BRUNEI DARUSSALAM'S INITIAL NATIONAL COMMUNICATION

Under the United Nations Framework for Climate Change

Energy and Industry Department
Prime Minister's Office
Brunei Darussalam

Brunei Darussalam's
Initial National Communication

Under the United Nations Framework

Convention on Climate Change

Published by

The Energy and Industry Department
Prime Minister's Office
Jalan Perdana Menteri
Bandar Seri Begawan BB3913
Negara Brunei Darussalam

Table of Contents

List of Figures

List of Tables

Preface

Brunei Darussalam ratified the United Nations Framework Convention on Climate Change (UNFCCC) on 7 August 2007. The ratification entered into force on 5 December 2007. Two years later on 20th August 2009, we ratified the Kyoto Protocol.

In accordance with Article 4 of the UNFCCC, Brunei Darussalam as a Non-Annex I party is obliged to prepare and communicate to the Conference of the Parties to the UNFCCC, information on greenhouse gas (GHG) inventories, measures to mitigate and to facilitate adequate adaptation to the climate change and any other information that are relevant to the achievement of the Convention objective.

As a country that rely on income from oil and natural gas production and commerce, we are faced with the challenge of addressing the potential economic impacts of climate change response measures. At the same time our GHG emission will inevitably grow as we strive to realise our sustainable development goal to diversify our economic base. Despite these challenges and as a manifestation of our commitment in joining the international community in combating climate change and its adverse impacts, we have and will continue our endeavour to fulfil Brunei Darussalam's obligations to the UNFCCC.

'Our people have high expectations on what we can achieve here today.

Brunei Darussalam is ready to play its part in this important global issue with the UN and the rest of the world.

We must succeed in generating the political commitment and momentum to move ahead with both urgency and practical actions to meet this great challenge.

Together we can create a sustainable future for generations to come.'

**Excerpt from Address By His Majesty Sultan Haji Hassanal Bolkiah Mu'izzaddin Waddaulah Sultan And Yang Di-Pertuan Of Brunei Darussalam At The United Nations Climate Summit, New York, 23 September 2014*

The Energy and Industry Department at the Prime Minister's Office, in its capacity as the Brunei Darussalam's national focal point to the UNFCCC is pleased to present its Initial National Communication (INC) to the Conference of the Parties. Brunei Darussalam's INC contains greenhouse gas inventory for 2010 and policies related to mitigation and adaptation that were implemented between 2009 and 2010. Policies implemented after 2010 will be reported in the Second National Communication.

Yours sincerely,

Pehin Dato Seri Setia (Dr) Awg. Haji Mohammad Yasmin Bin Haji Umar
Minister of Energy and Industry at the Prime Minister's Office
Brunei Darussalam

Executive Summary

Brunei Darussalam ratified the United Nations Framework Convention on Climate Change on 7 August 2007. The ratification entered into force on 5 December 2007.

Brunei Darussalam's Initial National Communication contained the national inventory of GHG for the year 2010 and measures representing policy and actions that contribute to reduction of GHG and address climate change impacts during this period. GHG emissions were estimated using the Revised 1996 Intergovernmental Panel on Climate Change (IPCC) Guidelines for National GHG Inventories. Emission estimates were based on the sectoral and reference approaches and were made using the default conversion and emission factors provided for in the Revised 1996 IPCC Guidelines. The Tier 1 methodology was used for emission estimates.

National Circumstances

For decades, the oil and gas industries have dominated the country's economy contributing more than 60% of the total GDP. Much of the crude oil produced is exported with a small fraction used in local refinery. About 90% of the natural gas production is liquefied and exported to major countries while the remaining amount is used for domestic electricity generation. Given the country's reliance on and the strategic importance of the oil and gas industry in driving and sustaining its development, it is natural that emissions attributable to the oil and gas consumption and production make up a large proportion of the country's emissions.

Given that Brunei Darussalam's economy is heavily dependent on income generated from production, processing and export of fossils fuels, the country faced with the economic and technical challenges of addressing the potential economic impacts of switching to alternative economic income source and alternative energy sources. Brunei Darussalam's relatively small resource base further limits the use alternative energy such as solar or hydro on a wide scale. Such difficulties are recognised by the UNFCCC as described by Articles 4.8 and 4.10 of the Convention.

National Greenhouse Gas (GHG) Inventory 2010

Brunei Darussalam's GHG emissions excluding land use change and forestry totalled 9,488.6 Gigagram (Gg) of Carbon Dioxide (CO_2) equivalent in 2010. Land use change and forestry (LUCF) had contributed to the removal of 2,876.2 Gg CO_2 equivalent. The net GHG emissions including LUCF were approximately 6,612.4 Gg CO_2 equivalent. Brunei Darussalam GHG emission including LUCF represented a small fraction of approximately 0.016% of global emissions in 2010.

The two most significant GHG emitted in Brunei Darussalam were CO_2 and CH_4, accounting respectively 62.0% and 36.8% of total CO_2 equivalent emission. Emission levels for nitrous oxide and hydrofluorocarbons were relatively small.

A total of 8,858.2 Gg CO_2 equivalent of emissions originated from the energy sector. Industrial processes emitted 106.7 Gg CO_2. Meanwhile, 27.1 Gg CO_2 equivalent of emissions came from the agriculture sector and waste sector emitted 496.6 Gg CO_2 equivalent. Land-use change and forestry had been the carbon sink with net removal of 2,625 Gg CO_2 equivalent.

Vulnerability and Adaptation

Records shows that Brunei Darussalam surface temperature had been increasing over the past 60 years. This trend is expected to continue until the end of this century.

Flooding and landslides are the two most frequent natural disasters that occur annually in Brunei Darussalam and common during the northeast monsoon season. The event had significant impacts on the people, disrupted economic activities and caused damages to properties and infrastructure. Although the country is generally safe from major typhoons, Brunei Darussalam has been affected by strong winds.

Reduction in precipitation from February to March, coupled with increasing temperature, have resulted in incidences of forest fires which affect forests cover and air quality. Intrusion of sea water into the ecosystems could pose a threat to wetland forest which could reduce productivity and decrease of wetland species. Increase in sea temperatures and ocean acidification may affect the growth of corals in Brunei Darussalam

The government has always placed high priority in ensuring the highest quality of life for its people, which encapsulates protecting their living and surrounding environment. Given Brunei Darussalam's vulnerability to climate change impacts, the Government of Brunei Darussalam has developed and implemented plans and actions to build and enhance resilience and adaptation to the adverse impacts of unusual and extreme weather and climate events.

Flood mitigation and coastline protection projects in flood prone areas and erosion susceptible areas were implemented under the National Development Plan 2007-2012.

Climate change adaptation is most advanced in the biodiversity and forestry sectors. In addition to the unique biodiversity, forest like peat provides flood protection, slope stability and support fresh water supply. The ground level in Brunei Darussalam is below sea level (up to 12 meters in some places) and the peat that accumulates in forest floors raises the ground level. The forests provides opportunities for both adaptation and mitigation of climate change.

Mitigation

From the national GHG inventory for 2010, it is estimated that tropical rainforests including mangroves and peat swamps sequestered about 2,625 Gg of CO2 equivalent from the atmosphere. This constitutes removal of about 25% of the total GHG emission.

For the past 80 years, forest conservation has been an important part of the national development strategy. Today, 75% of Brunei Darussalam's land area is covered by tropical rainforests comprised of highly diverse ecosystems. In addition, Borneo's pristine peat swamps forests, which act as a carbon sink to counter emissions, are acknowledged by scientists as being some of the only remaining examples of their kind in the world.

As a country endowed with a relatively small resource base, the government has to ensure that the country's natural resources are utilised in the most efficient and sustainable manner to meet long term development needs. In addition to promoting energy efficient behaviour and energy efficient measures among the public, private and government sectors, the government initiated the deployment of renewable energy by commissioning the Tenaga Suria Brunei (TSB) solar photovoltaic (PV) power plant in 2010 as an alternative source of energy.

1. National Circumstances

1.1. Land

Brunei Darussalam (Brunei), is located on the northwest coast of the island of Borneo in South East Asia between latitude 4°30'N and longitude 114°40'E, approximately 442 kilometres north of the Equator.

It has a total land area of 5,765 square kilometres and a coastline of 168 kilometres bounded by the South China Sea on the north and the East Malaysian states of Sarawak and Sabah on the east and west respectively.

Currently around 75% of Brunei Darussalam's land area is covered by tropical rainforests comprised of highly diverse ecosystem. Approximately 41% of the country's land area have been gazetted as forest reserves which are protected by robust legislation. Seven broad types of forests can be found in Brunei Darussalam which include mangrove forests, freshwater and peat swamps, tropical heath forests and mixed dipterocarp forests, among others. Brunei Darussalam's peat swamps make up 18% (103,860 hectares) of the land area, and are currently the most intact in Borneo. High leaching rates and low decomposition rates make these peat swamps internationally recognized as powerful carbon sinks, and their preservation has been reported as an important mitigation strategy for climate change in Brunei Darussalam. Between 2005 and 2010, the rate of forest conversion through land use change is on average about 0.5% per annum.

The country can be described as having hilly lowlands and peat swamp forests in the west, rugged mountains in the east, and swampy, flat plain along the coast. The southern part largely comprises mountains of Eocene to Miocene sediments, with summit levels ranging between 700 and 900 metres.

1.2. Climate

Brunei Darussalam has an equatorial climate influenced by the monsoon systems known as northeast monsoon and southwest monsoon. The northeast monsoon season occurs from December to March and southwest monsoon season occurs from June to September. The two seasons are separated by two transitional periods known as inter-monsoon periods of which the first occurs in April and May, while the second period occurs in October and November.

The country generally experiences wet conditions throughout the year with average annual rainfall of 3,000 millimetres (1981-2010).

Being in an equatorial climate country, the temperature is hot throughout the year. The mean daily temperature is 28.04°C, with maximum mean of 32.4°C and minimum mean of 23.7°C (1981-2010).

1.3. Population

The population of Brunei Darussalam was estimated at 386,800[1] in 2010. The average annual growth rate for 2010 was 1.8 percent. The population density is at 70 persons per square

[1] Department of Economic Planning and Development, Prime Minister's Office: *Brunei Darussalam Statistical Yearbook 2013.*

kilometre[2]. Around 66% of the population are Malays while the rest of the population are Chinese and other ethnics groups.

1.4. Economy

In 2010, Brunei Darussalam's Gross Domestic Product (GDP) at current prices was valued at BND 18,689.8 million and per capita income stood at BND 40,703.0. As shown in Table 1-1, the oil and natural gas accounts as the largest share of Brunei Darussalam's GDP.

Table 1-1: Gross Domestic Product (in million BND) by oil and gas and non-oil and gas sectors and income approach in 2010[3]

Overall GDP at current prices	**BND 18,689.8**
Oil and gas sector	**BND 12,199.8**
Non-oil and gas sector	**BND 6,843.0**
Government	BND 1,993.0
Private	BND 4,850.0

In 2010, the industrial sector (mining, manufacturing, construction, and electricity and water) was the largest contributor accounting for BND 12,831 million (67%) of the GDP. This was followed by the services sector (transport and communication, trade, finance, real estate, other services in private sector and government services) which contributed BND 6,074.7 million (31.9%) to the GDP. The primary sector (agriculture, forestry and fishery) contributed BND 137.1 million (0.7%) to the GDP[4].

In 2010, the economy registered a growth rate of 2.6% compared to a negative growth rate of -1.6% in 2009.

1.4.1. Oil and Gas Sector

The oil and gas sector recorded a growth rate of 2.2% in 2010 after a negative growth rate of -4.6% in 2009.

In 2010 the oil production amounted to 169,891 barrels per day while the average production of liquefied natural gas amounted to 960,483 million British thermal units (Btu) per day. Around 90% of the crude oil was exported with a small fraction used in local refinery. More than 90% of the liquefied natural gas were exported while the remaining amount was utilised for electricity generation.

Brunei Shell Petroleum (BSP), a joint venture company between the government and Shell, also operates a local refinery which produces around 10,000 bpd of petroleum products. The country's demand is however placed at around 15,000 bpd. Motor gasoline is the dominant product being consumed in the country, followed by diesel, kerosene/jet A-1 and liquefied petroleum gas (LPG).

To further diversify the economy, the government is also spearheading the development of the downstream industry. The government established a joint venture company, the Brunei Methanol Company (BMC) to produce and export methanol as a high value alternative to exporting natural

[2] *Ibid*.
[3] *Ibid*.
[4] *Ibid*.

gas. The USD 600 million methanol plant with a capacity of 850,000 metric tonnes per year was commissioned in 2010[5].

1.4.2. Non-Oil and Gas Sector

In 2010, the non-oil and gas sector, which comprised the services sectors (transport, information and communication, trade, finance, real estate, other services in the private sector, government services), manufacturing, construction, electricity and water, and the primary sectors (agriculture, forestry and fisheries), respectively contributed BND 6,0747.7 million, BND 2,786.1 million, BND 338 million, BND 131.7 million and BND137.1 million to the GDP.

The non-oil and gas sector recorded a growth rate of 2.4% in 2010 compared to growth rate of 0.9% in 2009.

Most of the manufacturing companies are small and medium enterprises. These manufacturing companies produced roof products, cement, electrical switch-board and electrical cable. There are nine industrial sites located throughout the country with a wide variety of manufacturing, services and storage activities.

The events of worldwide food shortage in 2007 and 2008 spurred the government in 2009 to embark on initiatives intended to move Brunei Darussalam closer to self-sufficiency in food supply for which the country was almost entirely reliant on imports. The government targeted to achieve 20% self-sufficiency in rice production by 2010. Although the country was largely self-reliant in terms of poultry and egg production, much of the other primary staples of grains, rice and livestock had to be imported. Domestic rice production which stood at 1,072 tonnes in 2010 represented only 3.31% of the total demand while the rest was supplied by imports.

The overall fish production in 2010 amounted to 15,753 tonnes. Capture fisheries contributed the most significant production, standing at 15,329 tonnes, while the aquaculture industry's production was 424 tonnes. Despite the decrease in overall production between 2009 and 2010, the total export value had increased to BND 7.62 million, equivalent to 87.7% increase.

1.5. Institutional Arrangement

The Energy and Industry Department at the Prime Minister's Office (EIDPMO) is Brunei Darussalam's designated National Focal Point for UNFCCC. EIDPMO coordinates the formulation and implementation of Brunei Darussalam obligations and commitments to the Convention.

A High Level Segment, a decision making body, presided by the Minister of Energy and Industry with members comprising of Permanent Secretaries from Energy and Industry Department, and International Affairs Department of Prime Minister Office, the Ministry of Foreign Affairs and Trade, the Ministry of Development, the Ministry of Primary Resources and Tourism and the Ministry of Communications coordinates the formulation of and oversee the implementation of national obligations and commitments to the UNFCCC.

