. GDP is divided by value or in nominal value and real GDP in units of quantity. Other variables observed were the reduction of GHG emissions and emissions per sector in Indonesia.

4.2. Aggregation and Analysis

The analysis was carried out using the GTAP-E (Global Trade Analysis Project)-Energy version 9A from Purdue University using a database in 2011. The aggregated sectors became coal, oil, gas and oil products to see the impact of carbon tax imposition in more detail on the sector energy because Indonesia is still a net importer and has a large dependency on this sector. While the state aggregation consists of Indonesia, Singapore, the rest of Southeast Asia, East Asia, South Asia, America, Mena, EU and RestofWorld.

4. Results and Analysis

To see the impact of carbon tariffs, especially related to Indonesia's commitment in reducing greenhouse gas emissions, the focus of the analysis will be directed at the country of Indonesia and as a comparison analysis will be carried out for Singapore countries that have planned to implement carbon tax in 2019 in the Southeast Asia region. . The results to be observed in this study include the impact

of carbon tax on change in value of GPD (VGPD), GDP quantity index (qgdp), CO2 emission and specific impacts on sectors in Indonesia.

5.1. Interrelationships Among Carbon Tax And Economic Growth

Previous studies such as Lin & Jia (2018) and Liu et al. (2018) has confirmed the relationship between carbon tax, greenhouse gas emission and economic growth. The growing opinion and consensus stated that the impact of the carbon tax on GDP representing economic growth was negative. This means that the higher the carbon tax that is applied it will reduce a country's economic growth.

For cases in Indonesia as one of the developing countries and still highly dependent on energy and fuel use in the production process, the use of carbon tax is also very logical and can have a major impact on the economy. The results of this study are presented in the following table.

Table 1. The Impact of Carbon Tax on Value of GDP

Negara	Sim 1	Sim 2	Sim 3	Sim 4	Sim 5
Singapore	0,60	1,14	1,65	2,14	2,61
Indonesia	0,86	1,41	1,81	2,13	2,40
East Asia	0,18	0,37	0,55	0,74	0,93
Southeast Asia	0,44	0,81	1,14	1,45	1,73
South Asia	0,11	0,40	0,74	1,08	1,42
Namerica	0,43	0,79	1,11	1,40	1,67
Eu_25	0,63	1,20	1,72	2,21	2,68
Mena	0,08	0,06	0,02	-0,04	-0,10
Row	0,14	0,21	0,24	0,24	0,21

Source: GTAP-E, processed

To recall, simulation 1 applied a carbon tax of 10 US$/tonne CO2, simulation 2 applied 20 US$/tonne, simuation 3 applied 30US$/tonne, simulation 4 applied 40US$/tonne and simulation 5 applied 50 US$/tonne. Based on the table above, it

can be observed that the carbon tax can influence the GDP (Gross Domestic Product) value in Indonesia of 0.86 in the first simulation. When compared to countries in the Southeast Asia such as Singapore and the rest of Southeast Asia, the change in GDP in Indonesia is the highest. In the results shown in the table, a positive sign can be an indication that the increase in carbon tax actually contributes positively to the increase in the value of GDP in Indonesia. This is contrary to what Ayu found (2018) for the same case in Indonesia that changes in carbon tax actually have a negative impact on the value of GDP in Indonesia.

The problem with this sign cannot be interpreted raw, because it requires in-depth analysis of the actual economic conditions in Indonesia such as the relationship between one sector and another sector, and how much industry and business sector dependence on fuel that produces a lot of emissions.

