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Economic Impact of the Emission-Reduction Policy: GTAP-E Model

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ABSTRACT

Increasing greenhouse gas (GHG) emissions is a severe global health and well-being problem. Countries around the world are striving to overcome climate change-related problems. This study analyzes the economic impact of Indonesia's emission-reduction policy of a carbon tax along with B40 renewable energy and trade regulation policies. This study uses a general equilibrium approach with several simulations of the Global Trade Analysis Project-Energy (GTAP-E) model. The GTAP-E approach analyzes the interaction between trade and energy policies. The GTAP-E model can simulate specific policies in government plans to assess their impact on macroeconomic conditions, bilateral trade, and the energy sector. The study results show that emission-reduction and trade regulation policies decrease inflation rates, economic growth, and welfare. According to bilateral trade research, Indonesia's crude palm oil (CPO) exports to India and China have increased, producing a trade surplus. This result demonstrates an increase in trade competitiveness despite trade regulations. These findings reveal that, while emission-reduction policies can impact economic growth in the short term, they can also boost international trade positions, support the transition to a low-carbon energy system, and achieve sustainable economic development.

Keywords: Carbon Tax, Greenhouse Gas Emission, GTAP-E, Growth, Sustainable Development, Trade Balance
JEL Classifications: F1, Q48, Q56, Q58

1. INTRODUCTION

In recent decades, climate change has received significant attention globally. Increased greenhouse gas (GHG)_ emissions are the leading cause of climate change, seriously impacting the environment and human well-being (Gielen et al., 2019; Mikhaylov et al., 2020). Energy is an essential commodity in many economic activities, and its use can increase CO_2 emissions and the greenhouse effect (Ertugrul et al., 2016). Thus, the energy sector is the main focus in climate change mitigation efforts, with many countries developing and implementing more sustainable renewable energy policies (Wuri, 2024b).

As the largest developing country in Southeast Asia, Indonesia plays a strategic role in global efforts to address climate change. Indonesia's position as the largest energy consumer in the region, coupled with its rapid economic growth, creates challenges and opportunities for the global energy transition (Purnomo et al., 2020). The oil and gas trade deficit reflects a high dependence on fossil fuels, reaching USD 15.92 billion in 2023. Additionally, the trade war tensions between the United States and China and the geopolitical crisis have increased world oil prices, resulting in a trade balance deficit and disrupting the global trade supply chain (Itakura, 2020; Wuri et al., 2023). International trade regulations, such as tariffs, can significantly impact the global energy market and the adoption of renewable energy policies (Balogh and Mizik, 2023). Changes in trade policies can affect the competitiveness of renewable energy technologies and the flow of energy commodities between countries. Many countries, including

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Indonesia, are addressing these challenges by reducing GHG emissions (Gielen et al., 2019; Nong et al., 2021).

Indonesia has shown a strong commitment to address this challenge through a series of strategic policies. Presidential Regulation No. 98 of 2021 established a target of reducing GHG emissions by 30% by 2030 in the business-as-usual scenario, which was adjusted to 31.89% based on the nationally determined contribution (NDC). This target is stated in the NDC document, an essential aspect of the Paris Agreement. Implementing this policy is supported by the Ministry of Energy and Mineral Resources Regulation No. 9 of 2023, encouraging the use of renewable energy, including the B40 biodiesel program, utilizing 40% vegetable oil derived from CPO as a fuel mixture.

Indonesia's position as the world's largest palm oil producer provides a comparative advantage in developing biodiesel (Pambudi et al., 2023). The B40 program, planning to be upgraded to B50, aims to reduce dependence on fossil fuel imports and support reaching national emission-reduction targets (Hong, 2023). However, implementing this policy requires considering the various economic impacts that may arise, including changes in trade patterns, production structures, and people's welfare. The success of renewable energy policies, such as the B40 program, also depends on the dynamics of international trade and the regulatory environment.

A carbon tax must be implemented to achieve the emission-reduction target (Konradt and Weder Di Mauro, 2023; Kura and Kawarazuka, 2021; Yahoo and Othman, 2017). Carbon emissions are negative externalities affecting the environment. Implementing a carbon tax of IDR 30,000 (equivalent to USD 1.91) per tCO_2e incentivizes producers and consumers to switch to cleaner energy sources. Revenues from carbon taxes can be allocated to support developing biodiesel production infrastructure and technologies, creating a more efficient value chain in the renewable energy industry.