A Stakeholders Consultative Committee on Climate Change (SCCCC) coordinates the technical and implementation aspects of national obligations and commitments to the UNFCCC. SCCCC tasks include coordinating the preparation of Brunei Darussalam Intended Nationally Determined Contributions (INDC) and Brunei Darussalam Initial National Communications (INC). The SCCCC

[5] Oxford Business Group: *The Report: Brunei Darussalam 2014*

is comprised of representatives from several government departments and agencies and the University of Brunei Darussalam.

A Tasks Force lead and coordinated by the Brunei National Energy Research Institute (BNERI) with members comprising of representatives from relevant departments was established under the SCCC to prepare the INC for Brunei Darussalam

2. National Greenhouse Gas Inventory 2010

Being the main economic driver of Brunei Darussalam, the energy sector is also the main source of greenhouse gas (GHG) emissions in the country. Carbon dioxide (CO_2) is the dominant GHG which mainly comes from energy sector. Methane (CH_4) which represents a substantial share in the total emissions came mainly from fugitive emissions from oil and gas and from the waste sector. Since around three quarters of the country's total land area is covered by forests, the removals of CO_2 from the forestry sector are significant.

2.1. Methodology

The GHG emissions were estimated using the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventory. To the most possible extent, the Good Practice Guidance on Uncertainty Management in National Greenhouse Gas Inventories and the Good Practice Guidance for Land Use, Land-Use Change and Forestry were applied to improve the transparency, consistency, comparability, completeness and accuracy in inventories.

The reference and sectoral approaches in the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories were used to estimate the GHG emissions for fuel combustion in energy sector. The reference totals are approximately 20% higher than the sectoral totals because of different sets of net calorific values applied and due to statistical differences.

2.1.1. Activity Data and Emission Factors

Brunei Darussalam's GHG inventory for 2010 covers CO_2, CH_4, nitrous oxide (N_2O) and hydrofluorocarbons (HFCs) by sources and sinks in energy, industry, agriculture, land-use change and forestry and waste sectors. The GHG emissions and removals were expressed in CO_2 equivalent using the global warming potentials (GWP) provided by the IPCC in its Second Assessment Report based on the effect of GHGs over a 100-year time horizon as shown in Table 2-1.

Table 2-1: Global Warming Potentials of GHGs

GHG	Chemical Formula	GWP (100-year time horizon)
Carbon dioxide	CO2	1
Methane	CH4	21
Nitrous oxide	N2O	310
Hydrofluorocarbons	HFCs	Between 140 and 11,700

There is no country-specific emission factor available at this stage. The default emission factors available in the IPCC Guidelines and Guidance were used for the GHGs estimates for all sectors. Based on the assessment of activity data and emission factors, the GHG emissions and removals were estimated using Tier 1 methods in the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.

2.1.2. Key Category and Uncertainty Analyses

Key category analysis was performed according to the Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories. According to the guidelines, the key categories are defined as the sectors whose absolute emissions, when summed up together in descending order of magnitude, add up to 95% of the total GHG emissions. The following key source categories as shown in Table 2-2 were determined using Tier 1 Level Assessment:

Table 2-2: Key Source Categories

Sector	Source Categories	GHG
Energy	Energy industries – natural gas combustion only	CO_2
Land-use Change and Forestry (LUCF)	Changes in forestry and other woody biomass stocks	CO_2
Energy	Fugitive emissions	CH_4
Energy	Road transportation	CO_2
Energy	Manufacturing and construction	CO_2
Waste	Solid waste disposal sites	CH_4

Uncertainty estimates are an essential element to help prioritize efforts to improve the accuracy of inventory in the future. Lack of the country-specific emission factors and national activity data, the emission factors from IPCC Guidelines and some activity data from the published documents were used to develop the GHG estimates for Brunei Darussalam. Estimates of uncertainty in activity data and emission factors were based on expert judgement.

2.1.3. Inventory Planning and Preparation

The preparation of the INC was based on the Terms of Reference (TORs) which include the scope of works, methodology, deliverables and timelines for preparation of Brunei Darussalam INC approved by the SCCCC.

The INC preparation started with an inception workshop to introduce to relevant stakeholders the terminology, concepts, process, methodology, work programme and IPCC Guidelines for preparation of the INC.

BNERI coordinated the compilation of data and with the guidance of the resource person and ensure quality control (QC) on data integrity, correctness, completeness, errors and omissions received and collated from members of the task forces. The use of appropriate inventory methodology was based on the assessment of data availability. IPCC software and emission factors were used for calculation of initial national GHG estimates.

For quality assurance (QA) purpose, the initial national GHG estimates were reviewed and verified by the SCCCC.

The draft INC which include the national inventory on GHG 2010 was prepared using the UNFCCC Guidelines contained in the annex of the Decision 17/CP.8. The draft INC went through two rounds of review and verification by the SCCCC. The Draft INC was presented at national workshop for final review and comments from experts and stakeholders before it was submitted for consideration and approval of the High Level Segment.

2.2. GHG Emissions in 2010

Brunei Darussalam's GHG emissions excluding land use change and forestry for 2010 totalled 9,488.6 Gg CO_2 equivalent. Land-use change and forestry removed 3,036.3 Gg CO_2 equivalent from the atmosphere. Taking into account land-use change and forestry, Brunei Darussalam's net emissions for 2010 totalled 6,612.4 Gg CO_2 equivalent. Table 2-3 provides the summary of the country's emissions and removals in 2010.

Table 2-3: Summary of Brunei Darussalam's GHG Emissions and Removals in 2010 (Note: (-) represents sink)

Sources and Sinks		GHG Emissions (Gg CO_2 equivalent)				
		CO_2	**CH_4**	**N_2O**	**HFC**	**Total**
Energy	Energy industries	4,166.1	7.8	2.5		4,176.4
	Manufacturing and construction	448.3	0.3	1.2		449.8
	Road transportation	1,163.3	5.0	3.1		1,171.4
	Residential sector	104.9	0.3	0.2		105.4
	Fugitive emissions from oil and gas		2,955.2			2,955.2
	Subtotal	**5,882.6**	**2,968.6**	**7.0**		**8,858.2**
Industrial Processes	Chemical industry		19.0			19.0
	Halocarbons and Sulphur Hexafluoride consumption				87.7	87.7
	Subtotal		**19.0**		**87.7**	**106.7**
Agriculture	Enteric fermentation		6.4			6.4
	Manure management		7.8			7.8
	Rice cultivation		1.6			1.6
	Agricultural soils			11.3		11.3
	Subtotal		**15.8**	**11.3**		**27.1**
Waste	Solid waste disposal on land		413.9			413.9
	Wastewater handling		73.4	9.3		82.7
	Subtotal		**487.3**	**9.3**		**496.6**
Total Gross Emissions		**5,882.6**	**3,490.7**	**27.6**	**87.7**	**9,488.6**
Land-use Change and Forestry (LUCF)	Changes in forest and other woody biomass stocks (sink)	-3,036.3				-3,036.3
	Forest and grassland conversion	160.2				160.2
	Subtotal	**-2,876.2**				**-2,876.2**
Total Net Emissions		**3,006.4**	3,490.7	27.6	87.7	**6,612.4**

2.2.1. Emissions by Gas Type

A breakdown of total GHG emission shown in Table 2-3 illustrated that the two most significant GHG emitted in Brunei Darussalam in 2010 were CO_2 and CH_4. CO_2 and CH_4 constituted 62.0% and 36.8% of total GHG emissions respectively, while HFCs and N_2O emissions were relatively insignificant at 0.9% and 0.3% respectively. Figure 2-1 illustrates the percentage breakdown of GHG emissions.

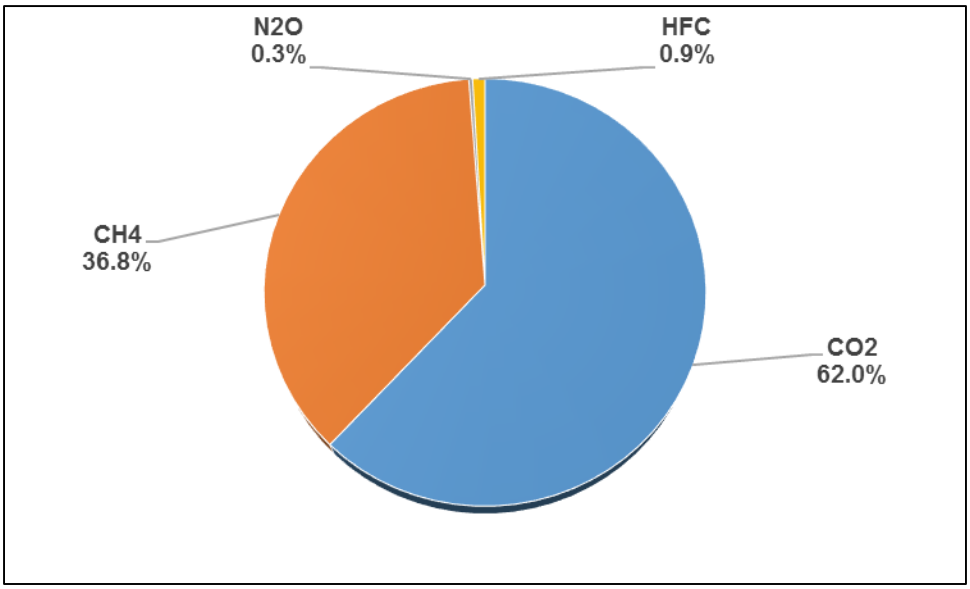

Figure 2-1: Percentage Share of GHG Emissions

2.2.2. Emission by Sectors

Energy sector contributed 8,858.2 Gg CO_2 equivalent, corresponding to 93.4% of the total emissions. This was followed by waste sector, which emitted 496.6 Gg CO_2 equivalent (5.2%), industrial processes at 106.7 Gg CO_2 equivalent (1.1%) and agriculture at 27.1 Gg CO_2 equivalent (0.3%). Figure 2-2 illustrates the emissions by sector.

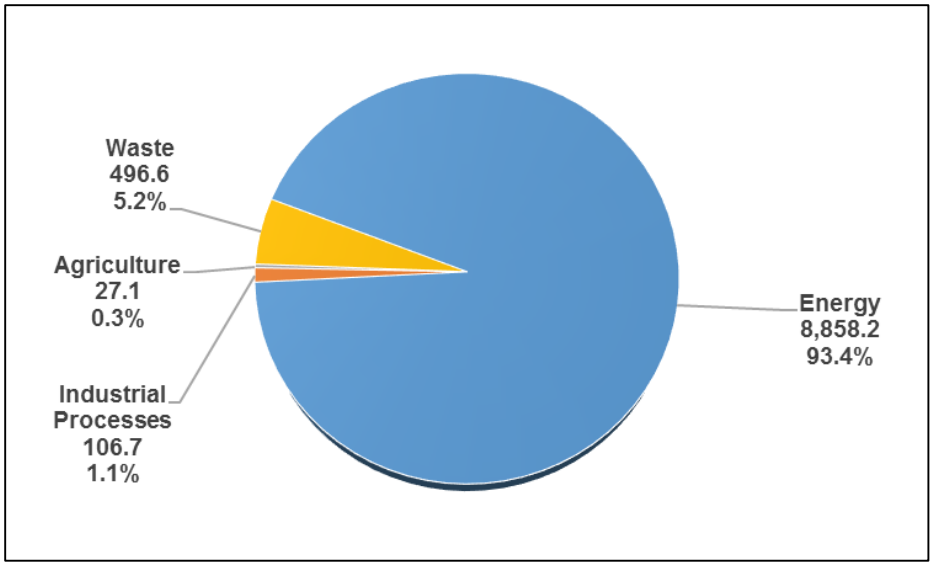

Figure 2-2: GHG Emissions by Sector (in Gg CO_2 equivalent)

2.2.2.1. Energy Sector

Energy sector constituted 8,858.2 Gg of CO_2 equivalent, which came from energy industries (combustion of natural gas and diesel for electricity and heat production) (4,176.4 Gg CO_2 equivalent), road transportation (1,171.4 Gg CO_2 equivalent), manufacturing and construction (449.8 Gg CO_2 equivalent), residential sector (105.4 Gg CO_2 equivalent) and fugitive emissions from oil and gas activities (2,955.2 Gg CO_2 equivalent). Figure 2-3 shows the emissions in the energy sector.

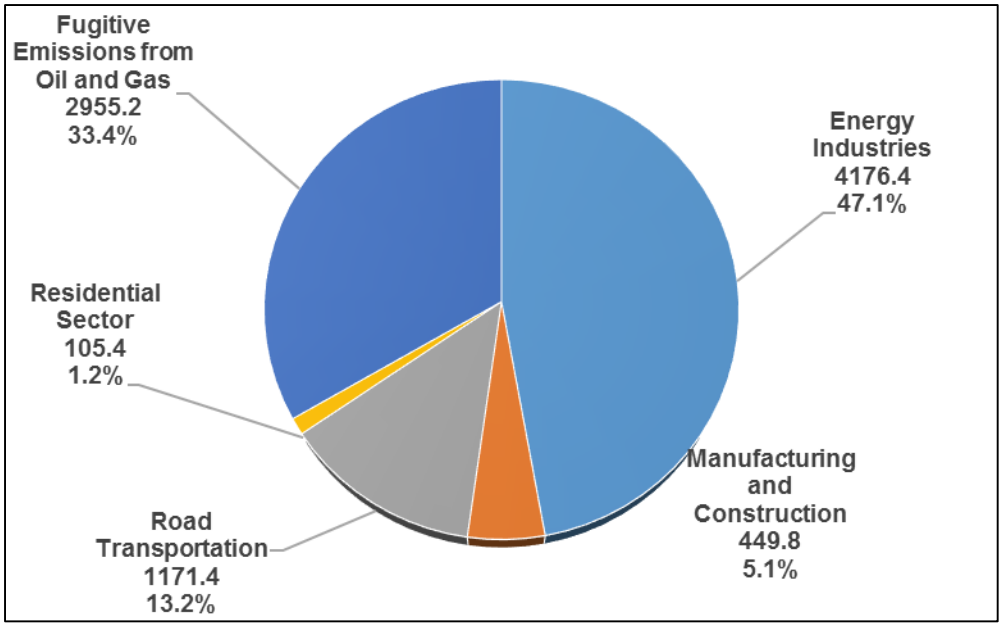

Figure 2-3: GHG Emissions in Energy Sector (in Gg CO_2 equivalent)

Electricity and Heat Production: Majority of the emissions in the energy industries was attributed to combustion of natural gas and diesel for electricity generation. Production of electricity emitted mainly CO_2 with emissions of 4,166.1 Gg CO_2 equivalent. 98% of the electricity generation comes from natural gas-fired open cycle power plants while the remaining 2% comes from a diesel power plant[6].

The production of electricity in 2010 was 3,792,229,554 kilowatt hour (kWh) with corresponding electricity consumption of 3,327,567,412 kWh[7]. The residential sector accounted for the highest consumption (35.5%), followed by commercial sector (25.4%) government sector (21.9%) and others (17.8%).

Road Transportation: In 2010, road transportation activities emitted 1,171.4 Gg CO_2 equivalent[8]. Majority of the emissions came from CO_2, accounting for about 99.3% of the total emissions. CH_4 and N_2O represented negligible shares of 0.4% and 0.3% respectively.

