



Vanuatu  
Department of Climate Change



# ENERGY SECTOR



## ENERGY SECTOR

As per the IPCC-2006, the Energy Sector mainly comprises of exploration and exploitation of primary energy sources, conversion of primary energy sources into more useable energy forms in refineries and power plants, transmission and distribution of fuels and the use of fuels in stationary and mobile applications where emissions arise from these activities by combustion and as fugitive emissions or escape without combustion. The GHG emission from Energy Sector includes all GHG emissions arising from combustion and fugitive release of fuels from following key categories, sub-category and activities including:

- Fuel Combustion Activities in Energy Industries (Main Activity Electricity and Heat Production- Electricity Generation, Combined Heat and Power Generation (CHP), Heat Plants, Petroleum Refining, Manufacture of Solid Fuels and Other Energy Industries, Manufacture of Solid Fuels, Other Energy Industries).



- Manufacturing Industries and Construction (Iron and Steel, Non-Ferrous Metals, Chemicals, Pulp, Paper and Print, Food Processing, Beverages and Tobacco, Non-Metallic Minerals, Transport Equipment, Machinery, Mining (excluding fuels) and Quarrying, Wood and wood products, Construction, Textile and Leather, Non-specified Industry).



- Transport (Civil Aviation-International Aviation, Domestic Aviation, Road Transportation- Cars, Light-duty trucks, Heavy-duty trucks and buses, Motorcycles, Evaporative emissions from vehicles, Urea-based catalysts, Railways, Water-borne Navigation, International water-borne navigation (International bunkers), Domestic Water-borne Navigation, Other Transportation)



- Other Sectors (Commercial/Institutional, Residential, Agriculture/ Forestry/ Fishing/ Fish Farms, Stationary, Off-road Vehicles and Other Machinery, Fishing (mobile combustion),
- Non-Specified (Stationary, Mobile -aviation component, water-borne component and others)
- Fugitive emissions from fuels (Solid Fuels - Coal mining and handling, Oil and Natural Gas, Other emissions from Energy Production).
- Carbon dioxide Transport and Storage (Transport of CO<sub>2</sub>, Injection and Storage and Others)



However all the listed category, sub-category and activities are not applicable for Vanuatu; the Energy Sector GHG emission in Vanuatu comprise of emissions from Fuel Combustion Activities in Energy Industries mainly for Electricity Generation, Manufacturing Industries and Construction, Transport (Civil Aviation, Water Born navigation, Road Transportation) and Other Sectors (Institutional, Commercial and Residential).

Hence, for the energy sector GHG inventory year 2007 to 2015, only Fuel Combustion activities were considered for estimation of GHG emissions.

Energy sector is the predominant emitter of GHG's in Vanuatu. The emission from the Energy sector includes emissions from fuel (fossil fuel or Petroleum), combustions activities from Energy industry (Electricity Generation), Manufacturing Industries and Construction, Transportation (Road, Domestic Aviation and water borne navigation) and others (Commercial, Institutional and Residential). The emissions are mainly attributed from the combustion of fossil fuel or petroleum.



## Main GHG Gases in the Energy Sector

Type of Gas	Chemical Formula	GWP (ARS)
Methane	CH <sub>4</sub>	28
Nitrous Oxide	N <sub>2</sub> O	265
Carbon Dioxide	CO <sub>2</sub>	1

The major and direct GHG gases in the Energy sector is the Carbon dioxide (CO<sub>2</sub>) and the minor non-CO<sub>2</sub> emissions are Methane (CH<sub>4</sub>) and Nitrous Oxide (N<sub>2</sub>O).

### SUB-SECTORS ESTIMATED FOR VANUATU

The sub-sectors emissions from the energy sector is estimated from fuel (fossil fuel or Petroleum) combustions activities from Energy industry (Electricity Generation), Manufacturing Industries and Construction and Transportation (Road, Domestic Aviation and water borne navigation). The International Aviation and International Maritime is also Estimated but not included in the GHG emission for Vanuatu, it is included in the analysis as a memo item and others (Commercial, Institutional and Residential). The emissions are mainly attributed from the combustion of fossil fuel or petroleum.

