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Assessment of TRAIN's Coal and Petroleum Excise Taxes: Environmental Benefits and Impacts on Sectoral Employment and Household Welfare

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Abstract

The study assesses the impact of the first package of the Tax Reform for Acceleration and Inclusion (or TRAIN), which includes an increase in petroleum and coal excise taxes, passed by Congress in 2017. The study also reviews the context of the energy sector in the country given that petroleum and coal are the largest sources of energy in the country. Using a computable general equilibrium- microsimulation model, this paper focused on the impact of the increase in petroleum and coal excise taxes and the whole TRAIN 1 package (which includes a reduction in the personal income tax and the broadening of the value added tax). Results from the simulations indicate a slight adverse output effect for most industries under an increase in petroleum and coal taxes scenario. Under the whole TRAIN package, the output effects are slightly positive, especially for the several agriculture and service sectors, resulting in a higher level of carbon emissions. There is a slight rise in employment under the whole package, but poverty incidence increases slightly as excise taxes have an adverse effect in terms of higher commodities prices among the poor.

Keywords: tax reform, computable general equilibrium, microsimulation, excise tax, coal, petroleum

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Assessment of TRAIN's coal and petroleum excise taxes: Environmental benefits and impacts on sectoral employment and household welfare

Czar Joseph Castillo, Ramon Clarete, Marjorie Muyrong, Philip Tuaño, and Miann Banaag[1]

1. Introduction

In 2016, the Philippine government has launched a series of tax reform schemes designed to broaden the base for revenue collection and to increase public revenues in order to fund critical infrastructure projects and social services. Dubbed as the Tax Reform for Acceleration and Inclusion (TRAIN), the tax proposals not only involve changes in tax rates across various government revenue sources but also aim to improve tax administration by mandating the use of electronic invoices and receipts as well as real-time sales reporting, among others.

The tax reform proposals were originally aimed to be undertaken through six packages which then evolved into the current four-package Comprehensive Tax Reform Program (CTRP). The first package—signed into law in December 2017 as Republic Act 10963 and now called TRAIN Law—covers changes in the personal income tax, the restructuring of the estate and donors' taxes, broadening the VAT, and staggered increases in taxes on selected commodities petroleum, sugar sweetened beverages and on motor vehicles. The complementary Package 1B, which was approved in the Senate only last November 19, seeks to grant amnesty on unpaid internal revenue taxes from 2017 and from previous years. If signed into law, DOF and the lawmakers hope to encourage more citizens and firms to correctly declare their incomes without fear of administrative offenses.

Other proposals included the adjustment of corporate income tax rate alongside the rationalization of fiscal incentives (Package 2: TRABAHO Bill); further increases in the excise taxes on alcohol and tobacco products to provide additional funds to the Universal Health Care (UHC) Program (Package 2+: UHC); broadening the tax base for the various property-related taxes (Package 3: Property valuation and taxes); and revising the tax rates on passive income and other taxes imposed on financial intermediaries (Package 4: Capital income and financial taxes).

Of special concern to many however was the so-called carbon taxes included in the first package. The TRAIN Law, besides mandating a lowering of the personal income tax rates and removing the exemptions on several industries on the imposition of the value added tax, includes increasing excise taxes on selected commodities like coal and petroleum products:

- Imposition of an excise tax on diesel, fuel oil, liquid petroleum gas and kerosene, and upward adjustments on other types of fuel, including premium and regular gasoline, aviation fuel and other types of gasoline, with yearly increases starting in January 2018 until 2020.

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- mandates a Php 50 per metric ton excise tax on domestic or imported coal and coke from PhP10.00/metric ton. That will go up to P100 per metric ton in January 2019 and to a higher P150 per metric ton in January 2020.

The rise in the imposition of taxes of carbon consumption has been the result of increasing concerns of climate change due to anthropogenic carbon emissions. To put simply, such types of taxes that regulate consumption or production of certain commodities is an acknowledgement of the presence of a particular type of market failure. In the Philippines, like in other countries, the imposition of a petroleum and coal taxes aimed at reducing reliance on fossil fuels and ultimately reducing carbon emissions. Such type of tax policy reform is a bold step for a developing country like the Philippines as such types of regulatory taxes can counter growth policies due to the obvious increase in production costs of fossil fuel-heavy industries.

The tax is being imposed at the same time as Philippine energy use has been growing over time. Since 1970, total energy consumption has been increasing by around 3 percent per year from around 15 million tons of oil equivalent (MTOE) to around 43 MTOE in 2015. At the same time, the projected energy use of the country is expected at around 4 percent per year until 2050, when the country's total final energy consumption (excluding consumption of the energy sector itself, losses during transformation (for example, from oil or gas into electricity) and distribution of energy and for non-energy purposes), will grow from 29.8 MTOE in 2015 to around 54.9 MTOE in 2030, according to the Department of Energy's 2016- 2030 Energy Plan.

At the same time, the proportion of oil, coal and other nonrenewable fuel in the Philippine energy mix has been growing over time. Oil and coal combined has contributed a total of 57 percent of the energy supply in 2016, up from just 47 percent in 2008. This is due to the fact that the use of coal has been rising; coal use has risen from just 6.4 million metric tons, of which 1.9 million metric tons have been sourced domestically, to 11.7 metric tons, of which 5.7 million metric tons were domestic, during the same period. Oil and other petroleum products will continue to see an increase in their use in transportation and commercial use. On the other hand, the proportion of renewables such as hydroelectric, geothermal, biomass, solar and wind power has declined in the past years to less than 40 percent.

This has contributed to the growth of pollutants in the country. Carbon dioxide emission intensity (which is the ratio of carbon dioxide per unit of energy) has grown from 1.5 kilogram per kilogram of oil equivalent energy use in 1990 to 2.2 kilogram in 2015. Methane emissions has increased from 3.7 million metric tons to 5.7 million metric tons, even if nitrous oxide emissions had declined slightly from 935 thousand to 737 thousand metric tons, in the same period.

However, despite the advantages of a spike in petroleum and coal taxes, there are more recent concerns that the recent spike in the Philippine inflation rates has been caused by the imposition of this tax at the same time that an increase in the world oil prices has been occurring. These concerns, together with the hike in domestic rice prices, has contributed to the significant increase in inflation rate from 3.4 percent in January 2018 to 6.7 percent by September the same year. The transport services component of the consumer price index, for example, has increased by around 8 percent from 4.5 percent, leading to observations that there are adverse effects in terms of welfare. Thus, macroeconomy-wide models like computable general equilibrium (CGE) can be useful to analyze the impacts of the carbon taxes on the productive sectors while microsimulation analysis can extend results from the CGE model to investigate the impacts of the tax on poverty and employment.

This study therefore serves as a preliminary step helpful in undertaking other macroeconomy-wide studies on economic and welfare effects. With the refinements that can be done following this study alongside others like that of Cabalu, et al (2015), it can be possible to implement a CGE analysis on the proposed low-carbon development strategies for the Philippines like those studied by Mondal, et al. (2018). A theoretical framework suitable for a model aiming to simulate the impacts of an increase in taxes on gasoline and coal as an energy source is thus developed, and the effects on national and sectoral output and household welfare is thus undertaken.

The next section provides a review of the potential impacts of the carbon taxes on the energy sector, while section three discusses the theoretical and empirical issues surrounding carbon taxation. Sections four explains the CGE model used in the analysis, while sections five and six discuss the data used and the various simulations of the CGE model. Section seven presents the results. Section eight concludes.

2. Industry Background & Policy Environment of the Philippine Energy Sector

Taxation policies in the country had been governed by the Local Government Code of the Philippines (Republic Act 7160) enacted in 1991 and then later in the National Internal Revenue Code of 1997 (Republic Act 8424). Under the Duterte administration, a series of tax reform packages are being rolled out under the banner of the Comprehensive Tax Reform Program (CTRP) implemented through the Department of Finance (DOF). In December 2017, President Rodrigo Duterte signed Republic Act 10963, legislating the first package of the reforms which came to be known as the Tax Reform for Acceleration and Inclusion (TRAIN) Law. As part of the changes in the excise taxes imposed on selected domestic and imported goods, the so-called "carbon taxes' has been increased in the TRAIN Law.

The imposition of excise taxes is meant to regulate an economic activity whenever negative externalities exists in the markets. Thus, the imposition of taxes on coal and petroleum aims to reduce reliance on fossil fuels thereby ultimately reducing our country's "carbon footprint". In the recent years, carbon emissions in the Philippines have been slowly increasing with carbon intensity at 2.22 kg CO_2 emissions for every kg of oil equivalent of energy use in 2014 compared to the lowest at 1.18 in 1985. However, such type of tax policy reform remains to be bold step for a developing country like the Philippines. Given the design of regulatory taxes, carbon taxes may counter growth policies which seek to revive and expand the very energy-intensive industrial sector. Furthermore, an increase in production costs due to higher energy costs can lead to constraints in the food and transport markets as well as in the labor markets. Inevitably, there will be a concern to the impacts of carbon taxes on the most vulnerable sectors of society.

The section therefore looks at the background of the Philippine energy sector vis-à-vis the potential impacts of the additional excise taxes on coal and petroleum products. It starts with providing an overview of the Philippine energy sector alongside data on greenhouse gas emissions. Then, provides an overview of the potential impacts of such carbon taxes on economic, social and environmental sectors.

2.1. Policy History in the Philippine Energy Sector

Electrification in the Philippines began very early. As **Table 1** shows, the history of the Philippine energy sector dates back to 1890 when electric lamps were first installed in Escolta at Manila and the first power plant was built on 1895 (Cham 2007). Soon after, the Manila Electric Light and Railroad Company (Meralco) took over the franchise of the first power station in the Philippines in 1901 in Manila and its surrounding municipalities. Private utility companies followed and started to provide electricity in other parts of the country.

Table 1. Highlights of the History of Philippine Energy Sector

1890	First electric lamps were installed along Escolta, Manila.
1895	First power plant was built.
1901	Meralco took over the franchise of the first power station.
1936	Creation of the National Power Corporation (Napocor) for hydroelectric power development.
1969	Creation of the National Electrification Administration (NEA).
1971	Developments in Tiwi began for a geothermal plant.
1972	Napocor was given monopoly as the power sector was monopolized.
1977	First geothermal plant became operational in Tongonan, Leyte. Construction of Bataan Nuclear Power Plant (BNPP) started.
mid-1980s	The Philippine power crisis started.
1987	The contracting of independent power producers (IPPs) began
1989	NEA declared insolvency after years of power shortages and outages.
1984	Construction of BNPP was finished.
1994	Resolution of power crisis through IPPs
2001	The Electric Power Industry Reform Act (EPIRA) was passed into law.
2006	The Biofuels Act was passed into law.
2008	The Renewable Energy Act was passed into law.

Source: Authors' compilation from various sources

Under the Commonwealth Act 120, the National Power Corporation (Napocor) was created in 1936 to develop and generate power from hydroelectric power. Following such efforts to source energy from alternative means was the Geothermal Energy, Natural Gas and Methane Law (Republic Act 5092) enacted later in 1967. By 1969, national electrification then became among the most important government program through the creation of the National Electrification Administration (NEA). By 1972, the then dictator Ferdinand Marcos nationalized the power sector and declared Napocor as a monopoly in power generation and transmission leaving Meralco as just among the power distributors alongside the many electric cooperatives across the country.

By 1971, the development of Tiwi Geothermal Field was started by then Philippine Geothermal, Inc. (PGI) and Napocor. By 1977, the first geothermal energy development efforts were from Energy Development Corporation (EDC) and Napocor leading to the very first geothermal plant in Tongonan, Leyte. While the efforts led to successful electrification of rural areas through the model in which National Electrification Administration (NEA) paid for the construction of distribution networks before downloading ownership and operation to the electric cooperative, NEA became insolvent by 1989 and the electricity shortages and outages became very common across the country. On the other hand, in 1977, Napocor decided it was wise to build the 623-MW Bataan Nuclear Power Plant by loaning USD 2.2 billion. The power plant was completed in 1984 but safety issues and various controversies resulted in the power plant not generating a single watt of electricity.

Thus, it can be concluded that earlier energy policies in the Philippines were focused on making the Philippines less reliant on the fossil fuels based on what was then available alternative technologies on power generation. At the same time, then dictator Ferdinand Marcos nationalized the energy sector. Arguing for the need for large investments in order to speed up the expansion, power sector essentially became a state monopoly through Napocor (Woodhouse 2005). However, not only were both NEA and Napocor plagued with inefficiencies and financial woes by the 1980s, the economic restructuring after the EDSA revolution in the late 1980s led the next decade into a power crisis. While there was high energy demand, the power sector lacked the generating capacity. Napocor ran its power plants on capacity resulting in breakdowns without funds for proper maintenance of the power plants. The early 1990s was plagued with power outages and blackouts that affected not only the residential sector but also the businesses (Cham 2007). This led Meralco to lead in contracting with independent power producers (IPPs) to generate the electricity they can distribute. These efforts led to the resolution of the power crisis by 1994 (Navarro, et al. 2016). Napocor started to benefit from its investments in renewable energy while the national government assumed its debt from the failed nuclear power plant. However, the late 1990s began with the Asian Financial Crisis which still affected the energy sector through the energy demand slowdown and peso depreciation. Napocor not only had to contend with lower demand, their losses grew with their debt payments as the Philippine peso depreciated against the dollar.

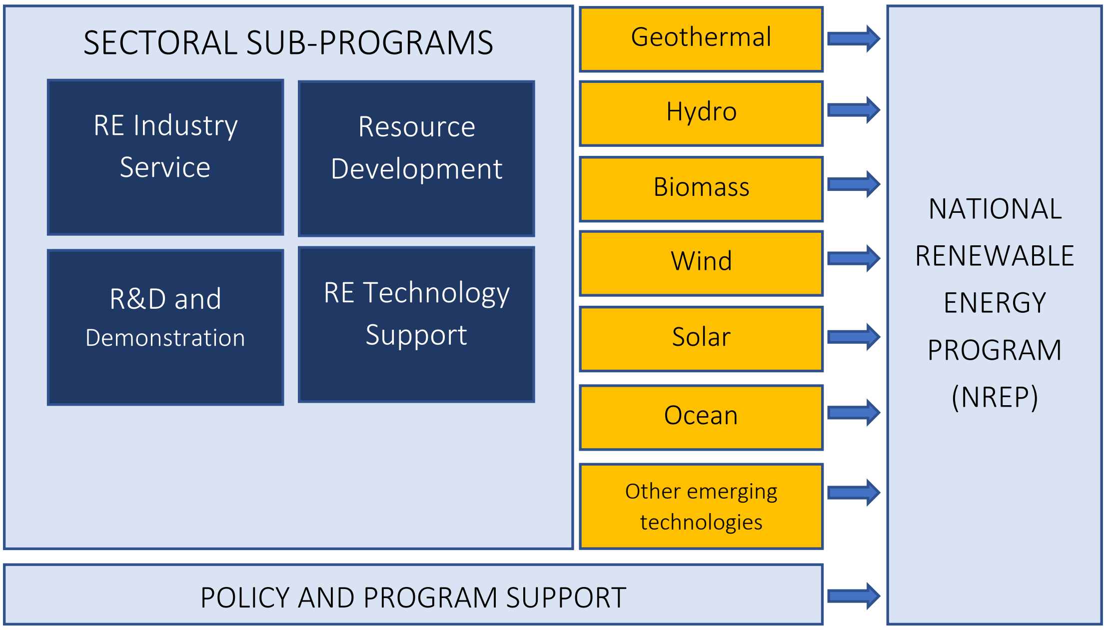
These events in the 1990s inevitably led to the passing of a law that was aimed at decreasing market inefficiencies associated with the monopoly of the power sector. Formally known as the Republic Act No. 9136, the Electric Power Industry Reform Act (EPIRA) of 2001 aimed to foster competition in the power sector and decrease electricity prices through unbundling, privatization, removal of cross-subsidies and establishment of a spot market for energy. EPIRA privatized the power generation and transmission assets (i.e. the NPC assets) to allow retail competition and open access, diversifying the energy supply base.

The changes under EPIRA specifically includes the deregulation of the generation sector, creation of a new government-owned transmission company, and the creation of an independent regulatory body (i.e. Energy Regulatory Commission) and a Joint Congressional Power Commission to oversee the implementation of the law. To put it another way, the Philippine power sector has been divided into four sectors: (1) generation, (2) transmission, (3) distribution and (4) supply. A spot market called the Wholesale Electricity Spot Market (WESM) was also created with the power generators on the supply side and the distributors and end-consumers comprising the demand side. However, the power sector continues to be plagued with high prices even with the existence of WESM aimed to make the market more competitive (Navarro, et al. 2016). However, supply reliability has indeed improved and no longer do the Philippine experience the same amount of power outages of the 1990s.

In the midst of this continuing issues in the power sector, interest in renewable energy grew to reduce reliant on fossil fuels and increase energy security in the country (Brahim 2014; Mondal, et al. 2018). Efforts to shift towards alternative energy sources have actually started very early in the Philippines. Owing to the 1970s oil crisis, the Philippines catapulted itself into geothermal energy generation taking advantage of known hot springs in the country. Over the decades, the Philippines had enacted a series of laws to further incentivize investment in the renewable energy sector which culminated in the Biofuels Act of 2006 (Republic Act 9367) and the Renewable Energy Act of 2008 (Republic Act 9153). Now, the Philippines is second biggest generator of geothermal energy, albeit our installed capacity of 1,916 megawatts, albeit still far behind 3,567-megawatt installed capacity of the United States. Furthermore, there seems to be renewed interest in the development of the hydropower energy sector, while solar energy has recently become popular among start-ups.

Over the recent years, the exploration and development of renewable energy resources has been among part of the energy development strategies of the Department of Energy (DOE). Some of the on-grid renewable energy strategies includes the Renewable Portfolio Standards (RPS), the feed-in tariff system, and non-metering for renewable energy, among others. The National Renewable Energy Board (NREB) was created to support the DOE in facilitating the formulation of mechanisms, rules and guidelines of the action plans through its sectoral sub-programs. This led to the creation of the National Renewable Energy Program (NREP) with goals to expand the country's renewable energy sector in terms of technological advancements. The NREP framework is shown in **Figure 1.**

Figure 1. The National Renewable Energy Program (NREP) Development Framework



Source: Renewable Energy Plans and Programs (2011-2030) by the Department of Energy

Beginning from the individual work programs known as the sectoral sub-programs, the NREP follows a roadmap which serves as the strategic building blocks that guides it towards "the achievement of the market penetration targets of a particular RE resource". Each sectoral sub-program has a corresponding RE resource covered under RE Law (e.g. geothermal, solar, ocean, etc.). Moreover, the Policy and Program Support is a group of cross-cutting activities which requires a coordinated and integrated implementation approach. The sub-programs can also coordinate with the policy and program support regarding their respective areas and targets.

Table 2 shows that NREP installation targets. In line of the targets set, the program technically intends to increase geothermal and hydropower capacity by 75 percent and 160 percent, respectively. Moreover, an additional 277MW of biomass power is foreseen to be delivered. Given a 20-year planning period, the NREP's overall expectation is to increase the country's energy self-sufficiency, ensure energy security, and promote sustainable development with the help of private sector investment and responsive market mechanisms for RE-based power generation. Additional 2,345 MW of wind power and 284 MW of solar power is also desired to be achieved. And lastly, it aims to develop the first ocean energy facility in the Philippines.

Table 2. NREP Installation Targets

RE Resource	Target Capacity Addition (MW)				
	2011-2015	2016-2020	2021-2025	2026-2030	Total
Geothermal	220.00	1,100.00	95.00	80.00	1,495.00
Hydro	341.30	3,161.00	1,891.80	-	5,394.10
Biomass	276.70	-	-	-	276.70
Wind	1,048.00	855.00	442.00	0.00	2,345.0
Solar	269.05	5.00	5.00	5.00	284.05
Ocean	0.00	35.50	35.00	0.00	70.50

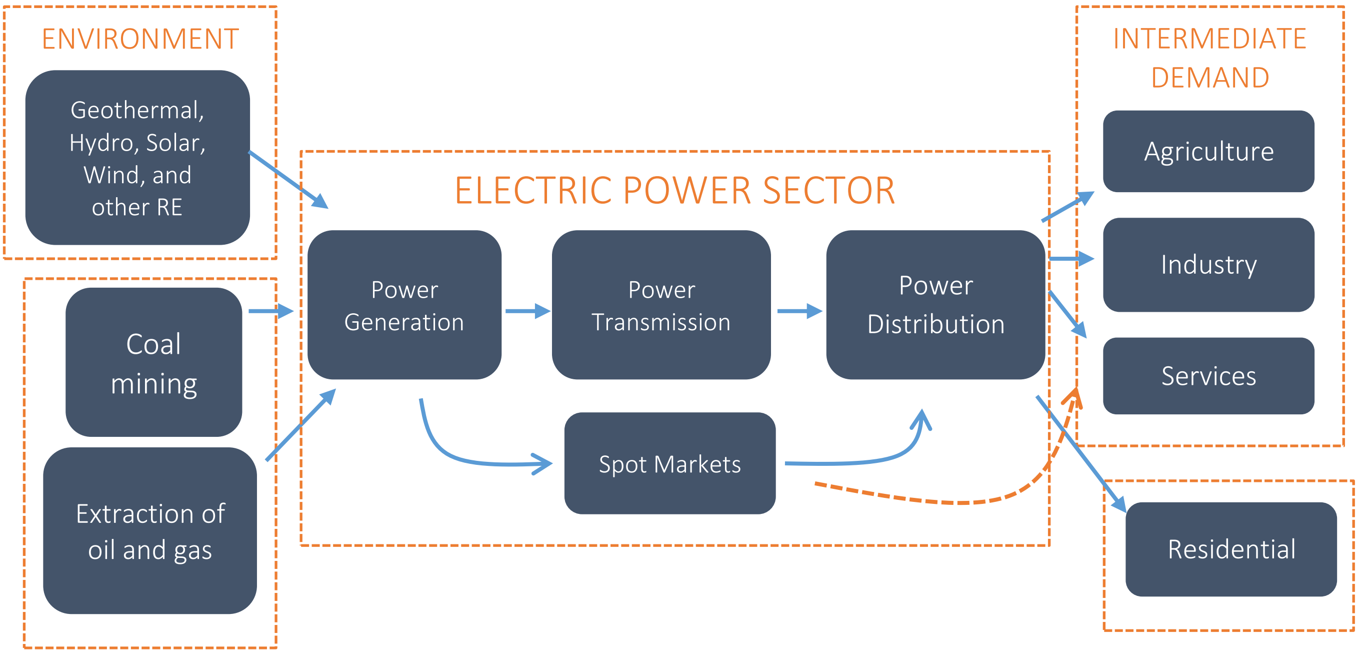
Source: Department of Energy.