[6] Wawasan Brunei 2035: *Outline of Strategies and Policies for Development (OSPD) 2007-2017: National Development Plan (RKN) 2007-2012*
[7] Department of Economic Planning and Development, Prime Minister's Office, op cit.
[8] Estimation from the 2010 GHG National Inventory. Raw data from EIDPMO.

In 2010, a total of 113,655 registered vehicles[9] were licensed. The dominance of private cars has been one of the challenges to the development opportunity for public transportation services such as buses and taxis. The length of permanent roads in 2010 was 2,434.5 kilometres[10].

Manufacturing and Construction: Emissions from manufacturing and construction were 448.3 Gg CO_2 equivalent. CO_2 contributed about 99.6% of the total emissions.

Residential Sector: Residential sector consumption of oil-based fuels and cooking gas distributed in canister emitted 104.9 Gg CO_2 equivalent, with CO_2 being the major emission at 99.5% share.

Fugitive Emissions from Oil and Gas: A total of 2,955.2 Gg CO_2 equivalent of CH_4 was emitted into the atmosphere due to venting and flaring activities in the oil and gas industry.

2.2.2.2. Industrial Processes

The industrial processes emitted a total of 106.7 Gg of CO_2 equivalent, comprising 17.8% CH_4 and 82.2% HFCs. The amount of CH_4 emitted from the chemical industry (methanol production) was 19.0 Gg CO_2 equivalent, while consumption of halocarbons and sulphur hexafluoride totalled 87.7 Gg CO_2 equivalent. Figure 2-4 shows the emissions under industrial processes.

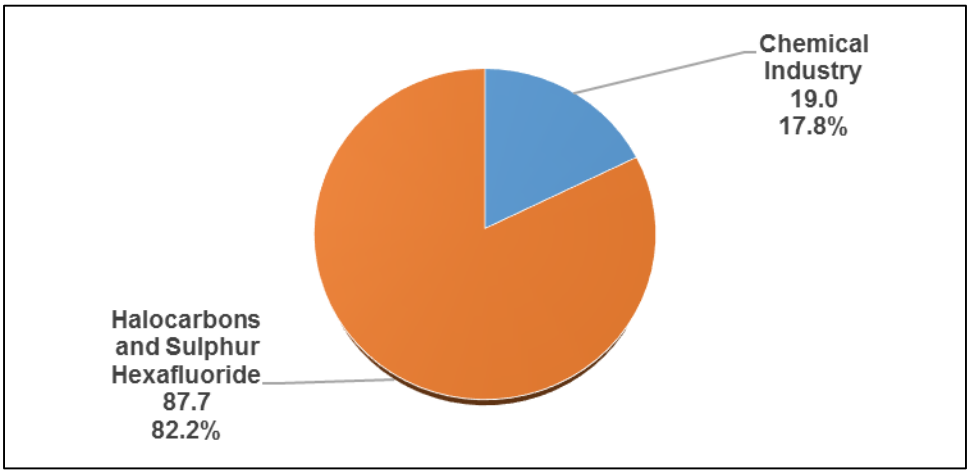

Figure 2-4: GHG Emissions in the Industrial Processes (in Gg CO2 equivalent)

2.2.2.3. Agriculture Sector

The agriculture sector in 2010 emitted 27.1 Gg CO_2 equivalent, which is insignificant relative to emissions from other sectors. Figure 2-5 shows the contribution of the emissions from manure management (7.8 Gg CO_2 equivalent), enteric fermentation (6.4 Gg CO_2 equivalent), rice cultivation (1.6 Gg CO_2 equivalent) and agricultural soils (11.3 Gg CO_2 equivalent). Figure 2-5 shows the emissions in agriculture sector.

[9] *Ibid.*
[10] *Ibid.*

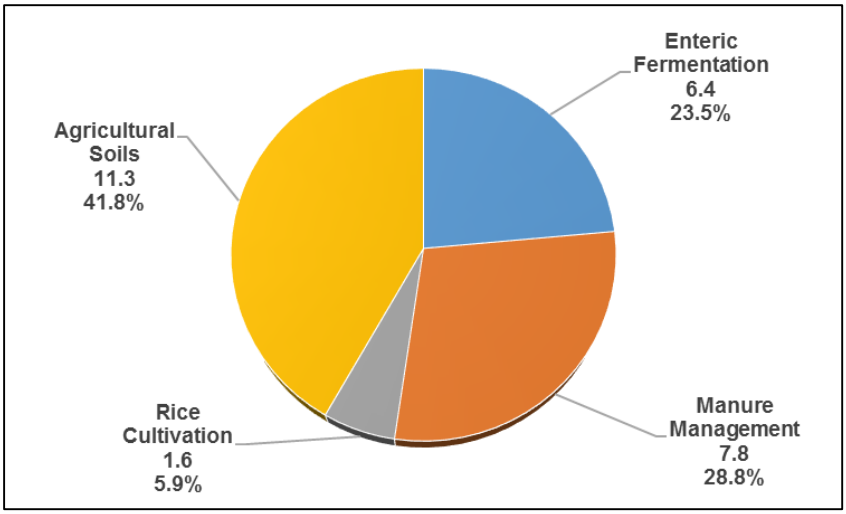

Figure 2-5: GHG Emissions in Agriculture Sector (in Gg CO2 Equivalent)

2.2.2.4. Waste Sector

Waste sector contributed 496.6 Gg of CO_2 equivalent of emissions, comprising 98.1% CH_4 and 1.9% N_2O. Majority of the emissions came from solid waste disposal with corresponding value of 413.9 Gg of CO_2 equivalent, while wastewater handling released 82.7 Gg of CO_2 equivalent, of which 9.3 Gg of CO_2 equivalent came from N_2O. Figure 2-6 presents the breakdown of emissions from the waste sector.

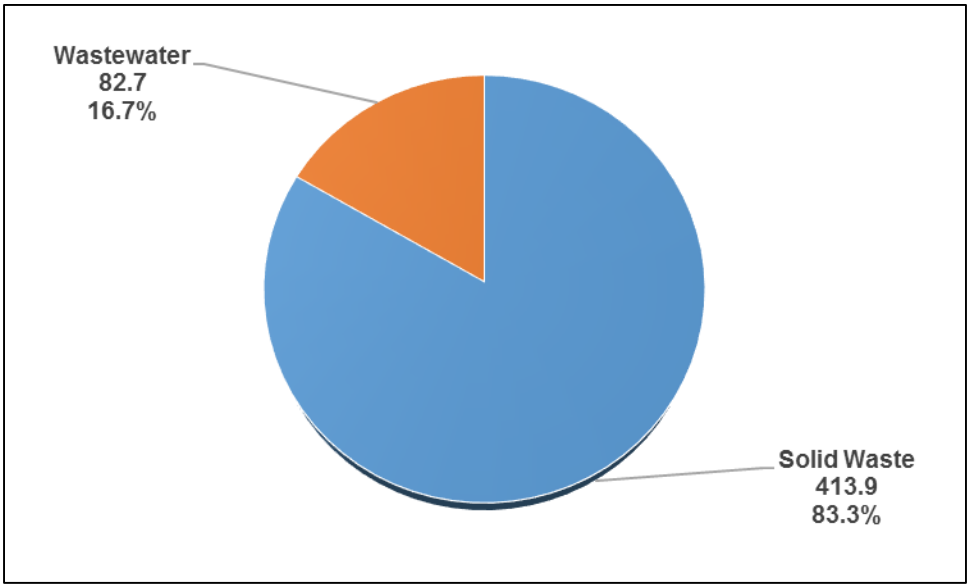

Figure 2-6: GHG Emissions from the Waste Sector (in Gg CO_2 equivalent)

Total solid waste generated in 2010 was estimated at 197,650 tonnes[11]. These wastes were disposed at 110-hectares engineered landfill area equipped with odour control measures, environmental monitoring systems and leachate treatment. Domestic wastewater are treated by centralised sewage treatment facility and septic tanks.

[11] Estimation from the 2010 GHG National Inventory.

2.2.2.5. Land Use Change and Forestry

Figure 2-7 shows that forests and other woody biomass stock removed an estimated amount of CO_2 of 3,036.3 Gg of CO_2 equivalent from the atmosphere. The emissions attributed to forest and grassland conversion were 160.2 Gg CO2 equivalent. Between 2005 and 2010, the rate of forest conversion through land use change is on average about 0.5% per annum. The land-use change and forestry contributed to removals of 2,876.2 Gg of CO2 equivalent.

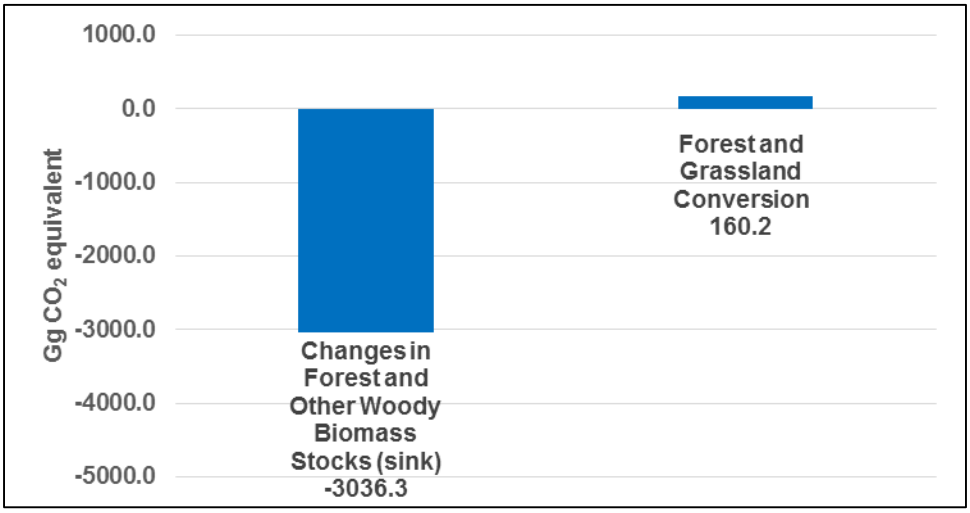

Figure 2-7: GHG Emissions and Removals in Land Use Change and Forestry (in Gg CO_2 equivalent)

2.2.3. Key Category and Uncertainty Analyses

Most of the key categories originated from energy sector, alongside land-use change and forestry and waste sectors. In descending individual percentage contribution, the main contributor was combustion of natural gas in the energy industries (32.2%), followed by changes in forestry and other woody biomass stocks (23.9%), fugitive emissions (23.3%), road transportation (9.2%), manufacturing and construction (3.5%) and solid waste disposal sites (3.3%). Cumulatively, as shown in Table 2-4, these categories add up to 95.4%, which is within the 95% threshold.

Table 2-4: Key Category Analysis for 2010 Inventory

Sector	Source Categories	GHG	Total Absolute Emissions (Gg CO_2 equivalent)	Individual Contribution	Cumulative Contribution
Energy	Energy industries – natural gas combustion only	CO_2	4,088.3	32.2%	32.2%
Land-use Change and Forestry (LUCF)	Changes in forestry and other woody biomass stocks	CO_2	3,036.3	23.9%	56.1%
Energy	Fugitive emissions	CH_4	2,955.2	23.3%	79.4%
Energy	Road transportation	CO_2	1,163.3	9.2%	88.6%

Energy	Manufacturing and construction	CO_2	448.3	3.5%	92.1%
Waste	Solid waste disposal sites	CH_4	413.9	3.3%	95.4%

In terms of uncertainty analysis, the overall uncertainty of Brunei Darussalam's 2010 inventory was approximately 50%. The high percentage value could be due to large percentage uncertainties in activity data and emission factor values, particularly in industrial processes, agriculture, land-use change and forestry, as well as waste sector. Improving activity data and emission factors in these sectors could reduce the overall uncertainty in the inventory and hence improve the emissions data. Table 2-5 below shows the uncertainty level estimates.

Table 2-5: Uncertainty Estimates in the Activity Data and Emissions Factors for All Sectors

Sector	**Source Categories**	**Emissions (Gg CO_2 equivalent)**	**Percentage Uncertainty**		**Combined Uncertainty**	**Contribution to Variance**
			Activity data value	***Emission factor value***		
Energy	Energy industries	4,176.4	10%	10%	0.141	0.008
	Manufacturing and construction	449.8	10%	10%	0.141	0.000
	Road transportation	1,171.4	10%	10%	0.141	0.001
	Residential sector	105.4	10%	10%	0.141	0.000
	Fugitive emissions from oil and gas	2,955.2	10%	50%	0.510	0.052
Industrial Processes	Chemical industry	19.0	40%	50%	0.640	0.000
	Consumption of halocarbons and sulphur hexafluoride	87.7	40%	50%	0.640	0.000
Agriculture	Enteric fermentation	6.4	15%	50%	0.522	0.000
	Manure management	7.8	15%	50%	0.522	0.000
	Rice Cultivation	1.6	25%	50%	0.559	0.000
	Agricultural Soils	11.3	30%	50%	0.583	0.000
Land-use Change and Forestry (LUCF)	Changes in forestry and other woody biomass stocks	-3,036.3	25%	90%	0.934	0.184
	Forest and grassland conversion	160.2	25%	30%	0.391	0.000

Waste	Solid waste disposal sites	413.9	10%	50%	0.510	0.001
	Wastewater handling	82.7	20%	50%	0.539	0.000
Total						**0.245**
Percentage Uncertainty in Total Inventory						**50.0%**

3. Mitigation

As a country with a relatively small resource base, Brunei Darussalam has placed prior emphasis on ensuring prudent and efficient utilisation of its resources to meet its long term development needs. This will discourage wastage and over consumption which contributes to reducing emission.

3.1. Energy Sector

Recognising that energy is a scarce resource, the government has been exploring the deployment of solar energy as an alternative energy source to meet the country's long term domestic energy need. In addition the government has also implemented measures to promote and instil the awareness and practice for the prudent use of power and discouraging wastefulness. In this sector Brunei Darussalam's mitigation efforts are primarily on energy related policies and actions on promoting energy efficiency and conservation and renewable energy.

3.1.1. Deployment of Renewable Energy

Brunei Darussalam commissioned its first photovoltaic solar power plant, the Tenaga Suria Brunei (TSB) in 2010. With an installed capacity of 1.2 MW, it is generating approximately 1,600 MWh of electricity per year, corresponding to a reduction of 960 tonnes of CO_2 emission[12]. TSB is an important step in the development of renewable energy in the country. The project was carried out to assess the performance of 6 different solar PV module types at local meteorological conditions.

3.1.2. Public Education and Awareness

Public outreach and education programmes to raise awareness on energy conservation and saving has been implemented for all sectors of the population. Seminars, roadshows, forums and exhibitions on energy efficiency and conservation and use of renewable energy has been organized for the public sector agencies, business sector, academia, the media, non-governmental organisations, grassroots leaders and the rural community. Energy efficiency and conservation has been incorporated as a curriculum in the national education system.

