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FOUR DETERMINANTS TO CONSTRAIN GHG EMISSIONS AND SIMULTANEOUSLY ENCOURAGE ECONOMIC DEVELOPMENT OF BRUNEI DARUSSALAM

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Abstract: *The purpose of this study is to discuss the four determinants of constraining greenhouse gas (GHG) emissions, namely, population size, output per person, the energy intensity of production and how much fossil fuel is used in energy production, and how they can be used simultaneously to devise policies to encourage economic development of Brunei Darussalam. The approach used in this study is the qualitative research approach via library research and content analysis. Data was collected through data archives and document reviews. This paper does not provide solutions or a comprehensive study on better ways to reduce GHG emissions. Rather, giving ideas on how policies can be devised through the four determinants of constraining GHG emissions.*

***Keywords**: Economic Policies, GHG Emissions, Economic Development, Brunei Darussalam*

Introduction

Garnaut et al. (2008) in their studies highlighted that there are four determinants of greenhouse gas (GHG) emissions, namely, population size, output per person, the energy intensity of production and how much fossil fuel is used in energy production. The government has the ability to limit emissions by influencing its first, third and fourth of the mentioned factors (Garnaut et al., 2008). Thus, the main objective of this paper is to discuss the government policies, with the application of the above factors, which can constrain GHG emissions and encourage economic development with a focus on Brunei Darussalam (hereafter Brunei). As Brunei is moving towards Wawasan Brunei 2035 (Brunei Vision 2035), thus, this is an important study to examine. The paper, firstly, addresses the brief facts of Brunei, the major sources of GHG emissions. Secondly, it highlights the current GHG emissions condition and energy use. Thirdly, it discusses a couple of high priority additional policies and examines the importance of these policies. Finally, some conclusions are drawn.

Brief facts of Brunei

Brunei is a small Sultanate country with a total population of 414,400 where its economy has been strongly dependent on the oil and gas industry for the past 80 years, and hydrocarbon resources contribute over 90 per cent of its exports and more than 50 per cent of its Gross Domestic Products. Its over-reliance on oil and gas results in the lack of diversification of the economy and over-consumption of natural resources such as fossil fuel and energy.

In 2018, Brunei has been ranked second on the list of countries with the least polluted areas by the World Health Organisation (WHO) in a study measuring ambient air pollution in 1,622 locations across 92 countries (Othman, 2018). This is due that Brunei has no major industrial activities. Although to date Brunei Darussalam has no major environmental pollution problems, it is realised that proper management of the quality of the environment is essential in view of population growth, urbanisation and economic development (Department of Environment, Parks and Recreation, n.d.). This is important as Brunei is thriving for its national vision 2035 (Brunei Vision 2035).

Brunei Vision 2035 aims to turn Brunei into a nation widely recognized for: the accomplishments of its well-educated and highly-skilled people as measured by the highest international standard; quality of life that is among the top 10 nations in the world; and dynamic and sustainable economy with income per capita within the top countries in the world (Brunei Embassy, n.d.). One of the strategies to accomplish the goals is the environmental strategy that ensures the proper conservation of our natural environment and cultural habitat. It will provide health and safety in line with the highest international practices (Brunei Embassy, n.d.).

Should Brunei Concern Over GHG Emission

The rise in environmental temperature and changes in related processes are directly connected to increasing anthropogenic greenhouse gas (GHG) emissions in the atmosphere. This rise in temperature was vehemently argued to be generally triggered by the emission of carbon-based compound (CO_2 in particular) from fossil fuels consumption for power generation (Latake et al., 2015).

According to Latake et al. (2015), atmospheric concentrations of greenhouse gases are determined by the balance between sources (emissions of the gas from human activities and natural systems) and sinks (the removal of the gas from the atmosphere by conversion to a different chemical compound).

With Brunei accounting for only a very small amount (0.016 per cent) of global greenhouse emissions, the Sultanate is prepared to play an active role in supporting the global effort to combat climate change (Othman, 2017). However, it had the highest per capita carbon emissions in the ASEAN region with emissions increasing at a rate of two per cent per year (Bandial, 2015). Bandial (2015) reports that every year, Brunei produces 15.5 metric tonnes of CO_2 per capita, compared to 7.1 metric tonnes per capita in Malaysia and 6.39 metric tonnes in Singapore – countries with larger populations and considerably more industrialised than Brunei. The study also found that the Sultanate produced an estimated 1.8 megatonnes of carbon dioxide every year, with most emissions generated from activities that do not bring about direct benefits to the economy (Bandial, 2015).