Carbon taxes have become an increasingly popular policy instrument for controlling CO_2 emissions. Empirical studies show that carbon taxes can effectively reduce emissions, although the impact on economic growth varies across countries (Andrianus et al., 2024; Gurtu et al., 2022). Research from different countries indicates that the impact of carbon tax policies depends on policy design, the use of tax revenues, and coordination with other energy policies (Konradt and Weder Di Mauro, 2023).

Research has been conducted on liberalization's impact on sectors in several countries to achieve a general balance with the GTAP model. However, there is limited research using GTAP-E for analyzing energy policy (Ertugrul et al., 2016; Nong et al., 2021). This study attempts to fill this gap in understanding the comprehensive impact of emission-reduction policies in Indonesia. This study aims to analyze emission-reduction policy's economic implications through implementing a carbon tax and trade regulation policies using the GTAP-E model.

The remainder of this article is structured as follows. A literature review is introduced in section 2. The methodology is presented in section 3. The results and discussion are presented in section 4, while the final section concludes with significant policy findings and recommendations.

2. LITERATURE REVIEW

Global climate change caused by increased GHG emissions is one of humanity's most significant challenges. GHGs have heat in the atmosphere, producing the greenhouse effect and global warming. Studies show that human activities, especially those involving the use of fossil fuels and deforestation, have significantly increased GHG concentration in the atmosphere since the industrial era (Gielen et al., 2019; Mikhaylov et al., 2020).

Renewable energy policies aim to reduce GHG emissions by replacing fossil energy sources with cleaner and more sustainable energy sources. Renewable energy includes solar, wind, water, biomass, and geothermal energy. Governments worldwide, including Indonesia, have adopted these policies to reduce dependence on fossil fuels, improve energy security, and mitigate climate change (Gielen et al., 2019; Nong et al., 2020). Indonesia has taken significant steps toward implementing renewable energy policies to reduce GHG emissions. A central policy is using Crude Palm Oil (CPO) as a biofuel in the form of biodiesel. Implementing the B40 policy, mixing 40% vegetable oil with diesel, is expected to reduce dependence on diesel imports, reduce the trade balance deficit, and support the country's transition to a green economy (Khatiwada et al., 2021; Wuri et al., 2024; Zahan and Kano, 2018). The success of renewable energy policies, such as the B40 program, is influenced by international trade regulations. Trade liberalization can facilitate the flow of renewable energy technologies and encourage investment in the sector (Balogh and Mizik, 2023). However, trade barriers, such as tariffs and subsidies for fossil fuels, can hinder the competitiveness of renewable energy and slow down the energy transition.

Carbon tax policies can be implemented to achieve B40 renewable energy in Indonesia and reduce CO_2 emissions. A carbon tax is a policy instrument imposed on CO_2 emissions to incentivize companies and individuals to reduce their emissions. This tax increases the cost of fossil fuel production, encourages a switch to cleaner energy sources, and reduces inefficient energy consumption. Carbon taxes have been implemented in several countries as part of their GHG emission-reduction strategies and to achieve climate targets (Ertugrul et al., 2016; Olabi and Abdelkareem, 2022). Imposing a carbon tax sends a solid signal to encourage developing carbon markets, technological innovation, and more efficient, low-carbon, and environmentally friendly investments. In the development context, state revenue from carbon taxes can increase development funds, invest in environmentally friendly technologies, or support low-income communities through social programs. In the initial stage, starting April 1, 2022, the carbon tax will be applied to the coal-fired steam power plant (PLTU) sector using a tax mechanism based on emission limits (cap and trade) at a rate of IDR 30000 (equivalent to USD 1.91) per tCO2e. It will be reviewed to increase to around 5% or achieve emission reductions according to the COP 28 agreement in 2023.

The general equilibrium (GE) approach analyzes the complex interactions among different economic sectors and the impact of economic policies on the whole economy. The GTAP model can be developed by incorporating energy elements to analyze energy and international trade policies. The GTAP model allows researchers to simulate the impact of renewable energy policies and carbon taxes on the economy, production, and trade (Burniaux and Truong, 2002; Mohsin et al., 2021). The GTAP model has been widely used to study the impact of trade liberalization and tariff reduction on various sectors of the economy (Aguiar et al., 2019). However, the model has been less frequently applied to analyze the interaction between trade policies and renewable energy policies.