3.2. Forestry and Land Use Sectors

His Majesty Sultan Haji Hassanal Bolkiah, the Sultan and Yang Di- Pertuan of Negara Brunei Darussalam addressed the UN Climate Summit in New York in September 2014 highlighted the following:

"For the past 80 years, forest conservation has been an important part of our national development strategy. Today, 75% of Brunei Darussalam's land area is covered by tropical rainforests comprised of highly diverse ecosystems. In addition, Borneo's pristine peat swamps forests, which act as a carbon sink to counter emissions, are acknowledged by scientists as being

[12] Tenaga Suria Brunei: *Information Booklet*

some of the only remaining examples of their kind in the world. Our commitment to preserving our environment is further reflected through the allocation of 58% of our land area to the "Heart of Borneo" forest conservation initiative. We continue to work with our neighbours, Indonesia and Malaysia, and other international partners such as the World Wildlife Fund (WWF) in this endeavour."

From the national GHG inventory for 2010, it is estimated that tropical rainforests including mangroves and peat swamps sequestered about 2,625 Gg of CO2 equivalent from the atmosphere. This constitutes removal of about 25% of the total GHG emission. Forest conservation has been an important part of the national development strategy. Under the National Forests Policy of 1989 Brunei Darussalam is committed to devote 55% of its land area as forest reserves[13]. The Government of Brunei Darussalam intends to increase the total gazette forest reserves to 55%, and has already commenced working with the relevant authorities to increase the area.

Approximately 41% of the country's land area (2,235 square kilometres) has been gazetted as forest reserves[14]. These forest reserves are protected by robust legislation. The forest reserve of Brunei Darussalam are classified under five categories or zones: protection forest, production forest, recreational forest, conservation forest, and national park. Timber harvesting for domestic timber supply is confined only to production forests, which make up approximately 24.0% or equivalent to 138,026 hectares of Brunei's land area.

3.3. Waste Management

The following key strategies are adopted as part of the integrated waste management system in Brunei Darussalam:

- Waste minimisation to reduce the generation of waste; and
- Recycling of waste to reduce the amount of waste disposed of at landfills. The Government is targeting a 15% recycling rate by 2020.

To realize these strategies, the government has implemented several environmental initiatives, including:

- 'No Plastic Bags Weekend' Initiative. Consumers have to bring their own bags on Friday, Saturday and Sunday as departmental stores and few shops do not provide plastic bags on these days;
- Promotion of paper bags as an alternative to the use of plastic bags for groceries. This collaborative effort undertaken by a local community, a local private company and the Department of Environment, Parks and Recreation was implemented in one locality. A few selected provisional shops in the locality were engaged to undertake this initiative;
- Collection of beverage cartons. This is a collaborative effort between the Department of Environment, Parks and Recreation, Tetra Pak (one of the world's leading food processing and packaging solutions company in the region), and Daikyo Environmental Recycling (a local company), to collect beverage cartons from the community, including schools and learning institutions, shopping malls and supermarkets, commercial areas like restaurants and hotels, and also residential houses, for the purpose of recycling; and

[13] Forestry Department: *National Forestry Policy 2006*
[14] Department of Economic Planning and Development, Prime Minister's Office, op. cit.

- Youth empowerment to allow youth to champion and partake in various environmental activities. This include the establishment of the Brunei Environment Youth Envoys and Eco-Clubs at schools.

4. Vulnerability and Adaptation

Brunei Darussalam is vulnerable to the impacts of climate change. The country is exposed to higher temperatures during the dry season and higher rainfall intensities during the wet season. As most of the population are living within 5 to 10 kilometres from the coastline and estuarine settlements, sea level rise effects is also of concern given some areas of the country are up to 12 meters below sea level. The socio-economic activities, including the hydrocarbon resources are also concentrated along the coastal areas.

4.1. Climate change projections

Over the past 60 years, Brunei Darussalam has experienced a rise in surface temperature as observed in the climate data collected by the Climate Data Centre of the Brunei Darussalam Meteorological Department. This trend is expected to continue over the next century.

The Regional Climate Modeling Experiment for Southeast Asia initiated by the Centre for Climate Research, Singapore of the Meteorological Service Singapore (CCRS-MSS) in collaboration with the Met Office Hadley Centre (MOHC) and also contribution from climate researchers from the ASEAN region's National Meteorological and Hydrological Services (NMHs) and Research Institutes (RIs), as well as scientists from the MOHC, indicated that the mean surface temperature would increase by 2-3 degree Celsius between 2031 and by 3-4 degree Celsius between 2071 and 2100.

Similarly, the Asian Development Bank (ADB) has reported that an increase in climate variability and severity of extreme weather events would be observed in the Brunei Darussalam-Indonesia-Malaysia-Philippines East ASEAN Growth Area (BIMP-EAGA) in the coming decades.

Key highlights of the climate change projections in the region encompassing Brunei Darussalam are the following:

- Warming of the area by an average of 1 to 1.5°C by mid-century (2040-2060) with increased risk of the occurrence of heat waves;
- Considerable increase in the 'hot' days frequency in the present climate;
- Overall increase rainfall with huge spatial and seasonal variation;
- Enhanced variability of rainfall that could increase the occurrence and duration of dry periods;
- Increased total annual rainfall; and
- Higher intensities of rainfall that could increase the risk of flooding and landslides.

4.2. Climate Change Vulnerability

Brunei Darussalam is exposed to flooding incidences particularly in low lying areas and heat stress. Sea level rise is also of concern given some areas of the country are up to 12 metres below sea level. The National Oceanic and Atmospheric Administration (NOAA) Oceanographic Data Centre, based on the interpolation of measuring gauges in Southern Philippines, Vietnam and Singapore suggest a sea level rise of 0.2 millimetres per year or 20 millimetres per century for Brunei Darussalam.

4.2.1. Flooding, Landslides and Strong Winds

Flooding and landslides are the two most frequent natural disasters that occur annually in Brunei Darussalam and common during the northeast monsoon season. This season normally lasts in between the months of October to January. January is the wettest and generally brings high intensity rainfall that can cause flash floods in the low-lying areas as well as floods in most flood plain areas particularly in Tutong and Belait Districts. Normally the flood plain inundations recede after two weeks.

In January 2009, Brunei Darussalam experienced an extreme heavy rainfall phenomenon for two days on 19 to 20 January which triggered more landslide cases and more widespread of flood and flash flood[15]. The event brought significant impacts to the socio-economic of the country ranging from disruption of electrical services, road connectivity, education as well as financial loss to small and medium enterprises. This event also claimed two lives. During this short period of time, a number of households were affected by flood. A three-day blackout due to flooding in a major power station affected many business and residential areas. The education sector was also disrupted when a number of schools had to be closed due to inaccessibility and safety issues. The transportation sector was also affected where some roads were impassable due to flood and debris from landslides and fallen trees.

It is also during the northeast monsoon period that landslides generally occur. The continuous rainfall is one of the trigger factors for landslides. There were a total of 401 reported landslide cases for the period of 2009 until 2011 with 2009 recorded the highest cases of 301 from the extreme heavy rain in January that year. Private residential, schools, roads and other public facilities mostly near or at the hillside are most of the affected areas by landslides.

Brunei Darussalam is generally safe from major typhoons in the region. However during active typhoon season, strong winds up to 50 – 60 kilometres per hour have ripped off rooftops of private residents. This also occurs regularly during northeast cold surges event and heavy thunderstorms.

4.2.2. Loss of Forestry and Biodiversity

Brunei experiences reduced precipitation during the dry period of February to March. This relatively drier period coupled with increasing temperatures resulted in incidences of forests fires affecting forests cover and air quality.

Sea level rise causing intrusion of sea water into the ecosystems also posed a threat to the vast area of wetland forest especially the endangered peat swamp forest ecosystems. The combination of waterlogging and increase in salinity can reduced productivity and the deterioration of wetland species.

Corals in the Brunei Darussalam coastal waters which are dependent on a certain temperature range in order to grow may also be affected by the increase of sea temperature resulting from the climate change impacts. The increased frequency and intensity of storms from climate change may also be able to damage coral formation. Ocean acidification due to the uptake of carbon dioxide from the atmosphere over an extended period time may also affect the growth of corals.

4.2.3. Loss of Agricultural and Fisheries Production

Rice and other agricultural production in the country are mainly dependent on rain-fed irrigation for supply of water over the cultivation and production period. Increased temperature paired with

[15] National Disaster Management Centre (NDMC), Ministry of Home Affairs

decreased amount of rain during the relatively drier periods in Brunei (November to February) can affect crops yield while the heavy rainfall can damaged crops. Furthermore, a study by Asian Development Bank (ADB, 2009) stated that the delayed rainy season and extreme climate events as a result from the El Niño Southern Oscillation (ENSO) as well as increased soil salinity may also affect agricultural production.

The study by ADB (2015) also reported that projected sea level rise as a result from climate change may also likely to result in important losses to coastal ecosystems that support fisheries. This could affect the fisheries industry in Brunei.

4.2.4. Public Health Impacts from the Resurgence of Diseases

Most of the Brunei's climate-sensitive diseases are vector-borne. Dengue fever is the most common vector-borne disease that is occurring in the country, from which around 299 cases were registered in Brunei Darussalam in 2010. According to the Nanyang Technological University (NTS) Report on the health governance and dengue in Southeast Asia (2015), dengue is one of the most common diseases in Southeast Asia and has been ranked as the most important mosquito-borne viral disease with epidemic potential in the world.

Incidences of forest fires during dry seasons affecting air quality can caused respiratory related illness such as asthma, flu and coughing especially among those who have acute respiratory problems.

4.3. National Adaptation Framework

The principal goals of Brunei Darussalam Long Term Development Plan (2007-2017) amongst others include the protection of its people and their livelihood and protection of its environment and ecosystem. Enhancing climate change resilience and adaptation play a major role in achieving these goals.

4.3.1. Brunei Darussalam Strategic National Action Plan for Disaster Risk Reduction (SNAP)

Through a participatory process in 2010, the NDMC[16] developed the SNAP for Disaster Risks Reduction to ensure a safer and disaster resilient country and community. SNAP covering the period 2012-2025 consists of five priority thematic areas of actions based on the Hyogo Framework for Action. The SNAP Framework also incorporates the United Nation's Sendai Framework for Disaster Risk Reduction for 2015-2030.

[16] The Disaster Management Order, 2006 (DMO) mandated the establishment of the National Disaster Council (NDC) and the National Disaster Management Centre (NDMC). The NDMC supports the NDC as the main strategic policy body in disaster management in ensuring effective disaster management. The NDMC is involved in every phase of the disaster management in Brunei Darussalam: response, recovery, mitigation and preparedness.

Table 4-1: Brunei Darussalam Strategic National Action Plan for Disaster Risk Reduction (SNAP) for 2012 to 2025

Priority	Theme	Identified Areas
1	Governance	Ensuring risk reduction a national and local priority with a strong institutional basis for implementation
2	Risk assessment and early warning	Identify, assess and monitor disaster risks and enhance early warning
3	Knowledge management	Use knowledge, innovation and education to build a culture of safety and resilience at all levels
4	Vulnerability reduction	Reduce underlying risk factors across key sectors of development activity
5	Disaster preparedness	Strengthening disaster preparedness for effective response at all levels

4.3.2. Coastal and Flood Protection

Flooding is one of the major climate related risks and causes the most significant climate change impacts in Brunei Darussalam.

Regarding flood protection, the Government has initiated an integrated approach in addressing flood protection, river quality improvement and coastal protection. Both structural measures (such as flood walls, upgrading of drains and outlets, canalisation and retention ponds, construction of sea walls) and non-structural measures (such as land use planning, flood forecasting and early warning system, capacity building, public education and awareness) on flood mitigation and adaptation were implemented.

4.3.3. Safeguarding Forestry and Biodiversity

Brunei Darussalam has been undertaking measures to protect its forests and its highly diverse ecosystems that provides co-benefits to climate change mitigation and adaptation. These include the following:

- Participating in the "Heart of Borneo" Initiative launched in 2007. Borneo's tropical rainforests stretch from north to south and are understood to be one of the world's oldest tropical rainforest ecosystems. The initiative builds on five pillars: trans-boundary management; protected area management and sustainable natural resource management, ecotourism development and capacity building;
- Ratification of the Convention of Biological Diversity of the United Nations.
- Restrictions and reduced-scale on logging activities which include an implementation of reduced cut policy which limits the annual timber logging quota to 100,000 m^3 in production forest.
- Carrying out aerial monitoring and forest patrols, in addition to dedicated border inspections; and
- Awareness raising activities such campaigns in schools and communities, along with initiatives like "International Day of Forests";

Finally, the forestry sector provide opportunities for both adaptation and mitigation. As explained above actions to preserve the forest provide flood management benefits (adaptation) and where this is coupled with reforestation or afforestation to expand the forests reserves area, there could be enhanced mitigation benefits too.

4.3.4. Managing Food Security

The global food crisis in 2008 spurred the government into action to safeguard the country against price spikes and future possible food shortage. In 2009 His Majesty Sultan Haji Hassanal Bolkiah called for self-sufficiency in the country's staple food, rice for which the country was almost entirely reliant on import. A rice self-sufficiency target of 20% was introduced in 2010. Other major food items tagged for self-sufficiency are tropical fruits, vegetables, poultry meat and eggs.

Various strategies have been adopted to boost local rice production, including the opening of more rice production areas and improving field productivity through the use of modern high-yielding varieties such as *Laila* and *Titih*. Although the country is largely self-reliant in terms of poultry and eggs production, Brunei Darussalam is still relying heavily on imported rice and livestock to cater for the needs of its population. In the future, it is envisaged that agriculture in Brunei must become 'climate-resilient' so that a threat to food security from climate change can be prevented.

With respect to fishery, Brunei Darussalam has an adequate domestic supply of fish and seafood together with fish imported from Sabah. However, it is still important for Brunei Darussalam to manage its fishery in order to ensure food security of the country as the effects from climate change may affect the environment and population of the marine habitat.

4.3.5. Strengthening Resilience in Public Health

In responding to vector-borne diseases including dengue incidences in Brunei Darussalam, several activities to prevent and reduce the spread of vector borne diseases have been implemented. These include the following:

- Implement vector borne diseases control consisting of various strategic plans and organized programs for the vigilance, elimination, control and prevention of diseases;
- Application of an integrated vector management (IVM) and to get more effective, cost effective, ecologically sound and sustainable vector control; and
- Combatting vector-borne diseases through Malaria Vigilance Programme; Entomology Programme, Vector Control Programme which entails mosquito, virus and human surveillance' public education and awareness; law enforcement and research.

In addition, the Ministry of Health (MoH) is also supporting the World Health Organisation (WHO) programme and activities to strengthen the country public health resilience to vector borne diseases and climate change.