Table 2. The Impact of Carbon Tax on GDP Quantity Index

qgdp	pre sim	post sim 1	post sim 2	post sim 3	post sim 4	post sim 5	qgdp (%)				
							sim 1	sim 2	sim 3	sim 4	sim 5
Sgp	274064,72	274082,13	274085,91	274078,53	274061,69	274036,66	0,01	0,01	0,01	-0,00	-0,01
Idn	845924,75	845996,25	845856,13	845600,56	845271,00	844888,63	0,01	-0,01	-0,04	-0,08	-0,12
EastAsia	15220268,00	15204992,00	15185615,00	15165583,00	15145682,00	15126079,00	-0,10	-0,23	-0,36	-0,49	-0,62
SEAsia	1072128,63	1071814,13	1071203,38	1070408,25	1069486,25	1068470,88	-0,03	-0,09	-0,16	-0,25	-0,34
SouthAsia	2305594,50	2303183,50	2300484,75	2298020,50	2295741,25	2293543,75	-0,10	-0,22	-0,33	-0,43	-0,52
NAmerica	18490694,00	18483692,00	18473872,00	18462312,00	18449614,00	18436150,00	-0,04	-0,09	-0,15	-0,22	-0,29
EU_25	17368588,00	17367446,00	17364792,00	17361080,00	17356556,00	17351374,00	-0,01	-0,02	-0,04	-0,07	-0,10
MENA	3988132,50	3987255,25	3984699,25	3981588,75	3978317,75	3974972,50	-0,02	-0,09	-0,16	-0,25	-0,33
RestofWorld	4085432,75	4083327,75	4080409,50	4076794,50	4072509,00	4067583,50	-0,05	-0,12	-0,21	-0,32	-0,44

Source: GTAP-E, processed

Even if it is viewed from the side of Indonesia's GDP value, it will increase due to the carbon tax, but if viewed from Indonesia's GDP quantity, it will decline. Analysis will be carried out between Indonesia and Singapore because Singapore will first implement carbon tax policies in the Southeast Asia region.

If seen in simulation 1 (ie the imposition of low carbon tax), the impact caused by the carbon tax between Indonesia and Singapore is the same, namely 0.01. However, when the tax was raised, Indonesia began to show a negative response from the side of GDP while Singapore was still constant.

In the subsequent simulations that apply the increase in carbon tax, it can also be seen that the impact on the decline in GDP is also increasing. In the 5th simulation with the implementation of a carbon tax of 50 US $ / tonne, Indonesia was affected by -0.12 while Singapore was only -0.01. The implication that arises is that there is a large tradeoff in economic growth when the government decides to use carbon tax in order to reduce CO2 emissions in accordance with the commitments it wants to carry out. Graphical comparisons can be seen as follows:

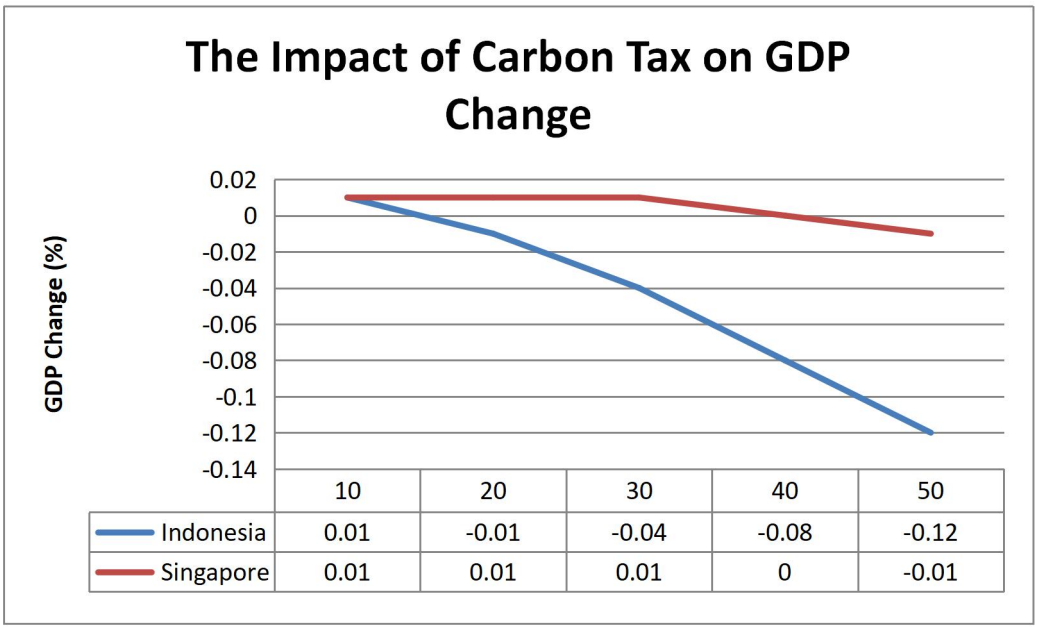


Figure 1. The Impact of Carbon Tax on GDP Change in Indonesia and Singapore

From the picture, it can be seen that the carbon tax policy that will be carried out by Singapore does not have much impact on economic growth. From the 1st to 3rd simulation, even the impact still looks stable at 0.01. The imposition of 40 US $ also did not have much impact on the economy in Singapore. Only when the carbon tax was applied with a high value of 50 US $ / tonne, GDP in Singapore began to show a decline. Simple conclusions that can be taken are, however, that the tax applied in Singapore (both low and high) does not affect much of the GDP in that country. That is, the country has indeed been quite stable, maybe even before the tax of economic sectors has been directed to be environmentally friendly.

While the conditions that occur in Indonesia are the opposite. A small carbon tax has made Indonesia's GDP react negatively. In the second simulation with 20 US $ / tonne until the last simulation, Indonesia continued to experience a

decrease in quantity in GDP. This shows that there are still many sectors in Indonesia that have not yet been efficient and have not been environmentally oriented. To continue to carry out its commitments, Indonesia needs to think about serious steps regarding the trade off.

5.2. Carbon Tax and GHG (Green House Gases) Reduction

In many countries, carbon tax becomes an emission control instrument that is quite easy to implement. Its influence is quite effective in reducing greenhouse gases as in the research conducted by Lin & Jia (2018). Based on the simulation with the five scenarios above, the following results are obtained:

Table 3. The Impact of Carbon Tax on CO2 Emission

gco2tb	sim 1	sim 2	sim 3	sim 4	sim 5
Sgp	-1,42	-2,84	-4,22	-5,53	-6,77
Idn	-5,39	-9,30	-12,40	-14,99	-17,22
EastAsia	-15,55	-24,44	-30,32	-34,61	-37,96
SEAsia	-5,74	-10,22	-13,89	-17,02	-19,73
SouthAsia	-26,92	-35,70	-40,33	-43,30	-45,47
Namerica	-6,90	-12,41	-16,96	-20,83	-24,18
EU_25	-3,16	-5,82	-8,12	-10,17	-12,02
MENA	-9,77	-15,79	-19,69	-22,49	-24,67
RestofWorld	-6,85	-12,20	-16,61	-20,35	-23,58

Source: GTAP-E processed

From the simulation results, it was found that all countries experienced a decline in CO2 after the implementation of carbon tax both in the Southeast Asia region which is still synonymous with developing countries and in Europe and America as developed countries that are already based on industrial sectors. Of all simulations, the biggest decline occurred in the South Asia region with a range of 27 to 45 percent. While the second largest decline occurred in countries in the East Asia region.

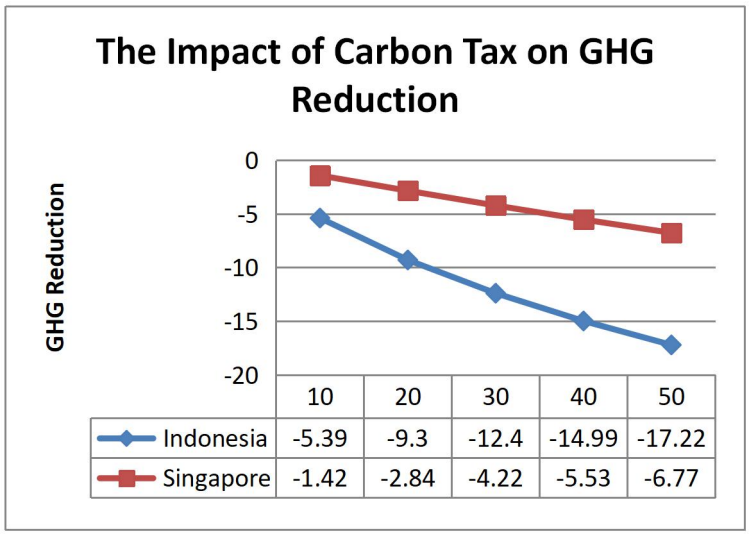


Figure 2. The Impact of Carbon Tax on GHG Emission (Indonesia and Singapore)