Previous studies have shown that implementing renewable energy policies can provide various economic and environmental benefits. For example, research in Thailand shows that promoting biofuels can reduce dependence on fossil fuels and improve energy security (Ike et al., 2020). In Vietnam, implementing the carbon tax and renewable energy policies has succeeded in lowering CO_2 emissions and supporting economic growth. Nong et al. (2019) integrated the national CGE model to analyze renewable energy policies specific to the electricity sector. They found that carbon taxes can help reduce CO_2 emissions but reduce people's welfare levels. Another study found that fuel subsidies to reduce CPO price volatility became a costly instrument; therefore, some European countries implemented climate finance policies to reduce GHGs and promote changes in the energy system that support replacing fossil sources with renewable sources (Johari et al., 2015). Renewable energy *policies* to reduce CO_2 emissions tend to decrease output and welfare levels (Johari et al., 2015; Nong et al., 2019). The impact of renewable energy policies can result in improved welfare when the imposition of carbon taxes and eliminated subsidies are accompanied by *revenue recycling*. The problems that arise are the high cost of biodiesel production and raw material prices, low capacity utilization, and low margins obtained, hindering the exploration of alternative raw materials for biodiesel production (Johari et al., 2015).

More research examining the impact of renewable energy policies with a GE approach is still needed; thus, this study is vital to fill this knowledge gap. These studies have not discussed the impact of *renewable energy* in the transportation sector on energy sector output. Neither do these studies consider critical factors in energy sector growth and macroeconomic variables in the study period, potentially changing an economy's structure and market share so that the final results based on the updated database will.

The Indonesian government has begun introducing B40 fuel and will continue to develop it, which has significant implications for the Indonesian economy. However, how this policy will affect the economy is still being determined because studies on this issue are still limited. Therefore, it is necessary to project the policy's impact on the economy and overcome the limitations of previous research. This study contributes significantly to the literature on this topic, which will help develop future environmental policies in Indonesia.

3. METHODOLOGY AND DATA

This study employs the GTAP-E model to analyze the economic impact of reducing GHG emissions. The GTAP-E model develops the standard GTAP model specifically designed to investigate energy and environmental issues. The model is advantageous in capturing the impact of energy policy on GHG emissions, modeling substitutions between different energy types, analyzing the interaction between energy policy and international trade, and evaluating the macroeconomic effects of environmental policies (Burniaux and Truong, 2002).

3.1. Database

This study uses the GTAP database version 10A, comprising 141 regions and 65 sectors with eight production factors (Aguiar et al., 2019). The data were aggregated into several areas and eight commodity sectors (Table 1). The GTAP model database includes data on the input-output of each country's economy, bilateral trade flows, transportation costs, tax and tariff information, and all other data involving social accounting matrices (SAMs) and elasticity parameters. SAMs describe the flow of income and expenditure in a national economy over some time, usually 1 year. It reports the value of all the goods and services produced and the revenue generated from their sales. Additionally, the SAM describes household income and expenses, government tax revenues and costs, investment savings and costs, and international trade. The SAM database contains fuel substitutions and provides a complete account of revenue and expenditure from carbon taxes and the treatment of carbon emissions trading. The GE model database uses data from official national accounts (Burniaux and Truong, 2002). Purdue University developed the GTAP model in 1992 using the Australian IMPACT model. It was implemented using GEMPACK software. GTAP analysis begins with a standard database, and then there are shocks with the calibration process of obtaining a new balance database. The study uses GE analysis to examine the economy, trade, and energy interconnectedness. The GE approach is the most appropriate methodology for investigating the impact of economic policies.