2.2. Overview of the Philippine Energy Industry Policy

2.2.1. Sector Contributions to GDP and Energy Prices

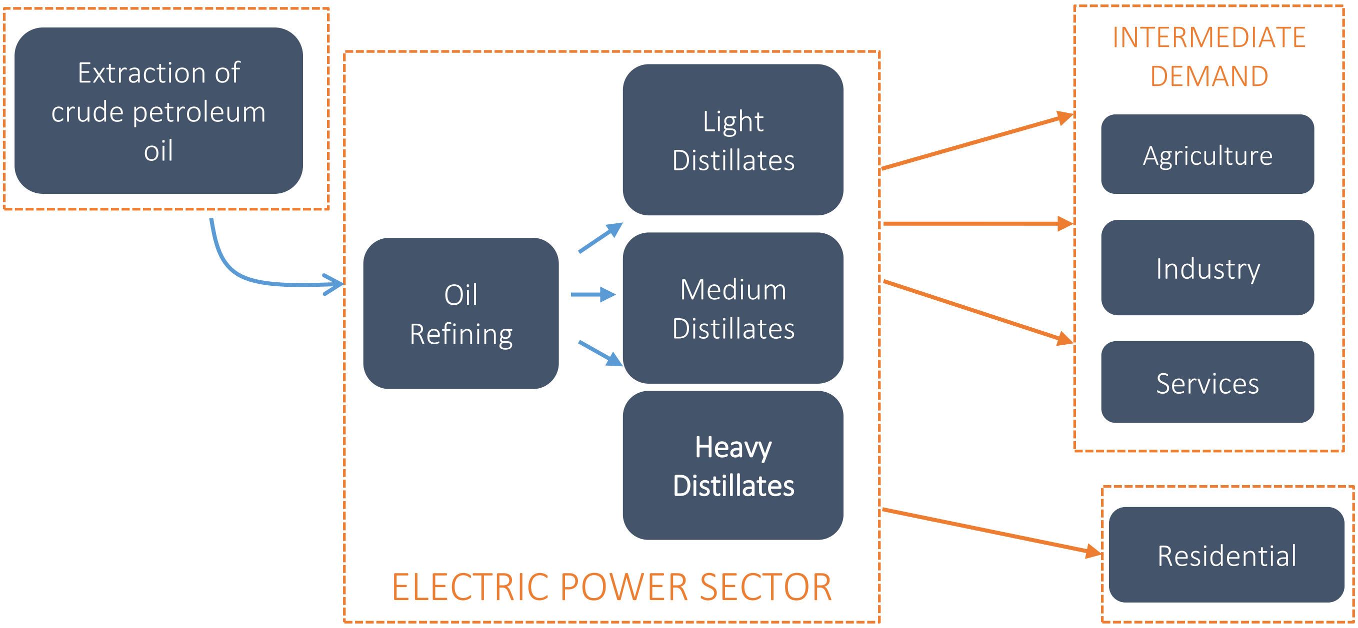
The energy sector of the Philippines is composed of the entire energy value chain beginning with coal mining and extraction of crude oil and natural gas and ending with the utilities sector with electric power generation and distribution alongside the consumption of petroleum products by end-consumers as shown in **Figure 2.** For the case of the petroleum sector, the value chain starts at the local extraction or importation of crude petroleum oil as shown in **Figure 3.**

Figure 2. Electricity Sector Value Chain



Source: Authors' illustration

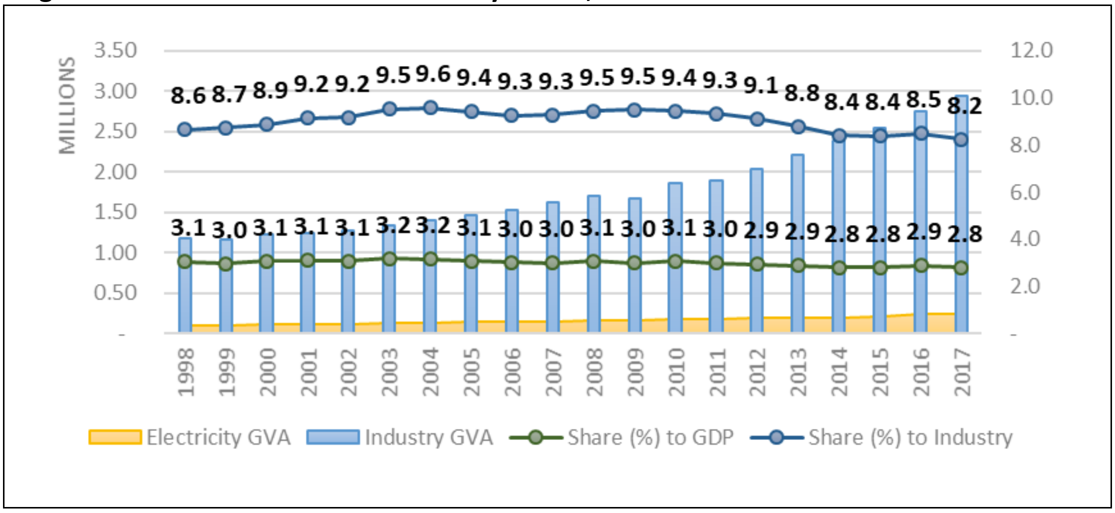
Figure 3. Petroleum Products Sector Value Chain



Source: Authors' illustration

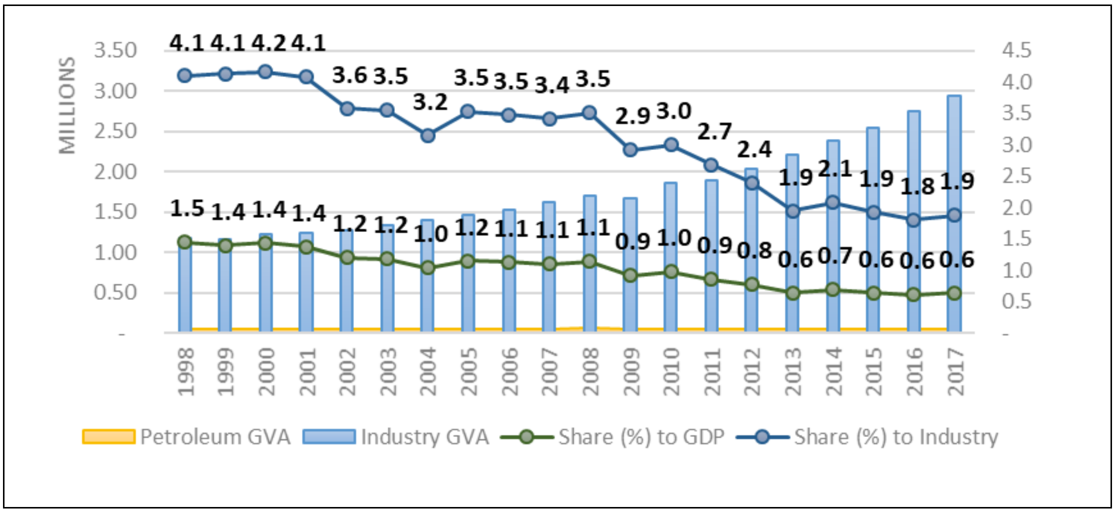
In 2017, the electricity sector alone, which is comprised of power generation, transmission and distribution, contributed 8.24% to the whole industrial sector and 2.8% to the entire Philippine economy. On the other hand, the petroleum products sector contributes less than 1% to the entire GDP in 2017. In fact, **Figure 4** illustrates that the GVA of the sector has remained at around 3.0% of the country's GDP and just a little less than 10% of the industrial GVA. On the other hand, **Figure 5** shows the contribution on the petroleum products sector to the economy has been declining over the years to only less than 2% of the GDP from around 4% in 1998.

Figure 4. Contributions of the Electricity Sector, 1998-2017



Source of basic data: National Accounts of the Philippines, Philippine Statistics Authority (PSA)

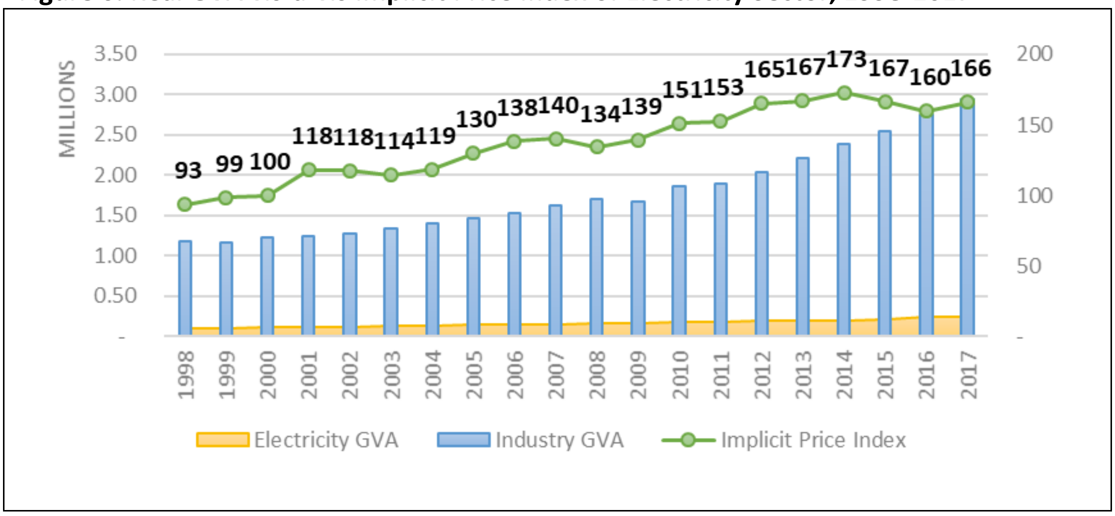
Figure 5. Contributions of the Petroleum Products Sector, 1998-2017



Source of basic data: National Accounts of the Philippines, Philippine Statistics Authority (PSA)

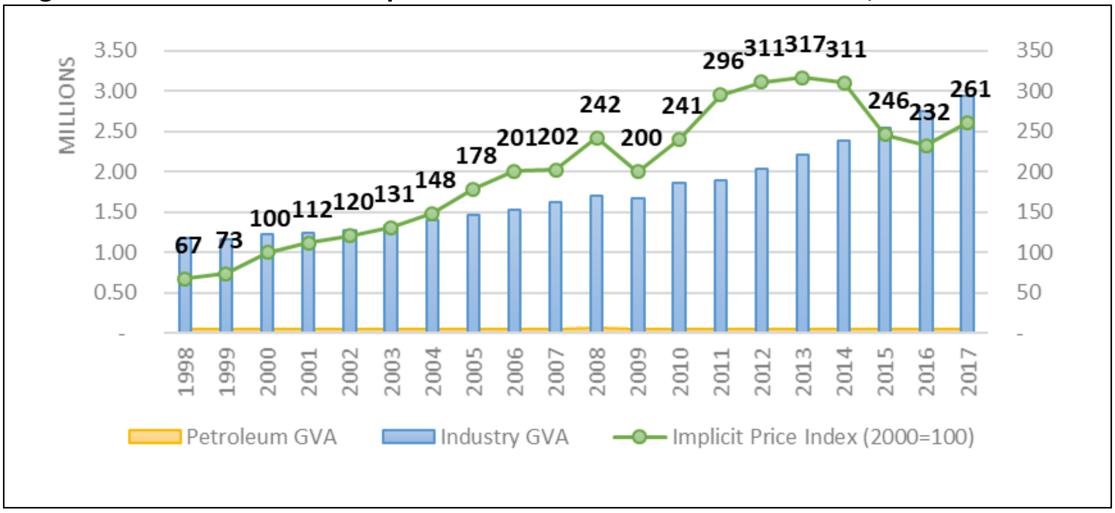
The data therefore reveal potential structural changes in the energy market. For the case of electricity, there has been a steady increase in prices as shown by the implicit price index in **Figure 6.** The implicit price index is a ratio between the nominal and the real values of the sectoral GVA. Since 2000, price is shown to have increased by 66% in the electricity sector. On the other hand, the petroleum products sector has shown a substantial increase in prices from 2010 to 2014 to be followed by dips in 2015 and 2016 as shown in **Figure 7**. The rate of price change is however faster for the sector with the prices doubling between 2000 and 2009. Such scenario can then be explained by the fact that a large portion of fossil fuel is imported and the energy sectors can only add a little more processing to the imported coal and crude petroleum. To put simply, small contributions to economy is also indicative of the amount value-adding activities of our energy sectors, albeit such activities remain very essential. In the end, it cannot be ignored that most manufacturing and services industries are fuel-intensive.

Figure 6. Real GVA vis-à-vis Implicit Price Index of Electricity Sector, 1998-2017



Source of basic data: National Accounts of the Philippines, Philippine Statistics Authority (PSA)

Figure 7. Real GVA vis-à-vis Implicit Price Index of Petroleum Products, 1998-2017

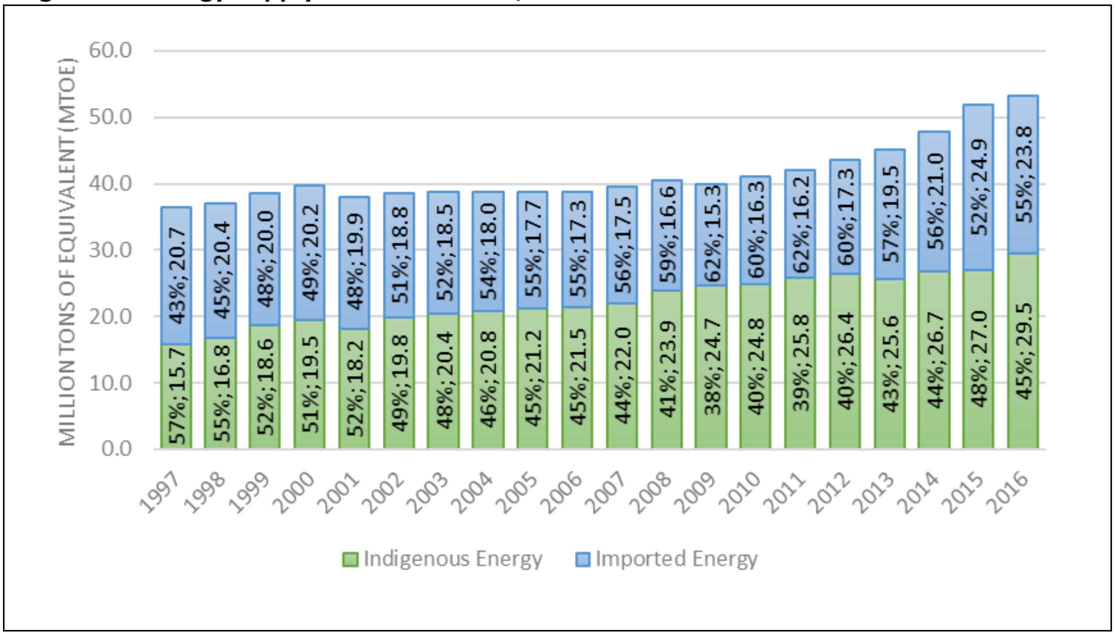


Source of basic data: National Accounts of the Philippines, Philippine Statistics Authority (PSA)

Figure 8a below shows that 55% of the energy produced in the Philippines come from imported sources in 2016 which is comparable to 43% in 1997. The historical trend of energy supply mix shows the gradual divergence from imported energy sources and the dominance of indigenous energy usage. Imported energy resources includes coal, oil, and ethanol where oil imports consistently consumed the largest chunk, with an average of 14.72 MTOE since 1997. From high dependence on imported energy in 1997 with 20.71 million tons of oil equivalent (MTOE) versus 15.72 MTOE of indigenous energy, the country is steadily rearing towards indigenous energy resources with 53.28 MTOE in 2016 (compared with imported energy of 23.78 MTOE). This allows the country to be less vulnerable to price volatility arising in the fossil fuel-based oil and energy markets. More specifically, it was in 2002 when the Philippines' level of self-sufficiency exceeded its energy imports, reaching 51.33% of total energy supply, thereby kickstarting the country's efforts to be more self-sufficient in energy.

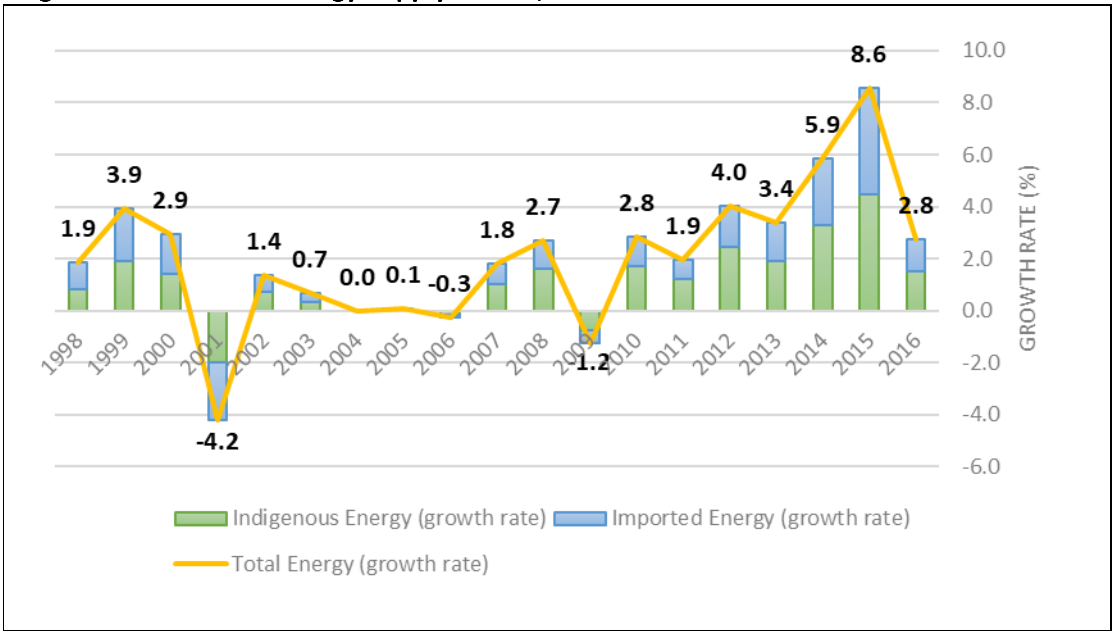
The increasing capacity of the country to produce its own energy therefore allows for further exploration and development of indigenous sources. Since 2000, geothermal has the largest share of the country's energy production with an average of 8.91 MTOE, followed by biomass which includes bagasse and other renewable energy averaging 6.57 MTOE. Although geothermal and biomass still comprises the biggest chunk of the with 9.52 MTOE and 7.49 MTOE respectively, coal production has been growing from 0.71 MTOE in 2000 to 5.92 MTOE by 2016. **Figure 8b**, on the other hand, reveals that the recent years have shown an increasing growth rate energy supply compared to a more erratic growth rate in the years prior. As the figure tells us, the growth rate is mostly uniformly distributed since the country has an equal distribution of energy source over the years. Such indicates that the energy sector is simply responding to growth of fuel-intensive sectors.

Figure 8a. Energy Supply Source in MTOE, 1997-2016



Source of basic data: Philippine Statistical Yearbook, 2000, 2008 and 2017

Figure 8b. Growth of Energy Supply Source, 1998-2016



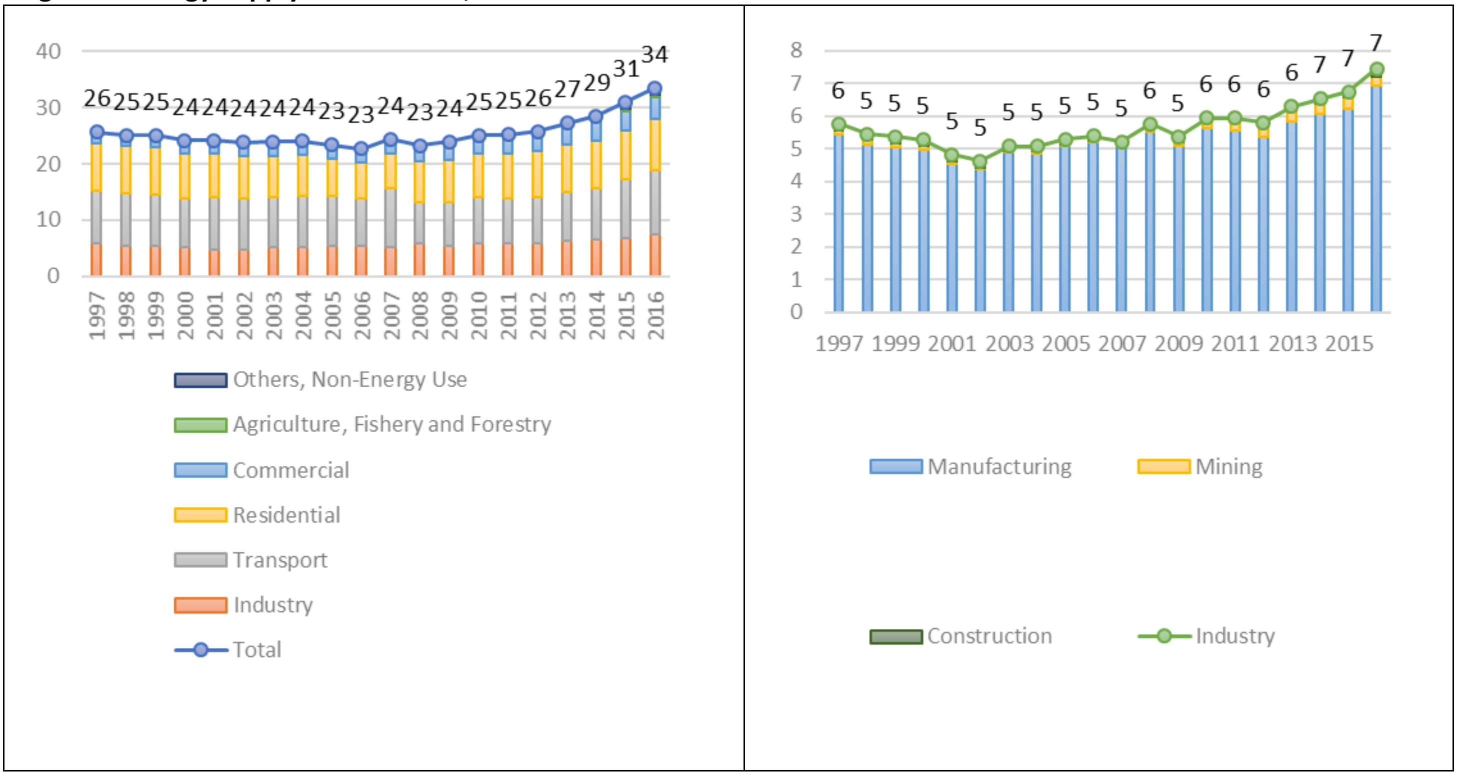
Source of basic data: Philippine Statistical Yearbook, 2000, 2008 and 2017

2.2.2. Households' Energy Use

According to the 2011 Household Energy Consumption Survey (HECS) from the Philippine Statistics Authority (PSA), the most common source of energy used by households is electricity, contributing 87.2% of 21 million households from March to August 2011. The rising need in energy prompted the government to explore alternative sources of energy such as hydroelectric, geothermal, coal, natural gas, among others. Moreover, the use of solar and wind power as non-conventional alternatives also played a significant role in the government's energy development program. According to the 2011 HECS, majority of households use electricity with 81% and LPG with 38%.