Goh (2010) reports that the over-consumption makes Brunei record one of the highest carbon emitters per capita and energy consumption per capita in ASEAN and is ranked 12th in the world

on per capita basis. Brunei is also one of the highest consumers of electricity per capita in the world (see Fig 1), and the domestic households account for the highest electricity consumption in the country (Ahmad and Othman, 2014). Figure 2 shows Brunei's electricity usage by consumer type. Malik (2011) reports that its power demand has risen rapidly by at least 7-10 per cent annually, which is higher than the world's average annual increase. This is worrying due to the absence of major industrial activities in the country.

1.	Iceland	18,774 koe
2.	Qatar	17,418 koe
3.	Trinidad and Tobago	15,691 koe
4.	Kuwait	10,408 koe
5.	Brunei	9,427 koe
6.	Luxembourg	7,684 koe
7.	UAE	7,407 koe
8.	Canada	7,333 koe
9.	USA	6,793 koe
10.	Finland	6,183 koe

Figure 1: World's Largest Energy Consuming Countries Per Capita 2014

Source: https://askjaenergy.com/2014/11/17/iceland-is-the-world-largest-energy-consumer-per-capita/

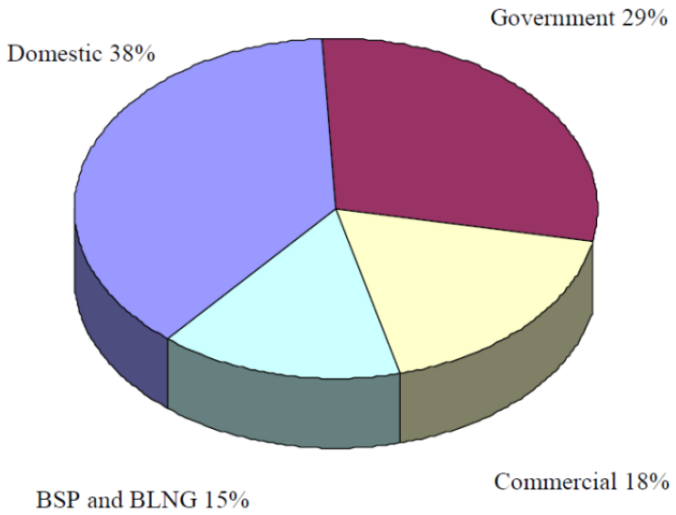

Figure 2: Brunei Darussalam's Electricity Usage by Consumer Type

Source: Ahmad and Othman (2014, p. 156)

Brunei's Issues Related to GHG Determinants

According to a recent report, Brunei spends about B$2 billion on energy which is electricity and domestic transportation fuel (Masli, 2013). The figure is seen to be big for a small population. The reasons for this high spending and the problem of overconsumption can be figured out by reviewing existing policies in Brunei.

Lawrey and Pillarisetti (2011) explain that, both electricity and petrol are highly subsidised by the government and the subsidised price has been fixed for many years. The subsidised price provides an incentive price provides an incentive for people to consume more electricity. In

2012, the Department of Electrical Services has introduced a 4-tier tariff structure for residential customers (Department of Electrical Services, n.d.).

Energy Intensity

Energy intensity means that, the additional amount of energy required to increase the country's GDP (Planete Energies, 2015). Hazair (2017) reports that between 1990-2015, Brunei's energy consumption — induced by industry, transport, residential and commercial activities — has grown at a rate of 5.7 per cent per annum, outpacing its current GDP growth rate of 1.7 per cent.

Masli (2013) reports that a consultant of the Mitsubishi Research Institute (MRI) found out from his comprehensive study on Brunei's energy consumption patterns that the average Bruneian consumed twice energy as a Japanese person, in spite of Japan's advanced industries, and more than 60 per cent of the energy consumed was used for cooling purposes.
Brunei has the highest average consumption of electricity per capita in Asia (Lawrey et al., 2005) and the highest consumer of electricity in Southeast Asia (United Nations Economic and Social Commission for Asia and the Pacific, 2013). The new electricity tariff structure can be seen in Table 1.

Table 1: New Electricity Tariff Structure

New electricity tariff structure	
0001 kWh to 0600 kWh	**B$ 0.01 cents**
0601 kWh to 2000 kWh	**B$ 0.08 cents**
2001 kWh to 4000 kWh	**B$ 0.10 cents**
4001 kWh and Above	**B$ 0.12 cents**

Source: http://www.des.gov.bn/SitePages/Electricity%20Tariff.aspx

The government charges low tariffs for electricity use, with an average residential tariff bill of B$0.06 per kWh (Ahmad and Othman, 2014). According to International Energy Agency (2013), subsidies were the highest in Brunei compared between Southeast Asian countries when measured on a per capita basis.