3.2. Production Structure

The GTAP-E model, an evolution of the GTAP model, uses a nested production structure with a constant elasticity of substitution (CES) function at each level (Burniaux and Truong, 2002; Nong et al., 2021). The GTAP-E model assumes perfect competition and a constant scale (Burniaux and Truong, 2002; Dissanayake et al., 2018). This structure allows substitution between primary inputs, substitutions between

Table 1: Regional and sectoral aggregations

Regional aggregation	Sectoral aggregations
Indonesia	Crude palm oil
India	Coal
China	Oil
ASEAN	Gas
East Asia	Energy-intensive industries
European Union	Manufacture
Rest of the World	Electricity
	Other industries

Source: Author's aggregation using the GTAP database

energy and nonenergy inputs, substitutions between different types of energy, and adjustments to production technologies in response to changes in relative prices. Inputs comprise primary (i.e., labor, capital, land, and natural resources) and secondary inputs (i.e., goods and services) used to produce other goods or services. It contains raw materials, energy, and inputs, and others. Labor inputs are divided into skilled and unskilled labor; capital includes investments in machinery, buildings, and other infrastructure used in production; land inputs are the primary inputs to the agricultural sector; and natural resources comprise oil, gas, and minerals used in production.

The GTAP model's production structure follows a tiered production structure. The first level is the substitution between capital, labor, and land. Capital, labor, and land can be substituted through the CES functions. The degree of substitution depends on the substitution set's elasticity in the model. The second level is the substitution between energy and nonenergy inputs, in which nonenergy inputs substitute energy inputs, such as electricity and fuel. The CES function captures these substitutions. The third level includes substitutions between energy sources, where energy sources, such as oil, gas, and coal, substitute one another. This model considers the different substitution elasticity for each pair of energy sources (Nong et al., 2021).

The GTAP-E model uses an input-output matrix to ensure the total number of inputs used in production equals the total number of outputs produced. The matrix covers all economic sectors and shows the relationship between inputs and outputs across sectors. The GTAP-E model allows for analyzing policy effects such as tariffs, subsidies, and carbon taxes. The impact of this policy is analyzed according to the changes in relative prices and input substitutions in the production structure. The GTAP-E model covers international trade, where goods and services are traded between countries, allowing for the analysis of how changes in trade and tariff policies affect interstate production and trade balances (Burniaux and Truong, 2002; Nong et al., 2021).

3.3. Simulation Scenario Design

In connection with the Indonesian government's commitment to comply with the 28th COP in 2023 to reduce greenhouse gas (GHG) emissions, this study develops three main scenarios. The scenarios implement a carbon tax increase of 5% per year (Dian, 2016). Additionally, to observe the prospects for CPO exports, this study also analyzes the policy impact of reducing CPO import tariffs from Indonesia by 2.5% imposed by India, Indonesia's largest trading partner. It examines the policy impact of increasing CPO import tariffs from Indonesia by 9% imposed by China. The Indian import tariff has been in effect since September 11, 2021, according to an official statement from the Department of Revenue of India's Ministry of Finance.

4. RESULT AND DISCUSSION

This section discusses the impact of emission-reduction policies by implementing carbon tax and trade regulation policies on macroeconomic conditions, bilateral trade, and the energy sector.

4.1. Macroeconomic Conditions

Table 2 shows the impact of emission-reduction policies accompanied by trade regulation policies. Implementing this policy as a commitment to reduce emissions by 31.89% based on the NDC by the Paris Agreement through implementing a carbon tax decreased Indonesia's consumer price index (CPI) by 0.03%. A carbon tax can potentially reduce inflation by encouraging a shift in energy consumption and increasing energy use efficiency. Implementing this carbon tax can change relative prices, especially rising energy costs, without significantly affecting other goods and services (Konradt and Weder Di Mauro, 2023). Relatively low inflation rates can stimulate sustainable economic development (Wuri et al., 2024), largely due to the higher investment in clean energy technologies (Bistline et al., 2023).

Applying the GTAP-E model, the world price remains because Indonesia is too small to influence global markets. Indonesia accounts for only a small part of global trade; therefore, any change in Indonesia's domestic demand does not impact world commodity prices. Consequently, a decline in Indonesia's price index will lower the terms of trade (TOT), increasing the Indonesian exporters' competitiveness in their trading partner markets. The larger the plant-based materials used for renewable energy and the higher the carbon tax, the more significant the margin. Implementing this policy will decrease the TOT by 0.019%. This is related to the use of primary energy in Indonesia, where CPO as a B40 fuel mixture has a dominant share of use. Government efforts continue to add value by increasing the dominance of downstream palm oil product exports. Therefore, domestic palm oil producers can encourage the development of more robust domestic supply chains (Purnomo et al., 2020; Wuri, 2024a).