Moreover, household also uses a combination of energy sources which also includes charcoal, gas (i.e. diesel, gas, and kerosene) and biomass with 10%, 19% and 6%, respectively. In terms of human settlements, the portion of urban households has a higher energy usage than its rural counterpart wherein, for instance, gas usage accounts for 26% versus the rural which only accounts for 17%. On the other hand, organic energy sources such as biomass and firewood are consumed more by households in rural areas than those in urban areas. For the industry sector, it's evident that manufacturing industries consumes most of its energy usage, way above mining and construction industries. The manufacturing sector accounts for an average of 94.4% of total industry energy consumption and 20.98% of total energy consumption. Use of energy supply is shown in **Figure 9.**

Figure 9. Energy Supply Use in MTOE, 1997-2016



Source of basic data: Philippine Statistical Yearbook, 2000, 2008 and 2017

As of 2012, there is a total of 265 establishments across the Philippines involved in the generation, transmission and distribution of electric power which also includes 6 establishments involved in production and supply of steam, air conditioning and ice production as shown in **Table 2.** The Philippine energy mix shows that renewable energy, despite being a significant energy source in the country, has not expanded in the recent years. Instead, the country has become even more coal-reliant most probably as a result of the push to grow the economy. As **Figures 10a and 10b** show, coal-based energy generation at 14,939 GWh which was 21.2% of total power generation in 2003 has more than doubled at 46,847 GWh by 2017. This stands at 39.8% of total power generation.

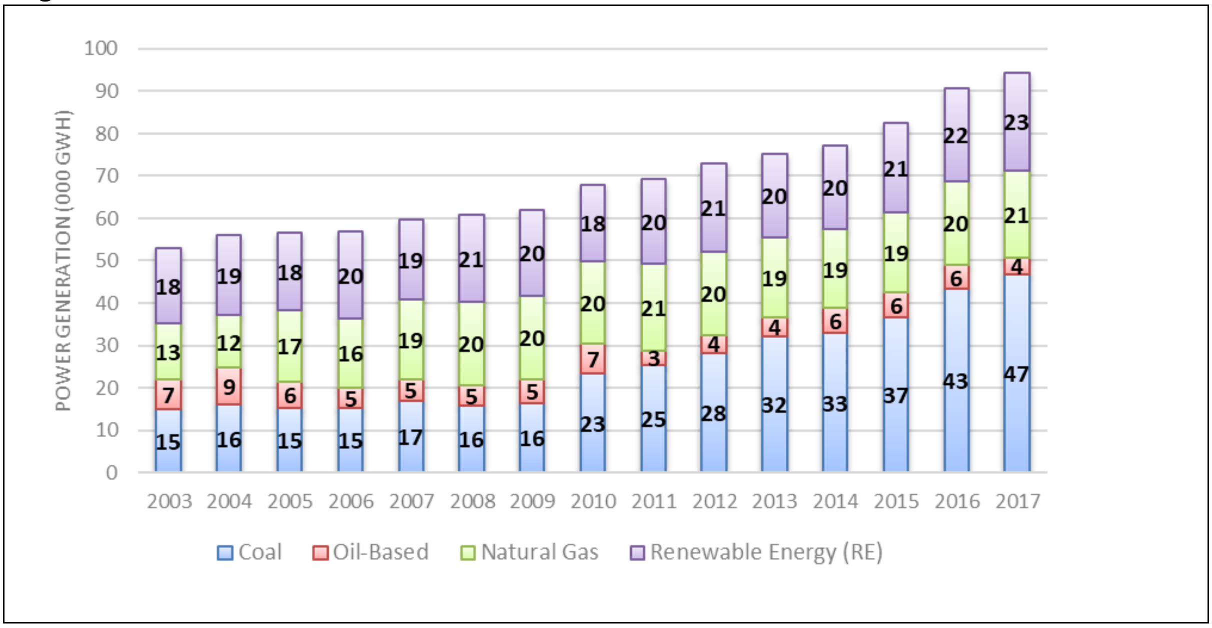
On the other hand, power generated from renewable energy had increased only to 23,189 GWh in 2017 from 17,692 GWh in 2003. In fact, the contribution of renewable energy to power generation had declined to 19.7% in 2017 from 25.0% in 2003. Indeed, despite recent investments made in the biomass, solar and wind energy sectors, their contribution to power generation had not become substantial.

Table 2. Distribution of Establishment by Number and GVA, 2012

Region		Number	Share (%)	GVA	Share (%)
Philippines		265		213,544,764	
Luzon		151	56.98	146,067,033	68.40
	NCR	5	1.89	21,761,342	10.19
	CAR	22	8.30	7,765,144	3.64
	Ilocos Region	19	7.17	13,654,858	6.39
	Cagayan Valley	10	3.77	14,719,348	6.89
	Central Luzon	32	12.08	30,066,881	14.08
	CALABARZON	29	10.94	51,649,413	24.19
	MIMAROPA	15	5.66	766,239	0.36
	Bicol Region	19	7.17	5,683,808	2.66
Visayas		59	22.26	41,667,063	19.51
	Western Visayas	19	7.17	7,940,899	3.72
	Central Visayas	24	9.06	19,771,431	9.26
	Eastern Visayas	16	6.04	13,954,733	6.53
Mindanao		55	20.75	25,810,669	12.09
	Zamboanga Peninsula	7	2.64	2,397,811	1.12
	Northern Mindanao	15	5.66	8,804,988	4.12
	Davao Region	8	3.02	5,385,110	2.52
	SOCCSKSARGEN	9	3.40	5,944,962	2.78
	Caraga	10	3.77	3,327,146	1.56
	ARMM	6	2.26	(49,348)	(0.02)

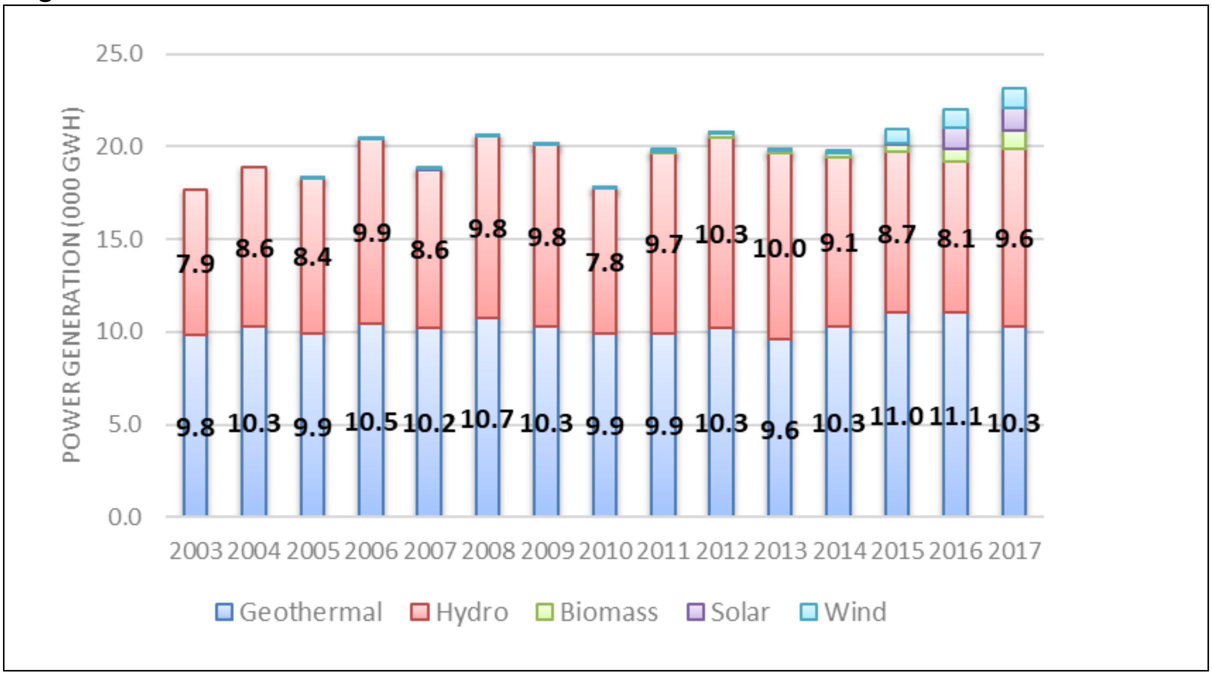
Source: 2012 Census of Philippine Business and Industry (CBPI)

Figure 10a. Power Generation Mix in GWh



Source of basic data: Philippine Statistical Yearbook, 2000, 2008 and 2017

Figure 10b. RE-based Power Generation Mix in GWh



Source of basic data: Philippine Statistical Yearbook, 2000, 2008 and 2017

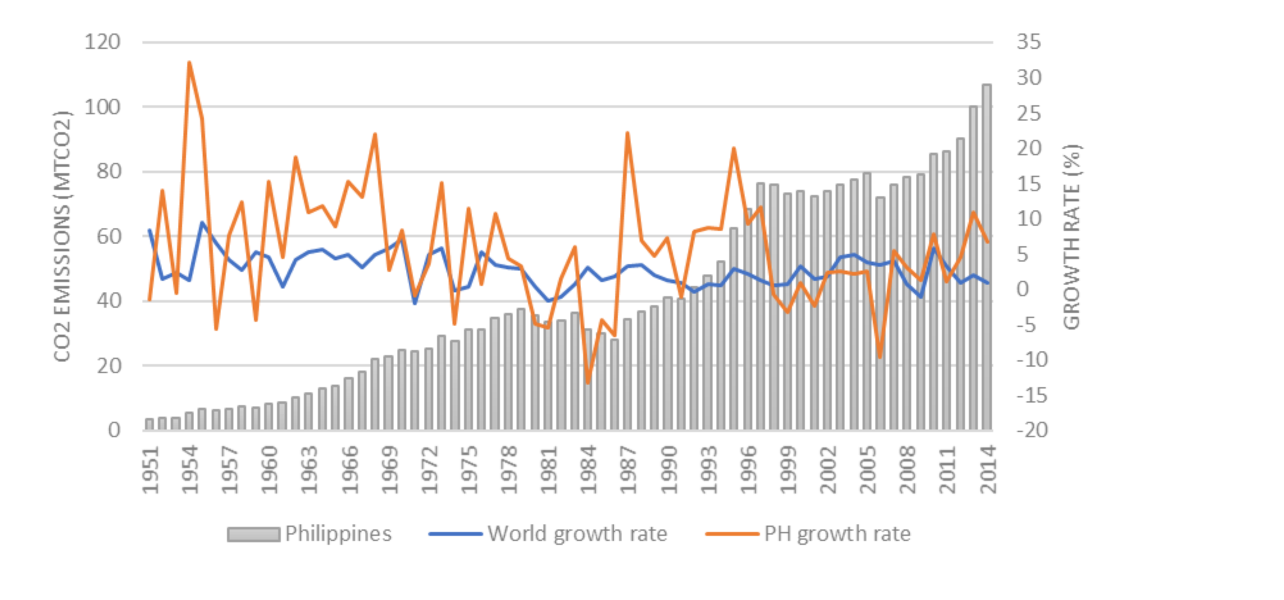
2.2.3. Energy and Carbon Emissions in the Philippines

The history of the Philippine energy sector brings to light changes in the carbon emissions in the Philippines. With only 3.55 metric tons of CO_2 emissions in 1951, it has grown to 106.9 metric tons by 2014. Such growth in CO2 emissions barely compare to the growth in emissions in China whose emissions already stand at 101.7 metric tons by 1951 and has grown to 10,328.7

metric tons by 2014—the highest in the world comprising 30% of total world emissions. Compared to some our neighbors in Southeast Asia, the Philippines remains to be a low carbon-emitter. Despite this, the Philippines has been active in fighting climate change adaption and mitigation due to the large impacts of climate change to the country. **Figure 11** illustrates how CO_2 emissions have grown over the decades, and its growth rate vis-à-vis the growth rate of world CO2 emissions. On the other hand, **Figure 12** below shows the change in CO2 emissions across different countries.

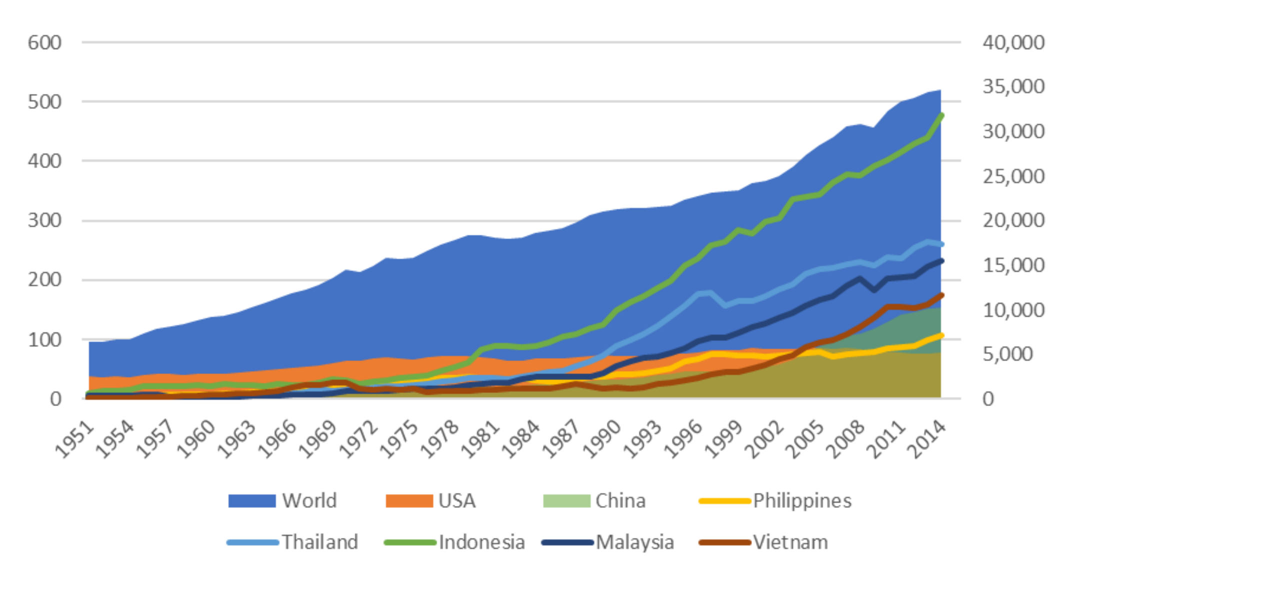
Figure 13 further reveals that energy emissions by sector reveal that the biggest contributor to greenhouse gas emissions in the Philippines over the years has been the energy sector followed by agricultural sector. In compliance with the environmental regulations and standards, Republic Act No. 9513 (also known as the Renewable Energy Act of 2008) was enacted to promote "the development, utilization and commercialization of renewable energy resources". Aside from reduction of harmful emissions and the protection of health and the environment, this act also aims improve the country's energy self-reliance by lessening the country's dependence on fossil fuels to minimize its vulnerability to international price fluctuations which severely affects majority of the country's sectors.

Figure 11. Historical Carbon Dioxide Emissions in the Philippines (mtCO2)



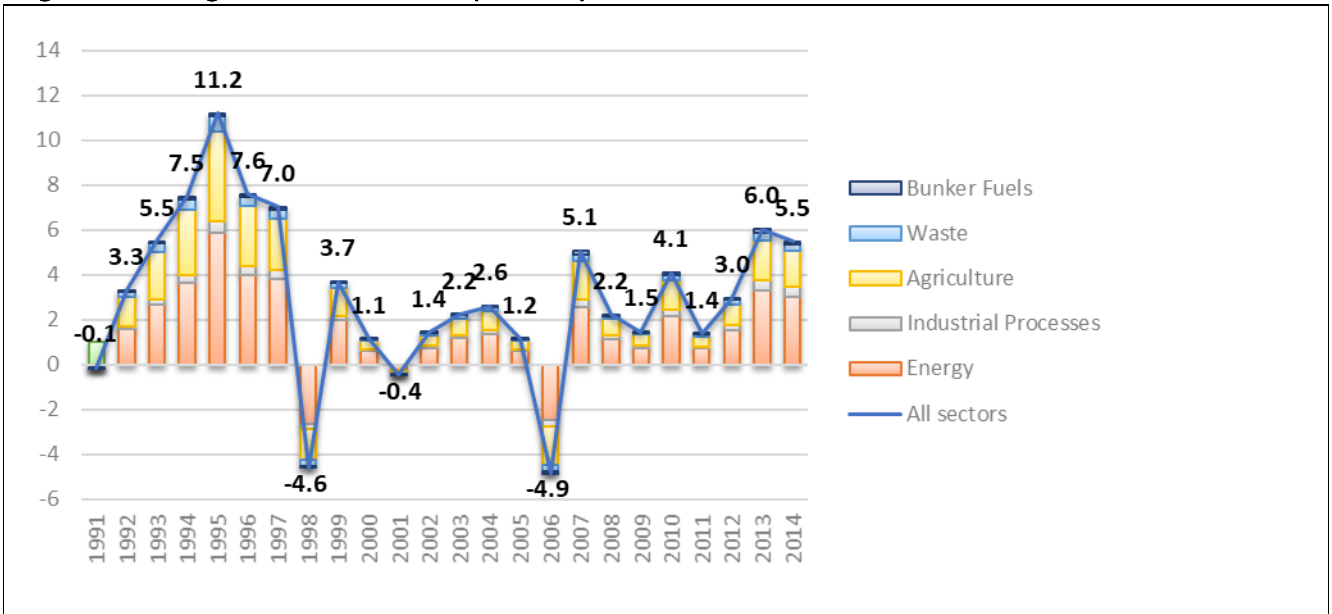
Source of basic data: WRI CAIT Database

Figure 12. Historical Carbon Dioxide Emissions in Selected Countries (mtCO2)



Source of basic data: WRI CAIT Database

Figure 13. Changes in GHG Emissions (mtCO2e)



Source of basic data: WRI CAIT Database.

2.3. Energy Demand and Supply Outlook

The recent experience of the Philippines as a high-growth country brings about an increase in demand in sectors that provide basic utilities like electric power for industrial, commercial and residential sectors as well as fuel sources for the transport sector. Furthermore, the increase in purchasing power of Filipino consumers as a result of increase in income also trickles down to the energy demand. As revealed by electricity sector value chain, demand from the various industries, particularly from manufacturing sectors, will be a driver for energy demand in the Philippines. Indeed, more economic activity would lead to higher demand for fuel and electric power.

In understanding the factors that will impact energy demand and supply in the next few years, understanding the value chain of the energy sector. For the case of the electric power sector, the value chain starts either from the coal mining sector as shown in Figure 8. On the other hand, power generators involved in renewable energy harness power from the environment thereby bringing in a sector not usually considered into the economic value chain. In 2016, the total power generated is 90.8 terawatt hours (TWh) which is equivalent to 7.8 MTOE. This has increased slightly from 82.4 TWh (7.1 MTOE) in 2015. Coal is the main source of electric power generation in 2016 comprising 47.7% of the total power generated, followed by natural gas at 21.9 percent. Oil-based energy generation is only 6.2 percent. Power from renewal energy comprise 24.2 percent. This includes geothermal energy (12.2 percent), hydropower (8.9 percent) and solar, wind and biomass sources (3.1 percent).

Electricity consumption in 2016 was 6.4 MTOE which is 19.3 percent of total energy consumption. The biggest consumers of electric power are the residential sector with a total electricity demand of 2.2 MTOE in 2016, the industrial sector at 2.1 MTOE, the commercial sector at 1.9 MTOE, and the agricultural sector at 0.2 MTOE. Negligible amounts are consumed by the transport sector as can be expected.

After generation, electric power goes through the transmission sector through the high-voltage power lines towards distribution to end-consumers through low-voltage power lines. In the Philippines, the National Transmission Corporation (TransCo) is a government-owned corporation created in 2003 through the EPIRA. Since 2009 however, the management and operation of TransCo has been awarded to the National Grid Corporation of the Philippines (NGCP) which secured the congressional franchise after a public bidding. However, ownership of all transmission asset remains with the government. The distribution utilities (DUs) can be either be privately-owned like the Manila Electric Company (Meralco) or owned by cooperatives. The supply sector of the electricity industry would then refer to spot markets that allow for the trade of electric power from generators to DUs or end-consumers.