5. Abbreviations and Units of Measurement

5.1. Abbreviations

BIMP-EAGA	Brunei-Indonesia-Malaysia-Philippines East ASEAN Growth Area
BMC	Brunei Methanol Company
BND	Brunei Dollar
BNERI	Brunei National Energy Research Institute
BSP	Brunei Shell Petroleum
CH_4	Methane
CO_2	Carbon Dioxide
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GWP	Global Warming Potential
HFCs	Hydrofluorocarbons
IPCC	Intergovernmental Panel on Climate Change
MoD	Ministry of Development
MoH	Ministry of Health
N_2O	Nitrous Oxide
NDMC	National Disaster Management Centre
NO_X	Oxides of Nitrogen
TSB	Tenaga Suria Brunei
UNFCCC	United Nations Framework Convention for Climate Change
USD	US Dollar
WHO	World Health Organisation

5.2. Units of Measurement

°C	Degree Celsius
bpd	Barrels per day
Gg CO_2 Equivalent	Gigagram of CO_2 equivalent
kWh	Kilowatt Hour
MW	Megawatt
MWh	Megawatt Hour

6. Acknowledgements

The Energy and Industry Department, as Brunei Darussalam's National Focal Point for the UNFCCC would like to sincerely accord its thanks and appreciation to members of the Stakeholders Consultative Committee and members of the Tasks Force For the Preparation of Brunei Darussalam INC for their relentless and untiring efforts in making the preparation of Brunei Darussalam INC possible.

The Energy and Industry Department is indebted to the support and contributions of stakeholders listed below:

Haji Marzuke bin Haji Mohsin	Deputy Permanent Secretary, Ministry of Development
Abdul Salam bin Abdul Wahab	Prime Minister's Office Energy and Industry Department
Abdul Matiin bin Haji Muhd Kasim	Prime Minister's Office Energy and Industry Department
Mohd Rifdi bin Haji Sahari	Prime Minister's Office Energy and Industry Department
Bahrum bin Haji Kadun	Prime Minister's Office Department of Economic Planning and Development
Pengiran Muhammad Fadhil bin Pengiran Dato Paduka Haji Yunus	Prime Minister's Office Department of Economic Planning and Development
Aminudin Zaki bin Dato Paduka Abdul Rahman	Prime Minister's Office Attorney General's Chambers
Siti Shahryenawaty bte Haji Abd Shahri	Prime Minister's Office Attorney General's Chambers,
Abdul Rahim bin Ismail	Ministry of Home Affairs National Disaster Management Centre
Rina Nurhafizah @ Rezza bte Abdul Rani	Ministry of Home Affairs National Disaster Management Centre
Md Syazwan bin Nordin	Ministry of Home Affairs National Disaster Management Centre
Mohd Adib bin Matali	Ministry of Home Affairs National Disaster Management Centre
Pengiran Asnawi Arbi bin Pengiran Dato Paduka Haji Sharifuddin	Ministry of Foreign Affairs and Trade Department of International Organisations
Siti Mardhiana bte Jorsni	Ministry of Foreign Affairs and Trade Department of International Organisations

Mohd Izzannudin bin Haji Bujang	Ministry of Primary Resources and Tourism Department of Agriculture and Agrifood
Dr Umi Fatimiah bte Haji Abdul Rahman	Ministry of Primary Resources and Tourism Department of Agriculture and Agrifood
Khairunnisa bte Omar Ali	Ministry of Primary Resources and Tourism Department of Agriculture and Agrifood
Shahri bin Haji Hussin	Ministry of Primary Resources and Tourism Forestry Department
Pengiran Mohammad Iskandar bin Pengiran Aliuddin	Ministry of Primary Resources and Tourism Forestry Department
Mahmud bin Haji Yussof	Ministry of Primary Resources and Tourism The Heart of Borneo
Haji Mohd Zakaria bin Haji Sarudin	Ministry of Development
Fatimah bte Haji Lamat	Ministry of Development
Haji Shaharuddin Khairul bin Haji Anuar	Ministry of Development Department of Environment, Parks and Recreation
Dayangku Haryanti bte Pengiran Haji Petra	Ministry of Development Department of Environment, Parks and Recreation
Mohammad Akmal Fikry bin Yusra	Ministry of Development Department of Environment, Parks and Recreation
Dr Hajah Norimtihan bte Haji Abdul Razak	Ministry of Development Department of Drainage and Sewerage, Public Works Department
Haji Ashrulsuhardy bin Haji Ibrahim	Ministry of Development Department of Water Services, Public Works Department
Pengiran Mohd Zaki bin Pengiran Haji Ibrahim	Ministry of Development Department of Water Services, Public Works Department
Dr Rohaniyati bte Pehin Orang Kaya Laila Wangsa Dato Seri Paduka Haji Md Salleh	Ministry of Development Department of Mechanical and Electrical, Public Works Department
Hajah Shazwani bte Dato Paduka Haji Mohd Nor	Ministry of Development Town and Country Planning Department
Hajah Fauziah bte Haji Abdul Hamid	Ministry of Culture, Youth and Sports
Khairunnisa bte Saidin	Ministry of Culture, Youth and Sports
Rasidah bte Hidup	Ministry of Culture, Youth and Sports

Siti Sa'adiah bte Haji Mohd Salleh	Ministry of Culture, Youth and Sports
Dr Yusma Jeffrin bin Dato Haji Md Yusof	Ministry of Health Department of Environmental Health Services
Kamaludin bin Md Yassin	Ministry of Health Department of Environmental Health Services
Dr Muhammad Hussein bin Abdullah	Ministry of Health Department of Environmental Health Services
Dr Haji Supry bin Haji Ladi	Ministry of Communications Land Transport Department
Fadzila bte Abdul Hamid	Ministry of Communications Land Transport Department
Muhamad Husaini bin Aji	Ministry of Communications Brunei Darussalam Meteorological Department
Rokiah bte Haji Anggas	Ministry of Communications Brunei Darussalam Meteorological Department
Marzeti bte Haji Mahadi	Ministry of Communications Brunei Darussalam Meteorological Department
Harnina bte Morani	Ministry of Communications Brunei Darussalam Meteorological Department
Nurulinani bte Haji Jahari	Ministry of Communications Brunei Darussalam Meteorological Department
Dr Saiful Azmi bin Haji Awang Husain	Universiti Brunei Darussalam
Dr Romeo Pacudan	Brunei National Energy Research Institute
Mohamad Hirman bin Dollah	Brunei National Energy Research Institute
Muhammad Nabih Fakhri bin Matussin	Brunei National Energy Research Institute

ANNEX – Revised 1996 IPCC Worksheets

			This spreadsheet contains sheet 1 of Worksheet 1-1, in accordance with the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.						This spreadsheet contains sheet 2 of Worksheet 1-1, in accordance with the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.					This spreadsheet contains sheet 3 of Worksheet 1-1, in accordance with the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.				
MODULE			**ENERGY**						**ENERGY**					**ENERGY**				
SUBMODULE			**CO_2 FROM ENERGY SOURCES (REFERENCE APPROACH)**						**CO_2 FROM ENERGY SOURCES (REFERENCE APPROACH)**					**CO_2 FROM ENERGY SOURCES (REFERENCE APPROACH)**				
WORKSHEET			**1-1**						**1-1**					**1-1**				
SHEETS			**1 OF 5**						**2 OF 5**					**3 OF 5**				
COUNTRY			**Brunei Darussalam**						**Brunei Darussalam**					**Brunei Darussalam**				
YEAR			**2010**						**2010**					**2010**				
			A	B	C	D	E	F	G [(b)]	H	I	J	K	L	M	N	O	P
			Production	Imports	Exports	International Bunkers	Stock Change	Apparent Consumption	Conversion Factor	Apparent Consumption	Carbon Emission Factor	Carbon Content	Carbon Content	Carbon Stored	Net Carbon Emissions	Fraction of Carbon Oxidised	Actual Carbon Emissions	Actual CO_2 Emissions
			(TJ/Unit)	(TJ)	(t C/TJ)	(t C)	(Gg C)	(Gg C)	(Gg C)	(Gg CO_2)								
FUEL TYPES								F=(A+B -C-D-E)		H=(FxG)		J=(HxI)	K=(J/1000)		M=(K-L)		O=(MxN)	P=(Ox[44/12])
Liquid Fossil	Primary Fuels (TJ)	Crude Oil	360,804		364,782		7,831	-11,809.05	1	-11,809.05	20	-236,180.90	-236.18		-236.18	0.99	-233.82	-857.34
		Orimulsion						0.00		0.00		0.00	0.00		0.00		0.00	0.00
		Natural Gas Liquids	24,623		293		168	24,162.48	1	24,162.48	17.2	415,594.64	415.59		415.59	0.99	411.44	1,508.61
	Secondary Fuels (TJ)	Gasoline		1,591				1,591.29	1	1,591.29	18.9	30,075.38	30.08		30.08	0.99	29.77	109.17
		Jet Kerosene		126		4,648		-4,522.61	1	-4,522.61	19.5	-88,190.95	-88.19		-88.19	0.99	-87.31	-320.13
		Other Kerosene						0.00		0.00		0.00	0.00		0.00		0.00	0.00
		Shale Oil						0.00		0.00		0.00	0.00		0.00		0.00	0.00
		Gas / Diesel Oil		3,601			126	3,475.71	1	3,475.71	20.2	70,209.38	70.21	0.00	70.21	0.99	69.51	254.86
		Residual Fuel Oil						0.00		0.00		0.00	0.00		0.00		0.00	0.00
		LPG						0.00		0.00		0.00	0.00	0.00	0.00		0.00	0.00
		Ethane						0.00		0.00		0.00	0.00	0.00	0.00		0.00	0.00
		Naphtha						0.00		0.00		0.00	0.00	0.00	0.00		0.00	0.00
		Bitumen						0.00		0.00		0.00	0.00	0.00	0.00		0.00	0.00
		Lubricants		84				83.75	1	83.75	20	1,675.04	1.68	0.00	1.68	0.99	1.66	6.08
		Petroleum Coke						0.00		0.00		0.00	0.00		0.00		0.00	0.00
		Refinery Feedstocks						0.00		0.00		0.00	0.00		0.00		0.00	0.00
		Other Oil						0.00		0.00		0.00	0.00		0.00		0.00	0.00
Liquid Fossil Totals										12,981.57		193,182.58	193.18	0.00	193.18		191.25	701.25
Solid Fossil	Primary Fuels	Anthracite [(a)]						0.00		0.00		0.00	0.00		0.00		0.00	0.00
		Coking Coal						0.00		0.00		0.00	0.00	0.00	0.00		0.00	0.00
		Other Bit. Coal						0.00		0.00		0.00	0.00		0.00		0.00	0.00
		Sub-bit. Coal						0.00		0.00		0.00	0.00		0.00		0.00	0.00
		Lignite						0.00		0.00		0.00	0.00		0.00		0.00	0.00
		Oil Shale						0.00		0.00		0.00	0.00		0.00		0.00	0.00
		Peat						0.00		0.00		0.00	0.00		0.00		0.00	0.00
	Secondary Fuels	BKB & Patent Fuel						0.00		0.00		0.00	0.00		0.00		0.00	0.00
		Coke Oven/Gas Coke						0.00		0.00		0.00	0.00		0.00		0.00	0.00
Solid Fuel Totals										0.00		0.00	0.00	0.00	0.00		0.00	0.00
Gaseous Fossil		Natural Gas (Dry) (TJ)	477806		353266			124,539.36	1	124,539.36	15.3	1,905,452.26	1,905.45	0.00	1,905.45	0.995	1,895.93	6,951.73
Total										**137,520.94**		**2,098,634.84**	**2,098.63**	**0.00**	**2,098.63**		**2,087.18**	**7,652.98**
Biomass total										0.00		0.00	0.00	0.00	0.00		0.00	0.00
		Solid Biomass						0.00		0.00		0.00	0.00		0.00		0.00	0.00
		Liquid Biomass						0.00		0.00		0.00	0.00		0.00		0.00	0.00
		Gas Biomass						0.00		0.00		0.00	0.00		0.00		0.00	0.00

MODULE	ENERGY						ENERGY					
SUBMODULE	CO_2 FROM ENERGY SOURCES (REFERENCE APPROACH)						CO_2 FROM ENERGY SOURCES (REFERENCE APPROACH)					
WORKSHEET	1-1						1-1					
SHEETS	4 OF 5 EMISSIONS FROM INTERNATIONAL BUNKERS (INTERNATIONAL MARINE AND AIR TRANSPORT)						5 OF 5 EMISSIONS FROM INTERNATIONAL BUNKERS (INTERNATIONAL MARINE AND AIR TRANSPORT)					
COUNTRY	Brunei Darussalam						Brunei Darussalam					
YEAR	2010						2010					

		A	B	C	D	E	F	G	H	I	J	K	L
		Quantities Delivered[(a)]	Conversion Factor (TJ/Unit)	Quantities Delivered (TJ)	Carbon Emission Factor (t C/TJ)	Carbon Content (t C)	Carbon Content (Gg C)	Fraction of Carbon Stored	Carbon Stored (Gg C)	Net Carbon Emissions (Gg C)	Fraction of Carbon Oxidised	Actual Carbon Emissions (Gg C)	Actual CO_2 Emissions (Gg CO_2)
FUEL TYPES				C=(AxB)		E=(CxD)	F=(E/1000)		H=(FxG)	I=(F-H)		K=(IxJ)	L=(Kx[44/12])
Solid Fossil	Other Bituminous Coal	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00		0.00	0.00
	Sub-Bituminous Coal	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00		0.00	0.00
Liquid Fossil	Gasoline	0.00	1.00	0.00	18.90	0.00	0.00		0.00	0.00		0.00	0.00
	Jet Kerosene	4,648.24	1.00	4,648.24	19.50	90,640.70	90.64		0.00	90.64	0.99	89.73	329.03
	Gas / Diesel Oil	0.00	1.00	0.00	20.20	0.00	0.00		0.00	0.00		0.00	0.00
	Residual Fuel Oil	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00		0.00	0.00
	Lubricants	0.00	1.00	0.00	20.00	0.00	0.00	0.5	0.00	0.00		0.00	0.00
			Total	**4,648.24**								**Total[(a)]**	**329.03**

MODULE	ENERGY	ENERGY
SUBMODULE	CO_2 FROM FUEL COMBUSTION BY SOURCE CATEGORIES (TIER 1)	CO_2 FROM FUEL COMBUSTION BY SOURCE CATEGORIES (TIER 1)
WORKSHEET	1-2 STEP BY STEP CALCULATIONS	1-2 STEP BY STEP CALCULATIONS
SHEETS	1 OF 16 ENERGY INDUSTRIES	2 OF 16 ENERGY INDUSTRIES
COUNTRY	Brunei Darussalam	Brunei Darussalam
YEAR	2010	2010