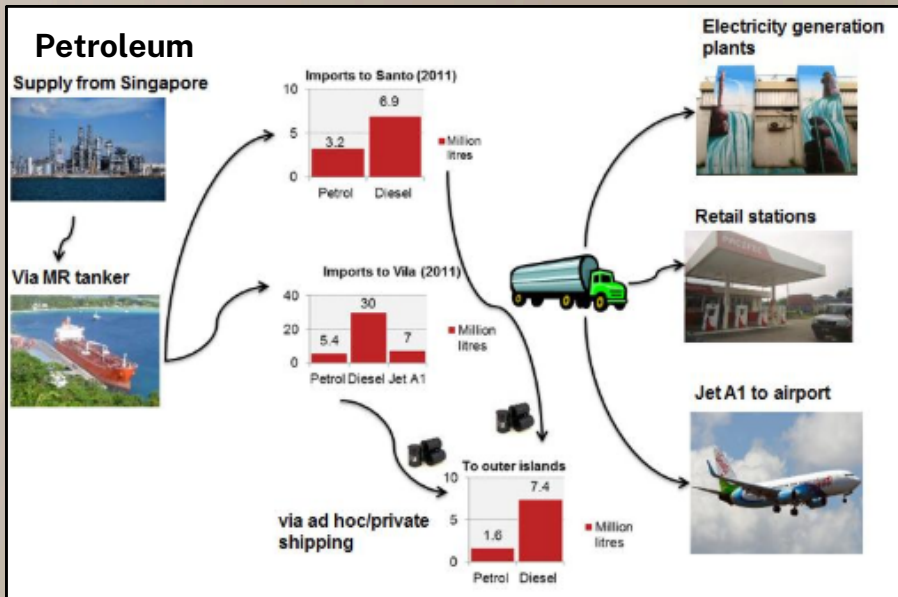
### MAIN PETROLEUM/FUELS ACCOUNTED FOR IN VANUATU

Aviation Gasoline (AVG/Avgas), Gasoline/Petrol/Benzene, Gas/Diesel oil/Mazut, Jet Kerosene (DPK – Dual Purpose Kerosene), Kerosene and Liquefied Petroleum Gas (LPG).

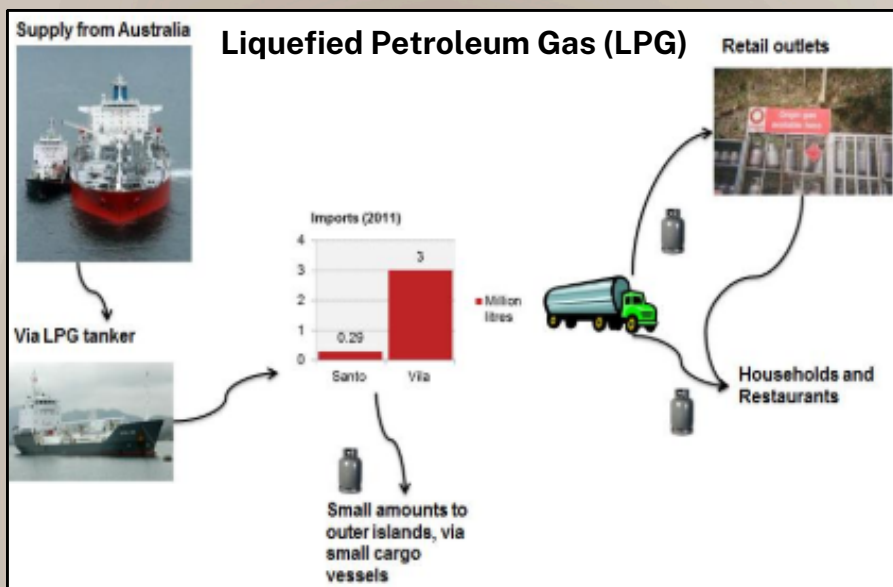
## DATA SOURCES:

Fuel Type	Info/Data Sources	Data Type	Product Suppliers
Aviation Gasoline (AVG/AvGas), Gasoline, Petrol/Benzene,Gas/Diesel, Oil/Mazut/ Jet Kerosene (DPK-Dual Purpose Kerosene), Kerosene	Pacific Petroleum, Department of Customs, Utility Regulatory Authority (URA), Department of Energy (DoE)	Petroleum import as per the fuel categories from each inventory year.	Singapore
Liquefied Petroleum gas (LPG)	Origin Gas, Department of Customs	Total Petroleum import as per the categories for each inventory year	Australia (Brisbane)

## PETROLEUM & LPG SUPPLY CHAIN



Source: Department of Energy. Final Report: Options for Increasing the Efficiency of Vanuatu's oil and gas supply chain. Prepared for the World Bank (2013).