Local petroleum companies purchase the crude petroleum oil to transforms it into different types of distillates that are then marketed as fuel for different uses: light distillates (gasoline, LPG, naphtha), medium distillates (jet fuel, kerosene, diesel) and heavy distillates (fuel oil). In the Philippines, there are two refineries: (1) Petron Bataan Refinery in Limay, Bataan, and (2) Pilipinas Shell Oil Refinery in Tabangao, Batangas City. In 2016, the combined total production of the two refineries is 9.9 million tons of oil equivalent (MTOE) increasing slightly from 9.7 MTOE in 2015. Diesel comprise the largest share of distillate production at 39.5 percent, followed by gasoline at 23.5 percent.

However, the country is a net importer of petroleum products as total demand for petroleum products in 2016 is 16.3 MTOE. As it can be expected, the biggest consumer of petroleum products is the transport sector with a total energy demand of 12.3 MTOE in 2016, 11.9 MTOE (96.4 percent) of which is demand for petroleum products. The biggest consumer is the road transport sector consuming 88.2 percent of to the total demand. This is followed by water transport at 6.9 percent, domestic air transport at 4.8 percent and railway at 0.1 percent. The other consumers of petroleum products are the residential sector at 1.1 MTOE, the industrial sector at 1.5 MTOE, the commercial sector at 1.6 MTOE, and the agricultural sector at 0.2 MTOE.

Inspection of the available data from the 2012 Input-Output (IO) Table further reveals the less obvious linkages in the sectors. However, **Table 4** also shows the energy sector indeed obtains its inputs from the extractive industries like coal mining and extraction of crude oil and natural gas, commodities whose main use would be really for energy production. Interestingly, the electric power generators can only "capture" potential energy from the environment and transform it to energy that is useful for society. Hence, this is something that the available IO Table is not able to show.

Table 4. Top 10 Backward Linkages of the Electricity and Petroleum Sectors, 2012

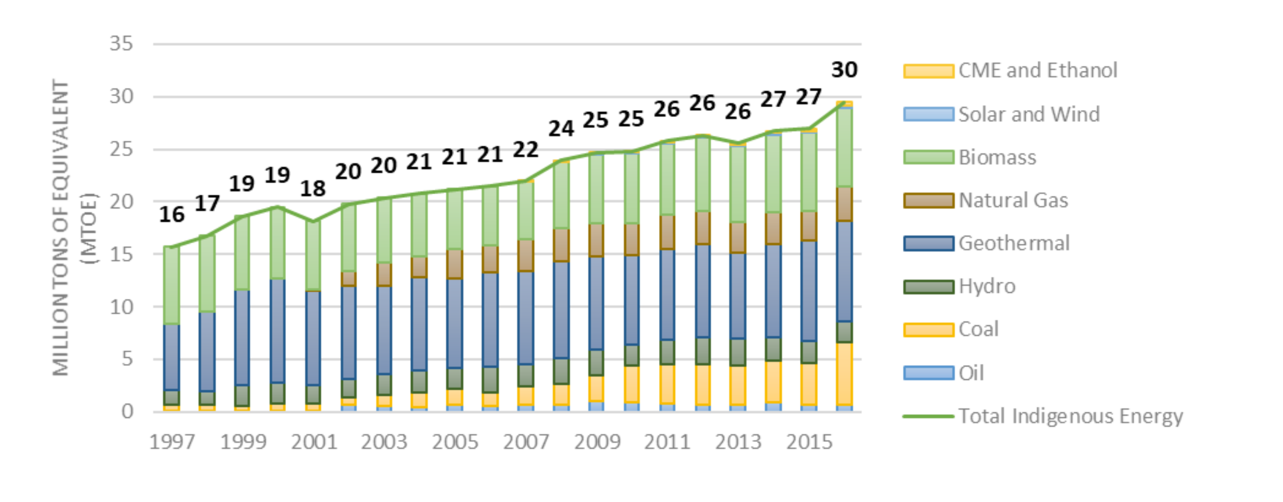
Top 10 Backward Linkages of the Electricity Industry		*Multiplier*
1	Petroleum and other fuel products	0.1200
2	Wholesale and retail trade; Maintenance and repair of motor vehicles	0.1195
3	Electricity	0.1010
4	Other mining and quarrying, nec	0.0671
5	Steam	0.0270
6	Food manufactures	0.0245
7	Chemical and chemical products	0.0160
8	Construction	0.0145
9	Insurance and activities auxiliary to financial intermediation	0.0139
10	Banking Institutions	0.0123
Top 10 Backward Linkages of the Petroleum Products Sector		*Multiplier*
1	Other mining and quarrying, nec	0.4585
2	Petroleum and other fuel products	0.2527
3	Wholesale and retail trade; Maintenance and repair of motor vehicles	0.2108
4	Food manufactures	0.0824
5	Banking Institutions	0.0480
6	Land transport	0.0274
7	Electricity	0.0258
8	Other Service Activities, nec	0.0205
9	Warehousing and support activities for transportation	0.0203
10	Non-bank Financial Intermediation	0.0188

Source: Authors' calculations from the 2012 Philippine Input-Output Table.

Brahim (2014) explains that the main issues surrounding the energy industry are (1) expected depletion of fossil fuel resources, (2) impacts of carbon emissions on climate change, and (3) oil price volatility. Such issues therefore have resulted in efforts here and abroad to increase the energy generation from renewable sources. Furthermore, the Philippines has consistently been cited for high electricity prices compared to our ASEAN neighbors thereby signaling market inefficiencies along the value chain. In the present high-growth scenario, the factors determining supply and demand of energy can therefore be analyzed using the value chains.

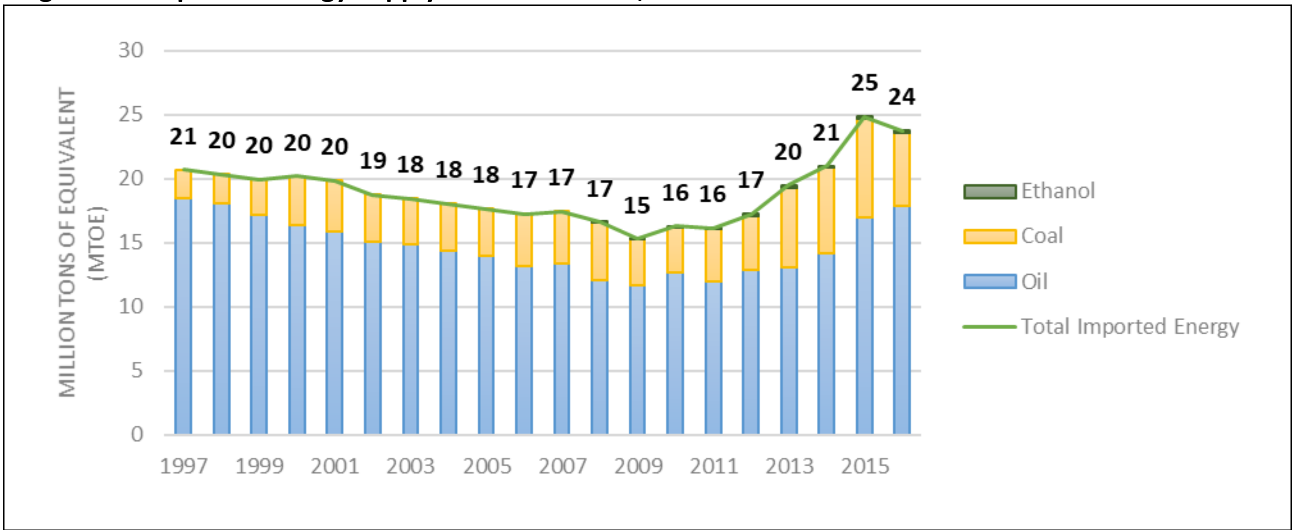
Indeed, the primary factor to consider with regards to the supply outlook is the availability of the fossil fuels from both domestic and imported sources. While the Philippines have made progress in increasing the generation of electric power from renewable energy sources, particularly from geothermal energy, **Figures 14 and 15** also show that the country is still largely dependent on coal. Hence, while the outlook on energy security of the country seems more positive for the electric power sector with the rise of renewable energy, a potential constraint therefore would be how to assist the market towards more investments in renewable energy across the country.

Figure 14. Indigenous Energy Supply Source in MTOE, 1997-2016



Source of basic data: Philippine Statistical Yearbook, 2000, 2008 and 2017

Figure 15. Imported Energy Supply Source in MTOE, 1997-2016



Source of basic data: Philippine Statistical Yearbook, 2000, 2008 and 2017

On the other hand, the petroleum products sector would seem to continue to face oil price volatility in the world market as the country still largely import our crude petroleum oil. Furthermore, the petroleum products sectors would seem to have to contend with not only geopolitical issues but the expected rise in prices as resources get depleted.

The work of the Energy Regulatory Commission (ERC) therefore is to ensure that prices become closer to the socially-optimal levels. Despite this inherent natural monopoly, the high electricity prices seem to come from the fact that electric power sector continues to face problems with system loss and other wastage due to the lack of existing technology when it comes to storing electricity. The generation of power is borne out of an algorithm that predicts hourly demand. If the generated power is not consumed, then it is simply wasted.

Factors affecting demand are of course related to the various economic activities. The more energy-intensive the sector is, the higher is its demand for electricity and fuel products. The 2012 IO Table can then quickly provide initial insight as to the sectors that demand these energy products—the forward linkages of the electricity and petroleum products sectors. **Table 5** shows the top forward linkages of the electricity and petroleum industries for that year.

Table 5. Top 10 Forward Linkages of the Electricity and Petroleum Sectors, 2012

Top 10 Forward Linkages of the Electricity Industry		***Multiplier***
1	Electricity	0.1010
2	Sewerage and waste water remediation activities	0.0940
3	Water	0.0841
4	Paper and paper products	0.0815
5	Rubber and plastic products	0.0769
6	Human Health and Social Work Activities	0.0726
7	Non-metallic mineral products	0.0722
8	Textile manufactures	0.0655
9	Printing and reproduction of recorded media	0.0651
10	Fabricated metal products	0.0598
Top 10 Forward Linkages of the Petroleum Products Sector		***Multiplier***
1	Air transport	0.2926
2	Water transport	0.2923
3	Land transport	0.2738
4	Petroleum and other fuel products	0.2527
5	Basic metal industries	0.1383
6	Electricity	0.1200
7	Non-metallic mineral products	0.1153
8	Paper and paper products	0.0988
9	Warehousing and support activities for transportation	0.0887
10	Construction	0.0869

Source: Authors' calculations from the 2012 Philippine Input-Output Table.

3. Theoretical and Empirical Methodology on Coal and Petroleum Tax Impacts

In most cases of domestic price surges, the source of a fuel price hike is the increase in world prices transmitted to prices in domestic markets (Ardnt, et al., 2008). This is due to the fact that fuel products are usually imported commodities in developing countries. Owing to the interindustry linkages, higher fuel prices are then transmitted to other sectors and ending up influencing the prices in food markets and transport markets. Hence, fuel prices can also have substantial impacts on the poverty situation of the country owing to the network effects of the fuel industry. Furthermore, the discussion can then be extended to understanding who among the vulnerable sectors become most affected due to such fuel price surges.

To better understand the impacts of higher fuel price, Ardnt, et al. (2008) try to answer the following questions: (1) How much does the level of fuel intensity in the economy change? (2) How does the agricultural supply respond? (3) How does the export markets respond? (4) How does the allocation of household consumption change? Hence, tracing the impacts of a fuel price hike may be done starting with the changes brought to the various economic sectors followed by its impacts to energy sector's forward linkages and to the end-consumers.

For the current study however, the source of the fuel price hike is the excise taxes. How will this now change the discussion? The concept of using taxation to correct negative externalities is generally credited to Pigou (1920). In this type of policy reform, the goal is to be able to set a tax rate that is equal to marginal external damage bringing the external cost into the decision of the transacting parties. This ensures that the producers take into account the full marginal social cost of the good which then trickles down to the price paid by the consumers. Carbon taxes therefore necessarily aim to make the market produce at the efficient level of the good.

In the context of carbon taxes, the concern arises from the undesirable by-products that are produced as normal commodities are produced by economic sectors. These undesirable by-products are the greenhouse gas emissions like carbon dioxide (CO2), methane (CH4), among others, that contribute to climate change as well as different types of pollutants that become respiratory health hazards. In return, countries can then expect carbon taxes to have a significant benefit in terms of local pollutant reductions in addition to CO2 reductions (Shah and Larsen, 1992). Mankiw (2015) adds that such carbon taxes can also help in easing congestion and preventing accidents. He added that such excise taxes that keep gasoline prices high may also keep congestion down by encouraging people to take public transportation. For the case of developing countries, this however seems to depend on how elastic the demand for private transportation is vis-à-vis the availability of public transportation.

However, there are obvious consequences of carbon taxation. One, such tax policy might lead to slower economic growth as firms would find production costlier because of higher fuel prices. In return, the tax revenues must be used to promote economic growth by using the collected taxes efficiently. Another issue however is the fact that the carbon tax will be mildly regressive as with the case of any type of indirect taxes imposed across the board. However, Shah and Larsen (1992) mention that national carbon tax is not likely to have regressive impact as commonly perceived. On the other hand, there is evidence that the economy-wide implications of carbon tax applied showed that the carbon tax had a negative impact on the GDP pathway looking at the Chilean electricity market (Benavides et al. 2015). Ultimately, the efficacy of the carbon tax policy depends on some variables which were not controlled by policymakers such as non-conventional renewable energies investment cost projections, prices of LNG, and the exploitation of hydroelectric resources.

3.1. Impacts on the Economy

It goes without saying that most industries depend on coal and petroleum for power generation and for transportation fuel. Historical trends however show that fuel prices are increasing over the past decades as a result of the growing global economy. Unfortunately, the incapacity of oil and gas rigs and refineries to keep up with the growth in energy consumption (Van der Heijden and Tsedu 2008).

Such scenario of increasing fuel prices may thereby constrain the growth of manufacturing in the country. In the case of South Africa, Van der Heijden and Tsedu (2008) explain that the negative impacts of high fuel prices are substantial due to the countries' reliance on roads in transporting goods as well as people. More specifically, large volumes of manufactured goods travel their road networks—98 percent of fast-moving consumer goods (FMCGs)—are distributed via road networks. Furthermore, the authors then remind us the economic constraints associated with increasing fuel prices seem to fall on the micro and small enterprises (MSEs) that are without access to efficient logistics systems or even to just larger trucks. Instead, they are forced to contend with the available transport for hire. Furthermore, the authors reveal that, for the case of South Africa, the price rates of these types of services are highly responsive to rising fuel prices but are very sticky when fuel prices go down. In the end, these issues tend to also constrain job creation.

Empirical studies from different countries however fail to conclude that fuel price increases influence prices in other sectors. Chapa and Ortega (2017) used a SAM-based price model in Mexico in order to assess the impacts of carbon tax on production cost, consumer prices, household consumption and government revenue. The carbon tax had a direct impact on the sectors like coke, refined petroleum and nuclear fuel as these sectors showed that highest price increases. Furthermore, large indirect impacts were found on the air transport and inland transport as transportation sectors consume fuel.

Rajbhandari and Limmeechokchai (2017) analyzed the impacts of carbon tax in energy development in Nepal and Thailand. They used the bottom-up technology rich MARKAL modeling framework. The imposition of carbon tax caused a higher CO2 reduction from residential sector in Nepal and power sector in Thailand which means the residential sector in Nepal will have cleaner fuel usage and more power generation based on nuclear and renewable energies in Thailand by 2050. NO2 emission will be also reduced. SO2 emissions in Thailand will a significant reduction but in Nepal will increase due to the use of biomass.

One study in Turkey by Nazlioglu and Soytas (2010) looked at the impact of world oil prices on agricultural commodity prices. It was concluded that there are no casual linkages between oil prices and agricultural commodity prices, either directly or indirectly. This can be due to the relatively low energy intense production process in Turkey which suggests that stabilization of agricultural prices do not need to account the changes in the world oil market. This also implies that inflation in agricultural prices must focus on internal factors such demand and supply of agricultural production due to its less vulnerability to world energy shocks. Moreover, it can be concluded that indirect effects such as appreciation (depreciation) of imports (exports) have no relationship with the Turkish agricultural prices.

In the US, same conclusion was found by Baumeister and Killian (2013). Using a structural econometric framework, the authors report that there seems to be no evidence that higher corn ethanol price lead to higher prices in agricultural markets in the US. Rather, both markets are simply both affected by the same macroeconomic determinants. Furthermore, there is also no evidence that higher fuel prices lead to higher costs along the value chain leading to higher retail food prices.

A number of CGE studies on the impacts of carbon taxation has been published over the years. Latest are carbon taxes implemented in China (Lin & Jia 2018; Shi, et al. 2015; Zhou, et al. 2011) and in Australia (Siriwardana, et al. 2011). In the Philippines, an earlier CGE study on carbon taxes was implemented by Cabalu, et al. (2015). A common result is the observed increase in commodity prices and decrease in GDP alongside a modest decline in emissions.

Siriwardana, et al. (2011) based their CGE model on Australian carbon tax from the ORANI-G model of Horridge (2000). The comparative static nature of ORANI-G helps to single out the effect of carbon tax policies while keeping other factors unchanged. They concluded that the impact of carbon tax showed that environmentally valuable reduction of carbon dioxide emission in Australia. The inflationary effects of the tax were fairly small which was measured by the change in consumer price index. They added electricity generating sectors will be negatively affected because some of it are heavy fossil fuel users. They suggested to focus on low income household so that, the government to compensate the burden of the tax.

Using a carbon tax of 15, 23 and 30 Australian dollar (AUD) tax per ton CO_2 emission for their simulations, their CGE results show that GDP can *decline* by 0.35 percent to 0.88 percent while their CO_2 emissions *decline* by 10.06 percent and 15.18 percent. However, this also means that relevant sectors will experience changes in their output level. The authors found a *decrease* in brown coal mining (between 15 percent to 36 percent) & brown coal-based electricity (between nine percent and 28 percent) as well as an *increase* in RE-based electricity (between nine percent and 14 percent). Finally, they find that 23 AUD tax reduced welfare of households measured in equivalent variation (EV) by 752.3 AUD with welfare decline higher in higher deciles

Shi et al (2015) used a CGE model in order to know the economic effects of coal resource tax reform in China. They mentioned that coal resource tax reform policy would have a negative effect on the Chinese economy because, such effect would increase with a higher tax rate but decrease gradually as the time goes. Dong et al (2017) mentioned that all of thirty provinces they used in their study will suffer from GDP losses after levying carbon tax. Developed eastern provinces such as Shandong, Henan, Guangdong and Jiangsu will suffer from the largest absolute GDP losses.

Lin and Jia (2018) used CGE model to study the energy, environmental and economic impacts of carbon tax rate in China. They mentioned that electricity industry is the largest tax-paying industry under the high carbon tax scenario. They added industries such as coal, oil, natural gas and electricity reduce the most energy consumption which illustrate the effectiveness of the carbon tax mechanism but the main reason for this effectiveness is that the carbon tax will cause an increase in energy prices. Zhou et al (2011) said that imposing a carbon tax in China will have adverse impacts on energy production, energy intensive sectors, and on household income. Levying a carbon tax and reducing the other tax rates of more vulnerable sectors can alleviate the negative impacts on sectors. Using a carbon tax of 30, 60, 90 RMB tax per ton CO2 emission for their simulations, the authors this time found that their GDP can *decline* by 0.11 percent to 0.39 percent while their CO_2 emissions also *decline* by between 4.52 percent and 12.26 percent. Similar to the study on Australia, they found that China may experience a *decrease* in coal mining and washing (-8.92 percent to 23.59 percent) & coke mining (-4.66 percent and -14.01 percent). They also find that income *decline* in the welfare of both urban households (-0.51 percent to -1.45 percent) and rural households (-0.51 to 1.43 percent).

3.2 Impacts on Vulnerable Sectors

For the case of households, higher energy prices cause production costs to increase, pushing fuel-intensive goods such as manufactured goods and transportation services to spike up. This also leads to higher costs of purchasing fuel, which is approximately 10 percent of total household consumption, (Baker 2008). According to Reyes, et al. (2009), the impacts of higher fuel prices have two components: (1) direct effect of higher price of petroleum products consumed by the households, and (2) the indirect effect on the prices of other goods and services consumed by the household that use fuel as intermediate input. Hence, increasing fuel prices affect household groups in varying manner as well.

Roberts (2008) identified the fuel-poor households as those who are low-income and who "would need to spend more than 10 percent of their income to attain the adequate energy services." It was concluded that if the income of individuals who fall under fuel poverty increases more slowly than the increase on fuel prices, fuel poor will worsen. On the other hand, *net* impacts on the agricultural sector can potentially be positive if the rural sector is a net producer (Arndt, et al. 2008, Reyes, et al. 2009). However, past studies show that rural poor are also net consumers (just like the urban poor) owing to their farm production constraints in responding to price incentives. Hence, even if these households may not be necessarily fuel-poor, they can also be affected by such price hikes.

In the Philippines, Reyes, et al. (2009) analyzed the impacts of price surges caused by 2008 Global Financial Crisis. Focusing on the demand side, since most households in the Philippines are consumers rather than producers, a nonparametric analysis of fuel consumption patterns across different group of households were used to analyze the impact of fuel price increases.

Using the data collected from the FIES, the study observed that poorer households tend to have higher expenditures on fuel as compared to richer households. In terms of the vulnerability of sectors on fuel price changes, agriculture-related industries made it to the list where the price of pesticides and insecticide, and fertilizer is expected to increase by about with six percent and 4.9 percent, respectively, because of fuel price increase, respectively. Based on the study's estimation, fuel price increase would push the total household spending up of 5.2 percent, resulting to higher poverty threshold of 15,840 Philippine pesos capita per year.

Using the 2006 FIES data, the most vulnerable group is considered to be households with per capital which is within 5.0 percent higher 20 than the provincial poverty threshold. Since this is the most vulnerable groups, consisting of 2.2 million people, simultaneous increase in rice and fuel prices will drag them below the poverty line. This translates to an estimate of 2.3 million more people which will fall below poverty with higher prices of rice and fuel. In the end, they conclude there was no substantial pass-through impacts of global markets to domestic markets. According to the authors, this may be due to the interventions provided by the government.