	A	B	C	D	E	F	G	H	I	J	K	L
ENERGY INDUSTRIES	Consumption	Conversion Factor (TJ/Unit)	Consumption (TJ)	Carbon Emission Factor (t C/TJ)	Carbon Content (t C)	Carbon Content (Gg C)	Fraction of Carbon Stored	Carbon Stored (Gg C)	Net Carbon Emissions (Gg C)	Fraction of Carbon Oxidised	Actual Carbon Emissions (Gg C)	Actual CO_2 Emissions ($Gg\ CO_2$)
			C=(AxB)		E=(CxD)	F=(E/1000)		H=(FxG)	I=(F-H)		K=(IxJ)	L=(Kx[44/12])
Crude Oil [(a)]			0.00		0.00	0.00		0.00	0.00		0.00	0.00
Natural Gas Liquids			0.00		0.00	0.00		0.00	0.00		0.00	0.00
Gasoline			0.00		0.00	0.00		0.00	0.00		0.00	0.00
Jet Kerosene			0.00		0.00	0.00		0.00	0.00		0.00	0.00
Other Kerosene			0.00		0.00	0.00		0.00	0.00		0.00	0.00
Gas/Diesel Oil (TJ)	418.76	1	418.76	20.2	8,458.96	8.46		0.00	8.46	0.99	8.37	30.71
Residual Fuel Oil			0.00		0.00	0.00		0.00	0.00		0.00	0.00
LPG			0.00		0.00	0.00		0.00	0.00		0.00	0.00
Ethane			0.00		0.00	0.00		0.00	0.00		0.00	0.00
Naphtha			0.00		0.00	0.00		0.00	0.00		0.00	0.00
Lubricants			0.00		0.00	0.00	[(b)]	0.00	0.00		0.00	0.00
Petroleum Coke			0.00		0.00	0.00		0.00	0.00		0.00	0.00
Refinery Gas	712	1	711.89	18.2	12,956.45	12.96		0.00	12.96	0.99	12.83	47.03
Anthracite			0.00		0.00	0.00		0.00	0.00		0.00	0.00
Coking Coal			0.00		0.00	0.00		0.00	0.00		0.00	0.00
Other Bituminous Coal			0.00		0.00	0.00		0.00	0.00		0.00	0.00
Sub-Bituminous Coal			0.00		0.00	0.00		0.00	0.00		0.00	0.00
Lignite			0.00		0.00	0.00		0.00	0.00		0.00	0.00
Peat			0.00		0.00	0.00		0.00	0.00		0.00	0.00
Patent Fuel			0.00		0.00	0.00		0.00	0.00		0.00	0.00
Brown Coal Briquettes			0.00		0.00	0.00		0.00	0.00		0.00	0.00
Coke Oven Coke			0.00		0.00	0.00		0.00	0.00		0.00	0.00
Gas Coke			0.00		0.00	0.00		0.00	0.00		0.00	0.00
Gas Works Gas			0.00		0.00	0.00		0.00	0.00		0.00	0.00
Coke Oven Gas			0.00		0.00	0.00		0.00	0.00		0.00	0.00
Blast Furnace Gas			0.00		0.00	0.00		0.00	0.00		0.00	0.00
Natural gas (TJ)	73241	1	73,241.21	15.3	1,120,590.45	1,120.59		0.00	1,120.59	0.995	1,114.99	4,088.29
Municipal Solid Waste			0.00		0.00	0.00		0.00	0.00		0.00	0.00
Industrial Waste			0.00		0.00	0.00		0.00	0.00		0.00	0.00
			0.00		0.00	0.00		0.00	0.00		0.00	0.00
			0.00		0.00	0.00		0.00	0.00		0.00	0.00
		Total	**74,371.86**								**Total**	**4,166.03**

MODULE	ENERGY						ENERGY					
SUBMODULE	CO_2 FROM FUEL COMBUSTION BY SOURCE CATEGORIES (TIER 1)						CO_2 FROM FUEL COMBUSTION BY SOURCE CATEGORIES (TIER 1)					
WORKSHEET	1-2 STEP BY STEP CALCULATIONS						1-2 STEP BY STEP CALCULATIONS					
SHEETS	3 OF 16 MANUFACTURING INDUSTRIES AND CONSTRUCTION						4 OF 16 MANUFACTURING INDUSTRIES AND CONSTRUCTION					
	PROCESS HEAT						PROCESS HEAT					
COUNTRY	Brunei Darussalam						Brunei Darussalam					
YEAR	2010						2010					

MANUFACTURING INDUSTRIES AND CONSTRUCTION	A	B	C	D	E	F	G	H	I	J	K	L
	Consumption	Conversion Factor	Consumption (TJ)	Carbon Emission Factor	Carbon Content	Carbon Content	Fraction of Carbon Stored[a]	Carbon Stored (Gg C)[a]	Net Carbon Emissions	Fraction of Carbon Oxidised	Actual Carbon Emissions	Actual CO_2 Emissions
		(TJ/Unit)		(t C/TJ)	(t C)	(Gg C)			(Gg C)		(Gg C)	(Gg CO_2)
			C=(AxB)		E=(CxD)	F=(E/1000)		H=(FxG)	I=(F-H)		K=(IxJ)	L=(Kx[44/12])
Crude Oil			0.00		0.00	0.00		0.00	0.00		0.00	0.00
Natural Gas Liquids			0.00		0.00	0.00		0.00	0.00		0.00	0.00
Gasoline			0.00		0.00	0.00		0.00	0.00		0.00	0.00
Jet Kerosene			0.00		0.00	0.00		0.00	0.00		0.00	0.00
Other Kerosene	168	1	167.50	19.6	3,283.08	3.28		0.00	3.28	0.99	3.25	11.92
Gas/Diesel Oil (TJ)	4397	1	4,396.98	20.2	88,819.10	88.82		(b) 0.00	88.82	0.99	87.93	322.41
Residual Fuel Oil			0.00		0.00	0.00		0.00	0.00		0.00	0.00
LPG			0.00		0.00	0.00		(b) 0.00	0.00		0.00	0.00
Ethane			0.00		0.00	0.00		(b) 0.00	0.00		0.00	0.00
Naphtha			0.00		0.00	0.00		(b) 0.00	0.00		0.00	0.00
Lubricants	84	1	83.75	20	1,675.04	1.68	(c)	0.00	1.68	0.99	1.66	6.08
Petroleum Coke			0.00		0.00	0.00		0.00	0.00		0.00	0.00
Refinery Gas	1633	1	1,633.17	18.2	29,723.62	29.72		0.00	29.72	0.99	29.43	107.90
Anthracite			0.00		0.00	0.00		0.00	0.00		0.00	0.00
Coking Coal			0.00		0.00	0.00		0.00	0.00		0.00	0.00
Other Bituminous Coal			0.00		0.00	0.00		0.00	0.00		0.00	0.00
Sub-Bituminous Coal			0.00		0.00	0.00		0.00	0.00		0.00	0.00
Lignite			0.00		0.00	0.00		0.00	0.00		0.00	0.00
Peat			0.00		0.00	0.00		0.00	0.00		0.00	0.00
Patent Fuel			0.00		0.00	0.00		0.00	0.00		0.00	0.00
Brown Coal Briquettes			0.00		0.00	0.00		0.00	0.00		0.00	0.00
Coke Oven Coke			0.00		0.00	0.00		0.00	0.00		0.00	0.00
Gas Coke			0.00		0.00	0.00		0.00	0.00		0.00	0.00
Gas Works Gas			0.00		0.00	0.00		0.00	0.00		0.00	0.00
Coke Oven Gas			0.00		0.00	0.00		0.00	0.00		0.00	0.00
Blast Furnace Gas			0.00		0.00	0.00		0.00	0.00		0.00	0.00
Natural gas (TJ)			0.00	15.3	0.00	0.00		(b) 0.00	0.00	0.995	0.00	0.00
Municipal Solid Waste			0.00		0.00	0.00		0.00	0.00		0.00	0.00
Industrial Waste			0.00		0.00	0.00		0.00	0.00		0.00	0.00
			0.00		0.00	0.00		0.00	0.00		0.00	0.00
			0.00		0.00	0.00		0.00	0.00		0.00	0.00
		Total	**6,281.41**								**Total**	**448.31**

MODULE	ENERGY						ENERGY					
SUBMODULE	CO_2 FROM FUEL COMBUSTION BY SOURCE CATEGORIES (TIER 1)						CO_2 FROM FUEL COMBUSTION BY SOURCE CATEGORIES (TIER 1)					
WORKSHEET	1-2 STEP BY STEP CALCULATIONS						1-2 STEP BY STEP CALCULATIONS					
SHEETS	11 OF 16 RESIDENTIAL SECTOR						12 OF 16 RESIDENTIAL SECTOR					
COUNTRY	Brunei Darussalam						Brunei Darussalam					
YEAR	2010						2010					
	A	B	C	D	E	F	G	H	I	J	K	L
RESIDENTIAL SECTOR	Consumption	Conversion Factor (TJ/Unit)	Consumption (TJ)	Carbon Emission Factor (t C/TJ)	Carbon Content (t C)	Carbon Content (Gg C)	Fraction of Carbon Stored	Carbon Stored (Gg C)	Net Carbon Emissions (Gg C)	Fraction of Carbon Oxidised	Actual Carbon Emissions (Gg C)	Actual CO_2 Emissions (Gg CO_2)
			C=(AxB)		E=(CxD)	F=(E/1000)		H=(FxG)	I=(F-H)		K=(IxJ)	L=(Kx[44/12])
Gasoline			0.00		0.00	0.00		0.00	0.00		0.00	0.00
Other Kerosene			0.00		0.00	0.00		0.00	0.00		0.00	0.00
Gas/Diesel Oil			0.00		0.00	0.00		0.00	0.00		0.00	0.00
Residual Fuel Oil			0.00		0.00	0.00		0.00	0.00		0.00	0.00
LPG (TJ)	670	1	670.02	17.2	11,524.29	11.52		0.00	11.52	0.99	11.41	41.83
Anthracite			0.00		0.00	0.00		0.00	0.00		0.00	0.00
Other Bituminous Coal			0.00		0.00	0.00		0.00	0.00		0.00	0.00
Sub-Bituminous Coal			0.00		0.00	0.00		0.00	0.00		0.00	0.00
Lignite			0.00		0.00	0.00		0.00	0.00		0.00	0.00
Peat			0.00		0.00	0.00		0.00	0.00		0.00	0.00
Patent Fuel			0.00		0.00	0.00		0.00	0.00		0.00	0.00
Brown Coal Briquettes			0.00		0.00	0.00		0.00	0.00		0.00	0.00
Coke Oven Coke			0.00		0.00	0.00		0.00	0.00		0.00	0.00
Gas Works Gas			0.00		0.00	0.00		0.00	0.00		0.00	0.00
Coke Oven Gas			0.00		0.00	0.00		0.00	0.00		0.00	0.00
Natural gas (TJ)	1131	1	1,130.65	15.3	17,298.99	17.30		0.00	17.30	0.995	17.21	63.11
			0.00		0.00	0.00		0.00	0.00		0.00	0.00
			0.00		0.00	0.00		0.00	0.00		0.00	0.00
			0.00		0.00	0.00		0.00	0.00		0.00	0.00
			0.00		0.00	0.00		0.00	0.00		0.00	0.00
		Total	**1,800.67**								**Total**	**104.95**

MODULE	ENERGY	ENERGY
SUBMODULE	NON-CO_2 FROM FUEL COMBUSTION BY SOURCE CATEGORIES (TIER 1)	NON-CO_2 FROM FUEL COMBUSTION BY SOURCE CATEGORIES (TIER 1)
WORKSHEET	1-3	1-3
SHEETS	2 OF 3 CH_4	3 OF 3 CH_4
COUNTRY	Brunei Darussalam	Brunei Darussalam
YEAR	2010	2010

ACTIVITY			B						C						D
			Emission Factors (kg/TJ)						Emissions by Fuel (kg)						Total Emissions (Gg)
									C=(AxB)						
			B1	B2	B3	B4	B5	B6	C1	C2	C3	C4	C5	C6	D= sum
			Coal	Natural Gas	Oil	Wood / Wood Waste	Charcoal	Other Biomass and Wastes	Coal	Natural Gas	Oil	Wood / Wood Waste	Charcoal	Other Biomass and Wastes	(C1..C6) / 1 000 000
Energy Industries				5	3				0.00	366,206.03	3,391.96	0.00	0.00	0.00	0.37
Manufacturing Industries and Construction					2				0.00	0.00	12,562.81	0.00	0.00	0.00	0.01
Transport	Domestic Aviation[(a)]										0.00				0.00
					Gasoline	Diesel					Gasoline	Diesel			
	Road				20	5				0.00	210,217.76	30,150.75			0.24
	Railways								0.00		0.00				0.00
	National Navigation[(a)]								0.00		0.00				0.00
Other Sectors	Commercial/Institutional								0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Residential			5	10				0.00	5,653.27	6,700.17	0.00	0.00	0.00	0.01
	Agriculture / Forestry / Fishing	Stationary							0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Mobile								0.00	0.00				0.00
Other (not elsewhere specified)									0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total [(a)]									**0.00**	**371,859.30**	**263,023.45**	**0.00**	**0.00**	**0.00**	**0.63**
Memo: International Marine Bunkers					5.00				0.00		18,425.46				0.02
Memo: International Aviation Bunkers					0.50						2,324.12				0.00

MODULE	ENERGY	ENERGY
SUBMODULE	NON-CO_2 FROM FUEL COMBUSTION BY SOURCE CATEGORIES (TIER 1)	NON-CO_2 FROM FUEL COMBUSTION BY SOURCE CATEGORIES (TIER 1)
WORKSHEET	1-3	1-3
SHEETS	2 OF 3 N_2O	3 OF 3 N_2O
COUNTRY	Brunei Darussalam	Brunei Darussalam
YEAR	2010	2010

ACTIVITY			B						C						D
			Emission Factors (kg/TJ)						Emissions by Fuel (kg)						Total Emissions (Gg)
									C=(AxB)						
			B1 Coal	B2 Natural Gas	B3 Oil		B4 Wood / Wood Waste	B5 Charcoal	B6 Other Biomass and Wastes	C1 Coal	C2 Natural Gas	C3 Oil		C4 Wood / Wood Waste	C5 Charcoal	C6 Other Biomass and Wastes	D= sum (C1..C6) / 1 000 000
Energy Industries				0.1	0.6					0.00	7,324.12	678.39		0.00	0.00	0.00	0.01
Manufacturing Industries and Construction						0.6				0.00	0.00		3,768.84	0.00	0.00	0.00	0.00
Transport	Domestic Aviation[(a)]												0.00				0.00
					Gasoline	Diesel						Gasoline	Diesel				
	Road				0.6	0.6					0.00	6,306.53	3,618.09				0.01
	Railways									0.00			0.00				0.00
	National Navigation[(a)]									0.00			0.00				0.00
Other Sectors	Commercial/Institutional									0.00	0.00		0.00	0.00	0.00	0.00	0.00
	Residential			0.1		0.6				0.00	113.07		402.01	0.00	0.00	0.00	0.00
	Agriculture / Forestry / Fishing	Stationary								0.00	0.00		0.00	0.00	0.00	0.00	0.00
		Mobile									0.00		0.00				0.00
Other (not elsewhere specified)										0.00	0.00		0.00	0.00	0.00	0.00	0.00
Total[(a)]										**0.00**	**7,437.19**		**14,773.87**	**0.00**	**0.00**	**0.00**	**0.02**
Memo: International Marine Bunkers					0.60					0.00		2,211.06					0.00
Memo: International Aviation Bunkers					2.00							9,296.48					0.01