In the Southeast Asia region and Indonesia, the average emission reduction is around 5 percent when the lowest carbon tariff is applied. While Singapore only experienced a decline in the range of 1.5 percent. In the second simulation, Indonesia showed a decrease in CO2 which almost reached twice that of the first simulation. Until the fifth simulation, with a carbon tariff of 50 US $ / tonne it can reduce CO2 by more than 17 percent. Whereas in Sinagapore only less than half is 6.77. This shows that the carbon tariff policy has proven effective in reducing CO2 emissions in Indonesia, considering that Indonesia is one of the five largest emitters in the world. But what also needs to be remembered is the consequences that arise from the imposition of these tariffs that can reduce economic performance.

As one country that is still very dependent on natural resources, especially fossil fuels, it is still very difficult for Indonesia to switch to renewable energy or gas. The high consumption of companies, communities and the government,

which is exacerbated by the technological level that is still not developed makes Indonesia have to prepare a lot of things to be able to achieve emissions reduction commitments in accordance with what is stated in the INDC manuscript.

5.3. The impact of carbon tax on CO2 Emissions by Sector in Indonesia

To see how the impact of carbon tax per sector in Indonesia is carried out an analysis of the main sectors that might contribute greatly to reducing emissions, namely coal, oil, gas, and oil pcts. Coal is a fuel that is widely used by large industrial sectors in Indonesia. Therefore, the tax imposition is expected to have a major impact on this sector.

Table 4. Carbon tax emission per sector

gco2[Idn*]	sim 1	sim 2	sim 3	sim 4	sim 5
1 coal	-14,17	-23,65	-30,60	-35,99	-40,32
2 oil	-5,77	-10,28	-13,90	-16,88	-19,40
3 gas	-4,98	-9,11	-12,67	-15,83	-18,66
4 oil_pcts	-0,89	-1,78	-2,67	-3,57	-4,46

Source: GTAP-E, processed

In the first simulation, the main contributors to reducing CO2 emissions in a row were coal, oil, gas and oil products with a total of -14.14 percent, -5.77 percent, -4.98 percent and -0.89 percent. In subsequent simulations, these sectors did not change and showed a downward trend when carbon tax was increased. Until the last simulation that applied the highest carbon tax, GHG emission could have more than tripled.

If we look further, the sectors that contribute to the emission reduction are in fact a sector that functions as fuel used by industry and society. For example for example oil products components which consist of petroleum which is widely used as motor vehicle fuel. Given that Indonesia's transportation growth is quite

rapid, this decline needs to be followed up, such as converting to gas. There are also many energy sectors that are still imported so that further policies need to be taken into account..

5. Conclusion

This study employs the CGE model to see the impact of imposing carbon tax on GDP and GHG emissions in Indonesia. Five scenarios have been applied to gauge the linkage between those factors. The main finding in this study is that carbon tax can reduce emissions in large numbers in Indonesia thus that carbon tax can be used as an effective emission control instrument. However, what needs to be concerned is the impact of carbon tax on decreasing GDP. It is different from Singapore where the impact of carbon tax almost does not affect GDP, in Indonesia even though the tax is applied in small amounts but has a significant effect on changes in GDP.

This tradeoff needs to be considered when the government wants to reduce GHG in 2030. Will it still fulfill its commitment to reduce CO2 emissions with the consequence of lowering economic growth or does the government want to maintain economic growth with the consequences of the emission target not being achieved. Strategic steps need to be taken into account in the future, for example by starting to use new technology for sectors that contribute to GHG emissions such as coal, oil and gas.

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