During the same period, Son (2008) checked whether inflation has hurt the poor. Using the price elasticity for the headcount ration to predict the additional number of people who would be forced into poverty because of a ten percent increase in price of fuel, the study concluded that the increase in fuel prices will result in an additional 0.16 million poor people.

Table 6. Poverty impacts of changes in rice, fuel and transportation prices

Expenditure Item	Price elasticity with respect to				Additional number of poor due to 10 percent increase in price (in millions)
	Average standard of living	Headcount	Poverty gap ratio	Severity of poverty	
Rice	-0.08	0.32	0.51	0.62	0.66
Fuel	-0.02	0.08	0.13	0.16	0.16
Transport and communication	-0.08	0.07	0.09	0.10	0.15

Source: Son (2008)

In further understanding the impacts of food and fuel price hike on children, there seems to be a need to identify the "impact pathways" that trace how changes from the global macroeconomy affects countries and how does these changes trickle down to communities and households (Jones, et al. 2009). Specifically, the impacts on the households are shaped by how government policy responds to such changes. Among the most obvious is the impact of price hikes on food security and how such price hikes lead to higher incidence of hunger. On the other hand, the authors also warn of "hidden hunger" in which highly-nutritious food either do not reach communities due to lack of availability or that households can no longer afford such types of food items. This therefore impacts the children's growth which potentially impact the human resource base of the country. To exacerbate matters, such scenario might force parents to ask their children to work in low-paying jobs just to put food on the table. Finally, another issue arising from impacts of such price hikes to government spending on social services. If the government cuts budget on social services, then it becomes even more difficult for children from indigent households to get nutrition.

In the Philippines, a recent study undertaken by Ang (2018) that current year inflation for food has positive direct impacts on the incidence of underweight children, while negative indirect impacts on the incidence of wasted children. A one percent increase in the price of a typical household's food basket leads to 0.5%, 0.36%, and 0.245% increase in the incidence of underweight, stunted, and wasted children. This implies the importance of ensuring that food prices, especially of meat, fruit, and vegetables, should be managed especially in regions (and neighboring areas) where the incidence of child malnutrition is high.

In the same SAM-based price model, Chapa and Ortega (2017) extended their discussion by looking at households as well. The explain that the impact of carbon tax on consumption and welfare differs by strata. In rural strata, it was not a defined pattern while on urban strata, the carbon tax was regressive because of household expenditure share in inland transport and petroleum products which showed highest price increased while household income decreased. He added that the Mexican government should use subsidies on transport services that uses clean energy services which will act also as subsidy to poor and non-poor households that uses clean energy services.

Using a Computable General Equilibrium model with disaggregated households, Yusuf and Resosudarmo (2015) stated that the impact of carbon in Indonesia had progressive overall distributive effect nationwide. It was driven by both the income and the expenditure patterns of households. With the introduction of the carbon tax, the reallocation of the resource was in favor of factors endowed more proportionally by rural and lower income class households because of expansion of agricultural and service sectors and contraction of energy intensive manufacturing sectors. They also mentioned that the typical expenditure pattern in developing countries was less energy-sensitive therefore, it also helped drive the progressivity of the result which was in rural areas.

Given the volatility of international fuel prices, the study investigates the welfare impacts of fuel subsidy reform for developing countries (Javier, et al 2012). First, there were two channels implied in analyzing the welfare impact of increasing domestic prices – direct and indirect. This will depend on the households' consumption baskets, i.e. the budget share for each fuel product for each household which was computed by dividing the fuel expenditure by the total household consumption. Another method used by the study was the computable general equilibrium (CGE) models to evaluate the welfare impact of higher fuel prices. The study concluded that the magnitude of the impact of fuel prices on poverty can be substantial, where a $0.25 per liter increase in fuel prices decreases household incomes by an average of 5 percent. Half of this impact is reflected by the indirect effects which depends on the fuel intensity of their consumption. La Viña (2017) mentioned that an increase in coal tax can reverse the anomalies like coal plants emission causes respiratory, cardiovascular, and neurological health hazards that children and elderly are most vulnerable.

3.3 Impacts on Environment

Fernandez (2018) mentioned that a tax increase on coal aims slash carbon emissions of the Philippines. She also mentioned that Ms. Angela Consuelo Ibay, head of WWF-Philippines's Climate and Energy Program, stated that the passage of coal tax hike is necessary to help protect the people environment against devastating impacts of coal consumption. La Viña (2017) added an increase in the coal tax in the Philippines allows the Philippines to have a transition from a coal to a cleaner, cheaper, and more sustainable energy system which is good for the environment. He also added that coal-fired power plants cannot function without using more natural resources (e.g. water) to operate its turbines and cool its thermoelectric plants. Mayuga (2017) quoted Renato Constantino, executive director of Institute for Climate and Sustainable Cities, the carbon tax approach will help the country achieve its COP 21 commitment which is to reduce the country's carbon emission by seventy percent between 2020 to 2030.

Shi et al (2015) used a CGE model in order to know the environmental effects of coal resource tax reform in China. The environmental influence of the coal resource tax reform would decrease the total carbon emissions which can effectively improve China's environment. Dong et al (2017) used a 30-Chinese province CGE model to conduct the provincial evaluations of carbon tax. They mentioned that carbon tax can effectively reduce industrial carbon emissions after 2020 with the increasing carbon price. Lin and Jia (2018) mentioned that medium carbon tax rate meet the reasonable carbon tax coverage industry so that China can achieve certain emission reduction effects but in high carbon tax rate, the emission reduction effect is very significant.

4. Methodology for Analysis

The assessment of the impact of excise tax changes in the Philippines is undertaken using a computable general equilibrium (CGE) model. Such types of methodologies have become useful tools to analyze economy-wide effects of policies like tax reforms. Given that there are not only direct effects but also indirect effects of any tax reform policies, it warrants a methodology that can trace its potential effects through the economy. For instance, an increase in taxes on consumer goods raises the prices of goods for households and reduces the demand for these goods. This would then have effects on firm production and then on the demand for firm factors, including labor, affecting therefore affecting employment and household incomes, which further affects the demand of goods. Capital is then also affected as decisions to postpone investment may result from the decline in terms of firm production.

In partial equilibrium models, these indirect effects are hardly captured as analysis is limited only to a portion of the sectors of the entire economy. If the repercussions are spread throughout the economy across the different production sectors and consumption deciles, CGE analysis will be more useful. The multiplier analysis springing from Leontief's input-output model, on the other hand, looks at all the sectors of the economy; albeit its results only take into account output changes as a result of firms changing their input demands given shocks in the final demand. Hence, assessment of impacts on households cannot be made. However, the main concerns of tax policy reforms would always boil down to its repercussions on household welfare. If it is important to differentiate welfare effects among the different types of households, the CGE model extended with a microsimulation analysis will be useful. As the combined price and quantity effects have important distributional outcomes, not only would the CGE model with several households allow for the assessment of changes in household welfare across different types of economic agents, but also changes in poverty rates with microsimulation analysis using household-based surveys.

4.1. Computable General Equilibrium Framework

In developing the CGE model for the current study, the standard Walrasian CGE model described in Rutherford (1999), is utilized. Like any CGE model, Rutherford and others seek to describe the typical economy in which firms maximize their profits, consumers maximize their welfare and supply equals demand in all markets. To put it another way, economic behavior is modeled following the principles of optimization. This allows firms' supply of goods and services to be modeled alongside their input and factor demands. At the same time, it also allows households' demand for goods and services and their supply of labor and capital to be modeled. The corresponding markets then settle to equilibrium with appropriate adjustments to commodity and factor prices.

Since a general equilibrium model is generally solved as an optimization problem, an objective function needs to be defined. Then the model would begin with profit and welfare maximization at the aggregate subject to the corresponding constraints. However, the optimization problem may become intractable and could result in inconsistencies, if there is more than one economic agent that needs to be considered. Given a multitude of economic agents and the corresponding multitude of solutions that need to be found, the objective function that is to be maximized may be difficult to define. Markusen and Rutherford (2004), utilizing the framework from Mathiesen (1985), suggested an alternative methodology that makes use of a system of simultaneous equations.

Rather than define a massive objective function, optimization problems for each of the agents are defined. To put it another way, Markusen and Rutherford (2004) and Mathiesen (1985) begins with solving the underlying cost minimization problems for consumers and producers, i.e., solving for cost and expenditure functions, essentially embedding the optimization behavior in the solution system. Then, demand for factors and commodities can be easily calculated through Shephard's lemma. Then a square system of 'weak' inequalities can be formulated, in which three sets of conditions have to be simultaneously evaluated, non-positive profits for goods and welfare, demand for goods and factors not exceeding supply, and that the income of the consumer is equal to the factor returns.

These equilibrium conditions can then be formulated as a complementarity problem in which each inequality is associated with a particular variable; the complimentary variable can be noted as what is not produced if strict inequality in the equation holds. For example, if profits for a production activity are negative, then the commodity resulting from the activity will not be produced. Or if supply exceeds demand for a good, then the price of the good would be zero, or it is free. As with the 'strict inequalities', there would be three inequalities in the general equilibrium system: zero-profit conditions, market clearing conditions and income balance. The solution system derived from Markusen and Rutherford (2004) and the standard model, including its parameters and calibration process, which utilizes the solution system can be made upon request.

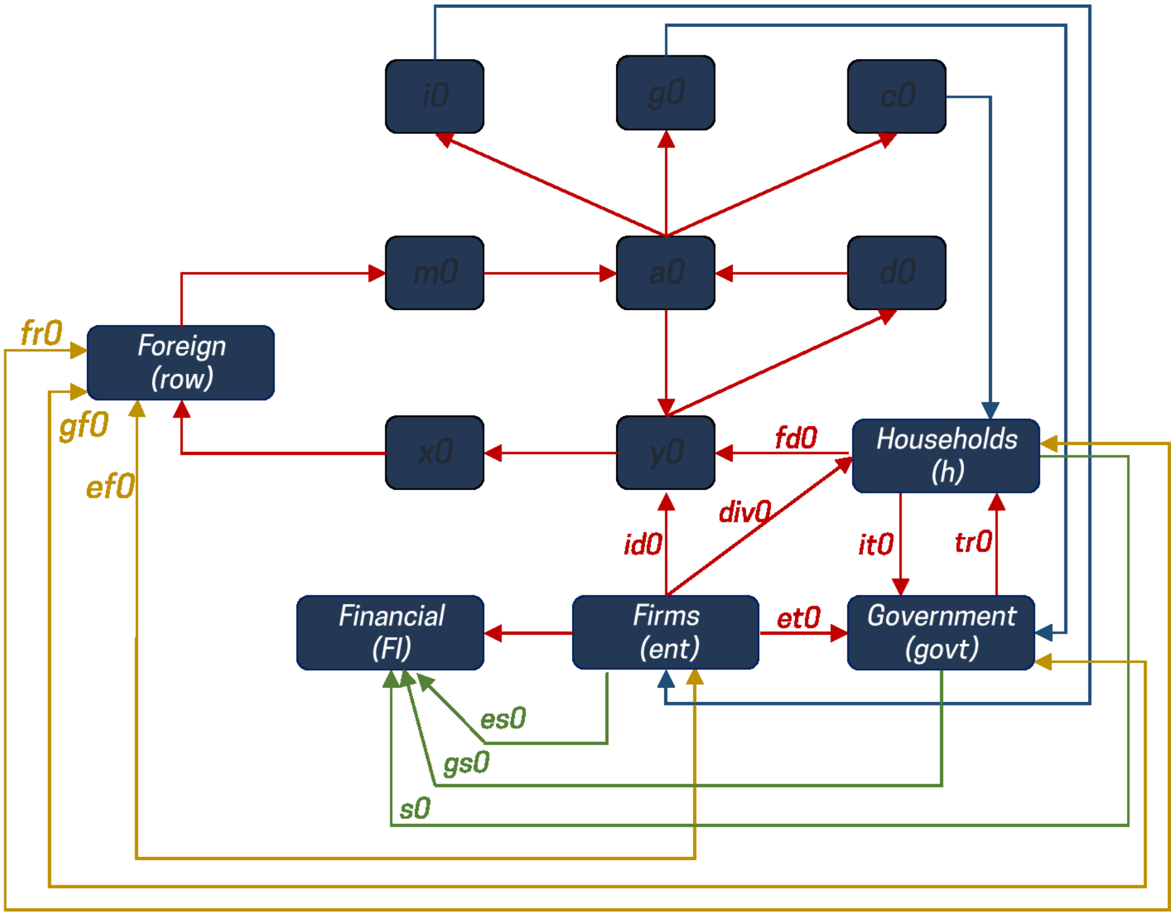
The advantage of modelling tax policies using a general equilibrium framework is therefore is capacity to measure the ultimate impact of these policies in a theoretically consistent way, by quantifying the change in the income and consumption of the different types of economic agents that result from the interactions and feedbacks of the different markets in the economy.

The resource and economic transaction flows are illustrated in **Figure 16** wherein each production sector *s* produces a quantity of a homogenous output *y0* by utilizing intermediate inputs *id0* and production factors *fd0*. In other words, the economy is simply divided into a certain number of sectors where each identified *s* is modeled to be producing only one commodity, even if the sectors are actually composed of even smaller sectors producing various types of goods and services.

The total domestic output *y0* is therefore composed of domestic supply d0 and imports *m0*, which is then equal to the composite supply *a0*. The composite supply of commodities is then used in production as intermediate inputs or consumed by households (consumption) *c0*, by firms (investments) *i0*, and by government (public sector demand) *g0*. Part of domestic output is also exported, *x0* to the rest of the world (row). While imported and domestic goods are imperfectly substitutable (Armington, 1969), the model maybe simplified by setting the so-called Armington substitution elasticity to unity.

In terms of firm behavior, production activities are modeled to exhibit constant returns to scale, i.e. a doubling of inputs and factors would lead to a doubling of output. Outputs are then produced making use of aggregate primary and intermediate inputs. The specific intermediate inputs making up the aggregate intermediate input, *id0,* however are modeled to be not substitutable with one another. Thus, the level of the aggregate is set by the raw material input that is most constraining, i.e. the aggregation is characterized by a Leontief-type function. On the other hand, the composite primary factor input *fd0* is aggregated using a standard production functional form such as the Cobb-Douglas function. In other words, unlike in intermediate inputs, primary factors are substitutes of each other.

Figure 16. Economic flows in a computable general equilibrium model



Source: Modified from Markusen and Rutherford (2004)

As previously mentioned, the local production output, *y0*, is exported, *x0,* or sold to the domestic market, *d0.* Furthermore, profits are modelled to be linearly homogenous in prices, while demand is modelled to be homogenous of degree zero. To put simply, because a doubling in prices of all goods does not double demand, relative and not absolute prices are important in determining production activity levels. The domestic good *d0* and imported product *m0* are aggregated to become an Armington (1969) good *a0* using a constant elasticity of substitution function.

Moving towards the demand side, households, government and the financial institutions make up the institutional sectors. In this model therefore, the Armington good is consumed by the different institutions including households (*h*), government (*govt*) and the rest of the world (*row*), and used as intermediate goods in the production process.

Each household *h* in the model has an initial endowment of factors *fe0* and a utility function defined over the products it consumes *c0* which were produced in the economy. Households pay taxes to the government, *it0*, receive dividends from firms, *div0*, and transfers from the government *tr0* and foreign remittances, *fr0*, from the rest of the world. Incomes are used in buying the products to be consumed. Any residual is treated as savings, *s0*, that flow into the financial sector to be invested, *i0*.

For the case of government, it received flows from the other institutions through taxation. Firms pay enterprises taxes, *et0*, to the government and generate savings, *es0*. Savings may also come as transfers from abroad in terms of foreign investments, *ef0.* Whatever the source, savings flow to financial institutions, *FI,* that allocate these to increase the capital stock in the economy in the next period, *i0*. On the other hand, the government collects income taxes from households and business enterprises, indirect taxes, *tz0*, from domestic sales, and tariff duties, *tm0,* on imported goods. It uses the revenues to provide basic public services. The government may generate savings, which then flow to financial institutions, *FI*.

Financial institutions, *FI*, gather savings from households, government, business enterprises, and from the rest of the world, *row.* These savings can be used to finance investments that can be utilized by firms in the production activities. Another institutional sector is the rest of the world, *row*, buys exported goods from and provides imported commodities to the domestic economy. Like in other institutions, income transfers flow to and from the economy. They flow in or out of the economy to or from its different institutions including households, firms, and the government.

4.2. CGE Model for Coal and Petroleum Excise Taxes

The CGE model for the current study contains 44 production sectors, of which eight are agriculture, 20 are manufacturing/ industrial, and eight are in services; in addition, there are seven other sectors that are utilized to specific types of energy sources that are specified in this model that are utilized to create an "energy-composite"; these energy sources include coal, gas, hydroelectric, wind, oil, solar and other electricity sources, and another, the electricity transmission sector, which provides spread the sources of energy in the composite sector. In addition, there are three production factors (skilled labor, unskilled labor and capital), ten households (representing the ten income deciles), and several institutions, representing government, firm/ enterprises, savings-investment and the rest of the world. The data utilized for numerically specifying the economic stocks and flows of each of these sectors and institutions are specified in the succeeding section.

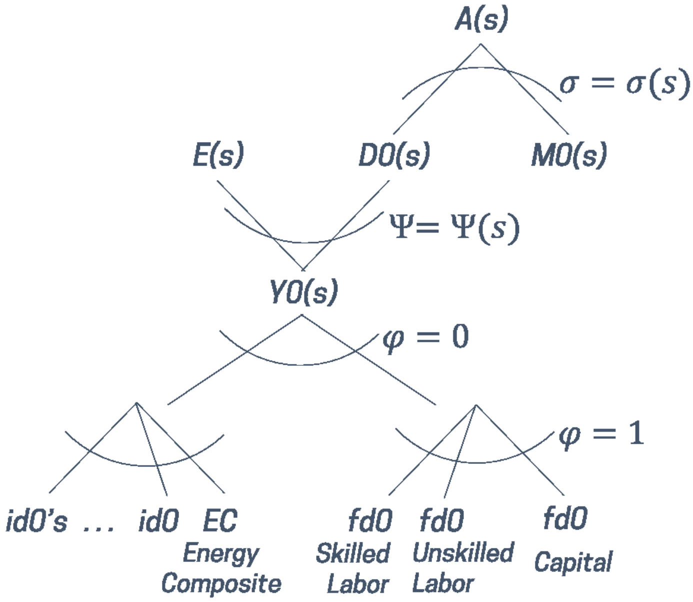
The production and consumption structure may be defined by showing the linkage between sectors and the elasticity of substitution in consumption and production; an illustration showing the nesting structure for production is shown in **Figure 17**. Furthermore, in order to feauture the linkages in the energy sector, including the substitution of the different sources of energy (i.e., coal, hydroelectric, geothermal), the CGE model in this study utilizes an "energy-composite" as the ability of firms to shift between the different sources of energy

The constant elasticity of scale (or CES) function is utilized intensively in the model undertaken for this study. When modeling with the CES production function for instance, it allows the CGE model to assure that changes in factor ratios stay the same as substitution between factors change. This means that elasticity of substitution σ can be expressed as:

$$\sigma = \frac{d\left(\frac{fd0_i}{fd0_j}\right)\Big/\left(\frac{fd0_i}{fd0_j}\right)}{d|MRTS|/|MRTS|} = \frac{d\ln\left(\frac{fd0_i}{fd0_j}\right)}{d\ln|MRTS|}$$

The above expression tells us that the percent change in factor ratios $fd0_i/fd0_j$ stays the same as substitution between two factor rations, $MRTS = dfd0_j/dfd0_i$, chane along various combination of factors. The same assumption holds for the utility function of consumers.

Figure 17. Production Nesting Structure of the Model



Source: Authors' illustration

The use of this function simplifies the modelling system, which is based on the MPSGE (or the Mathematical Programming System for General Equilibrium; see Rutherford, 1995). The price and quantity, the marginal rate of substitution and the convexity of these functions characterize the production and consumption functions utilized in this system. This implies that the data requirements would be the share and elasticity parameters for all the consumers and production sectors.

The base level intermediate inputs, *id0*, and the factor demands, *fd0*, depending on the type of factor, *f,* are aggregated to produce commodities at the sectoral level, *s*; this is known as sectoral production, *Y(s)* (The 0 suffix denotes the initial base runs) These outputs are produced for exports, *E(s),* and domestic output, *D(s)*. *D(s*), together with imports, *M(s),* produce the Armington product, *A(s*), for each of the sectors. The elasticity of substitution between the intermediate inputs and the aggregate composite of the production inputs have an elasticity of substitution (σ) which is zero.

On the other hand, the transformation elasticity of exports, *e0(s)*, and domestic supply, *d0(s),* is denoted by $\varphi(s)$, which differ across production sectors. The Armington elasticity, which denotes the substitution between domestic output *d0(s)* and imports *m0(s),* are denoted by $\sigma(s)$, which is also different across sectors. The substitution and transformation elasticities assume that the relationship between the different variables, for example, between domestic supply and imports, and between exports and domestic output, can be characterized by a constant elasticity of substitution (CES) function. This means that an increase in the price of domestic good vis-à-vis the price of exports reduces the supply of exports and increases the supply of domestic output at a constant value.

Adapting the notation that can be found in Rutherford and Light (2001), the production block in this model is modelled as a nested Leontief-Cobb Douglas technology. Intermediate inputs and aggregate value-added enter at the top level where t, s are production sectors:

$$Y(s) = min\left[min_t\left(\frac{x(t,s)}{a(t,s)}\right), \frac{v(s)}{b(s)}\right]$$

The value-added (va) represents a Cobb-Douglas aggregation of skilled labor, unskilled labor and capital resources, for each sector s:

$$va(s) = L(s)_S^{\alpha F} L(s)_U^{\alpha U} K(s)^{\beta}$$

in which constant returns to scale implies that $\alpha_S + \alpha_U + \beta = 1$ for each of the production sector, s.