Other vital macroeconomic variables, such as GDP, declined by 3.563%. This is due to higher production costs and reduced domestic consumption capabilities. Although carbon taxes aim to lower emissions, they can also increase production costs, reducing aggregate demand and overall GDP (Andrianus et al., 2024; Gurtu et al., 2022; Hasudungan, 2016). The impact of this decline in GDP can be mitigated through other tax reductions to maintain economic stability.

The level of community welfare is measured by the equivalent variation (EV) value, showing changes in people's welfare in response to the implementation of government policies, such as increasing carbon taxes at the same price level (Yahoo and Othman, 2017). The study results show that the decrease in EVs due to carbon taxes is 43.183%.

Emission-reduction policies through carbon taxes can decrease people's welfare. While carbon taxes may provide cleaner

Table 2: Macroeconomic impact

Variables	Unit	Change
Inflation (CPI)	%	−0.030
Terms of trade (TOT)	%	−0.019
Gross domestic product (GDP)	%	−3.563
Welfare (EV)	US$ Million	−43.183
Trade balance	US$ Million	10.946

Source: Author's aggregation using the GTAP database

environmental benefits in the long run, the direct economic burden on current generations may negatively affect welfare if not appropriately distributed. These results align with Yahoo and Othman's research (2017), which found that the necessary economic adjustments can decrease household consumption and welfare if the income generated does not effectively offset rising energy costs.

The renewable energy policy to reduce emissions through carbon taxes caused a trade balance surplus of US$ 10.946 million. Emission-reduction and trade regulation policies can result in a trade balance surplus by increasing the competitiveness of renewable energy technologies and reducing dependence on fossil fuel imports (Wuri et al., 2024). Increased renewable energy consumption helps balance carbon emissions, reducing the gap between production-based emissions and consumption. This shift reduces carbon transfer and boosts renewable energy technology production and exports, contributing to a positive trade balance (Guo et al., 2023). Decentralized energy markets and carbon trading within the energy community can facilitate efficient energy use and reduce carbon emissions, further improving the trade balance by encouraging renewable energy exports.

4.2. Bilateral Trade

Implementing the carbon tax policy to reduce CO_2 emissions within Indonesia's B40 renewable energy policy framework has significantly impacted CPO exports to India and China, Indonesia's main trading partners. The export volume of CPO from Indonesia to India increased by 0.4264%, while from Indonesia to China it increased by 0.0340% (Table 3).

The B40 renewable energy policy increases the domestic demand for palm oil as a raw material for biodiesel production (Khatiwada et al., 2021). Indonesian palm oil producers may increase production to meet this demand, resulting in a surplus of available quantities for export. Increasing production capacity can facilitate meeting both domestic and foreign demand. Along with growing biodiesel production under the B40 policy, economies of scale can reduce the overall cost of palm oil production, making the Indonesian CPO more competitive globally (Khatiwada et al., 2021).

In connection with the 28th COP in 2023, carbon emission-reduction policies to create a clean environment in the long term can be achieved through a carbon tax (Wuri, 2024b). Implementing a carbon tax incentivizes producers to adopt cleaner technologies and practices to reduce emissions. Compliance with these regulations can improve Indonesia's palm oil environmental image, making it more attractive to India and China, which are increasingly paying attention to sustainable practices in their import policies.

As other countries implement carbon taxes and renewable energy policies, the relative price and attractiveness of the Indonesian CPO may increase. If other palm oil-producing countries face higher production costs due to strict environmental regulations, Indonesia's more cost-effective production methods, supported by renewable energy policies, could make the Indonesian CPO more competitive internationally (Guo et al., 2023; Yahoo and Othman, 2017). Implementing carbon tax policies to reduce CO_2 emissions can also increase the export price index.

The B40 renewable energy policy, requiring biodiesel derived from palm oil, can produce higher value and sustainable palm oil products (Khatiwada et al., 2021). These products usually have a higher price in the global market, thus increasing the export price index. With stricter environmental regulations and the switch to renewable energy, Indonesian palm oil producers can focus on improving product quality to meet international sustainability standards. Certified sustainable palm oil often has a higher price, increasing the export price index. The shift of most palm oil production to domestic biodiesel production under the B40 policy could reduce the supply of palm oil available for export. Reduced supply during stable or increased demand could, in turn, drive up export prices.