Mahmud (2017) reports that electricity is subsidised up to an estimated B$48 million for the 2011-12 fiscal year while in the 2013-14 financial year, electricity subsidies rose to $97 million before new tariff rates were introduced.

In line with APEC aspiration, Brunei Darussalam is working towards an ambitious goal of a 45 per cent energy intensity reduction by 2035 (with 2005 as the base year). For 2005, at GDP of USD 6,864 million and population of 370,000, Brunei Darussalam energy intensity was at 390-ton oil equivalent per US$ Million GDP while in 2012, Brunei Darussalam's energy intensity was at 346-ton oil equivalent per US$ Million GDP at a GDP of USD 9,895 and population of 401,000 (Energy Department, 2014). The anticipated increase in power requirements from the development of Brunei Darussalam's emerging downstream industry and other economic activities will increase domestic energy demand, while new oil and gas discoveries are expected to boost the country's GDP (Energy Department, 2014). Efforts to promote energy efficiency and conservation as outlined in Brunei Darussalam Energy White Paper can be seen in the following figure.

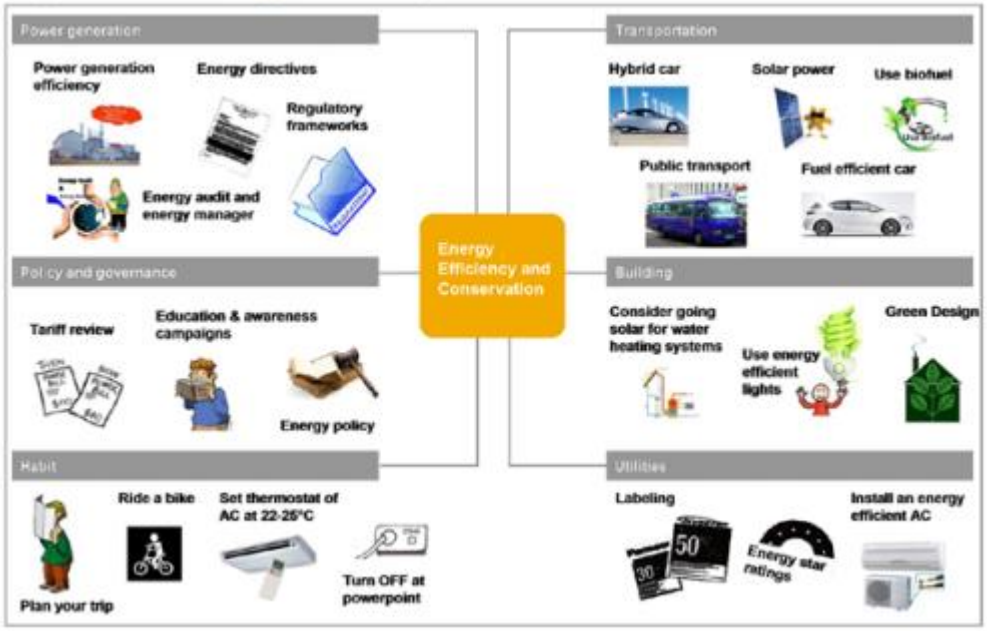

Figure 3: Energy Efficiency and Conservation

Source: Energy Department (2014).

Energy efficiency has become a global priority as it benefits individuals by enhancing their purchasing power, companies by cutting their costs and national governments by trimming their energy bills while helping to further the necessary reductions in carbon emissions to combat global warming (Planete Energies, 2015).

Petrol Consumption and Car Dependency

Goh (2008) reports that the government subsidised a total of B$340 million for fuel of vehicles while in 2004, Brunei spent about B$202 million. Mahmud (2017) reports that petrol subsidies, meanwhile, are based on the prevailing oil prices and raised in accordance with the increase in oil prices. For example, during the budget allocation for 2012-13, the petrol subsidy was $397 million; in 2013-14 it was $380 million; in 2014-15 $328 million. In the 2015-16 national budget, due to the global oil price decline, the petrol subsidy allocated by the government amounted to just $160 million (Mahmud, 2017). The estimated subsidies can be seen in Table 2.

Table 2: Estimated Subsidies on Automotive Fuels In 2006

Product	Regulated Price (B$/ltr)	Estimated cost (B$/ltr)	Subsidy (B$/ltr)	Consumption (thousand litre, 2006)	Annual subsidy (B$ millions)
Premium	$0.53	$1.29	$0.41	194 775	$80
Super	$0.51	$1.29	$0.43	30 369	$13
Regular	$0.36	$1.29	$0.58	54 060	$31
Diesel	$0.31	$1.29	$0.63	218 466	$138
Total				497 670	$262

Source: Lawrey and Pillarisetti (2011)

According to Oxford Business Group (2016), Brunei Darussalam continues to exhibit extremely high levels of car ownership, use and dependency and reliance on the automobile has been blamed on a lack of public transport, attractive deals and loan options on vehicle purchases

and the price of fuel is remarkably cheap (see Table 2). The population of road vehicles in Brunei can be seen in Table 3.