As noted earlier, each production sector produces domestic goods *D(s)* and goods for export *E(s)* These goods are assumed to be imperfect substitutes, and they have a constant elasticity of transformation. An algebraic formulation of this transformation function is written:

$$Y(s) = g\big(D(s), E(s)\big) = \big[\alpha(s)^D D(s)^{1+1/\eta} + (1 - \alpha(s)^D E(s)^{1+1/\eta}\big]$$

where $\alpha(s)^D$ is the benchmark value share of domestic sales in total output for sector s and η corresponds to the elasticity of substitution in production.

The model adopts an Armington representation of the import demand. Armington goods, A_i, are produced by combining domestic goods with imports from the same sector. These goods are treated as imperfect substitutes with σ as the Armington elasticity. The Armington aggregate good is the main commodity for use in production and final demand. It combines domestic output, D_i (which is produced via Y_i), with imports, M_i. The σ is the Armington elasticity.

$$A(s) = h\big(M(s), D(s)\big) = \big[\alpha(s)^M M(s)^{1-1/\sigma} + (1 - \alpha(s)^D D(s)^{1-1/\sigma}\big]$$

The real exchange rate (ρ) is determined by supply of exports and demand for imports, which is determined in units of foreign currency.

$$\sum_s \overline{p(s)}^E E(s) + B = \overline{p(s)}^M M(s)$$

Holding all else equal, rising import demand will increase ρ, which reflects increased demand for external currency. The fixed parameter B denotes the exogenously specified current account balance. Because this is a small-open economy, import and export prices, which are $p(s)^E$ and $p(s)^M$ are fixed exogenously.

There are ten different types of households that represent the different income deciles; each household (h) is endowed with primary factors of production: capital, labor, and resources. Each household demands investment, private and government goods. Investment and government output are exogenous, while private demand is determined by utility maximizing behavior. Each household's utility function is a Cobb-Douglas utility function:

$$U(A(h)) = \prod_s A(s)^{\alpha(s)} \qquad \sum_s \alpha(s) = 1$$

Each household (h)type maximizes utility, U(A(h)) subject to a budget constraint: $\sum_s p(s)A(s) \leq p_K K(h) + p_{LS} Ls(h) + p_{LU} L_U(h) - ptax(h) - trn(h) - sav(h)$, where *p(s)* is the price of the Armington good, *A(s)* is the value of Armington good, p_K, p_{LS} and p_{LU} are the respective price of capital, skilled labor and unskilled labor, *K(h)*, $L_S(h)$ and $L_U(h)$ are the different amounts of capital, skilled labor and unskilled labor of household type h, and *ptax(h), trn(h)* and *sav(h)* are the personal income tax, trn are other autonomous transfers and sav is the savings of household h.

In this static formulation, investment demand is held constant at base-year levels. Investments are aggregated into a single, national investment pool, then distributed among production and government sectors according to base-year accounts. Investment funds come from households and government. The level of investment can be altered in the steady-state formulation.

The government spends money on the purchase of government services and investment. Purchases are supported with tax revenue, capital rents, and net foreign exchange transfers. Total tax revenues are described above.

4.3. Modeling Philippine Excise Taxes and other Taxes in the TRAIN

In a general equilibrium model, taxes are typically specified in ad valorem manner. In this case, the tax at a given rate determines the fractional increase in the price level of the taxed commodity as in the case of excise and value added taxes. On the other hand, in terms of household income taxes, these are calculated as a reduction in return on both the capital and labor income of households.

In this model, the amount of the excise tax on domestic goods (*exct*) for each production sector (s) is calculated as the excise tax rate (*txrext*) multiplied by the domestic demand (*d*) minus the excise tax, other indirect tax (*oit*), percentage tax (*petx*) and road users tax (*rutx*), while the amount of excise tax on imported goods (*extm*) is calculated from the value added tax rate (*txrextm*) and the total value of the imported goods (*m*), and would thus be:

$$extd0(s) = txrext(s) * (d(s) - oit(s) - petx(s) - rut(s)$$
$$extm(s) = txrextm(s) * m(s)$$

In addition, other taxes are also included in this model, including the following taxes: value added tax, household income tax, corporate income tax, import duties and value added tax. road user tax and other taxes. Other taxes in this model are exogenously derived from the National Tax Research Center and the Department of Finance statistics.

In addition, to assess the inflationary impact of the tax policy, a scenario is also calculating assessing the impact of an endogenous price change on commodities from the petroleum industry and also the rice processing sector. This is calculated as a 20 percent change in the prices of these commodities in the sector.

The equilibrium conditions are then specified as an Arrow-Debreu problem (i.e., there is a set of prices that result in the equivalent amount of aggregate demand and aggregate supply for each set of commodities, under certain market conditions) with three types of equations defining the problem as follows:

- *Zero Profit* The first set of constraints requires that in equilibrium no producer earns an "excess" profit, i.e. the value of inputs per unit activity must be equal to or greater than the value of outputs, or $Cost_s(\mathbf{p}) \geq Rev_s(\mathbf{p}) \perp Y(s)$. The corresponding complementary variable for a zero-profit condition is output (*Y*). Holding all else equal, if output prices rise for commodity *i*, production activity increases until marginal cost equals marginal revenue.
- *Market Clearance.* The second class of equilibrium conditions is that at equilibrium prices and activity levels, the supply of any commodity must balance or exceed excess

demand by consumers and producers. This refers to produced commodities, a similar constraint holds for endowed goods like labor, capital and resources. The corresponding complementary (dual) variable for the market clearance condition is price (p_i or p_F ,p_K,P_R,w). Prices adjust until supply equals demand for a given commodity or factor.
- *Income Balance*. The third condition is that at an equilibrium, the value of each agent's income must equal the total value of expenditures. The model includes a set of utility functions which exhibit non-satiation, so Walras' law always holds.

In addition to the increase in excise taxes, the Tax Reform for Acceleration and Inclusion (or TRAIN) can be modelled to also include the following:

- Value added tax. The amount of the value added tax on domestic goods (*vatxd*) for each production sector (s) is calculated as the value added tax rate (*txrvatd*) and the amount of factors utilized in the production of the good (*fd*), while the amount of value added tax on imported goods (v*atxm*) is calculated from the value added tax rate (*txrvatm*) and the total value of the imported goods (*m*), and would thus be:
$vatxd(s) = txrvatd(s) * \sum_{i=1}^{f} fd(f,s)$ where f ∈ K (s), L_S(s), L_U(s)
$$vatxm(s) = txrvatm(s) * m(s)$$

- Household income tax (*ptax*). This is calculated from the implicit personal tax rate (*ptr*), transfers from ROW to households (*trrhh*), transfers from government to households (t*rghh*) and the sum of all income from factors of the households, or
$$ptax(h) = ptr(h) * \left[trrhh(h) + trghh(h) + \sum p_K K(h) + p_{LS} LS(h) + p_{LU} LU(h)\right]$$
- Corporate income tax (*ctax*). This is calculated from the implicit corporate tax rate (*ctr*), the total amount of enterprenuerial capital (*ek*), transfers from government to business (*trgb*) and transfers of foreign/ rest of the world to business (*trrbf*), or
$$ctax = ctr * [ek + trgb + trrbf]$$

- Import duties (*tm*) and total border tax (*btx*). The value of import duties is the tariff rate (*txrtm*) multiplied by the volume of imports (*m*); however, the amount of taxes imposed on imports would be the sum of import duties, the excise tax on goods and the value added tax.
$$tm(s) = txrtrm(s) * m(s)$$
$$btx(s) = tm(s) + vatxm(s) + extm(s)$$

- Road user tax and other taxes. Other taxes in this model are exogenously derived from the National Tax Research Center and the Department of Finance statistics.

The model utilized in this study is computed numerically utilizing the Mathematical Programming System for General Equilibrium Analysis (MPSGE) (Rutherford, 1999) utilizing the Generalized Algebraic Modelling System (or GAMS) software r. As noted above, in the MPSGE system, the underlying algebraic formulation of the functional forms need not be programmed into the system and thus, the general format of the underlying economic behavior and flows only should be specified.

Using the results in the model, we analyze the effects of the tax changes in two areas, household welfare and CO2 emissions, using through a microsimulation using the accounting approach. Prices and factor price changes are utilized to calculate the change in welfare, while the changes in output are used to calculate the change emissions caused by production in the economy.

4.4. Calculation of the Poverty and Employment Impact

The study calculates for changes in poverty incidence in the economy utilizing a micro-accounting approach. The method utilizes the information on factor income and price changes in the CGE model and then applies these changes separately for each of the households in the 2015 Family Income and Expenditure Survey (FIES). Since the income and price information is available for each of the income deciles in CGE mode, each of the households in the FIES is identified by this income decile information and then the appropriate income and price changes are undertaken. The growth rates or changes are then applied separately to the per capita disposable income or consumption expenditure of each household in the household survey. This provides absolute income or consumption expenditure levels following the shock.

Then, using the new absolute nominal levels of income and consumption for each group, we can then calculate standard income distribution measures such as the headcount index, the poverty gap, and the Gini coefficient. Then, we can compare the post-policy poverty and income distribution indicators with the baseline values to assess the impact of the shock on the different households. The poverty indicator used is the headcount index, which can be derived from Foster, Greer, Thorbecke (2008) FGT poverty measure:

$$P_{\alpha t} = \frac{1}{N}\sum_{y_{it}}^{z_t}\left(\frac{z_t - y_{it}}{z_t}\right)^{\alpha}$$

where α is the poverty aversion parameter, N is the total number of individuals or households, y_{it} is the individual or household's income at time period t and z_t is the poverty line, t is the time period (before and after the shock). The poverty headcount, in which $\alpha = 0$, is utilized in the calculation of poverty/ welfare.

According to Agenor, Chenn and Grimm (2004), comparing this relatively simple approach with other approaches in assessing the poverty impact of the macroeconomic policies, show that the differences in the results in poverty indicators. The advantage of this approach is that it does not presume a specific functional form for the distribution of income and consumption, which is adjusted to the corresponding levels in the macro model. However, the disadvantage is that this methodology does not account for changes in the employment structure caused by the behavioral variations at the household level. Poverty and income is only affected by the

Nevertheless, in addition to the poverty impact, the employment impact of the policies is also analyzed. This utilizes the 2015 Labor Force Survey to analyze the change in employment levels using the changes in output in the simulations. Using constant returns to scale production function, the change in employment is assumed to be the same as the change in output from the simulations, and the change in the level of employment is shown in the results section below.

4.5. Calculation of the Environmental Impact

In order to calculate the changes in the trajectory on changes in emission impact, emission multipliers are calculated from the Global Trade Analysis Project Energy (GTAP-E) information which has information on carbon dioxide (CO2) emissions The GTAP-E Data Base provides carbon dioxide (CO2) emissions data distinguished by fuel and by user for each of the 140 countries/regions in the GTAP version 9 Data Base. GTAP-E data is based on GTAP 9 and extended energy balances compiled by the International Energy Agency (IEA).

Two sets of information were obtained from the GTAP-E database, the CO2 emissions associated with the usage of a firm's usage of domestic commodity in sector s (also called as the CODF in the database) and the firm usage of imported commodity in sector s (also called the COIF). CO2 multipliers (defined as the impact of the CO2 emission coefficient resulting from a specific value of output) in each industry are then calculated by using the information on the carbon dioxide emission coefficient from the industry multiplied.

5. Data Used in the CGE Model

The primary dataset used in numerically specifying the CGE model is the Social Accounting Matrix or the SAM. The dataset traces the circular flow of incomes from producers/suppliers through factor payments to households and back to product markets through expenditures on final goods (or sales from activities). Additionally, income flows involving producers, government, financial intermediaries and the rest of the world (ROW) are also accounted for in the SAM.

A national SAM was constructed for the year 2015 initially based on the 2012 65x65 Input-Output (IO) Table of the Philippines published by the Philippine Statistics Authority (SAM).[2] The 2012 values in this latest IO Table were simply inflated to reflect 2015 level of the gross domestic economy in nominal terms. The various data required in the SAM were then collected from various sources, while those data that were also available in the 2012 IO Table were validated using other sources (e.g. imports and exports). **Table 7** below provides a list of production sectors utilized in the model.

Table 7. Listing of the Production Sectors in the Model

Sector No.		Description
AGRICULTURE		
1	rice	Paddy rice
2	corn	Corn
3	othcr	Other crops
4	sugr	Sugarcane
5	bana	Banana
6	live	Livestock and other animal products
7	fors	Forestry
8	fish	Fishery
INDUSTRY		
9	ming	Mining and quarrying
10	coal	Coal

[2] The procedure mostly follows that of Cororaton (2003), who assembled a 1994 Philippine SAM. Meanwhile, the 2012 65x65 Input-Output Table is the latest one available.

11	crdo	Crude oil
12	ngas	Natural gas
13	food	Food manufactures
14	sugm	Manufacture of sugar
15	beve	Beverage and tobacco
16	txtg	Textile and garments, tanneries and leatheries
17	wood	Wood and wood products
18	paper	Paper and printing
19	peta	Petroleum and other fuel products
20	chem	Chemicals, cosmetics, rubber and plastic products
21	minl	Non-metallic mineral products
22	metl	Metals (except for iron and steel)
23	irst	Iron and steel
24	elec	Computer, electronic and optical products
25	mach	Machineries and equipment (except for engine and turbines, etc.)
26	engines	Manufacture of engines and turbines, except aircraft, vehicle and cycle engines
27	treq	Transport equipment
28	otmg	Other manufactured goods
ELECTRICITY AND POWER		
29	elet	Electric transmission
30	cole	Coal power generation
31	gas	Natural gas power generation
32	hydr	Hydroelectric power generation
33	wind	Wind power generation
34	oil	Oil power generation
35	solr	Solar power generation
36	othe	Other energy generation
SERVICES		
37	othu	Utilities, excluding electricity
38	cons	Construction
39	trde	Wholesale and retail trade and maintenance and repair of motor vehicles
40	trans	Transport services and storage
41	telc	Telephone and communications
42	otsr	Other services, including business services, and tourism
43	Puba	Public administration, education and health

Source: Authors

The energy sectors from aggregated sectors using ratios computed from GTAP-Power data. Table 10 summarizes these sectors. We also used ratios from the GTAP-Power to compute for the energy consumption of economic sectors. The GTAP-Power data set contains energy consumption of 68 production sectors, and these were matched with the social accounting matrix that was produced from the 2012 Philippine Input-Output table. To compute for the energy consumption of sectors, a one-to-one correspondence between sectors of the GTAP-Power and the social accounting matrix must be established first and we do this by aggregating some sectors in both data sets so that the total number of sectors in the SAM is reduced. The study implemented a bi-proportional scaling procedure on the social accounting matrix and this resulted in a balanced matrix.

Besides the IO and the NIA datasets, several other datasets were utilized in constructing the SAM. These are the Balance of Payments (BOP) data, the Budget of Expenditures and Sources of Financing (BESF), which the DBM produces each year, and the government financing table of the Department of Finance, which gives information on the revenues from the various taxes on the Philippine economy. The Bangko Sentral ng Pilipinas (BSP) constructs the BOP table each year. The BOP data tracks the cross-border payment and transfer flows in and out of the Philippine economy. Imports and exports by sector are reported in the 2012 IO table. The sectoral shares of these were applied to the aggregate exports and imports of the economy in 2015 as reported in the BOP data.

Moving on to primary factor demands, the SAM used in the model has a more disaggregated labor than in the 2012 IO table. Labor in the SAM is disaggregated by skill namely skilled and unskilled labor; this was undertaken utilizing the shares of skilled and unskilled labor across different production sectors using the industry affiliation of individuals found in the 2015 Family Income and Expenditure Survey-Labor Force Survey.

The SAM disaggregates households based on their respective average income levels. The 2015 FIES is used in disaggregating the households. The disaggregation requires the allocation of aggregate consumption by industries to the ten households by income decile in the SAM. A consumption correspondence matrix was developed to map the expenditure categories of the FIES to the production sectors in the SAM. Furthermore, the factor payments, household taxes and savings and other transfers to and from households were obtained also from the 2015 FIES data.

The 2015 BESF of the DBM and the DOF's government financing tables was utilized for obtaining fiscal data. The direct and indirect tax rates are computed based on the actual collections of the various tax measures in 2015 divided by the corresponding tax bases. Information on the different types of taxes, especially excise tax, was obtained from the National Tax Research Center, and additional information was also obtained to disaggregate the various taxes provided to the different production sectors and households. For example, the information on the personal income tax disaggregated by deciles was obtained from the information

The 2015 Philippine SAM constructed for the study will serve as the baseline scenario. From this matrix, the CGE Model will determine equilibrium levels across all markets. To put simply, running the model would entail determining the general equilibrium scenario of the economy system. The implementation of the CGE Model to assess the impacts of changes in tax policy involves changing the tax rates applied to the affected goods. This thereby serves as the shock to the economy which will bring about a need for the system to find new equilibrium levels across all markets allowing for the calculation of changes in various macroeconomic variables**.** **Table 8** shows the structure of the SAM in a form where the productive sectors are aggregated into agriculture, industry and services in order to reduce the size of the matrix.

Table 8. SAM Structure

	Local Sales									Exports	Domestic Production of Goods
Intermediate Inputs by Sector						Household Final Consumption		Government Final Consumption	Investment Expenditures		Domestic Market Suppy of Goods
Sectoral Value Added											Factor Income
						Personal Income Tax	Corporate Income Tax				Tax Revenues from Direct Taxes
Indirect Taxes on Domestic Goods											Government Tax Revenues from Indirect Taxes and Other Taxes
	Tariffs & Indirect Taxes on Imported Goods										
						Other Payments Made to Government by Households and Firms				Other Payments Made to Govt by ROW	
		Income from Factor Endowments						Subsidies and other Transfers		Secondary Income from ROW	Household Income
										Primary Income from ROW	Firm Income
			Tax Revenues from Direct Taxes	Government Tax Revenues from VAT, Excise Taxes and Tariffs	Government Tax Revenues from Other Indirect Taxes and Other Taxes						Government Income
						Household Savings	Corporate Savings	Government Savings		Domestic Investments by ROW	Savings made by Domestic Agents
	Imports					Secondary Income Paid to ROW	Primary Income Paid to ROW	Foreign Debt Repayments	Investments to ROW		Foreign Exchange Outlays
Cost of Production	Absorption	Value Added	Tax Revenues from Direct Taxes	Government Tax Revenues from VAT, Excise Taxes and Tariffs	Government Tax Revenues from Other Indirect Taxes and Other Taxes	Household Expenditures	Corporate Expenditures	Government Expenditures	Investments by Domestic Agents	Foreign Exchange Earnings	

Source: Adapted from Coraraton (2003).

The aggregated social accounting matrix or Macro-SAM is available in Appendix 1. This shows the flows of the different sectors in the economy. The Macro-SAM provides the aggregated information of the different taxes in the economy. For the production activities, the tax imposed include the domestic excise tax and road users' tax on manufactured goods, the domestic value added taxes on agriculture, industry, service and energy activities, and the other indirect and percentage taxes on industrial activities. For commodities, the tax collections included the tariff revenue and excise taxes on imported manufactured goods, and the value added taxes on all imported commodities. Personal income taxes were collected from households while corporate income taxes were collected from enterprises. Rest of taxes, pension contributions, property taxes and fines and fees were collected from households, enterprises and the rest of the world. Total tax collections in the SAM were estimated at Php 2.68 trillion.

6. Simulation Scenarios

The objective of this study is to assess the effects of excise taxes on petroleum and gasoline on production and welfare; this is the first policy counterfactual. Two other scenarios are calculated, the effect of the changes in taxation in TRAIN, and second, the effect of the changes in the TRAIN plus the increase in world oil prices and rice prices in the country. The latter is utilized to assess the impact of the change in excise tax on the over-all inflation environment in the country.

6.1. Scenario 1 on the Changes in Excise Taxes in Coal and Petroleum.

In scenario 1, the focus is on the so-called additional carbon taxes from TRAIN Law. In particular, the focus is on the increase in the excise tax imposed on coal and petroleum products. The main challenge however is that excise taxes are specific taxes, i.e. a specific amount is identified as the tax for a specific unit of the commodity. Since the CGE model requires ad valorem tax rates, there was a need to translate both the old and the new specific tax rates into their ad valorem counterparts.

Table 9a shows the new specific tax rates following the tax reforms detailed in the TRAIN Law for coal and coke products. However, until the end of December 2018, tax rates on coal and coke has remained Php 10/ metric ton. On the other hand, **Table 9b** shows the original and revised specific tax rates for petroleum products.

Table 9a Revised Specific Taxes on Coal and Coke

Effective on	Tax to be paid is
January 1, 2019	Php 100/metric ton
July 1, 2020	Php 150/metric ton

Source: TRAIN Law (RA 10963)

Table 9b. Original and Revised Specific Taxes on Petroleum Products

Petroleum Products	NIRC 1997 Rates	Petroleum Products	TRAIN Law Rates		
			Effective on		
			Jan. 1, 2018	Jan. 1, 2019	Jan. 1, 2020
Lubricating oils (per liter) and greases (per kg)	Php 4.50	Lubricating oils (per liter) and greases (per kg)	Php 8.00	Php 9.00	Php 10.00
Processed gas (per liter)	0.05	Processed gas (per liter)	8.00	9.00	10.00
Waxes and petrolatum (per kg)	3.50	Waxes and petrolatum (per kg)	8.00	9.00	10.00
Denatured alcohol (per liter)	0.05	Denatured alcohol (per liter)	8.00	9.00	10.00
Naphtha, regular gasoline and other similar products of distillation (per liter)	4.35	Naphtha, regular gasoline, PYROLYSIS GASOLINE and other similar products of distillation and (per liter)	7.00	9.00	10.00
Leaded premium gasoline (per liter)	5.35	UNLEADED premium gasoline (per liter)	7.00	9.00	10.00
Aviation turbo jet fuel (per liter)	3.67	Aviation turbo jet fuel, AVIATION GAS (per liter)	4.00	4.00	4.00
Kerosene (per liter)		Kerosene (per liter)	3.00	4.00	5.00
Diesel fuel oil (per liter)		Diesel fuel oil (per liter)	2.50	4.50	6.00
Liquefied Petroleum Gas (per liter)		Liquefied Petroleum Gas (per kg)	1.00	2.00	3.00
Asphalt (per kg)	0.56	Asphalt (per kg)	8.00	9.00	10.00
Bunker fuel oil (per liter)		Bunker fuel oil (per liter)	2.50	4.50	6.00
		Petroleum coke (per metric ton)	2.50	4.50	6.00

Source: NIRC 1997, TRAIN Law (RA 10963), PwC (2018)

The specific tax rates above are then transformed into their ad valorem counterparts. Hence, the baseline excise tax rate (ETR) in the CGE model are in ad valorem rates. The process of transformation into ad valorem rates involve knowing the actual volume of sales or consumption of the various production sectors and using the sectoral consumption to weight the specific tax rates. In the petroleum products sector, the weight comes from the consumption of petroleum products based on DOE data.