Implementing the carbon tax policy can positively affect the CPO trade balance with India and China. India's CPO trade balance is 46.850 US$ million, while China's CPO trade balance is 36.040 US$ million (Table 3). The policy of reducing emissions by 30% has been adjusted to 31.89% based on the NDC following the Paris Agreement, encouraging producers to improve production efficiency and achieve economies of scale. This efficiency increase can reduce production costs, making Indonesian CPO prices remain competitive despite the potential for increased production costs due to carbon taxes. Implementing a carbon tax incentivizes producers to implement cleaner and more sustainable practices. This shift could enhance Indonesia's global reputation as a greener option, desirable to the Indian and Chinese markets, which are becoming more sustainability-conscious. As Indonesian CPO producers adapt to carbon taxes and trade regulations, they can develop products with higher added value. Improved sustainability and quality can provide higher export prices, improving the trade balance by increasing export revenues. The need to meet the B40 biodiesel mandate pushes producers to produce more efficiently. Increased efficiency reduces the overall cost per palm oil unit, making the Indonesian CPO competitive despite the additional carbon tax cost. A carbon tax encourages adopting sustainable practices (Hong, 2023), potentially making Indonesian palm oil more attractive to environmentally conscious international markets such as India and China, driving up demand.

4.3. Energy Sectors

Implementing emission-reduction policies through carbon tax and trade regulation policies has resulted in changes in energy sector output (Table 4). The carbon tax policy is IDR 30,000 (equivalent to USD 1.91) per tCO_2e, increasing by 5% per year to achieve the target of reducing GHG emissions by 31.89% based on the NDC. This policy increases production costs to reduce CPO production by 0.6998% (Table 4).

However, this policy can drive up production of different energy sectors, such as coal, oil, gas, oil products, electricity, and energy-intensive industries. This is possible because the revenue generated from the carbon tax can be reinvested in the energy sector, including improvements in the extraction and processing of coal, oil, and gas. Extraction technology and infrastructure

Table 3: Changes in CPO Exports from Indonesia to India and China

Variables	India	China
CPO (% change)	0.4264	0.0340
Export price index (% change)	0.004	0.0002
CPO trade balance (US$ million)	46.850	36.040

Source: Author's aggregation using the GTAP database

Table 4: Changes in energy sector output

Sectors	Output (% change)
Crude palm oil	−0.69984
Coal	0.01254
Oil	0.01795
Gas	0.01504
Energy-intensive industries	0.00479
Manufacture	0.06254
Electricity	0.01256
Other industries	0.00050
Crude palm oil	−0.69984

Source: Author's aggregation using the GTAP database

improvements can improve production efficiency, resulting in higher volumes. Increased production by the energy-intensive industry sector, including minerals, chemicals, rubber, plastic products, and metals, is 0.00479% due to the properties of raw materials, cold flow, viscosity, calorific value, cetane number, and the flash point of biodiesel can significantly affect engine compatibility, ease of combustion, storage, and transportation. Consequently, it affects the composition of palm fatty acids and their utilization for biodiesel production (Johari et al., 2015). CO_2 emission-reduction policies are essential for realizing environmental goals and a national green economy (Hong, 2023).

5. CONCLUSION

The Indonesian government issued an emission-reduction policy to address climate change through a carbon tax in connection with the regulation trade policy. This study uses the GTAP-E model to analyze GHG emission-reduction policies' economic impact to meet the government's commitments at the 28th COP 2023.

This study simulates the impact of reducing GHG emissions by establishing a carbon tax in connection with implementing B40 renewable energy to realize sustainable economic growth. Additionally, to assess the prospects of CPO exports to Indonesia's trading partners, this study also analyzes the impact of bilateral trade regulations. The determination of trade regulations includes reducing CPO import tariffs from Indonesia by 2.5% imposed by India as Indonesia's largest trading partner, as well as the policy of increasing CPO import tariffs from Indonesia by 9% imposed by China.

The study results show that the policy reduces inflation, TOT, economic growth, and welfare levels. The policy impact on Indonesia's bilateral trade with its central trading partners—India and China—shows positive developments, as can be seen from the volume of CPO exports, which has increased with competitive export prices. Trade regulation policies can improve the trade balance surplus. However, emission-reduction policies change the percentage of output in the energy sector. CPO output has decreased while other energy sectors have increased. The government must evaluate the carbon tax policy and increase the added value of downstream palm oil products to achieve sustainable economic development.

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