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## METHODOLOGY USED IN ESTIMATING EMISSION

There are three Tiers (1,2 and 3) presented in the 2006 IPCC Guidelines for estimating emissions from fossil fuel combustion. The Tier 1 method is fuel-based, since emissions from all sources of combustion can be estimated on the basis of the quantities of fuel combusted (usually from national energy statistics) and average emission factors. The Tier-1 approach has been applied for GHG emission from Energy Sector in Vanuatu.

The GHG emission calculation of overall emissions in this sector was relatively straightforward once the imported quantity of fossil fuel was known (activity data). The difficulty for Vanuatu has been in terms of the sectoral breakdown of emissions, given that there were no energy balances for the country available and the sectoral fuel sales forthcoming from the fuel suppliers/retailers are not available.

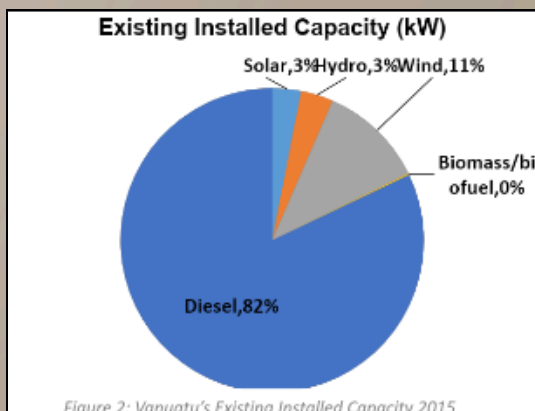


An attempt was made using some available data from stakeholders and proxy data to estimate the sectoral emissions. The sectoral data was entered into IPCC Inventory Software (Version 2.54- June 2017) as per the requirement of standard IPCC sectoral model, the IPCC tool was customized for specific requirement of GHG emissions calculation for Vanuatu i.e. by using the default emission factors for energy conversion and IPCC AR5 GHG emission factors. The result gives a sectoral breakdown of Vanuatu's energy sector CO<sub>2</sub> emissions for the period 2007 to 2015. The IPCC inventory software calculates direct CO<sub>2</sub> emissions and non-carbon dioxide emissions (CH<sub>4</sub> and N<sub>2</sub>O) for this sector; further other gases like SO<sub>x</sub>, NO<sub>x</sub> and NMVOC were negligible and outside the estimated accuracy of the main CO<sub>2</sub>, CH<sub>4</sub> and N<sub>2</sub>O emissions.

## GHG Emitter in the Energy Sub-sector

### 1. Energy Industries: Electricity Generation

The Electricity generation sub-sector composes of power generated from Diesel and Biofuel, Wind power, hydro and solar. Diesel based generation as per the graph to the left is the main source of electricity particularly in the grid-connected areas of Vanuatu particularly Port Vila, Luganville, Lakatoro and Lenakel which is operated by two electricity generation entities, VUI and UNELCO. Electricity generation is the second largest end user of petroleum products as diesel is the largest volume imported. The grid-connected power plants estimated to use 76% of the fuel leaving 24% for the outer islands use.



**Table 22 Fuel Consumption for Electricity Generation: 2007-2015**

	2007	2008	2009	2010	2011	2012	2013	2014	2015
	Litre	Litre	Litre	Litre	Litre	Litre	Litre	Litre	Litre
Gas/ Diesel Oil	10,426, 177	15,808 ,980	14,840,500	14,295, 306	14,590, 904	13,489, 193	11,910,1 08	13,438, 140	12,103, 880
Gasoli ne/ Petrol	-	-	-	-	800	400	400	600	800

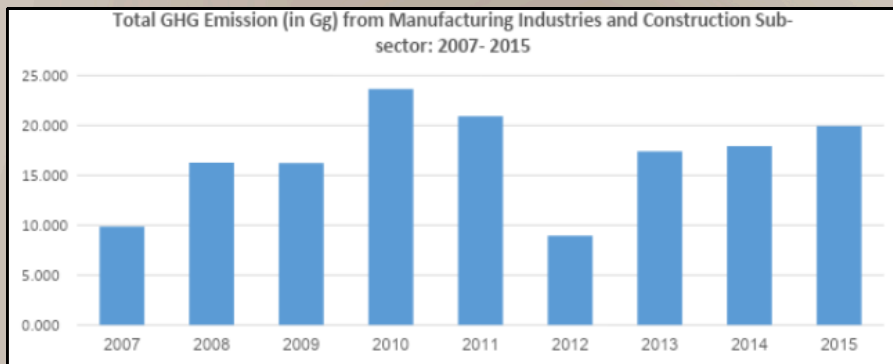
*Extracted from Vanuatu TNC Report*

Diesel consumption over the Inventory year (2007 – 2015) grew more slowly; dropping a little over the years with the introduction of more Renewable Energy in the generation mix. But is expecting an increase as per the new capacity additions with an increased target as per the NERM.