Since the available consumption data is not disaggregated in the same way as the study's chosen sectors, BOC imports are then utilized to disaggregate other fuels consumed in the country. Using the final weights, the specific tax rates were weighted for the NIRC 1997 rates and for TRAIN 1 rates. The growth rate between the two weighted averages is computed. Given the nature of the tax reforms, on the other hand, the calculation of the shocks would be focused on the final levels of statutory tax rates imposed. The final weighted increase in the excise tax on petroleum products sector is 281.01 percent

In this first scenario, we also include the revision in excise rates in the entire mining sector and not just on coal. For the coal mining sector, the excise tax on coal and coke will now be increased from Php 10 per metric ton to Php 150 per metric ton by 2020 which constitutes a 1,400 percent increase in the specific tax rate. On the other hand, all both nonmetallic and metallic mineral products will now be subject to 4 percent from 2 percent which is equivalent to a 100 percent rise in the ad valorem rate. Meanwhile, the mining of indigenous petroleum (i.e. crude oil) which was subject to 3 percent excise tax is now subject to 6 percent excise tax which also constitutes a 100 percent increase in the ad valorem rate. **Table 9c** shows the summary of the changes in excise taxes vis-à-vis the sectors of the model that are with excise taxes.

Table 9c. Summary of Changes in Effective Tax Rates, Excise Tax Rates, Petroleum and Coal

Sector	Estimated Shock (%)
Mining	100.0000
Coal	1400.0000
crude oil	100.0000
petroleum	281.0118

Source: Authors' calculations.

6.2. Scenario 2 on TRAIN 1 including changes in other excise taxes, value added tax broadening and changes in personal income tax.

6.2.1. Other Excise Taxes

The impact of other industries affected by changes in the tax rates are then also assessed in addition to carbon tax in the second scenario. Another affected industry is the beverage and tobacco sector. As a response to health issues related to the overconsumption of sugar, the sugar-sweetened beverages (SSBs) were targeted as new source of excise tax collection. This means that the change in the corresponding ad valorem excise tax is from zero percent. To simplify the estimation of the ad valorem ETR, we estimate prices for various types of sweetened beverages using raw survey data used by PSA in calculating the consumer price index (CPI).On the other hand, since excise taxes imposed on cigarettes is a specific tax, there is again the need to get the weighted average in the increase in specific taxes across the three major subsectors of the industry with their respective gross value added as weights in order to transform the tax rates into its ad valorem counterparts.

For the case of the automobiles, the complications in the simulation shock calculation the automobile sector come not only from the revision of the brackets but also on the various exemptions and reductions for certain types of cars. As it has been mentioned, taxes on automobiles have been raised as well. Furthermore, hybrid vehicles shall be subject to only 50 percent of the applicable excise tax rates on automobiles. Purely electric vehicles and pick-ups shall be exempt from excise tax on automobiles. On the other hand, while jeeps are considered automobiles, pick-ups are considered as trucks (and as such are not considered automobiles). Apart from these difficulties, data on cars to allow for the disaggregation of car sales or car revenues into the brackets are not readily available. To simplify the discussion, we simply consider the first price range which experiences a substantial increase in ad valorem excise from two percent to ten percent bringing about 400 percent change. Since the manufacture of vehicles is 36.44 percent of the entire transport equipment manufacture sector, the weighted increase in ad valorem is 146.578 percent. **Table 10** shows the summary changes in the beverage and tobacco sector and the transport equipment sector.

Table 10. Summary of Changes in Effective Tax Rates, Excise Tax Rates, Other Commodities

Sectors with Excise Taxes	Estimated % Change in Tax Rate
Beverages and Tobacco	37.17
Transport Equipment	146.578

Source: Authors' calculations.

6.2.2. Personal Income Tax

In terms of personal income taxes, from the National Internal Revenue Code (NIRC) of 1997, the income tax rate on individuals are shown in Table 10a. With the design to make the taxation scheme for individuals more progressive, the tax brackets are revised so as to (1) include more people in the lower tax brackets and (2) place the individuals earning an annual taxable income beyond Php 500,000 into more groups thereby allowing higher tax rates to individuals with higher income. The first revision to the tax rates came into effect last January 1, 2018. This reduction in personal income tax rates is slated to be revised again in 2023. Note that the personal (Php 50,000) and additional (P25,000 for each kid not exceeding four) exemptions has also been repealed by RA 10963. The changes in the personal income tax schedule is illustrate in **Table 11a.**

We compute the effective rate under the old tax regime as follows: First we note that compensation taxes are collected from individuals, thus we need to distribute household's income from salaries to household members who are wage and salary workers. To do this, we used the ratio of individual household member's daily basic pay to total daily basic pay of all members employed as wage and salary worker and multiplied this ratio to the total household income from salaries. This product is the member's compensation income. If the daily basic pay of a member is less than or equal to the upper bound of his/her region's minimum wage, we set his/her taxable income as zero.

Second, we also distribute total entrepreneurship income of a household to its members who are own account workers, i.e. either self-employed or employers. In the absence of weights for each own account worker in the household, we divide the household's entrepreneurship income by the number of own account workers in the household.

We assume that the household head receives other incomes (remittance from abroad, etc.). We apply personal deduction worth Php 50,000 to all both compensation income earners and to the incomes of own-account workers. We assume that only the employed household head or spouse or offspring of the household head avail of the deduction for dependents which is equal to Php 25,000 for each dependent below 21 years for a maximum of four dependents. Lastly, we impose fixed rates on dividends and interest incomes. Since there are no allowances applied on these income sources, the computation of tax due is straightforward. The total tax due for each household is just the sum of these tax dues.

Table 11a. Original and Revised Personal Income Tax Schedule

Annual Taxable Income (Php)	Tax to be Paid	Annual Taxable Income (Php)	Tax to be Paid	
			Effective January 1, 2018	Effective January 1, 2023
< 10,000	5%			
10,001 - 30,000	500 + 10% of excess over 10,000			
30,001 - 70,000	2,500 + 15% of excess over 30,000			
70,001 - 140,000	8,500 + 20% of excess over 70,000			
140,000 - 250,000	22,500 + 25% of excess over 140,000	< 250,000	0%	0%
250,000 - 500,000	50,000 + 30% of excess over 250,000	250,001 - 400,000	20% of excess over 250,000	15% of excess over 250,000
> 500,000	125,000 + 32% of excess of over 500,000	400,001 - 800,000	30,000 + 25% of excess over 400,000	22,500 + 25% of excess over 400,000
		800,001 - 2,000,000	130,000 + 30% of excess over 800,000	102,500 + 30% of excess over 800,000
		2,000,000 - 8,000,000	490,000 + 32% of excess over 2,000,000	402,500 + 32% of excess over 2,000,000
		> 8,000,000	2,410,000 + 35% of excess of over 8,000,000	2,202,500 + 35% of excess of over 8,000,000

Source: NIRC 1997, TRAIN Law (RA 10963), PwC (2018)

To compute the tax due under TRAIN 1, we also distribute the income to household members and apply the tax rates. First, we distribute wages and salaries using the same method we used above. We also distribute entrepreneurship income to own-account workers as above. We then give all other income to the household head after deducting dividends and interest incomes.

We apply the TRAIN compensation tax rates to wages and salaries. We apply 8-percent tax rate on entrepreneurship incomes that exceed 250,000 pesos. Then we apply the tax rates for dividend and interest incomes. We compute total household tax due as the sum of compensation tax, entrepreneurship tax and dividends and interest taxes. The results of the calculations are shown in **Table 11b.**

Table 11b. Reduction in Income Tax Rates

Decile	Tax Revenue (millions PHP)		Estimated Total Income per Decile (millions PHP)	Effective rates		
	Old	TRAIN (end game)		Old	TRAIN	Percent change
1	139.72	2.54	126,145.29	0.111	0.002	-0.982
2	732.89	2.09	199,650.12	0.367	0.001	-0.997
3	1,543.97	9.17	254,135.44	0.608	0.004	-0.994
4	3,213.58	5.63	308,565.23	1.041	0.002	-0.998
5	5,600.35	7.15	371,437.86	1.508	0.002	-0.999
6	11,218.40	25.93	452,633.09	2.478	0.006	-0.998
7	20,917.56	371.96	565,353.17	3.700	0.066	-0.982
8	41,836.66	4,744.44	725,575.49	5.766	0.654	-0.887
9	92,268.40	18,353.80	999,842.85	9.228	1.836	-0.801
10	339,198.26	117,897.06	2,064,823.94	16.427	5.710	-0.652
Total	516,669.78	141,419.78	6,068,162.49			

Source: Authors' calculations.

6.2.3. Value Added Tax

In the case of the broadening of the VAT rate, the shock calculation is the change a uniform VAT rate across the different sectors and there is a target 5 percent increase in the VAT collection. As one of the corresponding efforts to increase tax revenues following the reduction in personal income taxes, RA 10963 repeals 54 out of 61 special laws deemed "non-essential VAT exemptions." Hence, those goods that remain VAT exempt are those purchased by senior citizens and persons with disabilities. Housing with costs amounting to only below Php 2 million will be exempt from VAT beginning 2021. On the other hand, medicines for diabetes, high cholesterol, and hypertension will be exempt beginning 2019. Those entities that are exempted from paying VAT under RA 10963 are firms with annual gross sales of Php 3 million or lower, GOCCs, SUCs, and government agencies.

In the Philippines, those persons or entities that are required to file VAT returns are those who are engaged in (1) selling, bartering, exchanging, leasing of goods or properties, (2) rendering of services, (3) and importing goods and whose gross sales exceed the current VAT threshold of three million pesos. These persons or entities are required by NIRC to become a VAT-registered taxpayer.

In its basic structure, the VAT levies a tax of twelve percent on the amount of the value that a firm has added to its raw materials and other inputs during its economic activity. Note that while the VAT threshold is based on the gross sales of the entity, the VAT is essentially imposed only on the value added. Hence, such tax is essentially passed on to the buyers of the goods, properties or services as it was explicitly stated in NIRC. This tax is simply remitted to the government by the firm implementing the sale or lease of goods or properties or the performance of services.

To allow this, the tax system mandates that all types of sales must be levied with a 12% VAT and the VAT-registered entities need to account for the VAT they have collected from their sales called the output tax and the VAT they had to pay in their purchases input tax. As it can be expected, the input tax therefore is deducted from the output tax they have to remit. Hence, the VAT that one entity has to pay can be given by the following expression assuming that output tax>input tax.

$$VAT = Output\ Tax - Input\ Tax$$
$$VAT = Gross\ Sales \times 0.12 - Intermediate\ Inputs \times 0.12$$
$$VAT = (Gross\ Sales - Intermediate\ Inputs) \times 0.12$$
$$VAT = (Value\ Added) \times 0.12$$

The VAT is used as a fiscal incentive in two ways. A VAT-registered entity may either be involved (1) in the sale of goods, properties or services that is zero-rated or (2) in transactions may be exempt from VAT altogether. The case of zero-rated transactions refers to cases where the sale of goods, properties or services is subject to zero percent VAT. Hence, the seller does not remit any output tax to the government. However, these entities remain eligible to claim input tax credit as shown in the following expression:

$$VAT = Gross\ Sales \times 0.0 - Intermediate\ Inputs \times 0.12$$
$$VAT = -\ Intermediate\ Inputs \times 0.12$$
$$VAT = -\ Input\ Tax$$
$$Gain\ of\ the\ govt = (Gross\ Sales - Intermediate\ Inputs) \times 0.12 + -\ Intermediate\ Inputs \times 0.12$$

In this case, the government is unable to collect output tax from these VAT-registered entities. Instead, the government need to pay the seller the input tax the latter had to pay in the purchase of inputs for the manufacture of good and service delivery. Hence, allowing for transactions that can be zero-rated serve as an incentive for companies to engage in such types of transactions. The Philippine government, through the NIRC, had made direct and indirect export sales zero-rated thereby serving as incentive for the export value chain. In this manner, the price of such exports is smaller compared to what it would be without the zero-rated eligibility thereby stimulating more demand for such sales. At the same time, the sellers also have lower costs since they can get claim the VAT they have paid for in their input purchases.

Therefore, the introduction of zero-rated transactions led to lower VAT collections by the government compared to the counterfactual wherein no transaction can be considered zero-rated. The TRAIN Law, by taking out certain types of transactions among those that can be zero-rated, effectively allows the government to increase VAT collections by 12 percent of the value added of the zero-rated transactions. Since the government has always allowed the firms to reduce the input tax from the payments they have to pay as VAT-registered taxpayers, the gain of the government would be the sum of the (1) 12 percent of the value added they would start receiving and the (2) input credit they no longer have to pay as tax credit.

On the other hand, VAT-exempt transactions are also not subject to pay an output tax. Hence, the seller in VAT-exempt sales cannot levy the 12 percent VAT on their goods, properties or services just as in the case of entities with zero-rated transactions. However, as the transaction is exempted from VAT rather than being simply subjected to zero-rated VAT, it also means that the seller in the exempted transactions cannot claim input tax credit.

In this case, the government cannot collect output tax from VAT-exempt transactions. However, the government need not pay any input tax claim either. Hence, the increase in the number of transactions that are no longer VAT-exempt because of the TRAIN Law would lead to a gain by the government of 12 percent of the value added.

6.3. Scenario 3 on TRAIN 1 plus the UCT.

The last scenario considers the entire TRAIN package plus the introduction of the Php 3,600 annual (or Php 300 pesos per month) per family unconditional cash transfer (UCT) subsidy provided to the poorest five income deciles under the law, and implemented under the Memorandum Circular 3, series of 2018, of the Department of Social Welfare and Development. Similar to the tax scenario above, the scenario considers the "end game" as the government will be providing this subsidy for 2019 and 2020.

7. Simulation Results

Utilizing the three scenarios shown above, the change in domestic output, domestic supply and prices for each of the sectors and the change in each of the factors (skilled and unskilled labor and capital) were computed. These were the output that was derived from the CGE model. Then using the different results from the CGE model, namely, domestic output, prices and factor returns, the welfare and emissions data were then also calculated. The results of the simulations are shown below.

7.1. Sectoral Output

Table 12 below shows the changes in production output based on the various scenarios discussed above. The results from the petroleum and coal excise tax simulation show that the sectors that are affected by the increased commodities tax rates are the ones that suffer from a significant decline in output, including the following: petroleum and other fuel products (-4.3 percent), coal (-1.3 percent) and crude oil (-1.4 percent).

Table 12. Changes in production output,% change from the base, various scenarios.

Sector	PCEX	TRAIN 1	TRAIN 1+ UCT
Agriculture			
Paddy rice	-0.2	3.6	3.9
Corn	-0.1	1.6	1.7
Other crops	-0.1	5.1	5.4
Sugarcane	-0.3	3.1	3.3
Banana	0.0	4.0	4.2
Livestock and other animal products	-0.3	1.7	1.8
Forestry	0.1	3.0	3.4
Fishery	-0.1	2.3	2.6
Industry			
Mining and quarrying	-0.1	-5.1	-5.0
Coal	-1.3	-5.2	-5.2
Crude oil	-1.4	1.2	1.3
Natural gas	0.0	0.0	0.0
Food manufactures	-0.3	2.9	3.2
Manufacture of sugar	-0.4	2.7	3.0
Beverage and tobacco	0.0	-26.0	-25.9
Textile and garments, tanneries and leather	-0.8	5.2	5.5

Wood and wood products	-0.4	-5.5	-5.4
Paper and printing	-0.3	0.6	0.5
Petroleum and other fuel products	-4.3	-1.3	-1.2
Chemicals, cosmetics, rubber and plastic products	-0.6	-14.4	-14.2
Non-metallic mineral products	-0.7	-2.9	-2.9
Metals (except for Iron and Steel)	-3.5	-5.7	-5.6
Iron and steel	-2.5	-8.1	-8.1
Computer, electronic and optical products	-0.9	-6.0	-5.9
Machineries and equipment (except for engine and turbines, etc.)	1.0	-6.9	-6.9
Manufacture of engines and turbines, except aircraft, vehicle and cycle engines	-1.5	-43.5	-43.5
Transport equipment	-1.1	-2.5	-2.4
Other manufactured goods	-0.8	-9.6	-9.5
Services			
Utilities, excluding electricity	0.2	1.5	1.5
Construction	-0.4	-0.9	-0.8
Wholesale and retail trade and maintenance and repair of motor vehicles	0.1	-0.2	-0.2
Transport services and storage	-1.8	0.5	0.7
Telephone and communications	1.6	-1.8	-2.4
Financial services	1.2	-4.1	-4.6
Other services, including business services, and tourism	0.1	2.4	2.5
Public administration, education and health	1.1	-0.5	-0.8
Energy and Power			
Electric transmission	-0.1	0.8	0.9
Coal power generation	-0.1	3.5	3.8
Natural gas power generation	-0.4	5.1	5.9
Hydroelectric power generation	0.0	0.6	0.7
Wind power generation	0.0	0.6	0.7
Oil power generation	-2.5	1.5	1.6
Solar power generation	0.0	0.4	0.5
Other energy generation	-0.5	0.8	0.9

Source: Authors' calculations

Manufacturing in general would show a general decline in output as these are dependent on the energy inputs. The metals (-3.5 percent), iron and steel (-2.5 percent), engine manufacturing (-1.5 percent), transportation equipment (-1.1 percent) and other manufacturing (-0.8 percent) are the sectors that will be slightly adversely affected in this scenario. However, there are other sectors in the economy that would also show a marginal decline, including food manufacturing (-0.3 percent), sugar manufacturing (-0.4 percent), textile and garments (- 0.8 percent), wood and wood products (- 0.4 percent), paper and printing (-0.3 percent), non-metallic mineral products (-0.7 percent). The machineries and equipment industry (+ 1.0 percent), however, will benefit under this scenario.

Similar to the industrial sectors, agricultural commodities show a slight decline under the petroleum and coal excise tax scenario. Palay (-0.2 percent), corn (-0.1 percent), sugarcane (-

0.3 percent) and other crops (– 0.1 percent) show a decline in sectoral output. Forestry (+0.1 percent) show a slight improvement. Livestock also declines by 0.3 percent as a significant amount of inputs to the sector are from industries that also showed a decline; these are industries that provide storage and upkeep for livestock and cattle, including the iron and steel, metal, rubber and electrical and electronic equipment industry.

On the other hand, the services sectors show also mixed results in terms of output. There is a slight increase in the sectors with relatively high levels of capital and skilled labor, including telecommunications (+ 1.6 percent) and finance (+ 1.2 percent). Service industries with a relatively significant proportion of low skilled workers, such as transport services (- 1.8 percent) and construction (-0.4 percent), showed a decline in output.

On the other hand, there is a slight decline in all energy sectors, although the biggest decline in output had been recorded by the oil power generation sector (-2.5 percent). The other sectors show a decline, including gas power (-0.4 percent), coal (-0.1 percent) and other energy sources (-0.5 percent).

In the full TRAIN scenario, as the excise taxes for beverages is increased, the beverage sector shows a decline by 26.0 percent due to higher domestic prices. Coal further declines by 5.2 percent, while mining by 5.1 percent. Manufacturing industries all show a decline, except for food manufacturing (+2.9 percent), sugar manufacturing (+2.7 percent), textile and garments (+ 5.2 percent), and paper and publishing (+ 0.6 percent). Manufacture of engines decline significantly at -3.5 percent, while iron and steel decline by -8.1 percent. All agricultural sectors show an improvement in output due to the relatively higher demand for the goods given the reduction in personal income tax is included in this scenario. Banana production had the highest increase at 4.0 percent. Due to the higher consumer demand, electricity production, except for oil generation, becomes positive, with gas generation at positive 5.1 percent.

In the TRAIN and unconditional cash transfer (UCT) scenario, coal production is still down at -5.2 percent, mining at -5.2 percent and petroleum is at -1.2 percent. There is still a slight increase in the production of agricultural products, especially other crops to around +5.4 percent, and the increases are moderately higher compared to the previous full TRAIN scenario; palay increases to 3.9 percent, other crops increase by 2.9 percent, forestry increases by1.2 percent and fishery by 0.5 percent. There is also a slight increase of output among the electricity generating sectors, with gas generation increasing to 5.9 percent compared to 5.1 percent in the full TRAIN scenario.

7.2. Domestic Supply

The changes in domestic supply, which include both domestic production and imports are shown below in Table 13. The changes in domestic supply follows the trend in changes in domestic production. However, there is a slight decrease in domestic supply in the PCX scenario as there is a foreign exchange devaluation, in the case of excise tax imposition, which reduces the amount of imports for many of the industrial and service sectors. For example, the reduction in petroleum supply is more than 5 percent, but the reduction in domestic output is only slightly above 4 percent.