MODULE	ENERGY	ENERGY
SUBMODULE	NON-CO_2 FROM FUEL COMBUSTION BY SOURCE CATEGORIES (TIER 1)	NON-CO_2 FROM FUEL COMBUSTION BY SOURCE CATEGORIES (TIER 1)
WORKSHEET	1-3	1-3
SHEETS	2 OF 3 CO	3 OF 3 CO
COUNTRY	Brunei Darussalam	Brunei Darussalam
YEAR	2010	2010

ACTIVITY			B						C						D
			Emission Factors (kg/TJ)						Emissions by Fuel (kg)						Total Emissions (Gg)
									C=(AxB)						
			B1	B2	B3	B4	B5	B6	C1	C2	C3	C4	C5	C6	D= sum
			Coal	Natural Gas	Oil	Wood / Wood Waste	Charcoal	Other Biomass and Wastes	Coal	Natural Gas	Oil	Wood / Wood Waste	Charcoal	Other Biomass and Wastes	(C1..C6) / 1 000 000
Energy Industries				30	15				0.00	2,197,236.18	16,959.80	0.00	0.00	0.00	2.21
Manufacturing Industries and Construction					10				0.00	0.00	62,814.07	0.00	0.00	0.00	0.06
Transport	Domestic Aviation[(a)]										0.00				0.00
					Gasoline	Diesel					Gasoline				
	Road				8000	1000				0.00	84,087,102.18	6,030,150.75			90.12
	Railways								0.00		0.00				0.00
	National Navigation[(a)]								0.00		0.00				0.00
Other Sectors	Commercial/Institutional								0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Residential			50	20				0.00	56,532.66	13,400.34	0.00	0.00	0.00	0.07
	Agriculture / Forestry / Fishing	Stationary							0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Mobile								0.00	0.00				0.00
Other (not elsewhere specified)									0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total [(a)]									**0.00**	**2,253,768.84**	**90,210,427.14**	**0.00**	**0.00**	**0.00**	**92.46**
Memo: International Marine Bunkers					1000.00				0.00		3,685,092.13				3.69
Memo: International Aviation Bunkers					100.00						464,824.12				0.46

MODULE	ENERGY	ENERGY
SUBMODULE	NON-CO_2 FROM FUEL COMBUSTION BY SOURCE CATEGORIES (TIER 1)	NON-CO_2 FROM FUEL COMBUSTION BY SOURCE CATEGORIES (TIER 1)
WORKSHEET	1-3	1-3
SHEETS	2 OF 3 NMVOC	3 OF 3 NMVOC
COUNTRY	Brunei Darussalam	Brunei Darussalam
YEAR	2010	2010

ACTIVITY			B						C						D
			Emission Factors (kg/TJ)						Emissions by Fuel (kg)						Total Emissions (Gg)
									C=(AxB)						
			B1	B2	B3	B4	B5	B6	C1	C2	C3	C4	C5	C6	D= sum
			Coal	Natural Gas	Oil	Wood / Wood Waste	Charcoal	Other Biomass and Wastes	Coal	Natural Gas	Oil	Wood / Wood Waste	Charcoal	Other Biomass and Wastes	(C1..C6) / 1 000 000
Energy Industries				5	5				0.00	366,206.03	5,653.27	0.00	0.00	0.00	0.37
Manufacturing Industries and Construction					5				0.00	0.00	31,407.04	0.00	0.00	0.00	0.03
Transport	Domestic Aviation[(a)]										0.00				0.00
					Gasoline	Diesel					Gasoline	Diesel			
	Road				1500	200				0.00	######	1,206,030.15			16.97
	Railways								0.00		0.00				0.00
	National Navigation[(a)]								0.00		0.00				0.00
Other Sectors	Commercial/Institutional								0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Residential			5	5				0.00	5,653.27	3,350.08	0.00	0.00	0.00	0.01
	Agriculture / Forestry / Fishing	Stationary							0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Mobile								0.00	0.00	0.00			0.00
Other (not elsewhere specified)									0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total [(a)]									**0.00**	**371,859.30**	**17,012,772.19**	**0.00**	**0.00**	**0.00**	**17.38**
Memo: International Marine Bunkers					200.00				0.00		737,018.43				0.74
Memo: International Aviation Bunkers					50.00						232,412.06				0.23

MODULE	**ENERGY**
SUBMODULE	**METHANE EMISSIONS FROM OIL AND GAS ACTIVITIES (TIER 1)**
WORKSHEET	**1-7**
SHEETS	**1 OF 1**
COUNTRY	**Brunei Darussalam**
YEAR	**2010**

Category	A	B	C	D
	Activity	Emission Factor	CH_4 Emissions	Emissions CH_4
			(kg CH_4)	(Gg CH_4)
			C = (A x B)	D = (C / 1 000 000)
OIL				
Exploration *(Optional if data is locally available)* [a]	*number of wells drilled*	kg CH_4 */ well drilled*		
			0.00	0.00
Production [b]	*PJ oil produced*	kg CH_4 */ PJ*		
	385.98	5000	1,929,900.00	1.93
Transport	*PJ oil loaded in tankers*	kg CH_4 */ PJ*		
	365.01	745	271,932.45	0.27
Refining	*PJ oil refined*	kg CH_4 */ PJ refined*		
	30.689	1400	42,964.60	0.04
Storage	*PJ oil refined*	kg CH_4 */ PJ refined*		
			0.00	0.00
	TOTAL CH_4 FROM OIL			**2.24**
GAS				
Production [b] / Processing	*PJ gas consumed*	kg CH_4 */ PJ*		
	480.3	*288000*	138,326,400.00	138.33
Transmission and Distribution	*PJ gas consumed*	kg CH_4 */ PJ*		
			0.00	0.00
Other Leakage	*PJ gas consumed*			
	- non-residential gas consumed	kg CH_4 */ PJ*		
			0.00	0.00
	- Residential gas consumed	kg CH_4 */ PJ*		
			0.00	0.00
	TOTAL CH_4 FROM GAS			**138.33**
VENTING AND FLARING FROM OIL/GAS PRODUCTION [c]	*PJ oil and gas produced*			
	- Oil	kg CH_4 */ PJ*		
		14000	0.00	0.00
	- Gas	kg CH_4 */ PJ*		
			0.00	0.00
	- Combined	kg CH_4 */ PJ*		
	10.91	14000	152,740.00	0.15
	TOTAL CH_4 FROM VENTING AND FLARING			**0.15**

MODULE	AGRICULTURE
SUBMODULE	METHANE AND NITROUS OXIDE EMISSIONS FROM DOMESTIC LIVESTOCK ENTERIC FERMENTATION AND MANURE MANAGEMENT
WORKSHEET	4-1
SHEET	1 OF 2 METHANE EMISSIONS FROM DOMESTIC LIVESTOCK ENTERIC FERMENTATION AND MANURE MANAGEMENT
COUNTRY	Brunei Darussalam
YEAR	2010

	STEP 1			STEP 2		STEP 3
Livestock Type	A Number of Animals	B Emissions Factor for Enteric Fermentation (kg/head/yr)	C Emissions from Enteric Fermentation (t/yr)	D Emissions Factor for Manure Management (kg/head/yr)	E Emissions from Manure Management (t/yr)	F Total Annual Emissions from Domestic Livestock (Gg)
			C = (A x B)/1000		E = (A x D)/1000	F =(C + E)/1000
Dairy Cattle	10	56	0.56	27	0.27	0.00
Non-dairy Cattle	842	44	37.05	2	1.68	0.04
Buffalo	4,214	55	231.77	3	12.64	0.24
Sheep			0.00		0.00	0.00
Goats	6,808	5	34.04	0.22	1.50	0.04
Camels			0.00		0.00	0.00
Horses			0.00		0.00	0.00
Mules & Asses			0.00		0.00	0.00
Swine			0.00		0.00	0.00
Poultry	15,415,481	0	0.00	0.023	354.56	0.35
Totals			303.42		370.65	0.67

MODULE	AGRICULTURE
SUBMODULE	METHANE AND NITROUS OXIDE EMISSIONS FROM DOMESTIC LIVESTOCK ENTERIC FERMENTATION AND MANURE MANAGEMENT
WORKSHEET	4-1 (SUPPLEMENTAL)
SPECIFY AWMS	ANAEROBIC LAGOONS
SHEET	NITROGEN EXCRETION FOR ANIMAL WASTE MANAGEMENT SYSTEM
COUNTRY	Brunei Darussalam
YEAR	2010

Livestock Type	A Number of Animals	B Nitrogen Excretion Nex (kg//head/(yr)	C Fraction of Manure Nitrogen per AWMS (%/100) (fraction)	D Nitrogen Excretion per AWMS, Nex (kg N/yr)
				D = (A x B x C)
Non-dairy Cattle	842	2	0	0.00
Dairy Cattle	10	27	0.06	16.20
Poultry	15,415,481	0.023	0.01	3,545.56
Buffalo	4,214	3	0	0.00
Goats	6,808	0.22	0	0.00
Others				0.00
			TOTAL	3,561.76

MODULE	AGRICULTURE
SUBMODULE	METHANE AND NITROUS OXIDE EMISSIONS FROM DOMESTIC LIVESTOCK ENTERIC FERMENTATION AND MANURE MANAGEMENT
WORKSHEET	4-1 (SUPPLEMENTAL)
SPECIFY AWMS	LIQUID SYSTEMS
SHEET	NITROGEN EXCRETION FOR ANIMAL WASTE MANAGEMENT SYSTEM
COUNTRY	Brunei Darussalam
YEAR	2010

Livestock Type	A Number of Animals	B Nitrogen Excretion Nex	C Fraction of Manure Nitrogen per AWMS (%/100)	D Nitrogen Excretion per AWMS, Nex
		(kg//head/(yr)	(fraction)	(kg N/yr)
				D = (A x B x C)
Non-dairy Cattle	842	2	0	0.00
Dairy Cattle	10	27	0.04	10.80
Poultry	15,415,481	0.023	0	0.00
Buffalo	4,214	3	0	0.00
Goats	6,808	0.22	0.02	29.96
Others				0.00
			TOTAL	40.76

MODULE	AGRICULTURE
SUBMODULE	METHANE AND NITROUS OXIDE EMISSIONS FROM DOMESTIC LIVESTOCK ENTERIC FERMENTATION AND MANURE MANAGEMENT
WORKSHEET	4-1 (SUPPLEMENTAL)
SPECIFY AWMS	SOLID STORAGE AND DRYLOT
SHEET	NITROGEN EXCRETION FOR ANIMAL WASTE MANAGEMENT SYSTEM
COUNTRY	Brunei Darussalam
YEAR	2010

Livestock Type	A Number of Animals	B Nitrogen Excretion Nex	C Fraction of Manure Nitrogen per AWMS (%/100)	D Nitrogen Excretion per AWMS, Nex
		(kg//head/(yr)	(fraction)	(kg N/yr)
				D = (A x B x C)
Non-dairy Cattle	842	2	0.14	235.76
Dairy Cattle	10	27	0	0.00
Poultry	15,415,481	0.023	0	0.00
Buffalo	4,214	3	0	0.00
Goats	6,808	0.22	0	0.00
Others				0.00
			TOTAL	235.76

MODULE	AGRICULTURE
SUBMODULE	METHANE AND NITROUS OXIDE EMISSIONS FROM DOMESTIC LIVESTOCK ENTERIC FERMENTATION AND MANURE MANAGEMENT
WORKSHEET	4-1 (SUPPLEMENTAL)
SPECIFY AWMS	DAILY SPREAD
SHEET	NITROGEN EXCRETION FOR ANIMAL WASTE MANAGEMENT SYSTEM
COUNTRY	Brunei Darussalam
YEAR	2010

Livestock Type	A Number of Animals	B Nitrogen Excretion Nex	C Fraction of Manure Nitrogen per AWMS (%/100)	D Nitrogen Excretion per AWMS, Nex
		(kg//head/(yr)	(fraction)	(kg N/yr)
				D = (A x B x C)
Non-dairy Cattle	842	2	0.16	269.44
Dairy Cattle	10	27	0.21	56.70
Poultry	15,415,481	0.023	0	0.00
Buffalo	4,214	3	0	0.00
Goats	6,808	0.22	0	0.00
Others				0.00
			TOTAL	326.14

MODULE	AGRICULTURE
SUBMODULE	METHANE AND NITROUS OXIDE EMISSIONS FROM DOMESTIC LIVESTOCK ENTERIC FERMENTATION AND MANURE MANAGEMENT
WORKSHEET	4-1 (SUPPLEMENTAL)
SPECIFY AWMS	PASTURE RANGE AND PADDOCK
SHEET	NITROGEN EXCRETION FOR ANIMAL WASTE MANAGEMENT SYSTEM
COUNTRY	Brunei Darussalam
YEAR	2010

Livestock Type	A Number of Animals	B Nitrogen Excretion Nex	C Fraction of Manure Nitrogen per AWMS (%/100)	D Nitrogen Excretion per AWMS, Nex
		(kg//head/(yr)	(fraction)	(kg N/yr)
				D = (A x B x C)
Non-dairy Cattle	842	2	0.24	404.16
Dairy Cattle	10	27	0.29	78.30
Poultry	15,415,481	0.023	0	0.00
Buffalo	4,214	3	0	0.00
Goats	6,808	0.22	0.44	659.01
Others				0.00
			TOTAL	1,141.47

MODULE	**AGRICULTURE**
SUBMODULE	**METHANE EMISSIONS FROM FLOODED RICE FIELDS**
WORKSHEET	**4-2**
SHEET	**1 OF 1**
COUNTRY	**Brunei Darussalam**
YEAR	**2010**

Water Management Regime			A Harvested Area	B Scaling Factor for Methane Emissions	C Correction Factor for Organic Amendment	D Seasonally Integrated Emission Factor for Continuously Flooded Rice without Organic Amendment	E CH_4 Emissions
			(1000 ha)			(g/m^2)	(Gg)
							E = (A x B x C x D)/100
Irrigated	Continuously Flooded						0.00
	Intermittently Flooded	Single Aeration					0.00
		Multiple Aeration	0.60	0.2	1	18	0.02
Rainfed	Flood Prone						0.00
	Drought Prone		0.76	0.4	1	18	0.05
Deep Water	Water Depth 50-100 cm						0.00
	Water Depth > 100 cm						0.00
Totals			**1.35**				**0.08**