## **2. Manufacturing Industries and Construction**

This sub-sector is considered to be the 3rd largest GHG emitter and fossil fuel consumer in Vanuatu. The fuel type that is also used in this subsector were Diesel, Petrol, Kerosene, AVG, DPK and LPG. The main GHG gas in this sector is CO<sub>2</sub>, and depicts a slight increase and fall over of the emission overtime as per the below graph. The sectors involved comprises the manufacturing, construction, quarry, wholesale and retail. The primary manufacturing sectors in Vanuatu include Agriculture industries, Livestock Industries, Forestry industries and Fisheries industries.

**Figure 20: GHG Emission from Manufacturing Industries and Construction Sub-sector: 2007- 2015**



*Extracted from Vanuatu TNC Report*

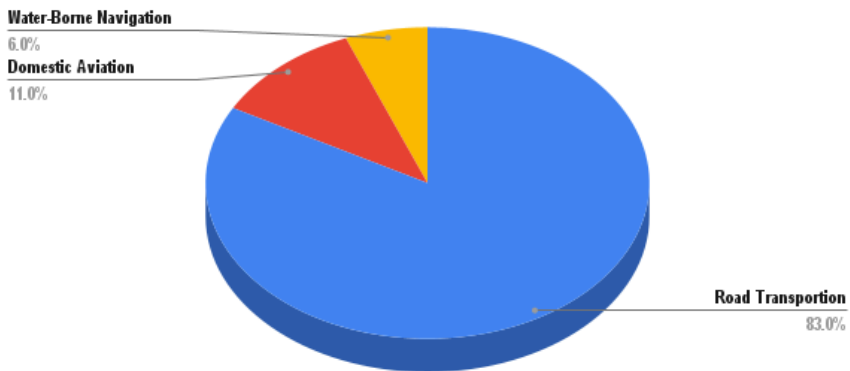
The uneven distribution of fuel consumption over the years from the Manufacturing sector is due to the critical nature of the industries and multiple international and domestic issues. This sub-sector is largely dependent on the international export and market prices, the volatility of both affects the overall performance of the sub-sector. The construction sector also shows negative growth over the inventory year; the activity is driven by private-sector retail, residential and a number of donor-funded government construction projects mostly on the island of Efate, particularly in Port Vila. With the challenges that are encountered within the sub-sectors, favoring policies with government support, domestic and international organizations will enable the steady increase in emission in the future.

### **3. Transport Sub-sector**

The Transport Sector is also one of the largest GHG emitters and fossil fuel consumers of the energy sector in Vanuatu. This sector involves inland road transport, domestic aviation and water borne navigation; the international aviation and international water borne navigation included as a memo item and not part of this GHG inventory. Transport consumes over 50% of the imported petroleum products. The main petroleum products used in the transportation sector from 2007 – 2015 as per the sub-categories are; Domestic Aviation (Aviation Gasoline (AVG) & Jet Kerosene (DPK)); Road Transportation (Diesel, Petrol, Kerosene) and Domestic Water-borne Navigation (Diesel, Petrol, Kerosene & DPK).

Road Transportation consumes 83% of fuel in the transport sub-sector with high GHG emission compared to the Domestic aviation and domestic water-borne navigation as per the data from the Inventory year 2007 – 2015 depicted from the graph below. This is due to the higher number of vehicles registered with no specific regulations governing the fuel efficiency in the transport sector (vehicle standards). The price of transport services such as buses, taxis, airfares and shipping are not regulated or are regulated in part. The public transport system in Vanuatu consists of privately-owned minibusses that run unspecified routes through Port Vila and Santo. In the near future increases in consumption are expected to be highest for land transport fuels (petrol and diesel) based on correlation with historical growth rates. Kerosene (for aviation use) will be influenced by operating efficiencies achieved by airlines and may not see substantial increases in demand, despite increases in tourist numbers