Table 13. Changes in Domestic Supply, % change from base, various scenarios

	PCEX	TRAIN 1	TRAIN 1+ UCT
Agriculture			
Paddy rice	-0.2	3.3	3.5
Corn	-0.1	1.2	1.4
Other crops	0.0	3.2	3.4
Sugarcane	-0.2	2.0	2.2
Banana	0.0	3.8	4.0
Livestock and other animal products	-0.3	0.9	1.0
Forestry	0.1	2.9	3.3
Fishery	-0.1	1.9	2.2
Industry			
Mining and quarrying	-4.1	-0.9	-0.8
Coal	-1.2	-6.8	-6.7
Crude oil	-1.6	-2.5	-2.4
Natural gas	0.0	0.0	0.0
Food manufactures	-0.2	1.1	1.3
Manufacture of sugar	-0.2	1.2	1.4
Beverage and tobacco	0.0	-28.6	-28.5
Textile and garments, tanneries and leather	-0.3	3.0	3.3
Wood and wood products	-0.5	2.1	2.2
Paper and printing	0.1	-2.3	-1.4
Petroleum and other fuel products	-5.2	-2.6	-2.5
Chemicals, cosmetics, rubber and plastic products	-0.2	4.7	4.9
Non-metallic mineral products	-0.3	-2.5	-2.5
Metals (except for Iron and Steel)	-1.0	-2.0	-2.0
Iron and steel	-0.9	-1.2	-8.1
Computer, electronic and optical products	-0.3	0.1	-5.9
Machineries and equipment (except for engine and turbines, etc.)	-0.3	-0.3	-6.9
Manufacture of engines and turbines, except aircraft, vehicle and cycle engines	-1.5	15.5	15.6
Transport equipment	-1.1	-0.3	-2.4
Other manufactured goods	-0.8	0.6	-0.7
Services			
Utilities, excluding electricity	0.2	1.5	1.5
Construction	-0.4	-0.9	-0.8
Wholesale and retail trade and maintenance and repair of motor vehicles	0.1	-0.6	-0.6
Transport services and storage	-1.3	-0.5	-0.3
Telephone and communications	1.6	-2.2	-2.8

Financial services	1.2	-4.1	-4.6
Other services, including business services, and tourism	0.2	1.0	1.0
Public administration, education and health	1.1	-0.6	-1.0
Energy			
Electric transmission	-0.3	0.5	0.9
Coal power generation	-0.5	3.5	3.8
Natural gas power generation	-1.4	5.1	5.3
Hydroelectric power generation	-0.1	0.6	0.7
Wind power generation	-0.2	0.6	0.7
Oil power generation	-5.7	1.5	1.6
Solar power generation	-0.1	0.4	0.5
Other energy generation	-1.2	0.0	0.1

Source: Authors' calculations

On the other hand, there is a revaluation in the full TRAIN 1 (scenario 2) and TRAIN 1+ UCT (scenario 3), which causes the domestic supply to decline marginally. This decreases in the amount of imports in many of the sectors, although the change is very marginal. For example, the increase in domestic output of palay in the two scenarios is 3.6 percent and 3.9 percent, respectively; however, in terms of domestic supply, the increase is 3.35 percent and 3.5 percent, respectively. This change also holds true for the other sectors in agriculture, and also in the industrial and service sectors.

In terms of energy output, there is no difference in the change in supply and output as the electricity transmission and generation are non-tradable goods.

7.3. Prices

The changes in sectoral prices are then assessed in terms of the different scenarios; the results are shown in **Table 14** below. In the excise tax scenario, coal prices increase by around 0.4 percent, while mining increases by 5.2 percent and petroleum increases by 8.5 percent. Agricultural products show a slight increase between 0.1 to 0.3 percent, including rice (+0.2 percent), corn (+0.2 percent), sugar (+0.3 percent) and livestock (+0.2 percent). Prices of metallic products and iron and steel industries, which are dependent on petroleum and energy, rise significantly at 1.9 percent and 1.6 percent, respectively. Natural gas prices increase by 2.1 percent. Among most other industrial sectors, prices increase by around 0.2 percent to 0.8 percent.

Table 14. Changes in sectoral prices, % change from base, various scenarios

	PCEX	TRAIN 1	TRAIN 1+ UCT
Agriculture			
Paddy rice	-0.2	3.3	3.5
Corn	-0.1	1.2	1.4
Other crops	0.0	3.2	3.4
Sugarcane	-0.2	2.0	2.2
Banana	0.0	3.8	4.0
Livestock and other animal products	-0.3	0.9	1.0
Forestry	0.1	2.9	3.3

Fishery	-0.1	1.9	2.2
Industry			
Mining and quarrying	5.2	-0.4	0.8
Coal	0.4	4.0	5.3
Crude oil	-0.1	8.1	9.4
Natural gas	2.1	2.0	3.2
Food manufactures	0.2	3.5	4.8
Manufacture of sugar	0.2	3.3	4.5
Beverage and tobacco	0.3	66.9	68.9
Textile and garments, tanneries and leather	0.3	2.2	3.4
Wood and wood products	0.8	-1.9	-0.7
Paper and printing	0.5	3.8	5.0
Petroleum and other fuel products	8.5	9.1	10.5
Chemicals, cosmetics, rubber and plastic products	0.3	-6.8	4.3
Non-metallic mineral products	0.7	4.9	6.1
Metals (except for Iron and Steel)	1.9	1.5	2.8
Iron and steel	1.6	-0.1	1.1
Computer, electronic and optical products	0.4	-0.5	0.7
Machineries and equipment (except for engine and turbines, etc.)	0.2	0.9	2.1
Manufacture of engines and turbines, except aircraft, vehicle and cycle engines	0.0	-32.0	-31.1
Transport equipment	0.3	3.7	5.0
Other manufactured goods	0.4	0.6	1.9
Services			
Utilities, excluding electricity	0.2	3.2	4.4
Construction	0.8	2.2	3.4
Wholesale and retail trade and maintenance and repair of motor vehicles	0.4	4.9	6.1
Transport services and storage	2.0	5.4	6.7
Telephone and communications	0.4	2.1	3.3
Financial services	0.2	8.4	9.7
Other services, including business services, and tourism	0.3	2.8	4.0
Public administration, education and health	0.4	2.1	3.2
Energy and Power			
Electric transmission	0.1	3.4	4.7
Coal power generation	0.1	0.7	2.0
Natural gas power generation	0.8	-0.4	-2.9
Hydroelectric power generation	-0.1	4.1	5.4
Wind power generation	0.0	4.0	5.3
Oil power generation	6.4	2.3	3.5
Solar power generation	-0.1	4.5	5.8
Other energy generation	1.3	3.6	4.8

Source: Authors' calculations

The transportation services sector shows 2.0 percent increase in prices, the highest among the services sectors; together with construction, which increase by 0.8 percent, other services sectors show an increase of less than 0.5 percent, including trade (+0.4 percent), telecommunications (+0.4 percent), financial services (+0.2 percent), and other services (+0.3 percent).

Prices in the electricity generation industries also show only a slight increase, except for the oil generating plants which increase by 6.4 percent. The solar energy sector shows a slight decline by around 0.1 percent.

In the full TRAIN scenario, the prices are significant higher due to the increased demand for many goods. Prices of agricultural commodities increase by around two to three percentage points, while the prices of energy generation sectors by around 3 to 4 percent. On the other hand, beverages and tobacco increase by more than two-thirds, while petroleum and gas increase by 9.1 percent. Manufacturing of engines, however, decline by around more than 30 percent.

On the other hand, in the TRAIN plus unconditional cash transfer, agricultural commodities' prices increase slightly with palay (+3.2 percent), corn (+3.4 percent), other crops (+3.4 percent), sugar (+3.7 percent), banana (+2.9 percent), livestock (+3.8 percent) and fishery (+3.8 percent), further moving up. Among the industrial sectors, beverages (+68.9 percent) and petroleum (+10.5 percent) increase the largest, while in the services sectors, transportation services (+16.8 percent) and trade (+10.9 percent) increase the largest. Among the energy sectors, which increase by more than eight percent, solar generation (+5.8 percent) increase the largest.

7.4 Factor Returns, Employment and Welfare

Table 15 shows the changes in factor returns. In the first scenario with higher excise taxes on coal and petroleum only, the returns to unskilled labor and capital decline slightly by 0.1 percent and 0.2 percent, respectively. This is due to the fact that the sectors with the larger production declines are those which are capital intensive, including the sectors that incur additional excise taxes such as crude oil, coal, and petroleum. On the other hand, under the full TRAIN scenario and TRAIN with price increase scenarios, there are positive returns that are shown in all of the sectors; the gains are highest among in the agricultural sectors, where there is a greater proportion of unskilled labor, which gains the most under this scenario. Under the TRAIN+ UCT scenario, the gains are the highest due to the fact that there is increased productive activity which increases returns to all the factors; however the greatest gain is for unskilled labor.

Table 15. Change in Factor Returns, Various Scenarios

	PCEX	TRAIN 1	TRAIN 1+ UCT
Unskilled	-0.1	2.4	3.7
Skilled	0.3	1.0	2.1
Capital	-0.2	0.8	2.0

Source: Authors' calculations.

On the other hand, **Table 15** provides the information on the changes in employment based on the simulated changes in output by sector. Under coal and petroleum tax excise increases, the biggest drop in employment is shown in the transport services and storage sector, which according to the simulation, will lose around more than 50,000 workers, greater than the aggregate employment loss of more than 36,000 workers. Construction and metal industries will also show a decline in employment, but public administration, education and health will show a gain. Under the full TRAIN scenario, employment in several manufacturing and service industries will show a decline, but this will be offset by a significant increase in employment in other services. There is a further gain in employment in the TRAIN plus unconditional cash transfer scenario.

Table 15. Change in Employment, Various Scenarios

SECTOR	PCEX	TRAIN 1	TRAIN 1+ UCT
Paddy rice	(5,061)	91,093	98,684
Corn	(1,421)	22,744	24,165
Other crops	(2,388)	121,808	128,973
Sugarcane	(1,231)	12,721	13,542
Banana	-	14,114	14,820
Livestock and other animal products	(2,538)	14,383	15,229
Forestry	223	6,677	7,567
Fishery	(1,331)	30,605	34,597
Mining and quarrying	(217)	(11,067)	(10,850)
Oil and gas	(13)	(25)	(25)
Food manufactures	(2,396)	23,158	25,554
Manufacture of sugar	(74)	501	557
Beverage and tobacco	-	(25,165)	(25,068)
Textile and garments, tanneries and leather	(4,872)	31,665	33,492
Wood and wood products	(1,377)	(18,938)	(18,594)
Paper and printing	(1,545)	3,091	2,576
Petroleum and other fuel products	(392)	(118)	(109)
Chemicals, cosmetics, rubber and plastic products	(920)	(22,082)	(21,775)
Non-metallic mineral products	(638)	(2,641)	(2,641)
Metals (except for Iron and Steel)	(7,039)	(11,463)	(11,262)
Iron and steel	(129)	(419)	(419)
Computer, electronic and optical products	(3,463)	(23,086)	(22,701)
Machineries and equipment (except for engine and turbines, etc.)	762	(5,261)	(5,261)
Manufacture of engines and turbines, except aircraft, vehicle and cycle engines	(121)	(3,504)	(3,504)
Transport equipment	(1,146)	(2,604)	(2,500)
Other manufactured goods	(1,779)	(21,347)	(21,124)
Utilities	(341)	2,636	2,899
Construction	(12,186)	(27,418)	(24,372)
Wholesale and retail trade and maintenance and repair of motor vehicles	7,686	(15,372)	(15,372)
Transport services and storage	(52,949)	14,708	20,591
Telephone and communications	597	(671)	(895)
Financial services	5,845	(19,972)	(22,407)
Public administration, education and health	45,578	(20,717)	(33,147)

Other services, including business services, and tourism	8,619	206,863	215,482
Total	(36,256)	364,898	396,702

Note: The coal, natural gas and crude oil has been integrated into the oil and gas sector, while electricity transmission, the electricity generation sectors (coal, hydroelectric, geothermal, etc.) and other utilities has been integrated into the utilities sector, as the Labor Force Survey does not have disaggregated information in the different industrial and service sub-sectors.
Source of basic data: 2015 Labor Force Survey.

Table 16. Poverty Incidence, by Scenarios

Sector	Baseline	Percentage point change from baseline		
		PCEX	**TRAIN 1**	**TRAIN 1 (plus transfers)**
Households	16.5	+0.16	+1.72	+0.26
Individuals	21.6	+0.20	+2.03	+0.65
Women	21.2	+0.19	+1.87	+0.57
Fisherfolks	32.5	+0.17	+3.20	+1.35
Transport workers	8.3	+0.26	+2.06	-8.16
Farmers	34.5	+0.32	+2.33	+0.06

Source: Authors' calculations.

Changes in welfare are measured by the change in poverty incidence which is affected by the change in incomes (through the changes in factor returns) and the change in commodity prices. Given that there are the increases in prices across many commodities is higher than the increase in factor returns (which is a proxy for the change in income), there is a slight decline in real income and therefore an increase in poverty incidence. In the first scenario, poverty incidence increases slightly, but given the increase in prices under the full TRAIN scenario, poverty incidence increases by around two percent for households and individuals, and between two to three percent for the different marginalized groups.

However, the provision of the cash transfers (assuming 100 percent coverage for those targeted by the subsidies in the first to fifth lowest income deciles) offsets the increase in poverty incidence across sectors, especially for transport workers; most transportation workers are near poverty so that the income support program results in a significant improvement in their welfare. But at the same time, there is a slightly higher poverty incidence for the other sectors.

Beronilla (2018) undertook a simulation of the tax reform together with the cash transfer program on households and showed that while the subsidy is relatively sufficient to meet the increased household expenditure (due to the higher excise taxes) for many of the households, especially in the poorest first to fifth income deciles, there are still households that will be worst off as the composition of expenditures are different from household to household and there are families that would be adversely affected by the reform. In fact, the study noted that assuming that the UCT subsidy would have the same efficiency as the targeting in the government's Pantawid Pamilyang Pilipino, poverty incidence will be slightly worst off.

7.5. Emissions

Lastly, the change in emissions resulting from production activities is assessed. This utilized the information on the CO2 emission multipliers (CO2 emissions in kilograms per Php 1 billion output in each sector). The information on the multipliers can be found in the Appendix II. **Table 17** shows the changes in emissions across the different scenarios.

Table 17. Changes in CO2 emissions, various scenarios

Sector	Baseline	PCEX	TRAIN 1	TRAIN 1+ UCT
CO2 emissions	97670.3	96904.5	98920.3	99147.3
Change from baseline	0.0	-0.78%	1.28%	1.51%

Source: Authors' calculations.

The results show that under the scenario of increased excise taxes, CO2 emissions decline by around 0.8 percent; this is due primarily to the decline in transport service activities, and there is some decline in the electricity generating sector, particularly from oil and coal.

Under the TRAIN 1 scenario, the declines are very slight due to the fact that there are improvements in output due to increased productive activity, and thus emissions slightly increase by 1.3 percent. And in the last scenario, where there are price increases in oil and rice, there is increased economic activity and thus the amount of emissions that are produced in the economy increases by 1.5 percent above the baseline level.

8. Summary and Conclusions

The study analyzed the impacts of increased taxes on petroleum and coal in the country in the midst of increasing energy utilization. The initial results show that the excise tax component in the TRAIN 1 would have a slight impact in terms of sectoral output and prices, and therefore in household welfare through incomes and employment and in carbon emissions in the country. Sectors that are energy-intensive would see a slight decline in output, and there would be a slight increase in poverty given heightened prices.

On the other hand, TRAIN 1 would increase domestic output in most industries and increase the output of power. This would be due to the increased economic activity following increased consumption brought about by lower income tax rates especially among the highest income deciles. But the increased economic activity would come at the expense of the welfare of marginalized groups and increased energy and emissions activity in the country. Given that the contribution of non-fossil fuel sources of power is significantly low, any short-term increase in economic activity would lead to still favor the growth of sources of electricity that are based on oil, gas and coal.

This leads to several considerations that policymakers have to undertake in designing tax policies. While the ultimate goal of the TRAIN as a tax reform is very commendable, which is to raise public revenues to improve the delivery of basic services and improve social and economic outcomes in the future, there are short-term considerations that the government should make. One would be the impact of the policy reform on sectors, and another on the impact on the targets that the Philippines must observe in terms of emissions.

In the first, complementary measures are necessary to ensure that the marginalized groups are not affected by the tax reforms even the short-term; the simulations in this study show that the unconditional cash transfer program would provide relief to sectors affected by the program. Besides the cash transfer program, the government has also undertaken an assistance program for jeepney drivers, called the Pantawid Pasada program, which provides a fuel subsidy (amounting to Php 5,000 in 2018 and Php 20,500 in 2019) managed by the Land Transportation

Franchise and Regulation Board. However, as this study shows, even with the subsidy program, there are still slight marginal adverse impacts on households and other sectors.

It is thus important to make sure that the poorest households continue to be supported by additional measures that may reduce the impact of the indirect taxes. This may include an additional cash transfer subsidy beyond the subsidy that is being provided under the unconditional cash transfer program. In addition, Mapa (2018) has suggested that the poor households could also be provided additional assistance in the form of discounted rice prices from the National Food Authority, which is promised under the TRAIN Law.

As noted above, besides the impact on incomes and therefore on the headcount index, as noted above, increases in prices have also other effects such as those on children. This is a very important consideration especially in the context of the high incidence of child malnutrition and stunting in the country. Given that under the TRAIN there is a slight increase in prices, then it would also be good to consider mitigating mechanisms for reducing the impact on one of the most vulnerable socio-economic groups.

In the second, the design measures to raise revenue may also consider how these would lead to improved use of alternative energy policies that would lead to greater sustainable development outcomes. The results in this simulation had shown that while the increase in excise taxes has reduced slightly the use of fossil fuels, increased economic production due to the impact of the other TRAIN components has ironically increased the use of these type of energy sources only due to the fact that their higher generating capacity of these type of plants.

Given that the exercise focused only on both the changes in taxes and the effects of the unconditional cash transfer, there may also be dynamic effects of the tax reform on output, employment and welfare given that the bulk of the incremental revenue would be allocated to infrastructure, under the Build-Build-Build program of government. The incorporation of the analysis of the change in employment structure would further enrich the analysis that is undertaken in this study.

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Appendix 1. Macro SAM, 2015

	ACTIVITIES				COMMODITIES				FACTORS				INSTITUTIONS					
	Agriculture	Industry	Service	Energy	Agriculture	Industry	Service	Energy	Low skilled	High skilled	Capital	Tax collection	Household	Enterprises	Government	Savings-Investment	Rest of the World	Total
Agriculture					2,428,891.21												153,963.37	2,582,854.58
Industry						7,281,918.56											1,849,086.35	9,131,004.91
Service							15,406,815.86										1,284,878.47	16,691,694.33
Energy								823,966.64									-	823,966.64
Agriculture	217,277.22	900,842.57	243,752.25	2,378.52									944,371.74		15,094.29	243,844.65		2,567,561.24
Industry	186,056.97	2,988,767.55	2,450,995.28	103,777.15									3,329,563.61		119,220.49	1,190,540.91		10,368,921.96
Service	542,650.31	1,900,394.15	5,237,136.94	139,943.11									5,204,131.32		1,742,947.20	1,873,222.90		16,640,425.93
Energy	3,330.98	108,604.65	323,759.11	40,404.49									347,816.32		51.09	-		823,966.64
Low skilled	540,286.58	300,102.26	1,008,735.63	9,072.89														1,858,197.36
High skilled	364,322.85	702,540.38	3,456,685.60	68,104.69														4,591,653.52
Capital	726,559.09	1,987,433.08	3,643,554.54	436,313.75														6,793,860.46
Tax collection	2,370.58	242,320.27	327,074.98	23,972.04	7,479.80	186,704.70	159,345.50	-	-	-	-		847,224.92	870,048.50	-	-	13,053.04	2,679,594.33
Household									1,858,197.36	4,591,653.52	3,515,619.72				254,747.00		1,095,911.38	11,316,128.98
Enterprises											3,278,240.74				89,619.00		437,818.83	3,805,678.57
Government												2,679,594.33						2,679,594.33
Savings-Investment													605,580.68	2,587,754.05	455,967.98	-	104,674.67	3,753,977.38
Rest of the World					131,190.23	2,900,298.70	1,074,264.57	-					37,440.39	347,876.02	1,947.28	446,368.92	-	4,939,386.11
Total	2,582,854.58	9,131,004.91	16,691,694.33	823,966.64	2,567,561.24	10,368,921.96	16,640,425.93	823,966.64	1,858,197.36	4,591,653.52	6,793,860.46	2,679,594.33	11,316,128.98	3,805,678.57	2,679,594.33	3,753,977.38	4,939,386.11	

Source: Authors' calculations from PSA and BSP data.

Appendix 2. CO_2 Emission Multipliers, 2014

		Domestic Inputs	Imported Inputs	All Inputs
1	rice	0.0995	0.0734	0.1729
2	corn	0.2268	0.1701	0.3968
3	othcrops	0.0295	0.0241	0.0536
4	sugarcane	0.7294	0.5835	1.3129
5	banana	0.1149	0.0919	0.2068
6	livestock	0.0065	0.0043	0.0108
7	forestry	1.5354	1.1811	2.7165
8	fishery	0.6107	0.4852	1.0958
9	mining	3.7287	2.6747	6.4035
10	Coal	2.2315		-
11	Oil	1.7502	0.1795	1.9297
12	Gas	1.2696	- 1.2696	-
13	foodmfg	0.2704	0.1502	0.4206
14	sugarmilling	0.5126	0.2278	0.7404
15	othbeverages	0.5354	0.3189	0.8542
16	textile	0.1199	0.0658	0.1857
17	wood	0.2999	0.1941	0.4940
18	paper	1.0021	0.1462	1.1483
19	petroleum	0.4484	1.4666	1.9150
20	chemicals	0.9293	0.4772	1.4065
21	minerals	15.3602	26.1491	41.5093
22	metals	0.2780	0.1192	0.3972
23	ironsteel	1.4393	1.5249	2.9641
24	electronics	0.0911	0.0674	0.1585
25	machineries	0.7298	0.4320	1.1618
26	engines	4.8802	0.9760	5.8563
27	transequip	0.0060	-	0.0060
28	othmfg	0.1316	0.0351	0.1667
29	Electrans	-	-	-
30	coal	127.8474	179.3900	307.2374
31	Gas	43.5736	0.0280	43.6016
32	Hydro	-	-	-
33	Wind	-	-	-
34	Oil	31.5297		-
35	Solar	-	-	-
36	OtherSource	-	-	-
37	otherutil	1.0785	0.0200	1.0985
38	construction	0.2045	0.1091	0.3137
39	trade	0.2174	0.1696	0.3870
40	transport	13.4029	10.1514	23.5543
41	comms	0.3033	0.2406	0.5439
42	finance	0.1678	0.1324	0.3001
43	othservice	0.0896	-	0.0896
44	publicadmin	0.1610	0.1235	0.2846

Source: Authors' calculations