Table 3: Population of Road Vehicles, 2010

Passenger

Mode	No. of Vehicles	Percent
Car	181,196	92.7
Bus	1,596	0.8
2W/3W	2,772	1.4
Freight		
Truck	9,848	5

Source: Institute for Transport Policy Studies (2014)

Another reason for the high level of car ownership is due to the lack of transport alternatives and public transportation which results in car dependency in the Sultanate (Oxford Business Group 2013). The preference to own a car is not seen to be a problem as. Due to this, Brunei has the highest car motorisation index in Southeast Asia where there were 452 registered motorisations for every 1000 people in 2010 (Institute for Transport Policy Studies, 2014).

Buses are the country's main mode of public transport facing challenges in ridership as they provide limited information to the commuters, and passengers note the irregularity of services (Institute for Transport Policy Studies, 2014). For transport, policies need to be evaluated in order to reduce CO_2 emissions. It has to be noted that the lack of public transport will continue motivating car use. If this will remain in the future, Brunei may experience worse traffic congestion, thus further exacerbating future transport emissions (Institute for Transport Policy Studies, 2014).

Recommendations

From the issues above, Brunei should work on a couple of additional policies to constrain the GHG emissions which will simultaneously promote economic development.

Firstly, Brunei should have its own target to lower the GHG emissions. This is possible through collaborative action. Currently, Brunei is setting its target to reduce its energy intensity by 45 per cent by 2035, with 2005 as the baseline year and this is the commitment that Brunei made at the Asia Pacific Economic Cooperation level (Masli, 2013). Brunei chose 2035 as it is moving towards its National Vision 2035. To achieve this, Masli (2013) explains that Brunei has just begun to work on National Energy Efficiency and Conservation (NEEC) towards its national framework as an initiative to reduce energy consumption. As Brunei is new in this area, it is best to be done through collaborative action. Masli (2013) reports that Brunei seeks help from Australian experts to help it to boost energy efficiency. Recommendations and suggestions will be provided to the NEEC for the development of an energy efficiency framework. Thus, not only can it reduce energy intensity, but it also can reduce the country's energy bill by 2035 (Masli, 2013). This will also tighten the economic relationship of Brunei with other countries as it diversifies its economy.

The government is also set to create a national baseline for greenhouse gas emissions and data will be gathered from residential, commercial and industrial sectors to create a baseline that will be used to formulate environmental policy (Bandial, 2015). Brunei is also one of 32

countries that have ratified Doha Amendment to the Kyoto Protocol, legally requiring to meet CO_2 emission reduction targets by 2020 (Bandial, 2015).

Secondly, the improvement in the infrastructure of Brunei can reduce the output per person and fuel use. For instance, the improvement and introduction of transportation such as buses and Mass Rapid Transit (MRT) will give the public alternatives apart from using their car. Eventually, this will reduce the consumption of fuel, and thus output per person, and the government spending on the subsidy of fuel. On the other hand, the government spending on the subsidy could be used for investment on the infrastructure. However, social issues arise from cutting subsidy need to be well studied.

Lawrey & Pillarisetti (2011) explain that Brunei is a small and well-integrated society and when the public is informed through effective education and awareness of the high opportunity cost of subsidies and the environmental consequences of overconsumption of energy, they will be motivated to voluntarily reduce their consumption and start to look for other alternatives.

However, getting away from over-reliance of oil and gas will require the government to look for other resources such as solar as a source of energy. Thus, Brunei can open its door to welcome the foreign investors to work on this, as a country project of development and this will lead to further economic diversification.

Conclusion

This paper does not provide solutions or a comprehensive study on better ways to reduce GHG emissions. Rather, giving ideas on how policies can be devised through the four determinants of constraining GHG emissions. Further and comprehensive studies on this need to be carried out. Commitment to reduce GHG emission will also reduce demand for fossil fuels. Brunei has the potential to reduce the GHG emission through the action of government which can influence the mentioned factors through the policy formulation of the national development plan. The reduction in the emissions will give positive impacts such as reducing the use of natural resources, enhance environmental quality, infrastructure and government spending. Further improvement will also result in economic diversification of the country. This is possible as Brunei sets its target towards National Vision 2035.

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