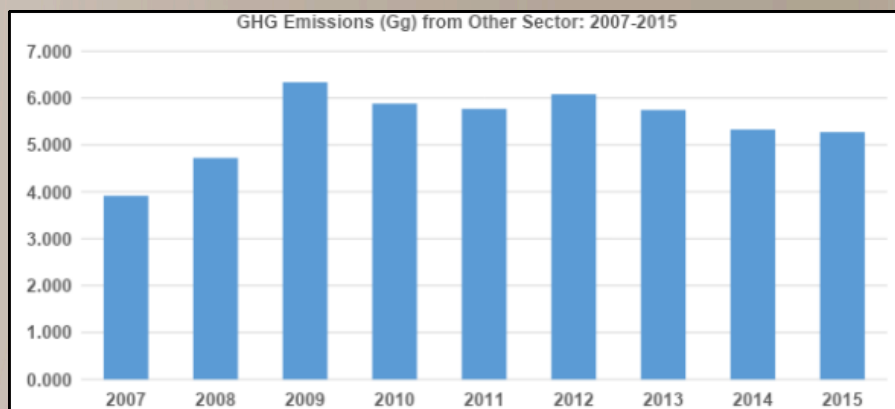
### Transport Sector Fuel Consumption and Emissions



Extracted from Vanuatu TNC Report

#### 4. Other Sectors – Commercial, Institutional and Residential

This sub-sector involves the direct fuel consumption from commercial, institutional, Residential and any other uncategorized and unorganized sector or purposes; this includes Hotels, tourism bungalow, guest houses, restaurants, retail, shopping complexes etc. the fuel type consume from this categories involves Diesel, Petrol, Kerosene, and LPG. The Residential and Commercial subsector were the main consumers of LPG for cooking purposes. It's easy access in the two main centers of Vanuatu (Port Vila & Luganville) making it easier for access unlike the other areas with limited access and affordability leading to more people accessing biomass given that it is easy and cheap to access. In near future the stability and expansion of the electricity grid would reduce the direct fuel consumption in this sector; however, the LPG consumption is expected to marginally increase due to awareness, affordability and access to modern cooking fuel for residential sector.



*Extracted from Vanuatu TNC Report*

*The GHG emission as per the above graph shows that the overall fuel consumption in these sub-sectors is mainly used for the electricity generation and lighting (Diesel and Petrol Generation Sets), since the grid connectivity is limited in outer islands and reliability of the grid availability is also a concern within the grid connected area. Government of Vanuatu has an ambitious plan to expand the grid connectivity and promoting the off-grid renewable electricity generation via renewable sources (solar PV etc.), hence the direct fuel consumption for lighting and electricity generation is expected to reduce over the period of time.*

# GHG EMISSION IN ENERGY SECTOR 2007 – 2015

Inventory Year: 2007-2015	Net CO <sub>2</sub> Emissions, (CO <sub>2</sub> Equivalents Gg)								
Categories	2007	2008	2009	2010	2011	2012	2013	2014	2015
1 - Energy	60.419	92.313	95.096	119.66 2	127.53 2	114.87 4	121.53 6	128.55 1	129.550
1.A - Fuel Combustion Activities	60.419	92.313	95.096	119.66 2	127.53 2	114.87 4	121.53 6	128.55 1	129.550
1.A.1 - Energy Industries	27.730	42.047	39.471	38.021	38.809	35.878	31.678	35.743	32.194
1.A.2 - Manufacturing Industries and Construction	9.847	16.263	16.209	23.671	20.908	8.962	17.395	17.921	19.943
1.A.3 - Transport	18.925	29.283	33.078	52.089	62.041	63.951	66.721	69.555	72.135
1.A.4 - Other Sectors	3.915	4.720	6.338	5.882	5.773	6.083	5.742	5.332	5.277
1.B - Fugitive emissions from fuels	NO (Not-Occurring)								
1.C - Carbon dioxide Transport and Storage	NO (Not-Occurring)								
Total GHG Emissions, excl. Removals	517.41 2	556.05 9	435.64 8	566.81 8	587.78 6	581.13 3	545.29 9	604.25 7	610.204
% Share of Energy Sector in Total GHG emissions	12%	17%	22%	21%	22%	20%	22%	21%	21%

*Extracted from Vanuatu TNC Report*

The total GHG emission for Vanuatu is 5004.616 Gg CO<sub>2</sub>e; however as per the GHG inventory analysis for the 2007 – 2015 shows that Energy sub-sector constitutes 19.2% of the total GHG emission for this inventory year with the total GHG emission of 989.533 Gg CO<sub>2</sub>e.



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