MODULE			**LAND USE CHANGE AND FORESTRY**				
SUBMODULE			**CHANGES IN FOREST AND OTHER WOODY BIOMASS STOCKS**				
WORKSHEET			**5-1**				
SHEET			**1 OF 3**				
COUNTRY			**Brunei Darussalam**				
YEAR			**2010**				
					STEP 1		
			A	B	C	D	E
			Area of Forest/Biomass Stocks	Annual Growth Rate	Annual Biomass Increment	Carbon Fraction of Dry Matter	Total Carbon Uptake Increment
			(kha)	(t dm/ha)	(kt dm)		(kt C)
					C=(A x B)		E=(C x D)
Tropical	Plantations	*Acacia spp.*			0.00		0.00
		Eucalyptus spp.			0.00		0.00
		Tectona grandis			0.00		0.00
		Pinus spp			0.00		0.00
		Pinus caribaea			0.00		0.00
		Dipterocarpus spp	3.71	6.45	23.93	0.5	11.96
		Mixed Fast-Growing Hardwoods			0.00		0.00
		Mixed Softwoods			0.00		0.00
	Natural Regeneration	Wet	114	16.12	1,837.68	0.5	918.84
		Seasonal			0.00		0.00
		Dry			0.00		0.00
	Other (specify)				0.00		0.00
Temperate	Plantations	Douglas fir			0.00		0.00
		Loblolly pine			0.00		0.00
	Commercial	Evergreen			0.00		0.00
		Deciduous			0.00		0.00
	Other				0.00		0.00
Boreal					0.00		0.00
Non-Forest Trees (specify type)			A Number of Trees (1000s of trees)	B Annual Growth Rate (kt dm/1000 trees)			
					0.00		0.00
					0.00		0.00
						Total	930.80

MODULE	**LAND USE CHANGE AND FORESTRY**
SUBMODULE	**CHANGES IN FOREST AND OTHER WOODY BIOMASS STOCKS**
WORKSHEET	**5-1**
SHEET	**2 OF 3**
COUNTRY	**Brunei Darussalam**
YEAR	**2010**

STEP 2

Harvest Categories (specify)	F	G	H	I	J	K	L	M
	Commercial Harvest (if applicable)	Biomass Conversion/ Expansion Ratio (if applicable)	Total Biomass Removed in Commercial Harvest	Total Traditional Fuelwood Consumed	Total Other Wood Use	Total Biomass Consumption	Wood Removed From Forest Clearing	Total Biomass Consumption From Stocks
	(1000 m^3 roundwood)	(t dm/m^3)	(kt dm)	(kt dm)	(kt dm)	(kt dm)	(kt dm)	(kt dm)
			H = (F x G)	FAO data		K = (H + I + J)	(From column M, Worksheet 5-2, sheet 3)	M = K - L
Roundwood	120.496	1.7	204.84	0.5916		205.43		
			0.00			0.00		
			0.00			0.00		
			0.00			0.00		
			0.00			0.00		
			0.00			0.00		
			0.00			0.00		
			0.00			0.00		
			0.00			0.00		
			0.00			0.00		
			0.00			0.00		
			0.00			0.00		
			0.00			0.00		
			0.00			0.00		
			0.00			0.00		
			0.00			0.00		
			0.00			0.00		
			0.00			0.00		
			0.00			0.00		
			0.00			0.00		
Totals	120.50		204.84	0.59	0.00	205.43	0.00	205.43

MODULE	LAND USE AND FORESTRY		
SUBMODULE	CHANGES IN FOREST AND OTHER WOODY BIOMASS STOCKS		
WORKSHEET	5-1		
SHEET	3 OF 3		
COUNTRY	Brunei Darussalam		
YEAR	2010		
STEP 3		STEP 4	
N	O	P	Q
Carbon Fraction	Annual Carbon Release (kt C)	Net Annual Carbon Uptake (+) or Release (-) (kt C)	Convert to CO_2 Annual Emission (-) or Removal (+) (Gg CO_2)
	O = (M x N)	P = (E - O)	Q = (P x [44/12])
0.5	102.72	828.09	3,036.32

MODULE	LAND-USE CHANGE AND FORESTRY				
SUBMODULE	FOREST AND GRASSLAND CONVERSION - CO_2 FROM BIOMASS				
WORKSHEET	5-2				
SHEET	1 OF 5 BIOMASS CLEARED				
COUNTRY	Brunei Darussalam				
YEAR	2010				
	STEP 1				
Vegetation types	A Area Converted Annually (kha)	B Biomass Before Conversion (t dm/ha)	C Biomass After Conversion (t dm/ha)	D Net Change in Biomass Density (t dm/ha) D = (B - C)	E Annual Loss of Biomass (kt dm) E = (A x D)
Tropical – Wet/Very Moist	1.4	166	10	156.00	218.40
Tropical – Moist, short dry season				0.00	0.00
Tropical – Moist, long dry season				0.00	0.00
Tropical – Dry				0.00	0.00
Tropical – Montane Moist				0.00	0.00
Tropical – Montane Dry				0.00	0.00
Tropical Savanna/Grasslands				0.00	0.00
Temperate – Coniferous				0.00	0.00
Temperate – Broadleaf				0.00	0.00
Grasslands				0.00	0.00
Boreal – Mixed Broadleaf/ Coniferous				0.00	0.00
Boreal – Coniferous				0.00	0.00
Boreal – Forest-tundra				0.00	0.00
Grasslands/Tundra				0.00	0.00
Other				0.00	0.00
Subtotals	1.40			156.00	218.40

MODULE	LAND-USE CHANGE AND FORESTRY
SUBMODULE	FOREST AND GRASSLAND CONVERSION - CO_2 FROM BIOMASS
WORKSHEET	5-2
SHEET	4 OF 5 CARBON RELEASED BY DECAY OF BIOMASS
COUNTRY	Brunei Darussalam
YEAR	2010

STEP 5

Vegetation types		A Average Area Converted (10 Year Average)	B Biomass Before Conversion	C Biomass After Conversion	D Net Change in Biomass Density	E Average Annual Loss of Biomass	F Fraction Left to Decay	G Quantity of Biomass Left to Decay	H Carbon Fraction in Above-ground Biomass	I Carbon Released from Decay of Above-ground Biomass
		(kha)	(t dm/ha)	(t dm/ha)	(t dm/ha)	(kt dm)		(kt dm)		(kt C)
					D = (B-C)	E = (A x D)		G = (E x F)		I = (G x H)
Tropical	Wet/Very Moist	1.4	166	10	156.00	218.40	0.4	87.36	0.5	43.68
	Moist, short dry season				0.00	0.00		0.00		0.00
	Moist, long dry season				0.00	0.00		0.00		0.00
	Dry				0.00	0.00		0.00		0.00
	Montane Moist				0.00	0.00		0.00		0.00
	Montane Dry				0.00	0.00		0.00		0.00
Tropical Savanna/Grasslands					0.00	0.00		0.00		0.00
Temperate	Coniferous				0.00	0.00		0.00		0.00
	Broadleaf				0.00	0.00		0.00		0.00
Grasslands					0.00	0.00		0.00		0.00
Boreal	Mixed Broadleaf/ Coniferous				0.00	0.00		0.00		0.00
	Coniferous				0.00	0.00		0.00		0.00
	Forest-tundra				0.00	0.00		0.00		0.00
Grasslands/Tundra					0.00	0.00		0.00		0.00
Other					0.00	0.00		0.00		0.00
									Subtotal	43.68

MODULE	LAND-USE CHANGE AND FORESTRY		
SUBMODULE	FOREST AND GRASSLAND CONVERSION - CO_2 FROM BIOMASS		
WORKSHEET	5-2		
SHEET	5 OF 5 SUMMARY AND CONVERSION TO CO_2		
COUNTRY	Brunei Darussalam		
YEAR	2010		
STEP 6			
A	B	C	D
Immediate Release From Burning (kt C)	Delayed Emissions From Decay (kt C) (10-year average)	Total Annual Carbon Release (kt C)	Total Annual CO_2 Release ($Gg\ CO_2$)
		C = A + B	D = C x (44/12)
0.00	43.68	43.68	160.16

MODULE	WASTE											
SUBMODULE	METHANE EMISSIONS FROM SOLID WASTE DISPOSAL SITES											
WORKSHEET	6-1											
SHEET	1 OF 1											
COUNTRY	Brunei Darussalam											
YEAR	2010											
STEP 1	**STEP 2**	**STEP 3**						**STEP 4**				
A	B	C	D	E	F	G	H	J	K	L	M	N
Total Annual MSW Disposed to SWDSs (Gg MSW)	Methane Correction Factor (MCF)	Fraction of DOC in MSW	Fraction of DOC which Actually Degrades	Fraction of Carbon Released as Methane	Conversion Ratio	Potential Methane Generation Rate per Unit of Waste ($Gg\ CH_4$/Gg MSW)	Realised (Country-specific) Methane Generation Rate per Unit of Waste ($Gg\ CH_4$/ Gg MSW)	Gross Annual Methane Generation ($Gg\ CH_4$)	Recovered Methane per Year ($Gg\ CH_4$)	Net Annual Methane Generation ($Gg\ CH_4$)	One Minus Methane Oxidation Correction Factor	Net Annual Methane Emissions ($Gg\ CH_4$)
						G= (C x D x E x F)	H= (B x G)	J= (H x A)		L= (J - K)		N= (L x M)
174.53	1.00	0.22	0.77	0.5	16/12	0.11	0.11	19.71	0	19.71	1	19.71
					16/12	0.00	0.00	0.00		0.00		0.00
					16/12	0.00	0.00	0.00		0.00		0.00

MODULE	WASTE
SUBMODULE	QUANTITY OF MSW DISPOSED OF IN SOLID WASTE DISPOSAL SITES USING COUNTRY DATA
WORKSHEET	6-1A (SUPPLEMENTAL)
SHEET	1 OF 1
COUNTRY	Brunei Darussalam
YEAR	2010

A	B	C	D	E
Population whose Waste goes to SWDSs (Urban or Total) (persons)	MSW Generation Rate (kg/capita/day)	Annual Amount of MSW Generated (Gg MSW)	Fraction of MSW Disposed to SWDSs (Urban or Total)	Total Annual MSW Disposed to SWDSs (Gg MSW)
		C = (A x B x 365)/1 000 000		E = (C x D)
386800	1.4	197.65	0.883	174.53

MODULE	WASTE
SUBMODULE	QUANTITY OF MSW DISPOSED OF IN SOLID WASTE DISPOSAL SITES USING DISPOSAL RATE DEFAULT DATA
WORKSHEET	6-1B (SUPPLEMENTAL)
SHEET	1 OF 1
COUNTRY	Brunei Darussalam
YEAR	2010

A	B	C
Population whose Waste goes to SWDSs (Urban or Total) (persons)	MSW Disposal Rate to SWDSs (kg/capita/day)	Total Annual MSW Disposed to SWDSs (Gg MSW)
		C = (A x B x 365)/1 000 000
386800	1.4	197.65

MODULE	WASTE				
SUBMODULE	METHANE EMISSIONS FROM DOMESTIC AND COMMERCIAL WASTEWATER AND SLUDGE TREATMENT				
WORKSHEET	6-2				
SHEET	1 OF 4 ESTIMATION OF ORGANIC WASTEWATER AND SLUDGE				
COUNTRY	Brunei Darussalam				
YEAR	2010				
STEP 1					
A	B	C	D	E	F
Region or City	Population (1,000 persons)	Degradable Organic Component (kg BOD/1000 persons/yr)	Fraction of Degradable Organic Component Removed as Sludge	Total Domestic/Commercial Organic Wastewater (kg BOD/yr)	Total Domestic/Commercial Organic Sludge (kg BOD/yr)
				E = [B x C x (1-D)]	F = (B x C x D)
Whole country	386.8	14600	0	5,647,280.00	0.00
				0.00	0.00
				0.00	0.00
				0.00	0.00
			Total:	5,647,280.00	0.00

MODULE	WASTE				
SUBMODULE	METHANE EMISSIONS FROM DOMESTIC AND COMMERCIAL WASTEWATER AND SLUDGE TREATMENT				
WORKSHEET	6-2				
SHEET	4 OF 4 ESTIMATION OF METHANE EMISSIONS FROM DOMESTIC/COMMERCIAL WASTEWATER AND SLUDGE				
COUNTRY	Brunei Darussalam				
YEAR	2010				
STEP 4					
	A	B	C	D	E
	Total Organic Product (kg BOD/yr)	Emission Factor (kg CH_4/kg BOD)	Methane Emissions Without Recovery/Flaring (kg CH_4)	Methane Recovered and/or Flared (kg CH_4)	Net Methane Emissions (Gg CH_4)
	from Worksheet 6-2, Sheet 1	from Worksheet 6-2, Sheets 2 and 3	C = (A x B)		E = (C - D)/1 000 000
Wastewater	5,647,280.00	0.60	3,388,368.00		3.39
Sludge	0.00	0.00	0.00		0.00
				Total:	3.39

MODULE		**WASTE**					
SUBMODULE		**METHANE EMISSIONS FROM INDUSTRIAL WASTEWATER AND SLUDGE HANDLING**					
WORKSHEET		**6-3**					
SHEET		**1 OF 4 TOTAL ORGANIC WASTEWATER AND SLUDGE**					
COUNTRY		**Brunei Darussalam**					
YEAR		**2010**					
				STEP 1			
		A	B	C	D	E	F
		Total Industrial Output (t/yr)	Degradable Organic Component (kg COD/m^3 wastewater)	Wastewater Produced (m^3/tonne product)	Fraction of Degradable Organic Component Removed as Sludge	Total Organic Wastewater from Industrial Source (kg COD/yr)	Total Organic Sludge from Industrial Source (kg COD/yr)
						E = [A x B x C x(1-D)]	F = (A x B x C x D)
Iron and Steel						0.00	0.00
Non-ferrous metals						0.00	0.00
Fertiliser						0.00	0.00
Food & Beverage	Canneries					0.00	0.00
	Beer					0.00	0.00
	Wine					0.00	0.00
	Meatpacking	21392	4.1	18	0	1,578,729.60	0.00
	Dairy products					0.00	0.00
	Sugar					0.00	0.00
	Fish processing	564.1	2.5	18	0	25,384.50	0.00
	Oil & grease					0.00	0.00
	Coffee					0.00	0.00
	Soft drinks					0.00	0.00
	Other					0.00	0.00
Paper & Pulp	Paper					0.00	0.00
	Pulp					0.00	0.00
	Other					0.00	0.00
Petroleum refining/Petrochemicals						0.00	0.00
	Bleaching					0.00	0.00
	Dying					0.00	0.00
	Other					0.00	0.00
Rubber						0.00	0.00
Other						0.00	0.00
					Total	1,604,114.10	0.00

MODULE	**WASTE**
SUBMODULE	**INDIRECT NITROUS OXIDE EMISSIONS FROM HUMAN SEWAGE**
WORKSHEET	**6-4**
SHEET	**1 OF 1**
COUNTRY	**Brunei Darussalam**
YEAR	**2010**

	A	B	C	D	E	F	G	H
	Per Capita Protein Consumption (Protein in kg/person/yr)	Population (number)	Fraction of Nitrogen in Protein $Frac_{NPR}$ (kg N/kg protein)	Amount of sewage N produced (kg N/yr)	Amount of sewage N applied to soils as sewage sludge (kg N/yr)	Net amount of sewage N produced (kg N/yr)	Emission factor EF_6 (kg N_2O-N/kg sewage-N produced)	Total Annual N_2O Emissions (Gg N_2O/yr)
				D = A x B x C		F = D - E		H = (F x G) x (44/28) / 1 000 000
Total	31	386800	0.16	1918528		1918528	0.01	0.03